KEMAS
JURNAL KESEHATAN MASYARAKAT

Social Construction of Defecation Behavior in Disadvantaged Villages

Edy Agustinus✉, Resky Nanda Pranaka, Efriani

Badan Penelitian dan Pengembangan Provinsi Kalimantan Barat, Indonesia
Prodi Antropologi Sosial, Universitas Tanjungpura, Indonesia

Article Info

Abstract

In 2020, the status of the Disadvantaged Village is pinned to Bengawan Ampar Village. The sanitation achievement is only 31% which indicates that defecation behavior in the area needs better direction. This study was conducted from July to December 2020. Informants were determined by purposive sampling. There are 8 informants, 4 have latrines, and the rest do not. They are 29-59 years old. This qualitative research aims to analyze the social construction of defecation behavior in people in disadvantaged villages. By using the analysis of the Miles and Huberman model, the study results confirm that most of the defecation behavior of the people of Bengawan Ampar Village is in the river and yard. The contributing factors include (1) the old habit of defecating in the river or yard; (2) economic conditions; (3) pigs are not penned; (4) limited infrastructure such as water, electricity, and roads; (5) lack of counseling; and (6) limited number of health workers.

Introduction

The behavior of defecating (BAB) in the community in West Kalimantan still needs to be pushed in a better direction, indicated by the low percentage of households with access to proper sanitation or healthy latrines. In 2019, through the 2018 Indonesia Health Profile, the Ministry of Health of the Republic of Indonesia reported that access to sanitation in West Kalimantan was in 29th place out of 34 provinces, with an achievement of 53.97% or below the national percentage, which had reached 69.71%. In 2020 the Ministry of Health of the Republic of Indonesia, in the 2019 Indonesia Health Profile, the percentage of West Kalimantan had increased to 71.91%. But its ranking had decreased to 33rd or below the national percentage, which had reached 87.81%.

At the Regency/City level, the Provincial Government of West Kalimantan reported that in 2018, out of 14 Regencies/Cities in West Kalimantan, there were 10 Regencies/ Cities whose access to sanitation was below the percentage of the Province, including Landak District. In 2020, in the report from the Public Housing and Settlement Area Office of West Kalimantan Province, it was noted that in 2019, community access to sanitation in Landak Regency decreased from 63.5% to 46.16%. This situation is a fact about the need to improve access to sanitation down to the District level. The Landak District Health Profile in 2017, 2018, and 2019 confirmed that from 2017-2019, there were sub-districts whose percentage figures ranged from 29% to 70% of which were in Kuala Behe District, where the achievement was 32.06% in 2017, 60 .89% in 2018, whereas in 2019, the achievement decreased to 29.9%.

Furthermore, in terms of the progress and independence status, which is determined based on the Development Village Index (IDM) in the Regulation of the Minister of Villages for Development of Disadvantaged Regions and Transmigration of the Republic of Indonesia Number 2 of 2016, in 2019 the

Directorate General of Village and Community Development and Empowerment, the Ministry of Villages reports the Villages in Kuala Behe District, are on average included in the classification of very underdeveloped villages. In 2020, the Directorate General of Village Development and Empowerment of the Ministry of Villages again reported that the situation had not changed much, only increased by 1 level out of 11 villages. The average status was a disadvantaged village.

This portrait of parallel access to sanitation and achievement of IDM status shows that between the two things there are interrelated slices. The slice in question is that one of the determinants of IDM status criteria is the achievement of scores on the Social Resilience Index (IKS), especially in the settlement dimension, with the indicator that most residents are identified as having healthy latrines. It means that if the residents' access to healthy latrines is in the low category, this condition will also contribute to being one of the reasons for the low achievement of IDM status.

The phenomenon of low access to sanitation in rural areas characterized by open defecation is a complex problem and seems difficult to solve. Because, in general, this behavior is caused by socio-cultural factors. So it is understandable that healthy latrines are available in the upper middle class, while the lower middle class have difficulty accessing them (Reilly et al., 2016). Indeed, if explored more deeply, poor welfare community affects low access to sanitation, especially the availability of standardized toilets at the household level (O'Reilly, 2016 ; Ross et al., 2021). The land unavailability to build proper sanitation and toilets encourages open defecation behavior (O'Reilly, 2018). Low sanitation services, of course, is a problem, especially for people's welfare and health (Ferreira et al., 2021 ; Kayser et al., 2021 ; Shermin and Rahaman, 2021).

Several studies in rural areas in India show the government's success in developing rural sanitation through various government policies prioritizing the availability of sanitation for the lower middle class (O'Reilly & Louiss', 2014 ; C. Sutherland et al., 2021). Another matter is addressed by the Ethiopian government, which implements the Community Led Total Sanitation (CLTS) policy or community-based sanitation, which has been judged effective in stopping open defecation (Crocker et al., 2021). In addition, in Eastern China, the involvement of farming communities in rural development programs is the key to owning and maintaining latrines (Li et al., 2021). Subsidies for sanitation, clean and healthy living campaigns, and regulations at the village level are also seen as a means of reducing open defecation in communities in remote areas of Nepal (Mcmichael, 2017). Other things show that stopping open defecation is more effective when it involves women (Winter et al., 2019) and is also socialized to children from an early age (Sutherland et al., 2017).

Therefore, the involvement of the government and the community simultaneously is the key to realizing Open Defecation Free (ODF) and increasing the status of the Village to become an Independent Village, especially in achieving the goals of sustainable development (SDGs6) (Greene et al., 2021). The West Kalimantan Provincial Government itself, based on West Kalimantan Provincial Regulation Number 2 of 2019 concerning the West Kalimantan Provincial Medium-Term Development Plan (RPJMD) 2018-2023, targets that by 2023 there will be 425 villages with the status of Independent Villages. With the condition of access to latrines, which is still relatively low, to achieve this target, the Social Security Index (IKS) score on the housing dimension with indicators of access to sanitation needs to be increased by the stakeholder. (Fleming et al., 2019).

This movement is in line with the global agenda, namely the Sustainable Development Goals (SDGs), where the diffusion and adoption of inclusive innovations such as latrines must be strengthened (Ramani, 2019). Therefore, community-based empowerment movements such as Community Led Total Sanitation (CLTS) need to be considered more to increase access to sanitation (Kresch et al., 2019 ; Zuin et al., 2019). Because what should be understood is sanitation development in rural areas needs to be oriented toward behavior change. And CLTS, or Community-Based Total Sanitation (STBM), is a development approach believed

can change people's behavior in the long run (S. L. Rautanen & Baaniya, 2008).

Furthermore, from a sociological perspective, open defecation can be explained by understanding the process of social construction that occurs in society. To understand it, the theory of social construction, by Peter L. Burger in a book entitled The Social Construction of Reality: A Treatise in the Sociology of Knowledge, is used as an analytical knife (Chaniotis, 2018). Social construction theory is useful for understanding social reality, which is formed through 3 moments, namely: externalization, objectification, and internalization (Friedman, 2015). Social construction is formed due to social and cultural influences (Sun et al., 2020), So by understanding the society social construction, objective and subjective realities regarding the behavior of defecating in society will be explained. Social reality itself is a reality created by individuals, and social reality is constructed based on human will (Chaniotis, 2018).

Humans should be understood as creative actors who produce and reproduce their social world through social interactions. Therefore, the reality regarding defecation behavior and low access to sanitation or healthy latrines in Kuala Behe District is believed to be the result of human production and reproduction. It means that human decisions to choose certain behaviors in defecating and decisions to have or not have access to healthy latrines have something to do with the social reality constructed. Herlina (2017) has studied the social construction of defecation behavior, but the work presented has not specifically explained this phenomenology in villages with the status of Disadvantaged Villages.

It should be understood the characteristics of a backward village in the IDM concept, especially in terms of the Social Composite Index (IKS) in the settlement dimension, the achievement of the indicator sets is deemed to still need improvement. The set of indicators referred to are: (a) access to clean and potable water, (b) access to sanitation facilities, (c) access to electricity facilities, and (d) access to information and communication facilities. Referring to the explanation that has been stated above, this study specifically aims to analyze the phenomenology of the social construction of defecation behavior in people in Disadvantaged Villages. In terms of usefulness, the results of this research can be input for policy makers to implement concrete steps in the context of alleviating the problem of access to sanitation, especially in Disadvantaged Villages.

Method

This qualitative research took time from July to December 2020. The research location was in Bengawan Ampar Village, Kuala Behe District, Landak Regency, West Kalimantan Province. From the perspective of IDM, in 2020, the village is included in the category of Disadvantaged Villages as reported by the Directorate General of Village Development and Empowerment, Ministry of Villages, Development of Disadvantaged Regions and Transmigration. In addition, as reported by the Health Office of the Landak District Government in 2020, the percentage of access to sanitation in Bengawan Ampar Village is low, namely 31%.

Social construction theory is the theoretical basis for designing this study. This theory is the theory of the sociology of knowledge. Its roots are phenomenological sociology. The form of the investigation emphasizes the experiences of informants. The informants' experiences were analyzed to identify the essence of the social construction of defecation behavior in disadvantaged villages (Merriam, 2002). Therefore, the informants in this study were selected by purposive sampling, with the following criteria: (1) Bengawan Ampar Village officials; (2) residents born and settled in Bengawan Ampar Village; and (3) come from a variety of occupations. Table 1 below informs that of the 8 informants: (1) 3 people aged 29-35 years, and 5 people aged ≥36 years; (2) the work ranges from village officials, teachers, housewives, to farmers; (3) All informants are Catholics, come from the Dayak tribe and were born and live in Bengawan Ampar Village; and (4) education from elementary to high school level. For more details, see the following table.

Table 1. Characteristics of Informants in Terms of Socio-Economic Conditions

Codes	Age (Years)	Occupation	Income (Rp)/Month/family	Number of Family Members
BL	52	Village Head	4000.0000	7 people
AA	46	Farmer	300.000	4 people
RO	30	Farmer	600.000	6 people
RI	31	Chief of Finance	2.500.000	6 people
TA	29	Contracted Teacher	700.000	4 people
DE	40	Farmer	8000.000	10 people
HE	38	Village Secretary	2.500.000	4 people
NO	38	Housewife	900.000	5 people

Source: Primary Data, 2020

Data collection techniques in this study were in-depth interviews, observation, and documentation. The in-depth interview process started with Bengawan Ampar Village officials and continued with the local community. Things observed included the location of the residents' toilets, the condition of the toilets, the location of feces disposal, environmental conditions, and sources of clean water. The documents collected include (1) demographics of Benga-wan Ampar Village; (2) Indonesia Health Profile 2018 and 2019; (3) West Kalimantan Province Health Profile 2018; (4) 2019 West Kalimantan Province Drinking Water and Sanitation Percentage Recap; (5) Health Profile of Landak District 2017 and 2018; and Rating or status of Developing Villages Index (IDM) for 2019 and 2020. The data analysis technique uses an interaction analysis model starting from data reduction, data display, and conclusion; drawing/verification (Miles B. & Huberman, 1994).

Result and Discussion

Table 2. Environment Condition

Code	Latrine Ownership	House Condition			
		Wall	Roof	Floor	Area (LxW)
BL	Have	Concrete brick	Zinc	Floortile	12x12
AA	No	Wood&Bamboo	Sago Leaves	Planking	8x4
RO	No	Wood	Sago Leaves	Planking	6x6
RI	Have	Wood	Zinc	Planking	6x7
TA	No	Concrete brick	Zinc	Concrete brick	6x5
DE	Have	Wood	Zinc	Planking	6x12
HE	Have	Wood	Zinc	Planking	6x10
NO	No	Concrete brick &Bamboo	Zinc	Concrete brick&Wood	6x7

Source: Primary Data, 2020

Table 3. Defecation Behavior

Code	Latrine Ownership	Tempat BAB
BL	Have	Latrine
AA	No	River
RO	No	River and Yard
RI	Have	Latrine and River
TA	No	River and Yard
DE	Have	Latrine and River
HE	Have	Latrine
NO	No	River and Yard

Source: Primary Data, 2020

Based on Table 2, out of 8 informants 4 already have latrines. The rest are not yet available. The informants' houses have the same length. Namely an average of 6 meters. 6 houses are similar. Meanwhile, the width of the house varies from 4 meters to 12 meters.

Paying attention to Table 3, only one informant has a latrine, and defecates consistently in the latrine, namely BL. BL is the Head of Bengawan Ampar Village. He and his family already have permanent toilets, namely the type of gooseneck, located inside the house or in the kitchen, and clean water is also available inside the house. The water source comes from the Kersik River. The Kersik River is located right behind their house.

In Figure 1, Clean and Healthy Behavior, especially related to defecation behavior in Bengawan Ampar Village, is classified into three parts. First, there were some of the informants who already had latrines and did not defecate on the river. Second, some don't have latrines, so they defecate on the river or around their yards. And third, some informants already have latrines but are still defecating on the river (see also Table 3).
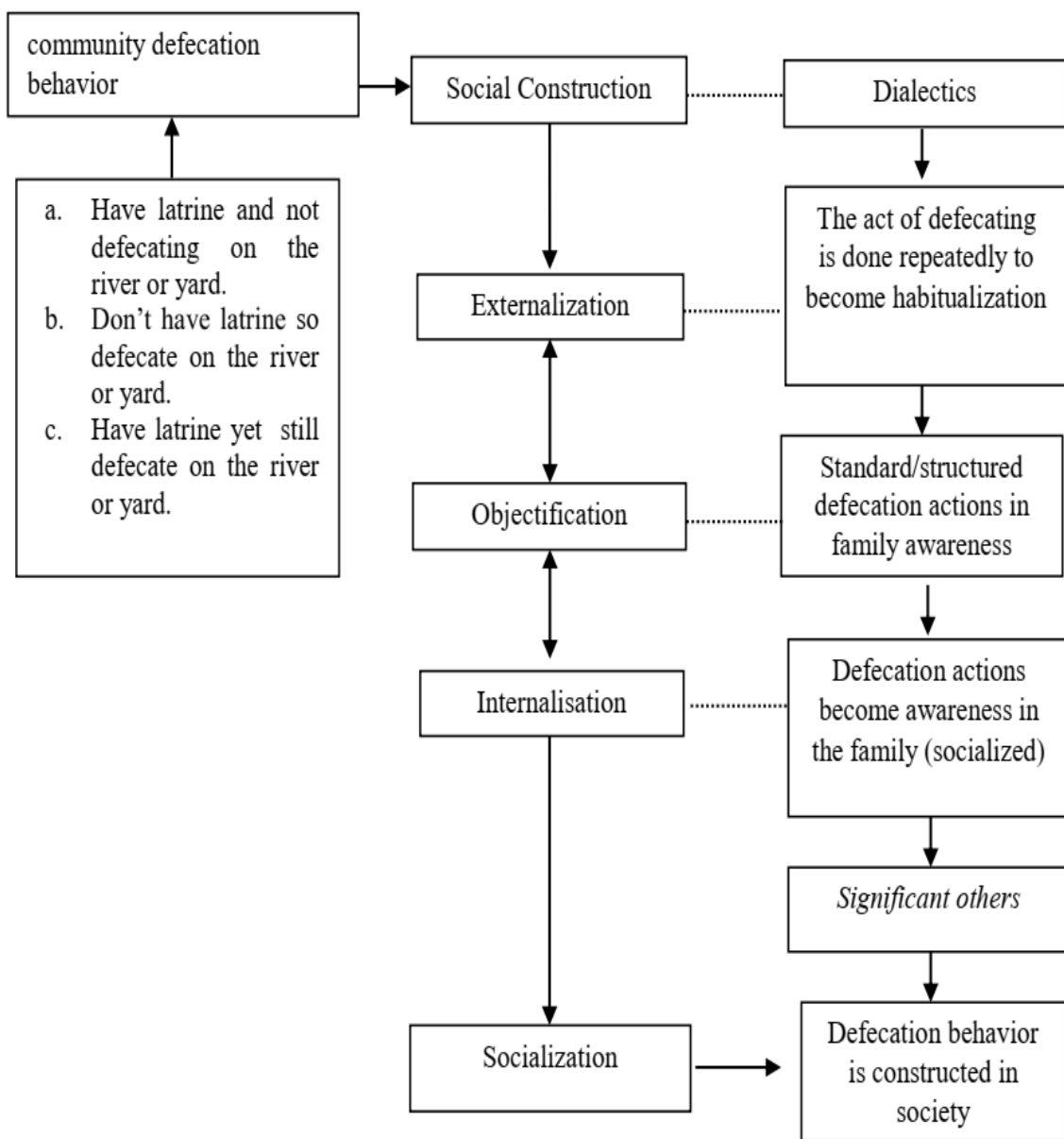

Figure 1. The Social Construction of Defecation Behavior of the Community in Disadvantaged Villages

These three behaviors generally become the collective consciousness in Bengawan Ampar Village. This behavior is carried out repeatedly until it becomes a pattern of action or capitalization, namely the process of depositing behavior determined by tradition, paradigm, ideology, and even the actions of actors (Yıldırım et al., 2020). However, it should be realized that the most dominant collective awareness, as presented in Table 3, is that 4 informants do not have latrines, thus defecating in rivers and yards. The remaining 3 out of 4 informants already have latrines but still often defecate in the river. It confirms that in general, the behavior of defecating in rivers and yards is still dominant. So people's awareness of the importance of owning and utilizing appropriate latrines still needs to be increased. Regarding the dialectics of externalization, objectivation, and internalization moments as presented in Figure 1, the following is an explanation.

From the perspective of social construction, the formation of these action patterns is caused by the existence of objective reality (read: reality), which becomes a stock of knowledge or past knowledge that shapes views about events happening in the present. Past knowledge shapes the behavior of individuals in the community in Bengawan Ampar Village. The objective reality in question is the behavior of defecating in the river or yard. One of the reasons for this behavior is the absence of a latrine (Ajisuksmo & Iustitiani, 2020). This reality is a paramount (the most vital fact) on the behavior of individuals in Bengawan Ampar Village.

The presence of objective reality in defecation behavior in rivers and yards continues to be carried out in the same way by some individuals or the community in Bengawan Ampar Village nowadays. This method is identical to what was done by previous generations. It is also a sign that the presence of objective reality in the people of Bengawan Ampar Village is taken for granted to be adopted in their actions. In this case the objective reality that prevails in Bengawan Ampar Village, as the anthropologist Karl Marx, with Berger's approval, is behavior that is formed as a product of socio-culture. Furthermore, that dimension is what is meant

by the moment of externalization, marked by the existence of individual actions as human products. It means that the act of defecating outside the latrine, a product of the past, has been adopted or accepted by individuals in the community in Bengawan Ampar Village without question.

Regarding "the product of past knowledge", BL (52 years) explained that it was around the 1970s to 1980s when there were still Betang or Radank houses in Tembawang, Pansik, and Ampar Villages. One house generally consists of 12 doors. Defecation behavior at that time was done in any place, anywhere. Because previously, there were no latrines like the current. Radank's house used to have a tall shape, under Radank's house, there were pets, namely pigs, which were still roaming freely. And at that time, the function of the pig is to "sweep/clean" the dirt. So that the dirt is as if it doesn't exist.

The product of past knowledge is what is meant by objective reality. This objective reality mentioned above has become the stock of knowledge of individuals in the community in Bengawan Ampar Village, which has influenced their behavior so far. Knowledge is one of the factors related to defecation behavior in society at various levels. It is needed in the frame of development and causes social change. Knowledge or stock of knowledge is needed in objective reality at the moment of externalization and subjective at the moment of internalization (Venugopal, 2018)

Apart from that, economic problems are also the main obstacle for the people in Bengawan Ampar Village to provide latrines, as is the case in various other low-income villages (Guo et al., 2021; Zerbo et al., 2021). The people in Bengawan Ampar Village, on average, make the agricultural sector, especially farming, the primary source of their livelihood. In 2020, in the IDM survey in Bengawan Ampar Village, out of 248 household heads (KK), 185 households were classified as poor. It is in line with the views of Paladiang, Haryanto dan Has (2020) and Fitriani, Nislawaty dan Mayasari (2021) that economic conditions and defecation behavior are interrelated, especially for those who have income below the City/Provincial minimum wage, will have difficulty

making healthy latrines.

In addition to these two things, according to BL (52 years), the availability of health facilities in Bengawan Ampar Village already exists. There is a Village Maternity Boarding School (Polindes), only 300 meters from the capital city of Bengawan Ampar Village. It's a shame that at the moment the Polindes are not active. Apart from the fact that there is only one health worker, it is also due to the difficulty of accessing the road to the village. So that the health workers had difficulty serving optimally. The impact is that knowledge about the importance of latrines for health and the environment cannot be socialized massively to the people of Bengawan Ampar Village. So it is not surprising that there are still individuals in the community in Bengawan Ampar Village who still defecate outside the latrines.

The understanding of these individuals then increases in the realm of dialectics (read: discussion) further, to give birth to a society that is sui generis. The characteristics of a unique society (sui generis) include knowledge understood and practiced collectively in the same situation. Therefore, the structure then appears together with the roles. Structures and roles are needed so that the institutionalization process that begins with the externalization process can result in the deposition of behavior, which is then passed on to the next generation. It was this event that marked the moment of objectification, when the deposition and traditions that emerged from the habitualization process were then passed on to the following generations. It is where, especially in relation to the inheritance and tradition of experience, there is a role in the institutional order. So, it represents a whole series of institutionalized behavior.

The unique characteristics of the individuals in the community in Bengawan Ampar Village referred to here are in the form of actions that have been carried out so far, especially regarding defecation behavior on the river or the yard. Meanwhile, the structures and roles that emerge serve to encourage these characteristics to be understood and carried out collectively by the target individual or group. In this paper, the intended target group is the family. Because of this, in this case, the father

and mother are the most vital structures in the nuclear family, which play a role in transmitting their experiences in defecation behavior to other family members. It can be observed by listening to the following interview excerpts.

"Occasionally there are still family members who defecate in the river. Especially when there are activities, and there are a lot of people who stay at home and when it's dry, and the water is dry" (RI, 31 years old, in the family his position/structure is as a father, while his role is someone who influences the availability of clean water in his house).

> "If it's dry season, it's normal for the river to be in, especially since the current condition is that the water is stuck, no water, since the fifth month [of 2020] yesterday" (DE, 40 years old, a housewife whose role is to ensure the availability of water at home).
> "It's convenient to go to the river for defecation because the water is about 200 meters away from the house" (AA, 46 years old, is a family head who plays a vital role in providing healthy latrines at his home)
> "When it's time to take a bath, we happen to have a stomach ache, we go to the river" (TA, 26 years old, a mother who participates in perpetuating the behavior of defecating in the river).

The study of the structures and roles that emerge within the nuclear family in the dialectical process at this moment of objectification shows that the defecating behavior in the river has gained legitimacy in the family institution. In this case the nuclear family does not only know and carry out these actions. However, they involve their rational considerations to make the ideas, ideas, or knowledge, contained in the behavior become their collective behavior. Their common sense considerations for defecating in rivers are due to unfavorable environmental conditions such as unavailable water and limited sanitation facilities. In this context, the family is an

institution whose function is to direct the behavior of its family members in particular patterns. It means the parents experience in a family institution can be freely transmitted to other family members.

From this incident, it can be understood that the family plays a vital role in controlling individual behavior, especially those belonging to family members. Behavior is an action that has been done repeatedly for a long time. Therefore, behavior change needs to be supported by the closest people, namely the nuclear family. Without the support of the closest family, changes in defecation behavior in the river will inevitably occur. In that context, legitimacy is an objectification of the second level of meaning and acts as knowledge with a cognitive and normative dimension. This role is caused by legitimacy, which does not only related with explanations but serves to objectify what has been institutionalized to make subjective sense.

The next moment in the dialectic of social construction is the moment of internalization. At this moment, humans have been able to interpret objective reality into subjective reality by involving cognitive experience. That objective reality is no longer being taken for granted but is starting to be questioned. That subjective reality is the basis for understanding whether an individual will follow the objective reality completely, or only partially. Therefore, at this moment, socialization involving significant others is vital. Assessment of objective reality tends to vary, adjusting their values, their ideology to the interests of both personal and group (Venugopal, 2018). The involvement of significant others in social construction is divided into two types of socialization. Namely primary and secondary. For Herlina (2017), significant others are people who are the main reference in acting as well as real and important people in the process of primary and secondary socialization. In other words, significant others are vital actors in the social construction process.

In Bengawan Ampar Village, important actors or significant others in primary socialization consist of parents, especially fathers, and mothers. They are the main people and are the first to perform defecation behavior

in the latrine, in the river, or other places. Subsequent individuals, especially children and closest relatives, will acquire this knowledge directly because they see and can be sure they are carrying out a learning-by-doing process when interact with each other. Meanwhile, the significant others in secondary socialization are the government, educational institutions, and other people outside the Bengawan Ampar Village community. The government as a significant other in secondary socialization plays a role in concocting and implementing health policies for people who are considered to be experiencing social problems (Ferreira et al., 2021; Gstrein, 2018). The government that concocted the policy was: the Indonesian Ministry of Health, the West Kalimantan Provincial Health Office, and the Landak District Health Office. Furthermore, the actors who implement it are health workers who work in the Kuala Behe District or Bengawan Ampar Village (Chevannes, 2002). Next, regarding the involvement of educational institutions and outsiders in secondary outreach, Mr. BL (51 years) gave an example that he obtained knowledge about latrines because he had studied outside Bengawan Ampar Village and often interacted with other individuals outside the village area.

Sources of knowledge obtained from primary and secondary socialization influence the understanding of individuals to assess whether the stock of knowledge, which is a product of the past or previous generations, is still relevant for full adoption or not. If borrowing the Weberian view, they will think about whether another creative action is needed so that they can adapt to the situation. Mr. BL (51 years) himself ultimately has a stock of knowledge that is new and different from the previous generations' knowledge stock who live and interact around Radank's house. According to him, every family must have a latrine because it is closely related to environmental hygiene and health. The knowledge stock is formed from the secondary socialization process. First, the septic tank (tube) going directly to the river is wrong because it pollutes the water source. Second, latrines must be clean to be healthy. Third, open defecation can trigger diarrheal disease. Fourth, if open defecation

is done carelessly, the waste will pollute the environment. Fifth, the cleanliness of the house is vital, so defecating in the latrines is very important. Sixth, the existence of a latrine is a primary requirement, and must be provided at home, and seventh, there is a sense of shame if you don't have a toilet, especially if you have guests visiting your house.

The moment of internalization occurred in the community individuals in Bengawan Ampar Village eventually resulted in a diverse stock of knowledge. It is undeniable, as mentioned at the outset, some people in Bengawan Ampar Village already have latrines and do not defecate in the river. Some other people who do not have it defecate on the river or around their yards. And some people already have latrines but still defecate in the river. Each society has independence in choosing which "knowledge" can be used as a reference for behavior. As stated by Herlina (2017), the stock of knowledge in this context covers the practical uses of whether it is vital or not to have a latrine and defecate in it. RO (30 years old) has an elementary school education, with a middle to lower economic category (monthly income below 1 million rupiahs), for example, as a representative of a community that does not have a latrine so that defecation is carried out in the river or around their yard, said that:

If you defecate in the river, urinate around here [in the neighborhood]. It's nicer on the river than around here. [Because] there is no water source [here], the wells, that are there are dirty, a lot of waste has gotten in, because there are lots of pigs under them. Pigs roam around a lot. That's why I don't use them. So defecating in the river since the time of our ancestors... The income from cutting [tapping] rubber is 7 kilos per day. So around 600 thousand per month. That's why they don't make latrines.

In contrast to RO, participants with the initials DE tended to combine knowledge gained through primary and secondary socialization as a guide in behavior, especially when defecating. That is, he is a representation of an individual who already has a latrine but still defecates in the river. The merger in question is a merger between the stock of knowledge of past production and the stock of knowledge obtained through cognitive experience. The cognitive experience in question is in the form of knowledge gained. For example, when an individual visits another place outside the area where he lives, he gains new knowledge about the importance of owning and using a latrine. According to DE's statement, the cognitive experiences gained. Included first, the requirements for a healthy latrine are not smelly. Second, open defecation can cause itching. And third, the transmission of hives can come from water.

In addition, the result of a combination of stock of knowledge from past production and obtained through cognitive experience regarding latrines is evident from the existence of a septic tank owned by DE's latrine, which goes directly to the river, without a septic tank on land. It is the same with several houses belonging to other residents in Bengawan Ampar Village, where the sewage or septic tank goes to the "pig" cage.

Another thing that should be known is the defecation behavior is not only caused by knowledge obtained through primary and secondary socialization. It is also caused by, first, limited water availability because the Kresik Dam was damaged; secondly, the unavailability of electric current; third, the role of health workers in building awareness of the importance of owning and using latrines is still minimal; and fourth, road infrastructure is still limited, making it difficult for residents to obtain the materials needed to build latrines. So, in the context of the social construction of defecation behavior in the Bengawan Village community at this moment of internalization, each individual can choose whether to act passively or actively when responding to the stock of knowledge that has gained legitimacy in the family institution. It really depends on the experience they have had. That experience turns out to be able to help individuals consider whether objective reality will be adopted in its entirety or requires modification by adding elements of new knowledge without eliminating knowledge that has been generally accepted. This fact actually explains that objective reality and subjective reality are realities that are not identical. And at this moment the subjective reality formed is a decision from humans that tends to be interpretive.

Conclusion

From the explanation regarding the dialectics of externalization, objectification, and internalization, the most dominant and constructed defecation behavior in the people of Bengawan Ampar Village, which bears the title of Disadvantaged Village, is defecation carried out in rivers and yards. This situation applies to those who do not have or already have latrines. Meanwhile, the defecating behavior consistently in latrines is only carried out by people who already have it. And in terms of numbers, they are fewer when compared to those who defecate outside. The constructed behavior is a paramount of reality, as well as objective reality and subjective reality that applies to the people of Bengawan Ampar Village. Reality is constructed because of the involvement of significant others both in primary and secondary socialization. Parents, especially fathers and mothers, are the core actors in primary socialization, parents in the primary socialization process serve as examples for children or their immediate family in determining defecation behavior. Meanwhile, the parties involved in secondary socialization came from external parties, namely the government and educational institutions. External parties play a role in providing input in the form of a new stock of knowledge related to the importance of defecating in latrines.

From this explanation, it turns out that changing the behavior of defecating in rivers and yards is not an easy matter. Apart from having a stock of knowledge that defecation outside the latrines has become habitualized, structured in family awareness, and socialized so that the stock of knowledge becomes the behavior of those closest to them, it is also caused by: (1) the existence of old habits of individuals who still feel comfortable defecating on the river or the yard; (2) economic conditions; (3) environmental conditions such as pets or pigs that have not been caged; (4) limited access to infrastructure in the form of water, electricity, and roads; (5) the lack of new knowledge received due to the lack of counseling regarding the importance of latrines; and (5) counseling regarding clean and health behavior or the importance of owning and using latrines cannot be socialized immediately due to the limited presence of health workers.

References

Ajisuksmo, C.R.P., & Iustitiani, N.S., 2020. The Implementation Of Community Based On Total Sanitation Among Fisherman Families In West Java. *Jurnal Kesehatan Masyarakat*, 16(2), pp.225–232.

Chaniotis, A., 2018. The Social Construction Of Emotion: A View From Ancient Greece. *Current Opinion In Behavioral Sciences,* 24, pp.56–61.

Chevannes, M., 2002. Social Construction Of The Managerialism Of Needs Assessment By Health And Social Care Professionals. *Health And Social Care In The Community*, 10(3), pp.168–178.

Crocker, J., Fuente, D., & Bartram, J., 2021. Cost Effectiveness Of Community Led Total Sanitation In Ethiopia And Ghana. *International Journal Of Hygiene And Environmental Health, Elsevier*, 232, pp.1-7.

Ferreira, D.C., Graziele, I., Marques, R.C., & Gonçalves, J., 2021. Investment In Drinking Water And Sanitation Infrastructure And Its Impact On Waterborne Diseases Dissemination: The Brazilian Case. *Science Of The Total Environment,* 779, pp.1-16.

Fitriani, I., Nislawaty, & Mayasari, E., 2021. Faktor-Faktor Yang Berhubungan Dengan PHBS Di Desa Pulau Rambai Wilayah Kerja Puskesmas Kampar Timur. *Jurnal Ilmiah Ilmu Kesehatan*, 1(1), pp.62–73.

Fleming, L., Anthonj, C., Thakkar, M.B., Tikoisuva, W.M., Manga, M., Howard, G., Shields, K.F., Kelly, E., Overmars, M., & Bartram, J., 2019. Urban And Rural Sanitation In The Solomon Islands: How Resilient Are These To Extreme Weather Events?. *Science Of The Total Environment*, 683, pp.331–340.

Friedman, A.M., 2015. Perceptual Construction : Rereading The Social Construction Of Reality Through The Sociology Of The Senses. *Cultural Sociology,* pp.1–16.

Greene, N., Hennessy, S., Rogers, T.W., Tsai, J., & De Los Reyes, F.L., 2021. The Role Of Emptying Services In Provision Of Safely Managed Sanitation: A Classification And Quantification Of The Needs Of Lmics. *Journal Of Environmental Management,* 290,

pp.1-9

Gstrein, V., 2018. Ideation, Social Construction And Drug Policy: A Scoping Review. *International Journal Of Drug Policy*, 51, pp.75–86.

Guo, S., Zhou, X., Simha, P., Mercado, L.F.P., Lv, Y., & Li, Z., 2021. Poor Awareness And Attitudes To Sanitation Servicing Can Impede China's Rural Toilet Revolution: Evidence From Western China. *Science Of The Total Environment,* 794, pp.1-9.

Herlina, M., 2017. *Sosiologi Kesehatan: Paradigma Konstruksi Sosial Perilaku Hidup Bersih Dan Sehat Dalam Perspektif Peter L. Berger & Thomas Luckmann*. Surabaya : Muara Karya.

Kayser, G.L., Chokhandre, P., Rao, N., Singh, A., Mcdougal, L., & Raj, A., 2021. Household Sanitation Access And Risk For Non-Marital Sexual Violence Among A Nationally Representative Sample Of Women In India, 2015-16. SSM - *Population Health,* 13, pp.1-10

Kresch, E.P., Lipscomb, M., & Schechter, L., 2019. Externalities And Spillovers From Sanitation And Waste Management In Urban And Rural Neighborhoods. *Applied Economic Perspectives And Policy,* 42(3), pp.395–420.

Li, Y., Cheng, S., Li, Z., Song, H., Guo, M., Li, Z., Mang, H.P., Xu, Y., Chen, C., Basandorj, D., Zhang, L., & Li, T., 2021. Using System Dynamics To Assess The Complexity Of Rural Toilet Retrofitting: Case Study In Eastern China. *Journal Of Environmental Management,* 280, pp.1-10.

Mcmichael, C., 2017. Toilet Talk : Eliminating Open Defecation And Improved Sanitation In Nepal. *Medical Anthropology:Cross-Cultural Studies In Health And Illness*, pp.1–42.

Merriam, S.B., 2002. Qualitative Research In Practice, Examples For Discussion And Analysis. Jossey-Bass A Wiley Company.

Miles B.M., & Huberman, A.M., 1994. *An Expanded Sourcebook Qualitative Data Analysis*. (Second Edi). Sage Publications, Inc.

O'Reilly, K., 2016. From Toilet Insecurity To Toilet Security: Creating Safe Sanitation For Women And Girls. *Wiley Interdisciplinary Reviews: Water*, 3(1), pp.19–24.

O'Reilly, K., 2018. The Influence Of Land Use Changes On Open Defecation In Rural India. *Applied Geography,* 99, pp.133–139.

O'Reilly, K., & Louiss', E., 2014. The Toilet Tripod: Understanding Successful Sanitation In Rural India. *Health And Place,* 29, pp.43–51.

Paladiang, R., Haryanto, J., & Has, E.M.M., 2020. The Determinants Of Open Defecation In East Nusa Tenggara. *Indonesia Journal Of*

Community Health Nursing, 5(1), pp.33–40.

Ramani, S.V., 2019. On Consortium Driven Sanitation Interventions To End Open Defecation: Insights From An Indian Village Study. *Innovation And Development,* 10(2), pp.245–261.

Rautanen, S., & Baaniya, U., 2008. Technical Work Of Women In Nepal ' S Rural Water Supply And Sanitation. *Water International*, 33(2), pp.202–213.

Reilly, K.O., Dhanju, R., & Louis, E., 2016. Subjected To Sanitation : Caste Relations And Sanitation Adoption In Rural Tamil Nadu. *The Journal Of Development Studies,* 2016, pp.1–14.

Ross, I., Cumming, O., Dreibelbis, R., Adriano, Z., Nala, R., & Greco, G., 2021. How Does Sanitation Influence People's Quality Of Life? Qualitative Research In Low-Income Areas Of Maputo, Mozambique. *Social Science And Medicine*, 272, pp.1-9

Shermin, N., & Rahaman, S.N., 2021. Assessment Of Sanitation Service Gap In Urban Slums For Tackling COVID-19. *Journal Of Urban Management,* 2021, pp.1-31.

Sun, Y., Liang, C., & Chang, C., 2020. Online Social Construction Of Taiwan's Rural Image : Comparison Between Taiwanese Self-Representation And Chinese Perception. *Tourism Management*, 76(1), pp.1–12.

Sutherland, C., Reynaert, E., Dhlamini, S., Magwaza, F., Lienert, J., Riechmann, M.E., Buthelezi, S., Khumalo, D., Morgenroth, E., Udert, K.M., & Sindall, R.C., 2021. Socio-Technical Analysis Of A Sanitation Innovation In A Peri-Urban Household In Durban, South Africa. *Science Of The Total Environment,* 755, pp.1-12

Sutherland, J., Carnett, A., Meer, L. Van Der, Bravo, A., & Mclay, L., 2017. Intensive Toilet Training Targeting Defecation For A Child With Autism Spectrum Disorder. *Research And Practice In Intellectual And Developmental Disabilities*, pp.1–12.

Venugopal, R., 2018. Ineptitude, Ignorance, Or Intent: The Social Construction Of Failure In Development. *World Development,* 106, pp.238–247.

Winter, S., Barchi, F., & Dzombo, M.N., 2019. Not Just Any Toilet–Women's Solutions To Sanitation In Informal Settlements In Nairobi. *Development In Practice,* 29(1), pp.15–25.

Yıldırım, M., Mills, C.W., & Mead, G.H., 2020. Individual, Organization and Structure : Rethinking Social Construction Of Everyday Life At Workplace In Tourism Industry.

Tourism Management, 76, pp.1–15.

Zerbo, A., Castro Delgado, R., & Arcos González, P., 2021. Water Sanitation And Hygiene In Sub-Saharan Africa: Coverage, Risks Of Diarrheal Diseases, And Urbanization. *Journal Of Biosafety And Biosecurity*, 3(1), pp.41–45.

Zuin, V., Delaire, C., Peletz, R., Cock-Esteb, A., Khush, R., & Albert, J., 2019. Policy Diffusion In The Rural Sanitation Sector: Lessons From Community-Led Total Sanitation (CLTS). *World Development,* 124, pp.1-14.

Jurnal Kesehatan Masyarakat

Predictor Factors of Multi-Drug Resistance Tuberculose on the Characteristics of Chest Radiographic Lesions

Ana Majdawati[1✉], Inayati Habib[2]

[1]Department of Radiology, Faculty of Medicine Health Sciences, Muhammadiyah University of Yogyakarta
[2]Department of Microbiology, Faculty of Medicine Health Sciences, Muhammadiyah University of Yogyakarta

Article Info

Abstract

This research aimed to demonstrate some predictors of screening diagnosis of multi-drug-resistant tuberculosis (MDR-TB). Researchers determined several predictors as a screening diagnosis of MDR-TB, based on clinical symptoms, WHO criteria, chest radiographic lesions, and sputum smear microscopy. The method demonstrated a correlation between several factors as predictors of the MDR-TB diagnosis consisting of clinical symptoms, WHO criteria, BTA sputum, and cross-sectional chest radiograph lesions, based on examination of Gene X-pert for suspected MDR-TB. The results demonstrated a significant and positive odds ratio value of the relationship between variables: 1). Clinical symptoms (p:0.000) with the largest percentage of coughing with shortness of breath exhibiting 51.32% and coughing exhibiting 27.9%; 2). WHO criteria are among others, new patients (p:0.000; OR:3); 3). Chest radiographic lesion: consolidation (p: 0.000; OR: 3); pleural thickening (p:0.003; OR:2); Fibrosis (p:0.000; OR:6) with location on the medial right (p:0.000; OR:2) and left inferior (p:0.000; OR:3). The BTA sputum is (p:0.000; OR:8). The predictors for screening the diagnosis of MDR-TB are coughing, and shortness of breath. Other WHO criteria include radiographic lesions, fibrosis, consolidation, pleural thickening with the location of lesions either left inferior or medial right and positive smear sputum results.

Introduction

WHO Global Tuberculosis Report 2017 data indicated that multi-drug-resistant tuberculosis (MDR-TB) and Rifampicin Resistance Tuberculosis (RR-TB) cases in Indonesia reached 32,000. These cases were recorded as pulmonary TB with 11,000 per 100,000 populations. With a total of 44,000 cases, drug-resistant TB (TB RO) increased by 2.8% of new cases and 16% of previously treated TB. MDR-TB cases with laboratory confirmation reached 2,757 cases, and only 1,931 cases followed the treatment with a 51% successful rate. Patients with TB who recover and relapse can be affected by several factors, such as contact with other patients in one home/environment, poor life quality (due to smoking and drinking alcohol), nutritional status, and other diseases such as DM, HIV, AIDS, and malignancy. Further, in developing countries, MDR-TB prevalence ranges from 4.6%–22.2% and increases with each year (Zida & Nur, 2019). The risk factor for increasing MDR-TB cases is the use of fluoroquinolones in the community without medical or rational considerations. Fluoroquinolones are second-line anti-TB drugs in MDR-TB cases, so the continuous use of Fluoroquinolones causes a tendency to become resistant to this drug. As a result, TB patients who are rifampin-resistant, need to consider the choice of this second-line TB drug. The success of MDR-TB treatment is around 60% and Extensively Drug-Resistant Tuberculose (XDR-TB) (Jeong et al., 2015; Singh & Jain, 2019).

Diagnosing MDR-TB is not easy, because

the symptoms and clinical signs are not typical. Patients with MDR-TB based on their treatment history are divided into primary and secondary groups (Zida & Nur, 2019). Medicine resistance in TB treatment, mainly MDR-TB and TB with Extensive Drug-Resistance (XDR) or XDR-TB, is a significant health problem in numerous countries, and this is an obstacle to global TB control programs (Alok, 2019). MDR-TB cases result in several losses including losses to patients, hospitals, and the government. Incurring costs by patients and the government are high. Further, one of the problems of MDR-TB is a long diagnosis (around 3 weeks to a month); therefore, M. tuberculosis bacteria transmission increases and inadequate treatment occurs as a result [2, 4, 6] (Zida & Nur, 2019; Emanuele et al., 2019).

Several studies state that the MDR-TB diagnosis based on several criteria for risk of resistant TB medicine (MDR-TB clinical sufferers): in chronic cases or patients with failing treatments with TB medicine categories II, patients with sputum examination results remaining positive after the third month with TB medicine categories II, patients who received TB treatment, including second-line TB medicine, such as quinolones and kanamycin, patients who fail treatment with TB medicine categories I, patients with sputum examination results remaining positive after insertion with TB medicine categories I, TB recurrent cases, patients returning for treatment after negligence in category I and/or category II treatment, patients with complaints of suspected TB, patients living near people with dual drug-resistant TB, including health workers of duty in the dual drug-resistant TB ward, and patients with HIV (José et al., 2017; Abu et al., 2019; Yi et al., 2018).

Thorax radiographic examination is still routinely performed on patients with TB and MDR-TB suspicion since this examination is considered affordable, easy, and available in almost all hospitals and healthcare clinics. Thorax radiographs between TB and MDR-TB generally vary and are difficult to distinguish. Some studies indicate thorax radiographic examination on MDR-TB exhibits several characteristics, namely, lesion type; these are multiple cavities with a diameter of less than 4 cm, multiple nodules with less than 3 cm, Pleural thickening; lesion location is most common in the superior lobe of the right or left lung, or the right lobe of the right lung, and lesion exhibits a large extent (Zida & Nur, 2019; Abu et al., 2019; Yi et al., 2018; Dwi et al., 2012).

Gene X-pert test is a molecular test with an automatic real-time PCR system for MTB complex DNA detection in suspected patients with TB. It can diagnose quickly and precisely; therefore, proper treatment can be performed on patients, mainly in patients with TB who are resistant to usual anti-tuberculosis medicine. This test can produce a result in less than 2 h and detect genetic mutation with rifampicin resistance. Unfortunately, Gene X-pert availability is limited only in certain hospitals in urban areas. So, MDR-TB diagnosis remains an obstacle, with a process that requires a long time (Pramanindyah & Soedarsono, 2019; Priyatam et al., 2019; Riele et al., 2019).

Based on the information above, MDR-TB incidents are increasing, while the biggest obstacle is Gene-X-pert diagnosis duration and availability, causing inadequate medication. This obstacle makes the researcher want to perform some component research as a MDR-TB diagnosis predictor including clinical aspects (risk factors) from medical record data based on WHO criteria, lesion characteristics, lesion location, and lesion area on thorax radiographic with suspected MDR-TB and Gene X results-pert. The current study demonstrates a sizeable extent of resistant cases among pulmonary TB patients. This study presaged a significant risk of Drug Resistant-TB (DR-TB) among females, young adults, unemployed, smokers, and patients with previous treatment failure and cavitation on chest X-rays. Timely identification of high-risk patients will give pronounced advantages regarding appropriate choices of prevention, treatment, and disease control (Saifullah et al., 2021).

This study aimed to find the predictor of MDR-TB, which is very important to an early screening of the suspect of MDR-TB so that he or she can be further examined by Gene X-pert. The diagnostic of MDR-TB can be conducted quickly so it will not infect other people, along with increasing the total number of recovered patients. By providing therapy treatment

immediately, the total number of recoveries from MDR-TB could be increased. The predictor, which highly contributed to faster diagnosis of MDR-TB, is based on nine clinical symptoms according to the WHO criteria and also characteristics of lesion in the thorax, type of lesion, location of lesion, and area of lesion that can b e visualized by radiography.

Methods

A cross-sectional research design was used, to obtain a relationship between MDR-TB risk factors (nine categories + additional categories), thorax radiographic characteristics lesions cover lesion type, lesion location, and lesion area with the results of Gene X-pert examination. 75 samples were included in this research, namely all patients with suspected MDR-TB with at least one risk factor, who met the inclusion and exclusion criteria at Dr. Sardjito General Hospital Yogyakarta and Sleman District General Hospital from 2015–2018. Inclusion criteria from patient medical record data are the following: patients aged >18 years old, patients with suspected MDR-TB with at least one risk factor among the nine risk factors for suspected MDR-TB, patients with thorax radiographic results, and patients with Gene X-pert results (Non-TB/TB-Resistant Rifampicin/ TB-Sensitive Rifampicin). The exclusion criteria were as follows: TB patient data with complications (malignancy, chronic metabolic diseases, and occupational diseases/ miners), thorax radiographic results, and non-TB abnormalities (mass, pneumonia, pulmonary edema, massive pleural effusion, and massive pneumothorax), as shown in Fig. 1.

This research variable consisted of independent variables: 1) Nine WHO criteria for MDR-TB risk factors; 2) thorax radiographic results (+) and thorax radiographic results (−), including lesion characteristics, location, and area. Dependent variables included Gen X-pert (+)/M tb Rif-R test results and Gen X-pert (−)/ M tb Rif-S test results. The research analysis objective was to obtain the relationship between independent and dependent variables with χ^2 (chi-square) statistical analysis by determining the p-value and Relative Risk (RR).
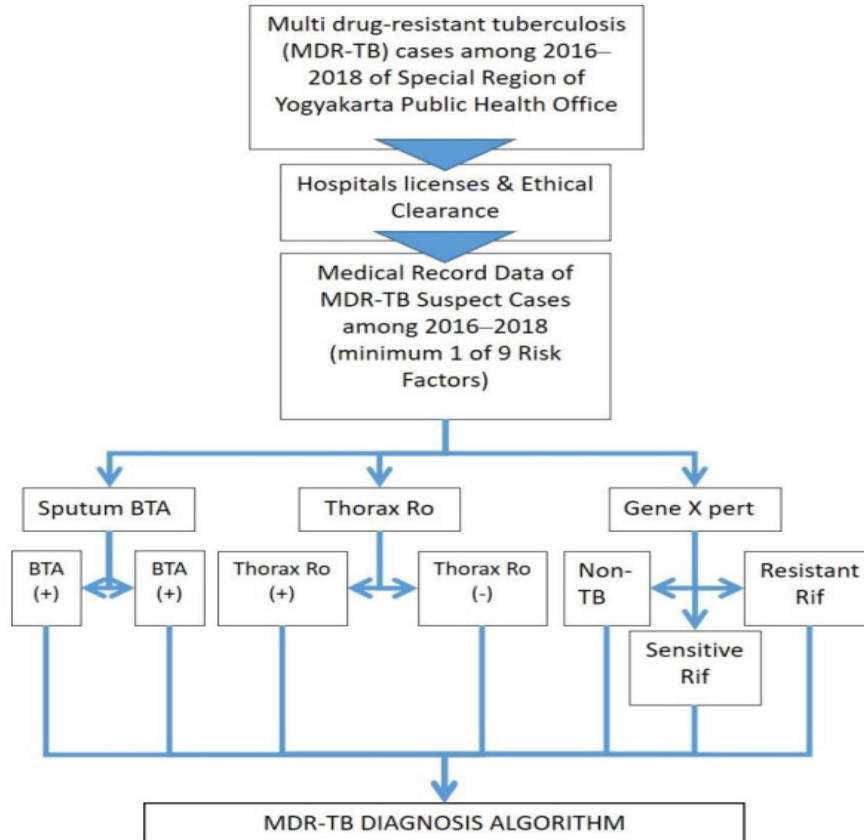
FIGURE 1. Research procedures diagram

Results and Discussion

As shown in Table 1, the research subject domicile was mostly from the special region of Yogyakarta (85.3%) and a small portion from outside the special region of Yogyakarta (14.7%). This condition occurred due to the sample came from RSUP Dr. Sardjito General Hospital Yogyakarta and Sleman District General Hospital; so, only a small portion originated from outside the special region of Yogyakarta. The age of most research subjects was adult (88.0%), followed by elderly (9.3%) and children (2.7%). The research subjects were mostly male (59.8%), with females being 40.2%.

Table 1. Research Subject Characteristics

Criteria	Result	Percentage	Number of Patients	p-value
Patients Domicile			75	
Special Region of Yogyakarta	64	85.3%		
Outside Special Region of Yogyakarta	11	14.7%		
Patients Age			75	0.000
Children	2	2.7%		
Adults	66	88.0%		
Elderly	7	9.3%		
Gender			75	0.591
Male	44	59.8%		
Female	31	40.2%		
MDR-TB Patient's Clinical Symptoms			75	0.000
Cough and shortness of breath	32	42.7%		
Cough (blood coughing, sputum coughing, dry cough)	29	38.7%		
Limp	8	10.7%		
Others (lack of appetite, thin, chest pain, etc.)	5	6.7%		
Shortness of breath	1	1.3%		
Gene X-pert result			75	
Rifampicin Resistant	33	44.0%		
Rifampicin Sensitive	40	53.3%		
Negative Gene X-pert	2	2.7%		
Diagnosis			75	
MDR-TB	33	44.0%		
TB-Sensitive Drug	39	52.0%		
NTM	3	4.0%		
Other Diagnosis				
Disorder of Mental/Psychosis/Depression/Hallucination	7	9.3%	75	
DM	16	21.3%		
More than one disorder	11	14.7%		
Anemia	3	4.0%		
No disorder	38	50.7%		

Source: Primary Data, 2021

Furthermore, clinical symptoms in patients with MDR-TB include coughing and shortness of breath (42.7%), followed by cough (blood coughing, dry coughing) with 38.7%, limp with 10.7%, others (thin, lack of appetite, and chest pain) with 6.7%, and shortness of breath with 1.7%. The results indicate that a significant relationship (p-value < 0.005) between clinical symptoms and MDR-TB incidents is found based on Gene

X-pert, as shown in Table 1. Suspected research subjects with MDR-TB tested by Gene X-pert sensitive Rifampicin (RS) results are 52.0%, and Rifampicin resistance indicates a diagnosis of MDR-TB by 44.0% and negative 2.7%. Patients with the most suspected MDR-TB with accompanying disease are patients with DM (21.3%), as s (Table 1). Comorbid patients in this study include mental disorders/psychosis, hallucinations, and depression by 7 people (6%), and other disorders such as hearing loss, nausea, vomiting, insomnia, and others include 11 people (14.7%), as shown in Table 1.

Table 2 indicates that thorax radiographic lesions in suspected patients with MDR-TB have a significant relationship with MDR-resistant TB Rifampicin in terms of mass, consolidation, pleural thickening, and fibrosis.

From the lesions with MDR-TB, the biggest predictor is fibrosis (p: 0.000 with an odds ratio value of 5.610), meaning that fibrosis lesions tend to MDR-TB 5x higher than other thorax radiographic lesions. The lesion location with a significant relationship to MDR-TB is the right medial, left superior-medial, and inferior lesion location. In addition, the lesion location with the biggest predictor is left inferior (p: 0.000 and OR: 2.632), meaning that the biggest probable factor for MDR-TB from lesion location is left inferior left lung, and the predictor is 2.672 times more likely to become MDR-TB than lesion location in other lung areas. Table 3 shows a comparison of the characteristics of the thoracic radiography lesions between the results of this study and previous studies.

Table 2. Thorax Radiographic Lesion Characteristics on MDR-TB

Thorax radiographic lesion characteristics on MDR-TB	p-value	OR
Lesion Type		
Infiltrates	0.000*	0.245
Cavitary	0.515	0.985
Nodules	0.038*	0.573
Mass	0.000*	2.631*
Consolidation	0.000*	2.681*
Pleural Effusion	0.099	0.681
Pleural Thickening	0.002*	2.314*
Fibrosis	0.000*	5.610*
Calcification	0.004*	0.004
Lesion Location		
Right-superior	0.000*	1.968*
Right medial	0.102	0.780
Right-inferior	0.444	0.940
Left superior	0.009*	1.606*
Left-medial	0.000*	0.508
Left inferior	0.000*	2.632*
Lesion Area	0.004*	0.000

*: significant p-value
Source: Primary Data, 2021

Table 3. Comparison of Results of Other Research Studies with the Present Research Study "Characteristics of Thoracic Radiography on MDR-TB"

The result of the research	Radiographic finding		
	Lesion	Lesion location	Area
Icksan et al. [19]	1. Consolidation 2. Cavity 3. Fibrosis	Lung bilateral	Large
Majdawati et al. [20]	nodule	upper lobe	Large
James et al. [23]; Yi et al [10]; Resta et al. [21]; Priyatam et al. [12]; Rielea et al. [13]	Multiple cavities with diameter Ɵ > 3–4 mm consolidation	upper lobe	Large
Present research	Fibrosis Pleural thickening consolidation	Upper lobe, left inferior	Large area

Source: Primary Data, 2021

Table 4. WHO Criteria by Gene X-pert Result

Clinical Symptoms based on WHO Criteria MDR-TB Suspect	Amt	Percentage	p-value, OR
Chronic cases or failing treatment patients with category II TB medicine	2	2.7%	p: 0.052
Patients with sputum test results remain positive after the third month with category II TB medicine	1	1.3%	p: 0.113
Patients who have received TB treatment. including second-line TB MEDICINE, such as quinolones and kanamycin	4	5.3%	p: 0.140
Patients who failed treatment with category I TB medicine	14	18.7%	p: 0.236
Patients with sputum test results remain positive after insertion with category I TB medicine	0	0%	-
Recur TB cases	16	21.3%	p: 0.326
Returning patients for treatment after negligence in Category I and/or Category II treatment	4	5.3%	p: 0.012*/ OR 0.361
Patients with TB suspicion, patients who live near people with dual medicine-resistant TB, including health workers on dual medicine-resistant TB	8	10.7%	p: 0.000* / OR 0.286
HIV Patients (CDK-215/ vol. 41 no. 4, yr. 2014)	4	5.3%	p: 0.053 OR 0.426
Other patients and new patients, outside the nine criteria	22	29.3%	p: 0.00 * / OR: 2.654

*: significant p-value

Source: Primary Data, 2021

Table 4 indicates 9 WHO criteria and one other criterion related to MDR-TB. From those nine criteria, the criteria with a meaningful relationship to MDR-TB are as follows: returning patients to treatment after negligence in treatment for category I and/or category II; Patients with TB suspicion complaints, patients living near people with dual medicine-resistant TB, including health workers on dual drug-resistant TB, Patients with TB-suspected complaints, patients living near people with dual drug-resistant TB, including health workers served in multiple drug-resistant TB; III) Other patients beyond nine criteria.

Therefore, the biggest predictors of MDR-TB are other patients outside the 9 WHO criteria, with an OR value of 2.654.

Some references and results did not discuss trends in several patients with MDR-TB by origin, age, and gender, because some data indicated that the number of patients with MDR-TB was mostly inconsistent among the numbers based on these criteria (Riele et al., 2019). Further, the highest number of patients with MDR-TB in another study was found at the reproductive age, around 20–55 years. This has been proved by this study, where the number of MDR-TB is mostly adults (88.0%) (Rosalia et

al., 2019). Other research results demonstrate a significant relationship between age and MDR-TB; people aged 15–29 years suffered the most MDR-TB, followed by people aged 30–44 years or those of reproductive age. MDR-TB events demonstrate no association with gender, although in some studies including the results of this study, most of the patients with MDR-TB are male. Several references from 15 articles reviewed, showed that age, gender, irregularity treatment, and medication adherence are the most influencing factors occurrence of MDR-TB. (Priyatam et al., 2019; Riele et al., 2019; Singla et al., 2018; Bawonte et al., 2021).

According to a study of patients with MDR-TB with the most clinical symptoms, including blood coughing, shortness of breath, and chest pain, as indicated by thorax X-ray with the highest grading for weight category with extensive lesions (Pramanindyah & Soedarsono, 2019; Samuel et al., 2016), the frequent symptoms in this research include cough followed by shortness of breath, blood, or sputum coughing, This is aligned with some research of the clinical symptoms, which demonstrates that a significant relationship exists between MDR-TB incidence and cough and chest pain (Abu et al., 2019; Priyatam et al., 2019). The risk factor for the increased incidence of MDR-TB is also influenced by the patient's clinical symptoms, such as shortness of breath due to sequelae of lung disorders, and pleural abnormalities due to MDR-TB infection (Bawonte et al., 2021).

Researchers reported that patients with type 2 DM are more susceptible to TB MDR in Texas and Mexico. They constitute the largest population of active TB cases in Mexico and Mexican America, and this population contributes to an increase in MDR-TB cases. Type 2 DM causes a decrease in the body's immune system, and this is related to poor blood sugar control. Poor blood sugar control can cause disorders of phagocytic function, chemotaxis, reactive oxygen species, and T-cell function (Dwi et al., 2012; Repon et al., 2015). Another risk factor presented in this study was the habit of smoking. Despite increasing the risk of active TB, we have found no sufficient evidence in the literature that smoking is an important risk factor for resistance. However,

studies show smoking as a factor associated with the failure of treatment of TB. The time to sputum culture conversion from positive to negative among smokers is higher than nonsmokers after the second month of the start of treatment with both first-line and second-line drugs (Fregona et al., 2017a).

Some previous studies indicated that the possibility of psychiatric disorderrelated medicine is cycloserine therapy. Sleep disturbance or insomnia might be caused by levofloxacin (Dwi et al., 2012). Some references to the side effects of MDR-TB treatment are vertigo, hearing loss, insomnia, and visual impairment. The frequent contributing factors accompanying patients with MDR-TB include DM disease, hypertension, heart disease, and Rheumatoid Arthritis (Repon et al., 2015). Previous studies found that the default or returning patients' criteria to treatment after negligence in category I and/or category II treatment demonstrate a significant relationship with MDR-TB incidents and 3.5 times higher to be classified as patients with MDR-TB (Devi & Sri, 2018). The biggest predictor of MDR-TB in this study is outside the 9 WHO criteria, namely other criteria and new patients with an OR value of 2.654. Based on WHO 2017 data, the MDR-TB rate is estimated at 2.8% of all new TB cases and 16% of TB cases with repeat treatment. The rate of MDR-TB cases in Indonesia is 32,000 out of a 100,000 population, in a year. Further, new patients and other found criteria demonstrate a 2.65 times tendency to become patients with MDR-TB, compared to patients with 1–9 WHO criteria. This number is likely occurring due to M. tuberculosis bacteria transmission, which is resistant to TB medicine and to people around them. Seeing this reality, we need to think about the increasing cases of MDR-TB seriously due to MDR-TB and RR-TB patients' transmission who do not obey the treatment of people around them (Abu et al., 2019; Icksan et al., 2018; Majdawati et al., 2019). The predictor factors in this study, of the 9 WHO criteria were new patients who were exposed to or in contact with people around them who suffered from MDR-TB, TB patients who were not regularly treated so that the possibility of relapse was very high (Fregona et al., 2017b).

In general, resistance to anti-tuberculosis medicine is divided into primary, initial, and secondary. First, the primary is if the patient never receives TB medicine treatment or receives TB medicine treatment for less than 1 month. Next, initial resistance is if we are not sure whether the patient exhibits a history of previous TB medicine treatment or not. Next, secondary is if the patient exhibits a history of TB medicine treatment for at least 1 month. Theoretically, five considered factors exist that play a role in causing MDR-TB outbreaks, namely inadequate treatment (rising to resistant M. tuberculosis mutants); late MDR diagnosis patients, then becoming a source of continuous transmission; patients with incurable TB medicine resistance will continue the transmission; Patients with TB medicine resistance, although they were treated continuously by inadequate medicine, they may cause resistant bacteria multiplication, and HIV infection facilitates primary and secondary resistances (Icksan et al., 2018). The main-factor cure for MDR-TB is treatment compliance (OR: 6.736), TB treatment history (OR: 4.198) and the suitability of the drug dose TB medicine (OR: 5.281). MDR-TB will increase 4–7 times in patients that do not correspond to those mentioned above. Moreover, regular, and orderly TB treatment as well as dosage and choice of TB medicine also affects the healing of MDR-TB (Resta et al., 2018). Irregularity in taking medication is one of the predictors of MDR-TB tendencies. This is caused by feeling lazy, forgetting to take medicine, and feeling bored from taking long-term medicine and making you feel uncomfortable (Mashidayanti et al., 2020).

Based on the research conducted, researchers concluded that from the research variables consisting of clinical symptoms, WHO criteria for suspected MDR-TB and thorax radiographic characteristics (lesion type, lesion location, and lesion area) are predictors of MDR-TB. The lesion area is significantly related to MDR-TB incidents; the wider the lesion, the more likely for MDR-TB to be present. Several studies on the community with TB endemic areas obtain that most lesions with a significant relationship to MDR-TB include consolidation, cavitary, mass/nodules, fibrosis, pleural thickening,

or pleural effuse. The lesion location on most thoraxes radiographic is in the upper right lobe, followed by the upper left lobe and medial and inferior lobes. Most MDR-TB is in the area/severe category according to the degree of severity or lesion area (Icksan et al., 2018; Majdawati et al., 2019).

Some researchers who researched the characteristics of the thoracic radiographic lesions of patients with MDR-TB found that most of the lesion results on MDR-TB are cavities, multiple quantities, most locations in the superior pulmo second lobe, and occupy a wide area of more than three segments of the right and left lung (Yi et al., 2018; Priyatam et al., 2019; Riele et al., 2019; Repon et al., 2015; James et al., 2013). Other researchers from Indonesia found that most lesions on MDR-TB are fibrosis, consolidation, and thickening of the pleural (José et al., 2017; Abu et al., 2019). Researchers from Indonesia took samples from the community, not from hospitals. Moderate research has now been carried out on samples from the hospital's case proofing MDR-TB. Lung cavitary nodules or masses were more frequently observed and also showed greater extent in primary multidrug-resistant tuberculosis compared with drug-sensitive tuberculosis. Thick-walled multiple cavity lesions present the most promising radiological sign for MDR-TB diagnosis. For future studies, cavity lesion characteristics should be quantified in detail. The extent of bronchiectasis was significantly greater in primary multidrug-resistant tuberculosis than in drug-sensitive tuberculosis. Calcification, large nodules, and calcified lymph nodes were more frequent in drug-sensitive tuberculosis (Li et al., 2017;

Conclusions

Clinical symptoms with the strongest predictor value are cough accompanied by shortness of breath (42.7%) followed by blood coughing or sputum coughing (38.7%). The strongest WHO criteria predictor is other criteria and new patients (OR: 2.654), followed by default patients, for instance, those who return to treatment after negligence on category I and/or category II treatment and suspected patients with TB living near people with dual drug-resistant TB, including on-

duty health workers or in dual drug-resistant TB wards. Thorax radiographic characteristics are as follows: lesion type: mass (OR: 2.631), consolidation (OR: 2.681), pleural thickening (OR: 2.314), and fibrosis as the strongest (OR: 5.610). Lesion location: superior right (OR: 1.968), superior left (OR: 1.606), and inferior left as the strongest (OR: 2,632). The lesion area with the strongest predictor is area/weight.

Acknowledgment

References

Abu, A.M., Rafael, G., Afranio, K., Ewan, T., & Bertel, S., 2019. Modelling the Impact of Chest X-Ray and Alternative Triage Approaches Prior to Seeking a Tuberculosis Diagnosis. *BMC Infectious Disease,* 19, pp.93.

Alok, D.R., 2019. Clinico-Radiological Difference between Primary and Secondary MDR Pulmonary Tuberculosis. *Journal of Clinical Diagnostic Research*, 13(3), pp.8-10.

Bawonte, T.G., Mambo, C.D., & Masengi, A.S.R., 2021. Faktor-Faktor Yang Mempengaruhi Tuberculosis Multidrug Resistance (TB MDR). *Jurnal e-Biomedik*, 9(1).

Devi, T., & Sri, R.R., 2018. The Incidence of Multi Drug Resistant Tuberculosis in dr. Kariadi General Hospital. *Journal of Public Health Research and Development*, 2(2), pp.194-204.

Dwi, S.R., Sri, N., & Isnani, Z.A., 2012. Analisis Faktor Risiko Multidrug Tuberculosis (MDR-TB) (Studi Kasus di BP4 Purwokerto). *Jurnal Kesehatan Masyarakat,* 8(1), pp.62-68.

Emanuele, P., Mario, C.R., & Giovanni, B.M., 2019. Regimens to Treat Multidrug-Resistant Tuberculosis: Past, Present and Future Perspectives. *European Respiratory Review*, 28(152), pp.190035.

Fregona, G., Cosme, L.B., Moreira, C.M.M., Bussular, J.L., Dettoni, V. do V., Dalcolmo, M.P., Zandonade, E., & Maciel, E.L.N., 2017a. Risk Factors Associated with Multidrug-Resistant Tuberculosis in Espírito Santo, Brazil. *Revista de Saúde Pública*, 51(0).

Icksan, A.G., Napitupulu, M.R.S., Nawas, M.A., & Nurwidya, F., 2018. Chest X-Ray Findings Comparison Between Multi-Drug-Resistant Tuberculosis and Drug-Sensitive Tuberculosis. *Journal of Natural Science, Biology and Medical*, 9(1), pp.42-46.

James, C.M.B., Andrew, R.B., Benjamin, Z., Linda, B.H., Yuming, N., Moonseong, H., van der Merwe, E.L., Bamber, S., Moll, A.P., Friedland, G.H., Shah, N.S., & Gandhi, N.R., 2013. Chest Radiograph Findings and Time to Culture Conversion in Patients with Multidrug-Resistant Tuberculosis and HIV in Tugela Ferry, South Africa. *PLoS ONE*, 8(9), pp.e73975.

Jeong, B.-H., Jeon, K., Park, H.Y., Kwon, O.J., Lee, K.S., Kim, H.K., Choi, Y.S., Kim, J., Huh, H.J., Lee, N.Y., & Koh, W.-J., 2015. Outcomes of Pulmonary MDR-TB: Impacts of Fluoroquinolone Resistance and Linezolid Treatment. *Journal of Antimicrobial Chemotherapy*, 70(11), pp.3127–3133.

José, A.C., Joan, A.C., José, M.G.G., Francisco, J.G.P., Juan, J.P., & Juan, R.M., 2017. Diagnosis and Treatment of Drug-Resistant Tuberculosis. *Archivos de Bronconeumologia*, 53(9), pp.501-509.

Li, D., He, W., Chen, B., & Lv, P., 2017. Primary Multidrug-Resistant Tuberculosis Versus Drug-Sensitive Tuberculosis in non-HIV-Infected Patients: Comparisons of CT Findings. *PLOS ONE*, 12(6), pp.e0176354.

Majdawati, A., Icksan, A.G., & Lolong, D., 2019. Comparison of Chest X-Ray Lesion Characteristics of Multidrug-Resistant Tuberculosis and Non-Tuberculous Mycobacterial Infection. *Polish Journal of Radiology*, 84, pp.162-170.

Mashidayanti, A., Nurlely, N., & Kartinah, N., 2020. Faktor Risiko Yang Berpengaruh Pada Kejadian Tuberkulosis dengan Multidrug-Resistant Tuberculosis (MDR-TB) di RSUD Ulin Banjarmasin. *Jurnal Pharmascience*, 7(2), pp.139.

Pramanindyah, B.A., & Soedarsono, S., 2019. Hubungan antara Pola Resistensi OAT Lini Pertama dan Gradasi Gambaran Foto Toraks Penderita TB Paru MDR. *Jurnal Respirasi*,

2(1), pp.1-5.

Priyatam, K., Januka, T., Ramesh, B.B., Gokarna, R.G., Jyoti, A., & Basista, P.R., 2019. Diagnosis of Tuberculosis from Smear-Negative Presumptive TB Cases Using Xpert MTB/Rif Assay: a Cross-Sectional Study from Nepal. *BMC Infectious Disease*, 19(1), pp.1090.

Repon, K.S., Dostogir, A.M., Faisal, M., & Priyanka, R., 2015. A Cross Sectional and Comparative Study of Tuberculosis Patients with Multi Drug Resistance Tuberculosis (MDR) Patients in Bangladesh. *Annals of Clinical and Laboratory Research*, 3(4), pp.1-6.

Resta, F.P., Yusuf, N., & Bambang, S. 2018. Chest X-Ray Evaluation of Cavitary Lesions Among Pulmonary MDR-TB Patients. *eJournal Kedokteran Indonesia*, 6(2), pp.118-122.

Riele, J.B., Buser, V., Calligaro, G., Esmail, A., Theron, G., Lesosky, M., & Dheda, K. 2019. Relationship between Chest Radiographic Characteristics, Sputum Bacterial Load, and Treatment Outcomes in Patients with Extensively Drug-Resistant Tuberculosis. *International Journal of Infectious Diseases: IJID*, 79, pp.65-71.

Rosalia, S.S., Aziza, G.I., Dina, B.L., & Fariz, N., 2019. Thoracic Radiography Characteristics of Drug Sensitive Tuberculosis and Multi Drug Resistant Tuberculosis: A Study of Indonesian National Tuberculosis Prevalence Survey. *Acta Medica*, 62(1), pp.24-29.

Saifullah, A., Mallhi, T.H., Khan, Y.H., Iqbal, M.S., Alotaibi, N.H., Alzarea, A.I., & Rasheed, M., 2021. Evaluation of Risk Factors Associated with the Development of MDR- and XDR-TB in a Tertiary Care Hospital: A Retrospective Cohort Study. *PeerJ*, 9, pp.e10826.

Samuel, M., Moherndran, A., & Raziya, B., 2016. Chest X-Ray Patterns of Pulmonary Multidrug-Resistant Tuberculosis in Children in a High HIV-Prevalence Setting. *SA Journal of Radiology*, 20(1), pp.1-6.

Singh, P. K., & Jain, A., 2019. Limited Scope of Shorter Drug Regimen for MDR TB Caused by High Resistance to Fluoroquinolone. *Emerging Infectious Diseases*, 25(9), pp.1760–1762.

Singla, R., Mallick, M., Mrigpuri, P., Singla, N., & Gupta, A., 2018. Sequelae of Pulmonary Multidrug-Resistant Tuberculosis at the Completion of Treatment. *Lung India*, 35(1), pp.4-8.

Yi, X.J.W., Myung, J.C., Aliaksandr, S., Alex, R., Andrei, G., & Michael, T., 2018. Radiological Signs Associated with Pulmonary Multi-Drug Resistant Tuberculosis: an Analysis of Published Evidences. *Quantitative Imaging in Medicine and Surgery*, 8(2), pp.161-173.

Zida, M.A., & Nur, M.R., 2019. Karakteristik Penderita Tuberculosis Multidrug Resistant (TB MDR) di Sulawesi Tenggara Tahun 2014-2017. *Medula*, 6(2), pp.547-557.

Physical Activity and Stress Levels on the Eating Behavior of Elementary School Amid the Covid-19 Pandemic

Ayu Mutiara Santanu✉, Syifa Fakhomah Syihab, Muchamad Rizki Sentani, Hurry Mega Insani
Faculty of Sport and Health Science Education, Universitas Pendidikan Indonesia, Bandung, Indonesia.

Article Info

Abstract

The objective of this study is to analyze the relationship between physical activity and stress levels on the eating behavior of elementary school-aged children amid the Covid-19 pandemic in Garuda Village, Bandung, West Java. A cross-sectional research design was used in this study. We recruited 173 elementary school children in Garuda Village, Bandung, West Java. Research data were collected by questionnaire. Study measures included a general information survey, anthropometric measurements, a Perceived Stress Scale (PSS), an International Physical Activity Questionnaire (IPAQ), and Food Frequency Questionnaire (FFQ). Univariate, bivariate, and multivariate analyses were used. The result showed children's nutrition intake is associated with the education of fathers and mothers. Students with mild stress levels showed a good eating pattern (55.8%) and students with moderate stress levels had a poor diet (54.2%). There was a relationship between physical activity and the diet of elementary school students (p-value = 0.049) (p < 0.05) and students with sedentary physical activity have an opportunity of 2.289 times to have an adequate diet. Gender, father's education, mother's education, father's occupation, mother's occupation, income, and perception of stress were not related to the student's diet (p-value > 0.05).

Introduction

Primary school children aged 6-12 years have physical growth that has reached maturity, they have been able to control their bodies and balance so they move actively and have the intelligence ability to sort numbers, letters, and words, enjoy talking, understand cause and effect and develop understanding against space and time (Bégin et al., 2020). At this time, children begin to think logically and concretely but they are not able to think abstractly because their reasoning is still limited (Bégin et al., 2020). This causes children to begin to be able to express whether they like or dislike the food and their activities, so parents need to regulate their children's food to maintain their food intake, activities, and screen time.

The study found that among children aged 6–12 years and 13–18 years, the prevalence of overweight increased from 5.1% to 15.6% and from 7.1% to 14.1% between 1993 and 2014, mainly in urban areas (Oddo et al., 2019). Low physical activity independently or moderate physical activity and high energy intake are risk factors for Indonesian children to get overweight (Harahap et al., 2018). Mothers play a key role as individuals who help sort and prepare family food intake whose selection is influenced by knowledge, attitudes, beliefs, income, and family support to regulate and prevent cases of obesity in children (Pradanie et al., 2020). For example, children frequently eating fruits and vegetables and reporting a low junk food energy intake were 70% less likely (OR = 0.30; 0.15–0.59) to be obese (Hadi et al., 2020). Preventive interventions for child obesity need multiple components to improve diets and raise levels of physical activity rather than just addressing one of the three types of assessed behaviors(Hadi et al., 2020).

The ecological system that surrounds children as proposed by Bronfenbrenner shows that the experience of fear, anxiety, stress, and loneliness of parents and society will affect the psychological well-being of children aged 6-12 years(An, 2020). During the COVID-19 pandemic, school - age children experience stress due to the impact of online learning and the decline in student active living from the moderate category to the low category, so it is important for children and parents to talk to each other more and to do physical activities. together so that the children can develop and grow healthy ((Beltasar & Hidayat, 2022; Budury & Khamida, 2020; Emilia & Mulyono, 2021). During the pandemic where the children should have online study at home also requires parents to be able to implement online learning, parents are expected to be better prepared to play a positive and dynamic role in their learning so the stress that occurs can be prevented (Tri Nugroho et al., 2022).

The program of each school activates children's activities, namely by providing a weekly schedule for the field of physical education and health studies, every Friday in several schools there are also morning exercises, as well as extracurricular activities such as drum band, scouting, volleyball, and soccer. The children are enthusiastic about participating in this school activity but still, some children are overweight. A poor physical activity pattern will cause an increase in overweight cases in children, low levels of child fitness, and affect the health level of children into adulthood (Fraysse et al., 2019; Mora-Gonzalez et al., 2020; Song et al., 2019).

But unfortunately, when the Covid-19 case soared, Physical Distancing was imposed so one of the effects was that schools were closed and students learned from home. Limited personal movement and being confined at home can increase stress levels in children and reduce physical activity. Lack of activity will affect bone growth, bone mass, and bone flexibility, so children who have less activity will not have optimal bone growth. One of the factors that affect physical activity is diet. People who are overweight tend to eat excessively. Obese people are usually more responsive than normal-weight people to external hunger cues, such as the taste and smell of food, or the timing of meals. They tend to eat when they feel like eating, not when they are hungry. This overeating pattern makes it difficult for them to get out of obesity if they do not have self-control and strong motivation to lose weight.

The importance of maintaining essential health services for children while mitigating the impact of the pandemic is an unprecedented challenge. There is a need to increase physical activity in primary school children during the pandemic. This study was conducted to determine the relationship between physical activity and stress levels with eating behavior in school children during the Covid-19 pandemic.

Method

In this study, we used a cross-sectional research design. Data were collected from March 2021 to October 2021. We recruited 102 elementary school children in Garuda Village, Bandung, West Java. Research data were collected by questionnaire. Study measures included a general information survey, anthropometric measurements, stress level and physical activity questionnaires, and food frequency questionnaires. Multiple logistic regression was used. Participants were invited to participate in the study through the distribution of WhatsApp messages and printed letters facilitated by the school administrations and community stakeholders. We included children between six and twelve years old who had no chronic disease that affected their nutritional status or physical activity pattern. Ethical considerations Approval to conduct the study was obtained from Komite Etik Fakultas Kedokteran Universitas Gajah Mada, Yogyakarta, Indonesia. Before participating in the study, the risks and benefits were explained to all potential mothers and children participants. After answering all the questions, written consent from mothers and assent from children were collected. Instruments and measures Study instruments included anthropometric measurements of children, a Perceived Stress Scale (PSS), International Physical Activity Questionnaire (IPAQ), and Food Frequency Questionnaire (FFQ).

This research uses statistical software with the following stages such as Edit Data,

Data Coding, Data Entry, and Data Analysis. Edit Data is the activity stage of cleaning the data that has been collected, both how to fill it, filling errors, and consistency of each answer contained in the questionnaire. Data coding is done by providing a code for each answer given to facilitate data entry. Data Entry is the list of questions that have been completed by filling in the answer code that is then entered into a computer program in the form of codes only. And the last Data Analysis is the variables that have been selected and stored in the form of a database program and are then analyzed using the statistical software STATA version 16. First,

descriptive statistics are compiled to describe physical activity, stress levels, and eating behavior. Second, all data were analyzed using ordinal logistic regression.

Result and Discussion

The research was conducted at SD Kelurahan Garuda, Andir Subdistrict, Bandung City in June 2021. A total of 107 students in grades 4, 5, and 6 were interviewed to fill out the questionnaire. However, only 93 could be analyzed because 14 student data were incomplete. The characteristics of the respondents can be described in the following Table:

Table 1. Descriptive Analysis

Variable	Adequate diet (n=47)		Good diet (n=46)	
	Total	Percentage	Total	Percentage
Gender				
- Male	27	50	27	50
- Female	20	51,3	19	48,7
Father Education				
- Elementary	5	38,5	8	61,5
- Junior High School	13	54,2	11	45,8
- Senior High School	27	51,9	25	48,1
- D1/D2/D3/D4/S1 Graduated	2	50	2	50
Mother Education				
- Elementary	9	45	11	55
- Junior High School	15	51,7	14	48,3
- Senior High School	22	55	18	45
- D1/D2/D3/D4/S1 Graduated	1	33,3	2	66,7
- Magister Graduated	0	0	1	100
Father's Job				
- Does not work	0	0	1	100
- PNS (Public worker)	1	33,3	2	66,7
- Entrepreneur	11	37,9	18	62,1
- Laborer	24	52,2	22	47,8
- Other	11	78,6	3	21,4
Mother's job				
- Does not work/housewife	36	52,9	32	47,1
- PNS (Public worker)	1	100	0	0
- Entrepreneur	4	28,6	10	71,4
- Laborer	4	66,7	2	33,3
- Other	2	50	2	50
Family income				
- < Rp 500.000,-	3	60	2	40
- Rp 500.000 - Rp 1.000.000,-	9	56,3	7	43,7
- Rp 1000.000,- - Rp 3.000.000,-	21	47,7	23	52,3
- Rp 3.000.000,- - Rp 5.000.0000,-	12	54,5	10	45,5
- > Rp 5.000.0000,-	2	33,3	4	66,7
Stress perception				
- Mild	14	45,2	17	55,8
- Moderate	32	54,2	27	45,8
- High	1	33,3	2	66,7
Physical activity				
- *sedentary*	29	60,4	19	39,6
- *moderate activity*	18	40	27	60

Source: Primary Data, 2021

The results of the descriptive analysis showed that the children's diet was good and adequate with almost equal percentages, namely 49.5% and 50.5%. The cut-off point set in the diet variable uses the median value because the data is not normally distributed. The family environment greatly influences healthy behavior habits in children, especially boys, other factors that affect children's food consumption such as knowledge, attitudes, and habits of bringing lunch and their peers (Gibson et al., 2020; Williams et al., 2018). Activities to improve healthy dietary practices are certainly highly recommended for good growth and development of children, starting with the food they eat (Fernández-Álvarez et al., 2021). Most of the respondent's mothers are housewives who can prepare food for their children at home so that their children's diet can be maintained properly. Children who have good consumption patterns can improve or maintain good nutritional status, while children who consume a lot of unhealthy snacks such as fruit syrup, flavored drinks, fried foods, pentol, brains, and sausages can trigger overweight or obesity in children (Desalew et al., 2017; Khamis et al., 2019).

Most of the respondents are male with the same proportion as those with good and sufficient eating patterns (50%). Meanwhile, more female students had a poor diet (51.3%) than students with a good diet (48.7%). The education of fathers and mothers are mostly high school graduates/equivalent both in the group with a good and sufficient diet. Most of the fathers work as laborers, while most of the mothers do not work/housewives. Most of the family income is in the category of IDR 1,000,000 to IDR 3,000,000. During the Covid-19 pandemic, all countries in the world experienced losses that resulted in mass job losses, especially in poor and developing countries, so at that time some communities experienced difficulties in accessing food security and medicines (Josephson et al., 2021). Families who suffered losses due to Covid-19 (through reduced income and stopped working) had 3 times higher risk to experience food insecurity compared to those who did not (Syafiq et al., 2022). Research respondents have a fairly high education, an average of 3 family

members, and sufficient income. High income can maximize food diversity (amount and type) such as the consumption of animal food (meat, eggs, chicken, and fish) in the household so that it can meet nutritional adequacy (Workicho et al., 2016).

Description of stress perception variable using Perceived Stress Scale (PSS) questions shows students have moderate stress level of 63.4%. Students with mild stress levels showed a good eating pattern by 55.8%, the value was higher when compared to students whose diet was less (45.2%). On the other hand, students with moderate levels of stress had more of a poor diet (54.2%), when compared to students who had a good diet (45.8%). During the pandemic, the stress level of primary school children in large classes is higher than in small classes due to the difficulty of accepting the latest learning methods for elementary school students, most of whom ultimately need to learn on their own (Cusinato et al., 2020). In addition to increasing children's stress levels during the pandemic, parents' stress levels also increase due to high screen time in children which triggers a sedentary lifestyle (Seguin et al., 2021). Screentime that is too high can interfere with children's physical activity and cognitive development, affect the quality and duration of sleep, increase the risk of hypertension, cause a decrease in HDL cholesterol, and is associated with depression in children (Domingues-Montanari, 2017; Lissak, 2018). Stress levels in children need to be reduced by getting used to physical activities outside the home with the family so that it can affect eating patterns in children.

Physical activity carried out during this pandemic is in the sedentary category with a percentage of 51.6%. Physical activity variables were divided into sedentary and moderate with a cut-off point of the mean value because the data were normally distributed (p-value of normality > 0.05). Students with more sedentary activities had a poor diet (60, 4%), while the rest had a good diet (39,6%). On the other hand, students with moderate activity had more good diets (60%) when compared to those with adequate diets. Higher levels of Physical Activity were associated with more favorable cardiometabolic health, with increasing levels

of stress minimizing the beneficial effect of Physical Activity on Body Mass Index (Schultz et al., 2020). Typical activities of daily living -days are like playing group games which will affect the physical and emotional development of children (Webster et al., 2019). Bivariate analysis was conducted to examine the relationship between characteristics, physical activity, and stress levels on the diet of elementary school students. The analysis used is chi-square. The data will be presented in the following table:

Table 2. Bivariate Analysis

Variable	Adequate diet (n=47)		Good diet (n=46)		P-value
	Total	Percentage	Total	Percentage	
Gender					0,903
- Male	27	50	27	50	
- Female	20	51,3	19	48,7	
Father Education					0,819
- Elementary	5	38,5	8	61,5	
- Junior High School	13	54,2	11	45,8	
- Senior High School	27	51,9	25	48,1	
- D1/D2/D3/D4/S1 Graduated	2	50	2	50	
Mother Education					0,744
- Elementary	9	45	11	55	
- Junior High School	15	51,7	14	48,3	
- Senior High School	22	55	18	45	
- D1/D2/D3/D4/S1 Graduated	1	33,3	2	66,7	
- Magister Graduated	0	0	1	100	
Father's Job					0,104
- Does not work	0	0	1	100	
- PNS (Public worker)	1	33,3	2	66,7	
- Entrepreneur	11	37,9	18	62,1	
- Laborer	24	52,2	22	47,8	
- Other	11	78,6	3	21,4	
Mother's job					0,347
- Does not work/housewife	36	52,9	32	47,1	
- PNS (Public worker)	1	100	0	0	
- Entrepreneur	4	28,6	10	71,4	
- Laborer	4	66,7	2	33,3	
- Other	2	50	2	50	
Family income					0,848
- < Rp 500.000,-	3	60	2	40	
- Rp 500.000 - Rp 1.000.000,-	9	56,3	7	43,7	
- Rp 1000.000,- - Rp 3.000.000,-	21	47,7	23	52,3	
- Rp 3.000.000,- - Rp 5.000.0000,-	12	54,5	10	45,5	
- > Rp 5.000.0000,-	2	33,3	4	66,7	
Stress perception					0,463
- Mild	14	45,2	17	55,8	
- Moderate	32	54,2	27	45,8	
High	1	33,3	2	66,7	
Physical activity					**0,049**
- *sedentary*	29	60,4	19	39,6	
- *moderate activity*	18	40	27	60	

Source: Primary Data, 2021

The results of the analysis showed that there was a relationship between physical activity and the diet of elementary school students, as evidenced by the p-value = 0.049 (p < 0.05). The value of the Odd Ratio (OR) is 2.289, which means that students with sedentary physical activity have an opportunity of 2.289 times to have an adequate diet when compared to students with moderate physical activity. These results indicate that the online learning process causes the average level of physical activity of students to be in the sedentary group which causes students' eating patterns to be less good or sufficient. As a result, if children do

not get good nutrition it will have an impact on obesity, besides that childhood obesity is closely related to the level of child fitness and motoric development, and causes cases of morbidity in children such as hypertension, psychological impacts, sleep apnea, gastroesophageal reflux disease, iron deficiency, anemia, and asthma (Han et al., 2018; Sahib et al., 2021; Tambalis et al., 2018). During a pandemic, increasing screen time and decreasing physical activity causes unhealthy behavior and affects stress levels for both father, mother, and child (Carroll et al., 2020). Students with moderate physical activity have a good diet because physical activity is a movement that involves skeletal muscles that require energy, school children have the characteristics of always being active in physical activities, so they require high energy intake to meet their needs (Al-Jawaldeh et al., 2020). Physical activity balances calories in food with calories used during physical activity to control body weight (Scaglioni et al., 2018).

Other variables such as gender, father's education, mother's education, father's occupation, mother's occupation, income, and perception of stress were not related to the student's diet because they had a p-value > 0.05. Strategies to improve dietary quality for groups that have easy access to healthier foods focus on improving the types of high-quality protein foods, such as milk and seafood, while the groups who have difficulty accessing healthier foods can choose to increase the types of high-quality but relatively cheap foods like vegetables and fruits considering the availability and living cost (Lan Wang et al., 2022).

Conclusion

Children's nutrition intake is associated with the education of fathers and mothers. Students with mild stress levels showed a good eating pattern (55.8%) and students with moderate stress levels had a poor diet (54.2%). There was a relationship between physical activity and the diet of elementary school students (p-value = 0.049) (p < 0.05) and students with sedentary physical activity have an opportunity of 2.289 times to have an adequate diet. Gender, father's education, mother's education, father's occupation, mother's occupation, income, and perception

of stress were not related to the student's diet (p-value > 0.05).

Acknowledgment

References

Al-Jawaldeh, A., Taktouk, M., Nasreddine, L., 2020. Food Consumption Patterns and Nutrient Intakes of Children and Adolescents in the Eastern Mediterranean Region: A Call for Policy Action. *Nutrients,* 2020.

An, R., 2020. Projecting the Impact of the Coronavirus Disease-2019 Pandemic on Childhood Obesity in the United States: A Microsimulation Model. *J Sport Health Sci,* 9.

Bégin, F., Elder, L., Griffiths, M., Holschneider, S., Piwoz, E., Ruel-Bergeron, J., & Shekar, M., 2020. Promoting Child Growth and Development in the Sustainable Development Goals Era: Is It Time for New Thinking?. *Journal of Nutrition,* 150.

Beltasar, T., & Hidayat, T., 2022. Effects of the COVID-19 Pandemic on Active Life Behavior of Elementary School Students in West Java. *Journal Sport Area*, 7, pp.69–78.

Budury, S., & Khamida, K., 2020. Playing "Walk And Stop" and Expressive Writing to Reduce Children's Stress During the Covid Pandemic 19. *Indonesian Journal of Cultural and Community Development*, 8.

Carroll, N., Sadowski, A., Laila, A., Hruska, V., Nixon, M., Ma, D.W.L., & Haines, J., 2020. The Impact of Covid-19 on Health Behavior, Stress, Financial and Food Security Among Middle to High Income Canadian Families with Young Children. *Nutrients,* 12.

Cusinato, M., Iannattone, S., Spoto, A., Poli, M., Moretti, C., Gatta, M., & Miscioscia, M., 2020. Stress, Resilience, and Well-Being in Italian Children and Their Parents During the COVID-19 Pandemic. *Int J Environ Res Public Health* ,17.

Desalew, A., Mandesh, A., & Semahegn, A., 2017. Childhood Overweight, Obesity and Associated Factors Among Primary School Children in Dire Dawa, Eastern Ethiopia; A Cross-Sectional Study. *BMC Obes,* 4.

Domingues-Montanari, S., 2017. Clinical and Psychological Effects of Excessive Screen Time on Children. *J Paediatr Child Health,* 2017.

Emilia, P.S., & Mulyono, 2021. Pengaruh Terapi Bermain Game Online terhadap Tingkat Stres Anak Usia Sekolah Dimasa Pandemi Covid-19. *Jurnal Ilmu Keperawatan Jiwa,* 4, pp.633–638.

Fernández-Álvarez, M. del M., Martín-Payo, R., Zabaleta-del-Olmo, E., García-García, R., Cuesta-Izquierdo, M., & González-Méndez, X., 2021. Assessment of Diet Quality and Physical Activity of Soccer Players Aged 13 to 16, from the Principality of Asturias, Spain. *An Pediatr (Engl Ed)*, 95.

Fraysse, F., Grobler, A.C., Muller, J., Wake, M., & Olds, T., 2019. Physical Activity and Sedentary Activity: Population Epidemiology and Concordance in Australian Children Aged 11-12 Years and Their Parents. *BMJ Open*, 9.

Gibson, E.L., Androutsos, O., Moreno, L., Flores-Barrantes, P., Socha, P., Iotova, V., Cardon, G., De Bourdeaudhuij, I., Koletzko, B., Skripkauskaite, S., & Manios, Y., 2020. Influences of Parental Snacking-Related Attitudes, Behaviours and Nutritional Knowledge on Young Children's Healthy and Unhealthy Snacking: The ToyBox Study. *Nutrients,* 12.

Hadi, H., Nurwanti, E., Gittelsohn, J., Arundhana, A.I., Astiti, D., West, K.P., & Dibley, M.J., 2020. Improved Understanding of Interactions between Risk Factors for Child Obesity May Lead to Better Designed Prevention Policies and Programs in Indonesia. *Nutrients,* 12.

Han, A., Fu, A., Cobley, S., & Sanders, R.H., 2018. Effectiveness of Exercise Intervention on Improving Fundamental Movement Skills and Motor Coordination in Overweight/ Obese Children and Adolescents: A Systematic Review. *J Sci Med Sport,* 2018.

Harahap, H., Sandjaja, S., Soekatri, M., Khouw, I., & Deurenberg, P., 2018. Association of Energy Intake and Physical Activity with Overweight among Indonesian Children 6-12 Years of Age. *Asia Pac J Clin Nutr,* 27.

Josephson, A., Kilic, T., & Michler, J.D., 2021. Socioeconomic Impacts of COVID-19 in Low-Income Countries. *Nat Hum Behav,* 5.

Khamis, A.G., Mwanri, A.W., Ntwenya, J.E., & Kreppel, K., 2019. The Influence of Dietary Diversity on the Nutritional Status of Children Between 6 and 23 Months of Age in Tanzania. *BMC Pediatr,* 19.

Lan Wang., Huang, W., Zhao, C., Hu, Y., & Cui, S., 2022. Exploring the Environment-Nutrition-Obesity Effects Associated with Food Consumption in Different Groups in China. *J Environ Manage,* 317, pp.115–287.

Lissak, G., 2018. Adverse Physiological and Psychological Effects of Screen Time on Children and Adolescents: Literature Review and Case Study. *Environ Res,* 164.

Mora-Gonzalez, J., Esteban-Cornejo, I., Solis-Urra, P., Migueles, J.H., Cadenas-Sanchez, C., Molina-Garcia, P., Rodriguez-Ayllon, M., Hillman, C.H., Catena, A., Pontifex, M.B., & Ortega, F.B., 2020. Fitness, Physical Activity, Sedentary Time, Inhibitory Control, and Neuroelectric Activity in Children with Overweight or Obesity: The ActiveBrains project. *Psychophysiology,* 57.

Oddo, V.M., Maehara, M., Rah, J.H., 2019. Overweight in Indonesia: An Observational Study of Trends and Risk Factors Among Adults and Children. *BMJ Open*, 9.

Pradanie, R., Rachmawati, P.D., & Cahyani, M.D., 2020. Factors Associated with Mothers' Behaviors in Selecting Complementary Feeding in Surabaya, Indonesia. *Nurse Media Journal of Nursing*, 10.

Sahib, H.S., Mohsin, R.K., & Mutlag, S.S., 2021. The Burden of Obesity on Children Health, Its Correlation to Their Age. *Revista Latinoamericana de Hipertension,* 15.

Scaglioni, S., De Cosmi, V., Ciappolino, V., Parazzini, F., Brambilla, P., & Agostoni, C., 2018. Factors Influencing Children's Eating Behaviours. *Nutrients,* 2018.

Schultz, N.S., Chui, K.K.H., Economos, C.D., Lichtenstein, A.H., Volpe, S.L., & Sacheck, J.M., 2020. Impact of Physical Activity, Diet Quality and Stress on Cardiometabolic Health in School Employees. *Prev Med Rep,* 20.

Seguin, D., Kuenzel, E., Morton, J.B., & Duerden, E.G., 2021. School's Out: Parenting Stress and Screen Time Use in School-Age Children During the COVID-19 Pandemic. *J Affect Disord Rep,* 6.

Song, C., Gong, W., Ding, C., Yuan, F., Zhang, Y., Feng, G., Chen, Z., & Liu, A., 2019. Physical Activity and Sedentary Behavior Among Chinese Children Aged 6-17 Years: A Cross-Sectional Analysis of 2010-2012 China National Nutrition and Health Survey. *BMC Public Health,* 19.

Syafiq, A., Fikawati, S., & Gemily, S.C., 2022. Household Food Security During the COVID-19 Pandemic in Urban and Semi-Urban Areas in Indonesia. *J Health Popul*

Nutr, 41.

Tambalis, K.D., Panagiotakos, D.B., Psarra, G., & Sidossis, L.S., 2018. Insufficient Sleep Duration is Associated with Dietary Habits, Screen Time, and Obesity in Children. *Journal of Clinical Sleep Medicine*, 14.

Tri Nugroho, W., Lisdianti, K.M., & Yusfar., 2022. The Relationship Between Online Learning Methods and The Stress Level of Parents of Primary School Students in Cimaung Village, Cimaung District, Bandung Regency. *KESANS: International Journal of Health and Science,* 1, pp.703–717.

Webster, E.K., Martin, C.K., & Staiano, A.E., 2019. Fundamental Motor Skills, Screen-Time, and Physical Activity in Preschoolers. *J Sport Health Sci,* 8.

Williams, B., Smith, C., Hubbs-Tait, L., Baldwin, J., Guseman, E., & Sisson, S., 2018. The Effect of Family Environment and Behaviors on Child Weight Status, Physical Activity, and Diet. *J Nutr Educ Behav,* 50.

Workicho, A., Belachew, T., Feyissa, G.T., Wondafrash, B., Lachat, C., Verstraeten, R., & Kolsteren, P., 2016. Household Dietary Diversity and Animal Source Food Consumption in Ethiopia: Evidence from the 2011 Welfare Monitoring Survey. *BMC Public Health,* 16.

The Spatial Pattern of the Spread of the COVID-19 Pandemic (Case Study: DKI Jakarta Province)

Dwi Arini[1✉], Agung Syetiawan[2], Eliza Nanda Pitria[1], Ilham Armi[1]
[1]Teknik Geodesi, Fakultas Teknik, Institut Teknologi Padang, Indonesia
[2]Pusat Riset Geospasial, Badan Riset dan Inovasi Nasional

Article Info	Abstract
	The COVID-19 pandemic has been running in Indonesia for more than two years. The first case was found in March 2020. DKI Jakarta as the capital city of the country with a high population density and an economic center that was threatened because the area has a high vulnerability to the spread of COVID-19. The number of confirmed cases that continue to soar and the spread that is difficult to be controlled have resulted in the DKI Jakarta government taking policies such as implementing large-scale social restrictions (PSBB), which aims to stop the spread of COVID-19 and to look for patterns of spread of COVID-19. This study uses a geographic information system in looking for patterns of the spread of COVID-19. The analytical method used is spatial autocorrelation, which is carried out using the Moran Index. In addition, the autocorrelation test was also carried out using a Local Indicator of Spatial Autocorrelation (LISA) with the results in the form of a cluster map and a map of significance. The Ordinary Least Squares analysis method is a regression technique that provides a global model for understanding and predicting variables in research. The correlation variables used in this research are Markets, Supermarkets, Buses, and Stations. The result of this study is the spatial autocorrelation of the pattern of spread of COVID-19 between villages and spatially the distribution pattern is clustered. In the OLS regression distribution pattern, the supermarket variable with an R-Squared value of 0.128555 or 12% affects the spread of COVID-19. Based on the calculation of R-Square, Koenker (BP) in addition to the OLS model, the assumption of homoscedasticity is not met, so the model is Ordinary Least Squares not good compared to other models in analyzing the pattern of the spread of COVID-19 in DKI Jakarta.

Introduction

Wuhan Municipal Health and Health Committee reported a pneumonia cluster of unknown etiology on December 8, 2019, in the city of Wuhan, Hubei Province, China, which was officially named by the World Health Organization (WHO) as Corona Virus Disease-2019 (COVID-19) (Mo et al., 2020). Coronavirus is a positive single-strain RNA virus, encapsulated and non-segmented (Huang et al., 2020). Coronavirus belongs to the order Nidovirales, the Coronaviridae family. The structure of coronavirus forms a cube-like structure with the S protein located on the surface of the virus (Wangping et al.,

2020). COVID-19 spread quickly from Wuhan to all cities in China, including Indonesia. The first recorded case in Indonesia was found in March 2020 (Djalante et al., 2020).

The COVID-19 pandemic has been running in Indonesia for more than two years and is currently continuing. Based on data compiled by the Ministry of Health as of 31 July 2021 the Government of the Republic of Indonesia has reported 3,409,658 people confirmed positive for COVID-19 with the number of deaths reaching 94,199 people (Case Fatality Rate: 2.8%) (Ministry of Health RI, 2021). DKI Jakarta is one of the areas with the highest confirmed cases of all cases in

✉ Correspondence Address:
Teknik Geodesi, Fakultas Teknik, Institut Teknologi Padang, Indonesia
Email : dwiarini@itp.ac.id

Indonesia in the last two years. Meanwhile, DKI Jakarta as the national capital that has the largest population density in Indonesia as well as the country's economic center, makes Jakarta highly vulnerable to the spread of COVID-19.

The increase in patients confirmed positive for COVID-19 in DKI Jakarta is getting more massive day by day. This significant increase in cases is very worrying, especially for the ability of healthcare facilities. According to Ristiantri et al. (2022), most referral hospitals in DKI Jakarta have a referral hospital readiness index with moderate to low criteria. The shortage of referral hospitals with a high readiness index creates a very serious threat to handling the spread of COVID-19 in DKI Jakarta. Therefore, the regional government took several other policies such as implementing large - scale social restrictions or also known as PSBB. Furthermore, there is a new policy that has been stipulated, namely Imposing Restrictions on Community Activities or abbreviated as PPKM to stop the spread of the COVID-19 virus. To find patterns of spread of COVID-19, disease mapping is needed, one of which is by utilizing a Geographic Information System (GIS).

GIS is a system for manipulating geographic data. In simple terms, a Geographic Information System is a useful tool for presenting the topographical conditions of the earth by utilizing spatial data (Yuwono et al., 2015). GIS can be used to identify patterns of the spread of COVID-19 so that spatial connectivity can be identified in each region (Pourghasemi et al., 2020). Disease mapping and modeling have so far been implemented to map potential risks and facilitate policymakers to minimize disease transmission. In addition, disease mapping is used to study patterns of spread and the process of mitigating the spread of disease (Koch, 2005). Spatio-temporal data can be visualized and represented in outbreak information processing. One response that is often carried out is to make spatial decisions to help overcome pandemics through early detection of high-risk locations (Liu et al., 2017). Disease modeling and mapping are statistical approaches that can be utilized by policymakers in formulating actions that can be taken to reduce the spread and number of disease cases. Therefore, GIS can help local governments see the regional ability

to deal with the COVID-19 outbreak spatially.

The relationship between COVID-19 outbreaks per region can be observed using autocorrelation analysis. To identify autocorrelation, 2 ways are often used. The first is the Moran Index, which is by measuring global autocorrelation. Then the second way is the Local Indicator of Spatial Association (LISA) index which measures local autocorrelation. In addition, there is also the Ordinary Least Squares (OLS) method. This method is used to minimize the number of squared errors and this method is considered the most popular for solving arithmetic averaging problems.

With indications that positive cases of COVID-19 are spatially related, this study will conduct a spatial autocorrelation analysis of confirmed cases of COVID-19 using the Moran Index and the LISA Index to determine whether there is a pattern of the spatial distribution of COVID-19 in the DKI Jakarta area. This research can later be used to provide input and suggestions to the government, especially the DKI Jakarta government in optimizing the handling of cases of the spread of COVID-19. As well as assisting the government in making policies according to COVID-19 case data.

Methods

The research was conducted in DKI Jakarta administratively located in the lowlands with an average height of 7 meters above sea level. Based on the Decree of the Governor of DKI Jakarta in 2007, the area of the Province of Daerah Khusus Ibukota Jakarta is 7,639.83 km², with a land area of 662.33 km² (including 110 islands spread across the Kepulauan Seribu) and a sea area of 6,977.5 km2. This research uses spatial-temporal analysis with several calculation approaches. The data prepared is daily case data and total positive data obtained from the DKI Jakarta government website.

Spatial autocorrelation measurements for spatial data can be calculated using Moran's Index, Geary's C, and Tango's excess. Several analyses can be performed on spatial autocorrelation by performing several calculation methods. This method applies geospatial techniques and spatial statistics to examine and detect hotspot areas for the spread of COVID-19 (Parvin et al., 2021). In addition,

this method can be used to detect the onset of spatial randomness. This spatial randomness can indicate clustered patterns or trends in space (Algert et al., 2006). Spatial autocorrelation calculations based on feature locations and attribute values use the global Moran's I statistic which is calculated as (Cliff & Ord, 1981):

1. Moran's index with a non-standardized spatial weighting matrix W*

$$I = \frac{n \sum_{i=1}^{n} \sum_{j=1}^{n} w_{ij}(x_j - \underline{x})(x_j - \underline{x})}{S_0 \sum_{i=1}^{n} (x_j - \underline{x})} \qquad \text{.......................(1)}$$

with $S_0 = \sum_{i=1}^{n} \sum_{j=1}^{n} w_{ij}$

Wij* = element in non-standardized weights between area i and j

2. Moran's index with a standardized spatial weighting matrix W:

$$I = \frac{n \sum_{i=1}^{n} \sum_{j=1}^{n} w_{ij}(x_j - \underline{x})(x_j - \underline{x})}{S_0 \sum_{i=1}^{n}((x_j - \underline{x})^2)} . \qquad \text{.........................(2)}$$

with :
I : Moran's index
n :number of incident locations
Xi:value on location i
Xj:value on location j
X: the average of the number of variables or values
Wij*:element in non-standardized weights between area i and j
Wij :element in standardized weights between area i and j

The range of values of Moran's index in the case of a standardized spatial weighting matrix is $-1 \leq I \leq 1$. Values of $-1 \leq I < 0$ indicate a negative spatial autocorrelation, while a value of $0 < I \leq 1$ indicates a positive spatial autocorrelation, Moran's Index value is zero indicates no group (Ijumulana et al., 2020; Moran, 1950). The research steps are outlined in the flowchart in Figure 1 so that the research can be focused and well-illustrated. The research phase began with data collection, namely

information related to positive confirmed patients in the DKI Jakarta area obtained from the Jakarta provincial government website (corona.jakarta.go.id). The spatial unit used in this study was the sub-district, patient data confirmed positive was then displayed per sub-district using administrative data from the Indonesian Geospatial Information Agency. The stages of data processing are divided into two, namely spatial autocorrelation analysis and analysis of the correlation of COVID-19 cases to driving variables. Spatial autocorrelation analysis is used to determine the spatial pattern of COVID-19 outbreaks in Jakarta, whether the spread of COVID-19 is random or spatially clustered. In addition, autocorrelation analysis is used to find out which areas have high cases surrounded by high cases, and vice versa. On the other hand, correlation analysis is used to see the relationship between the addition of COVID-19 cases in Jakarta and the driving variable in the form of the number of transportation hubs and crowded centers in each urban village to determine the behavior of the area. These two analyzes are very important for the government so that the government can find out which areas are the priority for social restrictions and priority for giving vaccinations. Identification of the pattern of the spread of COVID-19 in DKI Jakarta is calculated using two methods, namely Global Moran's I and Local Moran's I. Global Moran is calculated using autocorrelation analysis in ArcGIS while Local Moran is calculated using the Local Indicator of Spatial Autocorrelation (LISA) method using the Geoda tool. Local Moran shows a positive spatial relationship based on the level of significance using the Geoda tool developed by Anselin, et al (2006) by analyzing the relationship of cases in an area to the cases around it (Anselin, 1995).
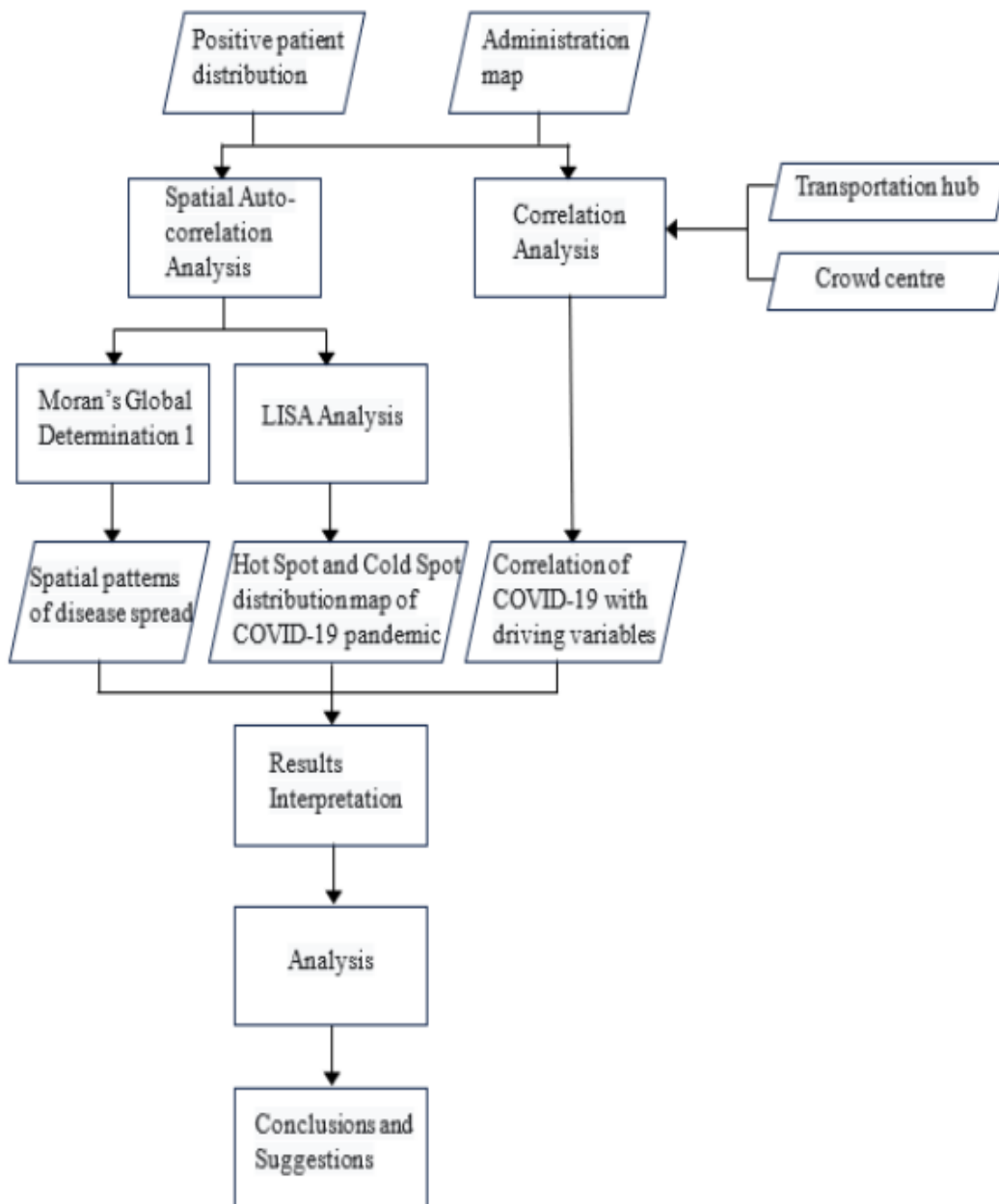
Figure 1. Research Flow Chart.

Results and Discussion

The results and discussion in this study explain the results of identifying patterns of the spread of COVID-19, the relationship of correlation analysis variables that affect distribution, explanatory variables, and Ordinary Least Squares (OLS) correlations. The same model was proposed by Raymundo et al (2021) who applied global regression models such as OLS and local regression models called multiscale geographically weighted regression (MGWR) which resulted in the finding that the higher the GINI Index (to measure income inequality), the higher the incidence disease in the city, as well as the higher the ratio of nurses per 1,000 residents in the municipality, the higher the incidence of COVID-19. While the death ratio is inversely proportional to the incidence of disease. Social inequality increases the risk of transmission in municipalities that show better social development in municipalities associated with a lower risk of disease compared to populations with increased social vulnerability having a higher

risk of disease. In the study of Purwanto et al (2021), distribution patterns are interpreted based on hotspots and space-time cubes (STC) which produce Spatiotemporal Trend Hotspots, interpreted with 3D visualization in the Surabaya Raya area in 3 phases. The distribution pattern resulting from this study produced an Amoeba-shaped pattern which indicated that the spread of the Coronavirus was more widespread in urban centers than in rural areas. This pattern is different from that produced in DKI-Jakarta considering that the distribution parameters used are also different to identify distribution patterns. This distribution pattern will be analyzed based on the results of the Local Indicator of Spatial Autocorrelation (LISA) which is in line with the COVID-19 mapping carried out in central Iran by Jesri et al (2021), who succeeded in obtaining a spatial estimate of the distribution pattern in Qom Province, namely clusters of 365 populations, 75/100,000 population. The patterns formed are in the high-high category (areas with high values surrounded by high values) and low-high (areas with low values surrounded by high values) so it can be seen that distance and spatial proximity have a major role in the spread of the disease.

The methods used in previous research were also carried out in this study but used different parameters and calculation models so that identification of patterns of distribution of COVID-19 in DKI Jakarta based on analysis of spatial patterns with a moran index for the distribution of COVID-19 is recommended in previous studies as in (Jaber et al., 2022; Rodríguez et al., 2021) which produced a simple neighbor pattern to investigate the presence of spatial autocorrelation (grouping) so that one could see the relationship between variables distributed throughout the study area.

Furthermore, the identification is divided into several variables, namely the Dependent Variable and Independent Variable which consists of some data for all public facilities that allow crowds to occur in that place. Data on the factors causing this spread are data transport hubs, crowd centers such as offices, entertainment shopping centers, and others. The circulation of population movements was also carried out in Liu et al's research (2021),by collecting population travel during several periods such as the spring festival so that it provides dynamic information based on Baidu location-based services (LBS) and is statistically significant which produces Moran's I local Anselin statistics which are presented as spatial clusters. However, the pattern of movement referred to in the spread of research in DKI Jakarta is more to the distribution of transport hubs which causes the population to move to public facilities which are reported to increase the risk of spreading COVID-19.

In this study, daily total data for confirmed COVID-19 cases were used from March 25, 2020, to August 31, 2021. The total available data for confirmed COVID-19 cases was 524 days, there was 1 day of case distribution which was not available on January 31, 2021. The spatial unit used in this study is the sub-district. Pattern identification using the same method was carried out in the previous study by Kan et al. (2021), by looking at transmission patterns related to demographic patterns during the COVID-19 pandemic which were detected significantly in space-time clusters at the Large Street Block Group (LSGB) level, Hong Kong among 23 January and 14 April 2020. Two types of high-risk areas were identified at residences and several places visited by confirmed cases, and two types of cases (imported and local) need to be considered. The results show that high transportation accessibility, dense and high-rise buildings, high commercial land density, and mixed land use have a higher risk of confirmed cases. The distribution pattern seen from the demographics of this area and the pattern over time was adopted in a study in DKI Jakarta to see patterns in spatially confirmed total cases using space-time pattern analysis.

Furthermore, the results of the spatial pattern analysis based on the Moran Index show a positive spatial relationship as shown in Table 1. Based on the results of the spatial pattern analysis based on the Moran Index, a spatial relationship was obtained with a significance level of 11.89% in the spread of COVID-19 in DKI Jakarta. With an average Moran Index value of 0.118976853 which is in the range of 0 and 1, it can be concluded that the resulting autocorrelation is positive spatial

autocorrelation. A positive autocorrelation indicates that adjacent locations have similar values and cases of the spread of COVID-19 in DKI Jakarta tend to be clustered. In the analysis, the provisions of neighborhood based on sub-district are used, therefore the group in question is between one sub-district and another in groups with almost the same number of cases.

The results of the Local Indicator of Spatial Autocorrelation (LISA) are divided into two results, namely the results of the Cluster Map of the Spread of COVID-19 Cases in DKI Jakarta and the Results of the Map of Significance of Patterns of Spread of COVID-19 in DKI Jakarta. Based on the thematic map analysis of the spatial distribution of output from LISA. You can see the pattern formed on the map of the DKI Jakarta area. This pattern is a grouping within the region. This grouping can be positive or negative. Cluster pattern for a pattern of spread of COVID-19. The process of identifying spatial relationships between variables uses Moran's index.

The Moran index is used to show spatial autocorrelation and spatial cluster relationships in a data set. The results of spatial autocorrelation are in the form of four types of spatial associations, including (Anselin et al., 2006): 1. high-high (HH), namely the spatial concentration of high case scores and high independent variable values from neighboring areas, 2. low-low (LL), namely in the form of spatial concentration of low case values and low independent variable values from neighboring areas, 3. High low (HL), namely in the form of spatial concentration of high case values and low independent variable values from neighboring areas, 4. low-high (LH), namely in the form of spatial concentration of low case values and high independent variable values from neighboring areas HH and LL are types for spatial clustering of the same value, while HL and LH are types of spatial clustering of different values. Based on Figure 2.a, it can be concluded that areas that are significant for the spread of COVID-19 can be seen from several date plots that have been observed on the DKI Jakarta cluster map. Analysis of the Global Moran Index was empowered to analyze the existence of spatial relationships of the spread of COVID-19 in the province of DKI Jakarta.

The results of this Moran index obtained from the Geoda software show that the spatial pattern of COVID-19 distribution is clustered.

Table 1. Results of Spatial Pattern Identification of Moran's Index.

Date	Moran Index Value	Spatial Pattern
03/26/2020	0,175743	Clustered
03/27/2020	0,171075	Clustered
03/28/2002	0,152707	Clustered
03/29/2020	0,166294	Clustered
03/30/2020	0,183173	Clustered
03/31/2020	0,167766	Clustered
04/01/2020	0,166876	Clustered
04/02/2020	0,14911	Clustered
04/03/2020	0,157958	Clustered
04/04/2020	0,157958	Clustered
04/05/2020	0,158879	Clustered
04/06/2020	0,166805	Clustered
04/07/2020	0,193078	Clustered
04/08/2020	0,195587	Clustered
09/04/2020	0,200966	Clustered
10/04/2020	0,200594	Clustered
Average	0,118976853	

Source: Primary Data, 2021

DKI Jakarta has 261 sub-districts. Based on the results of the COVID-19 distribution cluster map, it can be concluded that on September 14, 2020, during the PSBB, the two spatial patterns of COVID-19 distribution were in observation areas that had a high value, which was seen in 25 sub-districts including Sunter Jaya, Sunter Agung, West Pademangan, East Pademangan, Slipi, and Petamburan. High-High Clusters (hotspots) are areas with high cases surrounded by high cases. According to (Syetiawan et al., 2022), hotspot areas with a high number of confirmed cases should be highly considered areas in determining rapid test locations.

Based on Table 2, it can be concluded that in this date range, the spatial pattern of autocorrelation of the pattern of the distribution of COVID-19 in DKI Jakarta is clustered so that in general the pattern of distribution of COVID-19 undergoes a spatial grouping process in 2020 in the province of DKI Jakarta. At the end of 2020, the High-High cluster

dominates the northern part of Jakarta. The area is densely populated. Similar results were also shown by Jaber et al. (2022) that High-High clusters are closely related to population density in Iraq.

The results of the LISA test on the significance of the distribution pattern of COVID-19 in DKI Jakarta provide information that there are several areas with significant values or there is spatial autocorrelation in subdistricts in DKI Jakarta. The following is the result of the significance map.

Table 2. Results Identification of Spatial Pattern of the Spread of COVID-19 in DKI Jakarta Based on the Time of Observation

Date Plot	Spatial Pattern
26 March 2020	Clustered
3 April 2020, 1 week before PSBB	Clustered
10 April (PSBB I)	Clustered
17 April 2020, 1 week after PSBB I	Clustered
24 April 2020, 2 weeks after PSBB	Clustered
10 May 2020, 2 weeks before Eid Al-Fitr	Clustered
24 May 2020, Eid Al-Fitr	Clustered
7 June, 2 weeks after Eid Al-Fitr	Clustered
7 August 2020, 2 weeks before Islamic New Year	Clustered
21 August 2020, the Islamic New Year holiday	Clustered
4 September 2020, 2 weeks after Islamic New Year	Clustered
14 September 2020, PSBB II	Clustered

Source: Primary Data, 2022
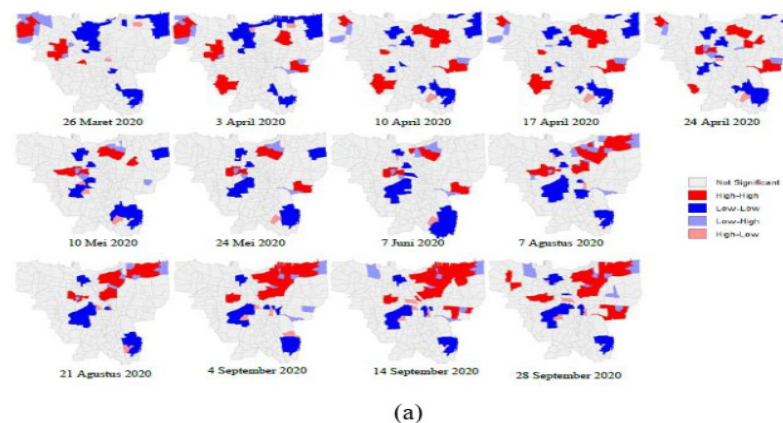
(a)
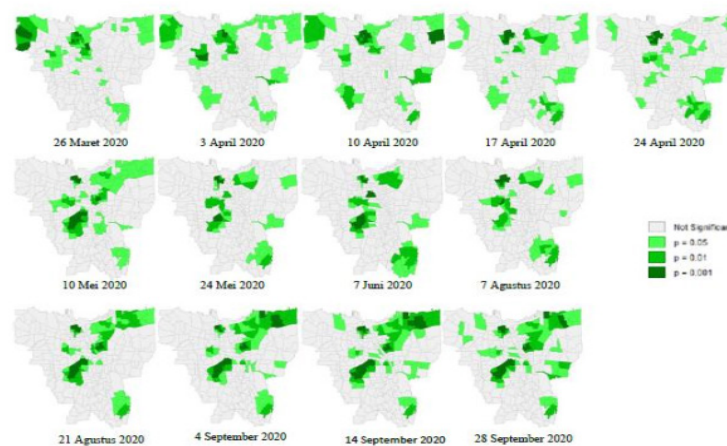
(b)

Figure 2. (a) Map of Cluster Distribution of COVID-19 in DKI Jakarta, (b) Map of Significance of DKI Jakarta

Based on Figure 2.b, the results of the LISA test on the significance of the distribution pattern of COVID-19 in DKI Jakarta, where the p-value is declared significant if the value is below 0.05 (Anselin, et al., 2006). On September 14, 2020, it shows that there are 35 sub-districts with a significance level of 0.05. Shows that the Pademangan Timur, Sunter Agung, and Kapuk Muara sub-districts are in areas with a low percentage of the spread of COVID-19 but these areas are surrounded by sub-districts that have a higher spread of COVID-19. The Significance Value of 0.01 is occupied by Menteng, Kebon Melati, and Kuningan Timur sub-districts, which means that on that date the distribution pattern was clustered. Then it can be concluded that with a significance value of 0.001, namely the Johar Baru, Karet Kuningan, and Senayan villages, the distribution is clustered.

Results of Identification of Correlation Analysis Variable Relationships Affecting the Spread of COVID-19 in DKI Jakarta. The research correlation variables used include stations, markets, supermarkets, and buses. Some of the variable layouts can be seen as follows:

1. Distribution of transportation hubsDKI Jakarta has bus terminals and bus stops which are quite spread across several urban villages. The results of the layout of data processing the distribution of terminals and bus stops. Based on Figure 3.a, it can be concluded that several sub-districts have bus terminals, including Ancol sub-district 5 bus terminals, Angke 1 bus terminal, Bendungan Ilir 9 bus terminals, Bidara Cina 6 bus terminals, Bungur 4 bus terminals and stops, Cideng 15 bus terminals bus, Ciganjur 19 bus terminals, 17 West Cilandak bus terminals, 14 East Cilandak bus terminals, Cipedak 32 bus terminals, Gambir 23 bus terminals and stops, Gunung Sahari Selatan 18 bus terminals, Gunung Sehari Utara 10 bus terminals, Jaga Karsa 51 bus terminals. Most bus terminals are dominated in the southern part of DKI Jakarta. On the other hand, DKI Jakarta has train stations spread across several sub-districts. The layout results from the processing of the distribution of train stations. Based on the layout results of Figure 3.b, it can be concluded that several urban villages have train stations, namely Bali Mester 1 train station, Ceger 6 train station, and finally Cipete Selatan 1.

2. Distribution of Shopping Centers in DKI JakartaDKI Jakarta has markets spread across several sub-districts. The layout results from the processing of market distribution in DKI Jakarta. The results of the layout in Figure 3.c can be concluded that several sub-districts have markets, including Angke sub-district has 1 market, Kali Deres 4 markets, Cengkareng Timur 2 markets, Cempaka Putih Barat 3 markets, Cengkareng Barat 5 markets. DKI Jakarta has supermarkets spread across several sub-districts. The layout results from the processing of supermarket distribution in DKI Jakarta. In Figure 3.d. It can be concluded that several urban villages have supermarkets spread across DKI Jakarta, including Bali Mester village with 1 supermarket, Bangka 2 supermarkets, and Kembangan Selatan 3 supermarkets.

Table 3. explains the explanatory of several independent variables of the spread of COVID-19 in DKI Jakarta with 13 observation times. The observation time was obtained which showed a value indicating a sufficiently influential relationship in the adjusted r-squared value in the market area, namely April 3, 2020, namely 1 week before the PSBB with a value of 0.08, September 14 when PSBB II was with a value of 0.09, and September 29, which is 2 weeks after PSBB II with a value of 0.09. The bus stop variable with the r-squared value of the time stated is in the range 0-0.09, the station area is in the range 0.09-0.1, and the supermarket is in the range 0.02-0.08, so the results of the Ordinary Least test Squares April 3, 2020, September 14, 2020, and September 29, 2020, on markets, buses, stations, and supermarkets in Table 3. It is known that several values, significant for the spread of COVID-19, affect the correlation analysis variable.

Table 3. Explanatory Variable

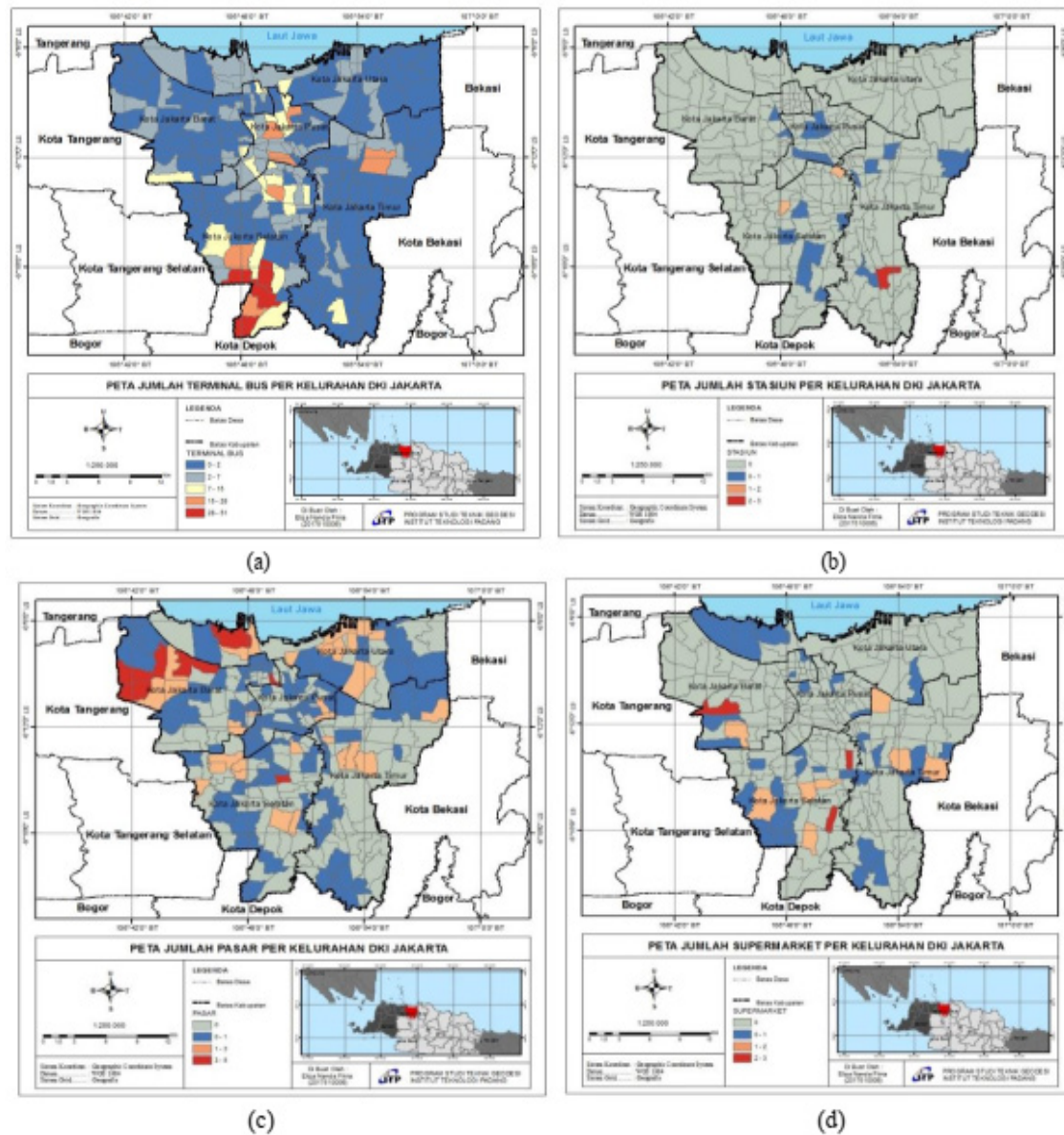| Variables	Adjusted R-Squared		
	03/04 /2020	14/09/ 2020	29/09/ 2020
Market	0,08	0,09	0,09
Bus	0	0,09	0
Station	0,09	0,1	0,09
Supermarket	0,08	0,02	0,08

Source: Primary Data, 2021

Figure 3. Transportation Hub Distribution Map: (a) Number of Bus Terminals; (b) number of Train Stations; Distribution Map of Shopping Centers: (c) Number of markets; (d) Supermarkets.

Conclusions

In carrying out the Spatial test, it can be concluded that the spatial autocorrelation of the pattern of the spread of COVID-19 is clustered. This shows that the geographical position of the region has the potential to affect the surrounding area. The results of this study also show positive spatial phenomena and autocorrelation between sub-districts in the DKI Jakarta province so that clustered distribution occurs. The variable relationship that is quite binding on the OLS regression distribution pattern is the supermarket variable with an R-Squared value of 0.128555 or 12% influencing the spread of COVID-19. Based on the calculation of R-Square, Koenker (BP) and also on the OLS model, the assumption of homoscedasticity does not meet the requirements, so the ordinary least squares model is not good compared to other models in analyzing the pattern of the spread of COVID-19 in DKI Jakarta.

References

Algert, S.J., Agrawal, A., & Lewis, D.S., 2006. Disparities in Access to Fresh Produce in Low-Income Neighborhoods in Los Angeles. *American Journal of Preventive Medicine*, 30(5), pp.365–370.

Anselin, L., 1995. Local Indicators of Spatial Association—LISA. *Geogr Anal,* 27(2), pp.93–115.

Anselin, L., Syabri, I., & Kho, Y., 2006. GeoDa: An Introduction to Spatial Data Analysis. *Geogr Anal*, 38, pp.5–22.

Cliff, A.D., & Ord, J.K., 1981. *Spatial Processes: Models & Applications.* Taylor & Francis.

Djalante, R., Lassa, J., Setiamarga, D., Sudjatma, A., Indrawan, M., Haryanto, B., Mahfud, C., Sinapoy, M.S., Djalante, S., Rafliana, I., Gunawan, L.A., Surtiari, G.A.T., & Warsilah, H., 2020. Review and Analysis of Current Responses to COVID-19 in Indonesia: Period of January to March 2020. *Prog Disaster Sci, 6.*

Huang, C., Wang, Y., Li, X., Ren, L., Zhao, J., Hu, Y., Zhang, L., Fan, G., Xu, J., Gu, X., Cheng, Z., Yu, T., Xia, J., Wei, Y., Wu, W., Xie, X., Yin, W., Li, H., Liu, M., Xiao, Y., Gao, H., Guo, L., Xie, J., Wang, G., Jiang, R., Gao, Z., Jin, Q., Wang, J., & Cao, B., 2020. Clinical Features of Patients Infected with 2019 Novel Coronavirus in Wuhan, China. *Lancet*, 395(10223), pp.497–506.

Ijumulana, J., Ligate, F., Bhattacharya, P., Mtalo, F., & Zhang, C., 2020. Spatial Analysis and GIS Mapping of Regional Hotspots and Potential Health Risk of Fluoride Concentrations in Groundwater of Northern Tanzania. *Science of The Total Environment,* 735, pp.139584.

Jaber, A.S., Hussein, A.K., Kadhim, N.A., & Abid, A., 2022. A Moran's I Autocorrelation and Spatial Cluster Analysis for Identifying Coronavirus Disease COVID-19 in Iraq using GIS Approach. *Caspian Journal of Environmental Sciences,* 20(1), pp.55–60.

Jesri, N., Saghafipour, A., Koohpaei, A., Farzinnia, B., Jooshin, M.K., Abolkheirian, S., & Sarvi, M., 2021. Mappingcl and Spatial Pattern Analysis of COVID-19 in Central Iran Using the Local Indicators of Spatial Association (LISA). *BMC Public Health*, 21(1), pp.1–11.

Kan, Z., Kwan, M.P., Wong, M.S., Huang, J., & Liu, D., 2021. Identifying the Space-Time Patterns of COVID-19 Risk and Their Associations with Different Built Environment Features in Hong Kong. *Science of the Total Environment,* 772(December 2019), pp.145379.

Koch, T., 2005. *Cartographies of Disease: Maps, Mapping, and Medicine.* ESRI Press.

Liu, M., Liu, M., Li, Z., Zhu, Y., Liu, Y., Wang, X., Tao, L., & Guo, X., 2021. The Spatial Clustering Analysis of COVID-19 and Its Associated Factors in Mainland China at the Prefecture Level. *Science of the Total Environment*, 2021.

Liu, Y., Watson, S.C., Gettings, J.R., Lund, R.B., Nordone, S.K., Yabsley, M.J., & McMahan, C.S., 2017. A Bayesian Spatio-Temporal Model for Forecasting Anaplasma Species Seroprevalence in Domestic Dogs within the Contiguous United States. *PloS one*, 12(7).

Mo, C., Tan, D., Mai, T., Bei, C., Qin, J., Pang, W., & Zhang, Z., 2020. An Analysis of Spatiotemporal Pattern for COVID-19 in China Based on Space-Time Cube. *J Med Virol,* 92(9), pp.1587–1595.

Moran, P.A.P., 1950. Notes on Continuous Stochastic Phenomena. *Biometrika,* 37(1–2), pp.17–23.

Parvin, F., Ali, S.A., Hashmi, S.N.I., & Ahmad, A., 2021. Spatial Prediction and Mapping of the COVID-19 Hotspot in India Using Geostatistical Technique. *Spatial Information Research*, 29(4), pp.479–494.

Pourghasemi, H.R., Pouyan, S., Heidari, B., Farajzadeh, Z., Fallah Shamsi, S.R., Babaei, S., Khosravi , R., Etemadi, M., Ghanbarian, G., Farhadi, A., Safaeian, R., Heidari, Z., Tarazkar, M.H., Tiefenbacher, J.P., Azmi, A., & Sadeghian, F., 2020. Spatial Modeling, Risk Mapping, Change Detection, and Outbreak Trend Analysis of Coronavirus (COVID-19)

in Iran (days between February 19 and June 14, 2020). *International Journal of Infectious Diseases,* 98, pp.90–108.

Purwanto, P., Utaya, S., Handoyo, B., Bachri, S., Astuti, I.S., Utomo, K.S., & Aldianto, Y.E., 2021. Spatiotemporal Analysis of COVID-19 Spread with Emerging Hotspot Analysis and Space–Time Cube Models in East Java, Indonesia. *ISPRS International Journal of Geo-Information,* 10.

Raymundo, C E., Oliveira, M.C., de Araujo Eleuterio, T., André, S.R., da Silva, M.G., da Silva Queiroz, E.R., & de Andrade Medronho, R., 2021. Spatial Analysis of COVID-19 Incidence and the Sociodemographic Context in Brazil. *PLoS ONE*, 16, pp.1–16.

Ristiantri, Y.R.A., Susiloningtyas, D., Shidiq, I.P.A., Syetiawan, A., & Azizah, F.N., 2022. Multi-criteria Decision Analysis for Readiness of COVID-19 Referral Hospital in Jakarta. *IOP Conference Series: Earth and Environmental Science,* 1039(1), pp.12022.

Rodríguez, O.F.-, Gustafsson, P.E., & Sebastián, M.S., 2021. Spatial Clustering and Contextual Factors Associated with Hospitalisation and 19 in Sweden: a Deaths due to COVID Geospatial Nationwide Ecological Study. *BMJ Global Health*, 6(e006247), pp.1–9.

Syetiawan, A., Harimurti, M., & Prihanto, Y., 2022. A spatiotemporal Analysis of COVID-19 Transmission in Jakarta, Indonesia for Pandemic Decision Support. *Geospatial Health,* 17(s1), pp.1–13.

Wangping, J., Ke, H., Yang, S., Wenzhe, C., Shengshu, W., Shanshan, Y., Jianwei, W., Fuyin, K., Penggang, T., Jing, L., Miao, L., & Yao, H.,2020. Extended SIR Prediction of the Epidemics Trend of COVID-19 in Italy and Compared With Hunan, China. *Frontiers in Medicine,* 7(169).

Yuwono, T., Sigit, Prahasta, E., Pramono, D., & Jantarto, D., 2015. Aplikasi Sistem Informasi Geografis Untuk Keselamatan Penyelaman Menggunakandata Kedalaman, Temperatur Dan Jenis Dasar Laut (Studi Kasus Di Perairan Teluk Ambon). *Jurnal Chart Datum,* 1(2), pp.115–120.

Jurnal Kesehatan Masyarakat

Reassuring The Prevalence of Cerebral Palsy in Asian Children and Adolescents

Andromeda[1,2✉], Nurul Hartini[3], Suryanto[3]

[1]Psychology Doctoral Program, Faculty of Psychology, Universitas Airlangga
[2]Faculty of Education and Psychology, Universitas Negeri Semarang
[3]Faculty of Psychology, Universitas Airlangga

Article Info

Abstract

Cerebral palsy is becoming more common as a cause of developmental disorders in children. Several studies in low-income Asian countries found a higher prevalence of CP than in Europe. However, another study discovered the inverse result. The disparity in the results of these studies emphasizes the importance of the current study in updating the prevalence of CP in Asia. A systematic review and meta-analysis approach has been used in this study by searching for articles on three databases: PubMed, Scopus, and ScienceDirect. Eight articles were chosen through several screening stages and subjected to quality assessment. According to the study's findings, the prevalence of CP in Asia is 2.19 per 1000 children and adolescents (95% CI). Children and adolescents from low-income families have the highest incidence rate, with spastic-CP type being the most common classification.

Introduction

Cerebral Palsy (CP) is a non-progressive neurological condition that affects the development of the brain. Most people with this illness are born with it, but some get it later in life. Cerebral palsy can affect muscle mobility, coordination, and strength (Aal-Blowi et al., 2020). Comorbidities such as epilepsy, secondary musculoskeletal disorders, sensory, perception, cognitive, and behavioral impairments are common in people with CP (Rosenbaum et al., 2007; Earde et al., 2018). With an incidence of about 2 per 1000 live births, cerebral palsy is a prominent cause of impairment in children. An estimated 17 million persons live with CP worldwide (Khandaker et al., 2019). According to the global data, the prevalence of cerebral palsy is predicted to be between 2-3 per 1000 live births (Nelson & Ellenberg, 1978; Green & Hurvitz, 2007).

Cerebral palsy, on the other hand, seemed to be more common in low and middle income countries than in high-income ones (Tseng et al., 2018). In Uganda and Egypt, the prevalence of CP was 2.9-3.6 cases per 1000 children, whereas, in Europe, Australia, and the United States, the prevalence was 1.8-2.4 cases per 1000 children, respectively (Hirtz et al., 2007; Arneson et al., 2009; Oskoui et al., 2013; Himmelmann & Uvebrant, 2014; Froslev-Friis et al., 2015; Smithers-sheedy et al., 2016; Robertson et al., 2017; El-Tallawy et al., 2014; Kakooza-Mwesige et al., 2017). Correspondingly, European studies found a decrease in the prevalence of CP among children with a birth weight of less than 1500 g (Sellier et al., 2016).

Most reported overall prevalence rates for the birth-year periods of 1985-2010 showed no significant changes. Nevertheless, Asian children were shown to have a lower prevalence of CP than Caucasian children in studies conducted in the United States (Wu et al., 2011; Lang et al., 2012). Furthermore, according to

polls in China and Hong Kong, it was found that between 1.3-1.6% of people identified as having CP. The number of cases per 1000 people is lower than in Western countries (Liu et al., 1999; He et al., 2017). The findings of these studies are still unclear and require further study to reassure and update the prevalence of CP in Asian populations.

This study examines the Asian population since Asia has the biggest population, accounting for 60% of the total global population. According to the World Bank's classification by Gross National Income (GNI) per capita, the majority of nations in the area are low- and middle-income (Asian Development Bank, 2015; ADB Briefs, 2020). Social protection is a critical subject that is now occupying the attention of Asian countries. Social protection policies are implemented to ensure that economic prosperity and social development are spread equally. One of the goals is to address disability issues and reduce poverty (Wagle, 2017). Disability and poverty are inseparable (Dalal, 2010). Finding the most recent statistics on the incidence of CP in children and adolescents with CP in Asia is one step toward facilitating the implementation of social protection programs for individuals with disabilities. Based on the rationale above, the authors conducted this study to answer questions about the current data on the prevalence of CP in children and adolescents in Asia; CP prevalence data based on socioeconomic status analysis; and CP prevalence data based on classification type analysis. This study's findings can be used as a reference for other studies that require up-to-date data on the prevalence of CP in children and adolescents throughout Asia, as well as specifically based on gender, socio-economic status, and type of CP classification.

Method

This study was conducted using a systematic review method, meta-analysis. The review follows the item reporting guidelines for a systematic review and meta-analysis from PRISMA 2020 (Page et al., 2021). The authors searched for articles published in various English language databases (PubMed, Scopus, and ScienceDirect) and published between

2000-2022. The selection of this publication year range was chosen to update the findings of previous studies on the prevalence of CP in Asian ethnic groups (Lang et al., 2012). Lang obtained data on the prevalence of CP in children born between January 1, 1991 and December 31, 2001 for his research findings. The search for articles is conducted by the authors using keywords that have been compiled and discussed previously. The keywords used in all databases are: "cerebral palsy", "prevalence", "infant", "child", "children", "adolescent", "Asian", and "Asia". The inclusion criteria were: population-based research; prospective or retrospective, cross-sectional, and cohort studies; involving the participation of children and adolescents under the age of 19; and conducted in Asian countries. The exclusion criteria were: the study used adult participants over the age of 18; CP diagnostics is not explicitly stated; not reporting relevant findings or outcomes; hospital-based research; and data using the same population as the included study. All articles were listed and classified by authors, year of publication, study location, study design, sampling technique, sample size, number of CP cases, and prevalence of CP. The authors also identified the sub-group information required for data analysis, such as participant age, gender, socio-economic status, and CP type classification. The authors conducted a formal assessment of the articles included in this study using the Loney et al. assessment criteria (Loney et al., 1998). Health professionals have widely used this assessment guide to critically evaluate research articles that estimate the prevalence and incidence of a disease or health problem (Chauhan et al., 2019). The quality of an article is assessed from the representativeness of the sample, the assessment, and diagnosis of a disease or disorder, and the interpretation of the results that are linear with the research objectives. This guide is divided into 3 sub-assessments, with a total of 8 question items. Each item receives a score of 1, out of a total of 8 possible scores. Jamovi 2.2.5 software was used to calculate the pooled prevalence. Furthermore, the authors employ Excel 2021 for data management, calculating prevalence using the point prevalence rate formula (Achmadi, 2013), and

performing sub-group analysis of the data obtained, such as socio-economic status and CP type classification.

Result and Discussion

The search strategy produced 493 abstracts: 28 from PubMed, 17 from Scopus, and 448 from ScienceDirect. After eliminating duplicates, 411 abstracts were obtained. In addition, 411 abstracts were screened using the following criteria: type of disability, location, and research type. There are 53 articles were obtained as a result of this screening. Following that, 53 articles were re-examined to determine the diagnostic criteria for CP. The screening results based on these CP diagnostic criteria yielded 29 abstracts. The authors used inclusion and exclusion criteria to determine the eligibility of 29 complete articles. In the final stage, the authors obtained 8 eligible articles that met the requirements for quantitative synthesis and meta-analysis. Figure 1 shows the PRISMA flowchart with the exclusion criteria and their details.
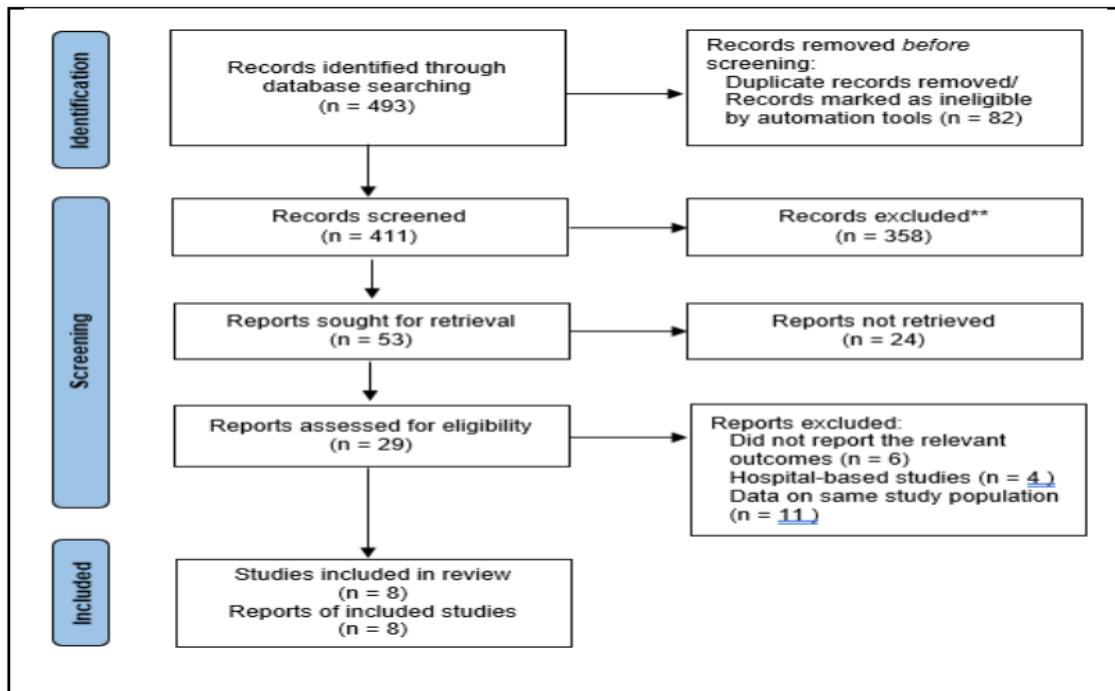
Figure 1. PRISMA Flowchart for Study Selection Process
Source: Primary research data-the framework for systematic review

Based on the overall quality assessment, all articles in this study received a score greater than 5 and were classified as high-quality research. There is only one article that gets a score of 5, the others are 7 (62.5%) and 8 (25%). Articles with a score of 5 have limitations in interpreting research findings in an adequate and detailed manner. Three of the five articles that received a score of 7 did not use standardized measures to determine CP diagnosis. A more detailed description of the measuring instrument can be seen in Table 2.

Between 2000 and 2020, eight studies were published. Data collection took from around 6 months to 6 years. Three studies were completed in less than a year, four were accomplished in one year, and one was accomplished over six years. The participants' ages ranged from 0 to 19, with the majority being children under 6 years old. The studies included in this review discuss the findings based on an analysis of various sub-groups according to their respective research objectives. The authors summarize it broadly based on the sub-characteristics shared by the majority of the research. The sub-characteristics are sample size, the global number of people with CP, the number of people with CP by gender, family socioeconomic level, and CP type classification. Table 1 provides a detailed summary of research characteristics.

The majority of the research was conducted through a population-based survey of children and adolescents in the city, district, or province. Meanwhile, research in Taiwan and Hong Kong involves a larger population than in other countries because it includes the entire population of children and adolescents in these countries. Each study employed a different instrument to assess and diagnose CP. To avoid measure-

ment bias, the majority of these are performed using standardized measuring instruments by a multi-disciplinary team of assessors. One out of every eight studies, however, did not clearly define the CP assessment and measurement tools used. Table 2 explains the research design, sampling technique, measuring instruments, and assessors.

Table 1. Demographic Characteristics of The Included Studies

Study Label	Geographical Location	Sample Size (n)	N with CP	Prev (*)	Gender	Social-Economic Status	Type of CP
Jahan, *et al* (2020)	Southwest Sumba Regency, Sumba Island, East Nusa Tenggara (NTT), Indonesia, Southeast Asia	152.471	130 <18 years	0,85	*Not defined*	Poor families: 118 Wealthy families: 12	Spastic (n=105), dyskinesia (n=13), ataxia (n=1), hypotonia (n=11)
Yuan, *et al* (2019)	Henan Province, Central China, East Asia	50.596	120 <7 years	2,37	Boys: 76 Girls: 44	*Not defined*	*Not defined*
Khandaker, *et al* (2018)	Shahjadpur, Bangladesh, South Asia	226.114	726 <18 years	3,21	Boys: 449 Girls: 277	Poor families: 706 Wealthy families: 20	Spastic (n=578), Spastic-monoplegia/hemiplegia (n=198), Spastic-diplegia (n=124), Spastic-triplegia (n=70), Spastic-quadriplegia (n=186). Hypotonic (n=87), Dyskinetic (n=60), Ataxic (n=1)
Tseng, *et al* (2018)	Taiwan, East Asia	1.843.143	4.774 <7 years	2,59	Boys: 2.804 Girls: 1.970	Poor families: 4,558 Wealthy families: 216	Severe CP (n=2.300)
Raina, *et al* (2011)	Pura City, Jammu, Northern India, South Asia	3.966	11 <10 years	2,77	Boys: 8 Girls: 3	*Not defined*	Spastic-quadriplegia (54,5%), Spastic-paraplegia (36,3%). Dyskinetic (9%)
Banerjee, *et al* (2009)	Kolkata, Benggala Barat, India, South Asia	16.979	48 <19 years	2,83	Boys: 26 Girls: 22	Poor families: 25 Wealthy families: 23	Spastic (n=37). Spastic-diplegia (n=35), spastic-quadriplegia, (n=2), Spastic-hemiplegia (n=6). Dystonic (n=3). Hypotonic (n=2)
Yam and Chan (2006)	Hongkong, East Asia	435.572	578 6-12 years	1,33	*Not defined*	*Not defined*	Spastic (n=429). Spastic-hemiplegia (n=132), Spastic-diplegia (n=156), Spastic-triplegia (n=16), Spastic-quadriplegia (n=109), Spastic-unclassified or others (n=16). Dyskinetic (n=38). Ataxic (n=20). Mixed (n=19). Unclassified or others (n=72)

Liu, *et al* (2000)	Jiangsu Province, China, East Timur	388.192	622 <7 years	1,60	*Not defined*	*Not defined*	*Not defined*

Prev: Prevalence

Source: Secondary research data for meta-analysis

Table 2. Research Design and Measurement of The Included Studies

Study Label	Study Design	Sampling Frame	Measurements	Unbiased Assessors
Jahan, *et al* (2020	Survey	A community-based key informant method	The Australian cerebral palsy register and the Bangladesh cerebral palsy register	A multidisciplinary medical assessment team including a pediatrician and a physiotherapist
Yuan, *et al* (2019)	Survey	NA	Magnetic Resonance Imaging (MRI) of the head, electromyography, etc. Potential cases of CP, or subjects who could not be diagnosed or excluded, were referred to senior pediatric neurologists or rehabilitation specialists in the local hospitals	A multidisciplinary medical assessment team including a pediatric physician or neurologist
Khandaker, *et al* (2018)	Survey	A population-based surveillance study, A community-based key informant method	BCPR registration form, a modified version of the Australian CP Register record form, Gross Motor Function Classification System (GMFCS), and Manual Ability Classification System (MACS)	A multidisciplinary medical assessment team comprised of a pediatrician, a physiotherapist, and a counselor
Tseng, *et al* (2018)	Survey	A population-based surveillance study from the Taiwan National Health Insurance Research Database	ICD-9-CM codes 343.x within 1 year	CP diagnosis confirmed by specialists
Raina, *et al* (2011)	Survey	NA	A screening questionnaire was written in the local vernacular that had been prepared by the WHO protocol	All evaluations from the case ascertainment phase were reviewed by a clinical reviewer (neurologist)
Banerjee, *et al* (2009)	Survey	A population-based, cross-sectional, observational study	The measurement using a 'General Screening Questionnaire'divided into two parts – Part I, socio-demographic details and Part II, the screening questionnaire.	The survey team comprised four field workers headed by a neurologist
Yam and Chan (2006)	Survey	A cross-sectional survey	NA	A multidisciplinary medical assessment team including a neurologist and pediatrics

The point prevalence rate calculation revealed that the overall prevalence of CP in children and adolescents in Asia was 2.19 per 1000 people. This means that every child born has a 0.002% chance of having CP. According to the forest plot of statistical analysis using Jamovi 2.2.5 software (figure 2), Taiwan had the highest proportion of CP (13.61%; 95% CI), and India had the lowest (7.90%; 95% CI). However, these findings do not consider variations in the number of population and study samples. Several studies with large populations would almost certainly show a higher proportion, such as research in Taiwan (Tseng et al., 2018) and Hong Kong (Yam et al., 2006) that used the entire population of children and adolescents in both countries as the study population. Studies with smaller populations conducted in a region/city such as in India, on the other hand, will show a lower proportion (Raina et al., 2011; Banerjee et al., 2009). In addition to displaying the proportion of CP in each study, visualization using forest plots can explain the precision and extent to which a study's results

are considered convincing. The accuracy or suitability of the results with the research objectives is one indicator of good research. Three studies conducted in the East Asian region agree on this (Tseng et al., 2018; Yam et al., 2006; Liu et al., 2000). These studies include a more detailed sub-group analysis, such as prevalence by areas (urban, suburban, and rural-urban), socio-economic status, as well as birth characteristics (single or multiple birth and weight birth).
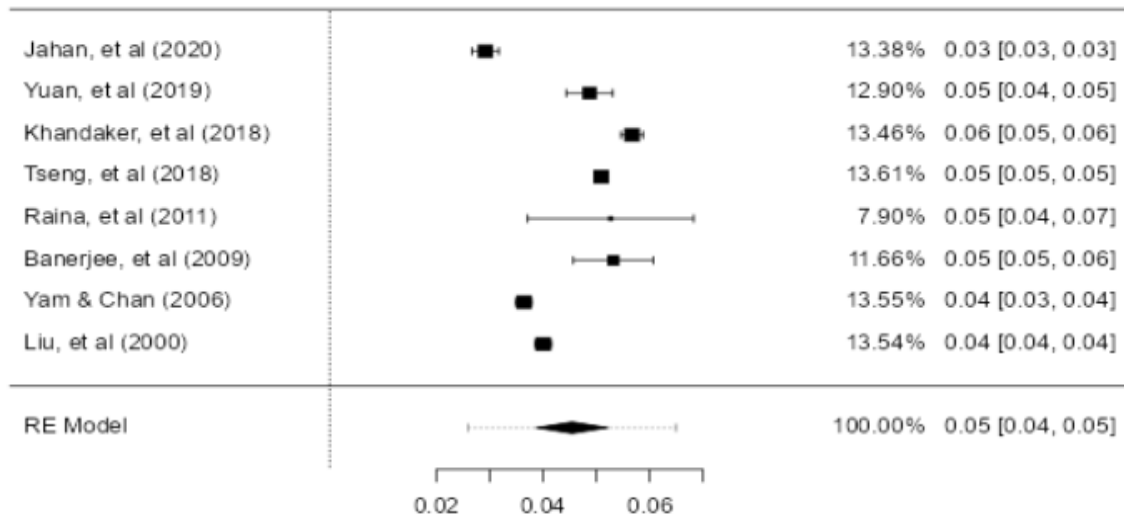
Figure 2. Forest Plot of CP Prevalence in Children and Adolescents in Asia
Source: Statistical data analysis by Jamovi 2.2.5 software

Cerebral palsy appears to affect boys more than girls, with a prevalence of 1.71 per 1000 people. The prevalence of CP was classified into two groups based on the family socio-economic status analysis. The prevalence of CP in families living below the poverty line is 1.46 per 1000 people, while it is 0.91 per 1000 people in wealthy families. In other words, children born into poor families are more likely to have CP than children born into wealthy families. Children and adolescents with CP from low-income families make up 63.67% of the total study population. This review obtained prevalence data based on the classification of CP type in addition to CP type classification. The spastic type is the most common type of CP (1.79 per 1000 people), properly accounting for 80.51% of all children and adolescents diagnosed with CP.

According to the data analysis, the heterogeneity value (I2) is 98.95%. The breadth of the variance in scores owned by the respondent group of the entire study influences the heterogeneity that is classified as high. The remarkably diverse characteristics of all the studies involved also contribute to the review's high heterogeneity. Geographic location, demographic conditions (mean age, education level, family income), and sample size are among these characteristics. Furthermore, heterogeneity is caused by differences in the measuring instruments used to determine CP diagnostics, as well as differences in the analysis of research results based on demographic data available in each study. The funnel plot display in Figure 3 was used to assess the publication bias of this study. This review has significant publication bias because the majority of the included studies are at the top of the plot and the distribution was asymmetric. If at least four studies are in the lower area of the funnel plot, this publication bias may not occur (Chauhan et al., 2019).
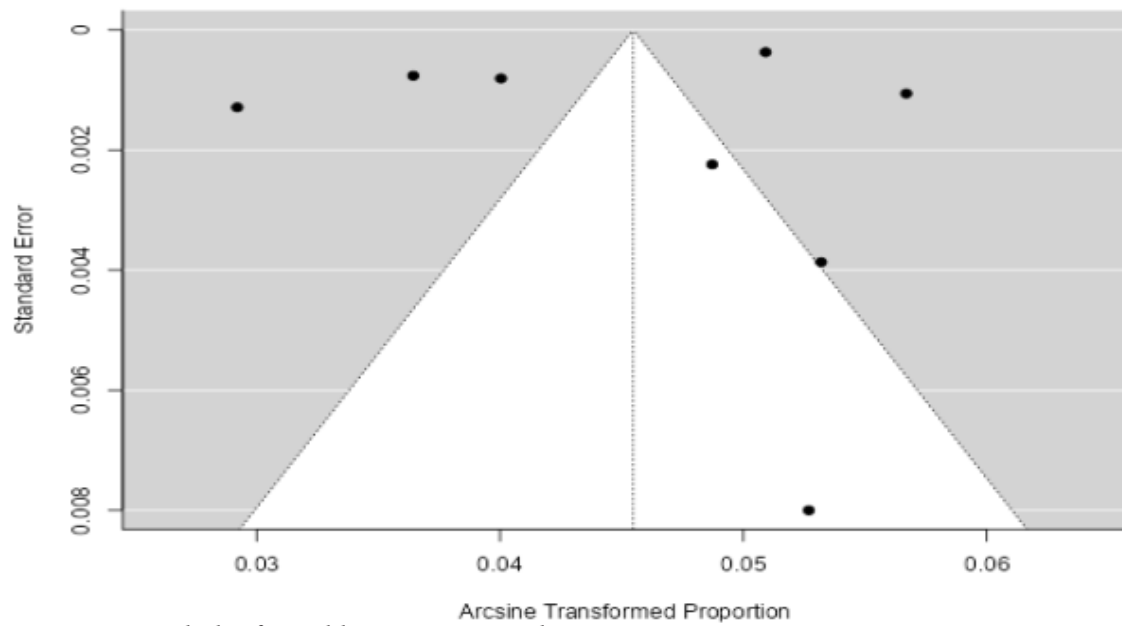
Figure 3. Funnel Plot for Publication Bias Analysis
Source: Statistical data analysis by Jamovi 2.2.5 software

This study is a single systematic review of the prevalence of CP in Asia. Highlighting the prevalence of children and adolescents in Asia, this study found that the incidence rate of CP in countries in the Asian region was 2.19 per 1000 children and adolescents (95% CI). This figure is nearly identical to the global prevalence of CP in the world, which is 2.21 per 1000 (Oskoui et al., 2013). However, these statistics show an increase in the prevalence of CP during the last 10 years, from 1.09 per 1000 children to 2.19 per 1000 children (Lang et al., 2012).

The current study's findings differslightly from previous studies that found that the number of CP cases per 1000 people in Asia was lower than in Western countries (Liu et al., 1999; He et al., 2017). In Europe, Australia, and the United States, the prevalence of CP is 1.8-2.4 cases per 1000 children, respectively (Hirtz et al., 2007; Arneson et al., 2009; Oskoui et al., 2013; Himmelmann & Uvebrant, 2014; Froslev-Friis et al., 2015; Smithers-sheedy et al., 2016; Robertson et al., 2017; El-Tallawy et al., 2014; Kakooza-Mwesige et al., 2017). In comparison to these figures, the prevalence of CP in Asia and Europe is not significantly different. These findings imply that governments in various nations continue to focus on this topic to alleviate societal burdens that arise as a consequence of handicap situations.

According to this study, males had a 30% greater risk of having CP, with a case prevalence of 1.71 per 1000 live births. These findings confirm the previous study, which found that in prematurely born children, boys had a greater prevalence of brain-based developmental impairments such as mental retardation, autism, Attention Deficit Hyperactivity Disorder (ADHD), and cerebral palsy, than girls (Tioseco et al., 2006; Johnston & Hagberg, 2007; Romeo et al., 2022). Many contributing causes have been identified as biological vulnerability, neurodevelopmental abnormalities such as brain disorganization, genetic predisposition, and distinct hormonal impacts between males and females (Vasileiadis et al., 2009; Chen et al., 2013; Bi et al., 2014).

Five of the eight studies included in this review found a high percentage of CP prevalence among poor children and adolescents. They outnumber children and adolescents from wealthy families. (Jahan et al., 2020; Yuan et al., 2019; Khandaker et al., 2019; Tseng et al., 2018; Banerjee et al., 2009). According to the findings of studies conducted in the United States and the United Kingdom, socioeconomic deprivation is associated with an increased risk of having a child with CP. Malnutrition, premature birth, low birth weight, postnatal injury, and risk factors for CP are all caused

by low socioeconomic status (Himpens et al., 2008; Taguri et al., 2008; Solaski et al., 2014; Oskoui et al., 2016; Pacheco et al., 2017).

This review discovered that the prevalence of spastic type CP was the highest based on the classification of CP type. According to the findings of several studies, spasticity is the most common motor disorder in children with cerebral palsy and can be classified based on the area of the body affected: hemiplegia, diplegia, tetraplegia, or the type of movement disorder: spastic cerebral palsy, athetoid, ataxic, and hypotonic (Reeuwijk et al., 2006; Shea et al., 2018; Reilly et al., 2020). Spasticity is a significant barrier to the rehabilitation of children with cerebral palsy. Spasticity can impair or inhibit activity, cause discomfort, disrupt sleep, bring unneeded problems, and make life difficult for caregivers (Birns & Irani, 2015; Reilly et al., 2020). Appropriate treatments are critical in helping a CP person function and live more efficiently (Tilton, 2004).

The three studies in this review categorized CP into three types: spastic, dyskinetic, and ataxic (Jahan et al., 2020; Khandaker et al., 2019; Yam et al., 2006). Other studies only distinguish between two types: spastic and dyskinetic (Chauhan et al., 2019; Banerjee et al., 2009). There was also a study in Taiwan that only determined the prevalence of CP based on the degree of disability, namely severe and mild (Tseng et al., 2018), whereas two other studies did not (Yuan et al., 2019; Liu et al., 2000). The majority of the studies employed a population-based survey design, two were cross-sectional studies, and the remaining two were not specified in their articles. The study was carried out in Asia, including Indonesia (Southeast Asia), China (East Asia), Bangladesh (South Asia), Taiwan (East Asia), India (South Asia), and Hong Kong (East Asia). Several studies in the same country (China and India) used different populations.

Based on the results of the article quality assessment, the majority of the research included in this review can be classified as high-quality research. This classification refers to quality assessment guidelines for healthcare prevalence and incidence research (Loney et al., 1998). There is only one study with a moderate quality rating because it lacks adequate and detailed interpretation of research findings (Raina et al., 2011). Furthermore, in two other articles that received a score of 7, there were limitations related to the use of non-standardized measuring instruments in establishing the diagnosis of CP. These articles, however, remained in the good category.

This review also emphasizes the high clinical heterogeneity across studies as a result of sample size variations and the use of various screening tools for the assessment and diagnosis of CP. Standardized questionnaires have been used as a measuring tool in several studies. Several studies use more than one measurement method, such as questionnaires and clinical observations, and are supported by machine assessment accuracy. In addition to the high heterogeneity, publication bias was discovered using the funnel plot diagram. More studies with different results are required to break down the analysis of the findings of this study.

The framework of this systematic review, which refers to the flowchart of the PRISMA 2020 guide to reporting items (Page et al., 2021), is the study's strength. Furthermore, the authors created detailed inclusion and exclusion criteria to screen the articles. The authors also reported the screening process and the final results obtained systematically using the PRISMA diagram. However, if the high heterogeneity value is highlighted, this study can be expanded into a meta-regression study. This limitation can be used as a starting point for future research. Jamovi 2.2.5 was chosen by the authors for practical reasons. However, the analysis has some limitations. As a result, the authors complete it with Excel 2021 for data management, calculating prevalence using the point prevalence rate formula (Achmadi, 2013) and performing sub-group analysis of the data obtained, such as family economic level and CP type classification. However, the authors are well aware that using other software, such as STATA, can be more efficient.

Conclusion

This review found that the prevalence of CP in children and adolescents in Asia was not significantly different from that in Europe or even the global prevalence of CP. These

findings address the controversy surrounding previous studies that compared the prevalence of CP in Asia and Europe. The high prevalence of CP in Asia has certainly been concerning because there is still a support and quality of service gap between Asia and Europe for people with disabilities and their families. One interesting fact is that the majority of children and adolescents with CP come from low-income families. The authors recommend to many related parties be concerned about prioritizing the poor so that they have better access to health services. The health services in question are socio-educational services that serve as prevention or protection against disability, as well as rehabilitation for better handling of CP cases. Suggestions for the next researchers are expected to be able to develop this research by relating it to other variables such as malnutrition and family quality of life.

Acknowledgement

References

Aal-Blowi, A., Aal-Mutairi, R., Ghabbany, R.M., Manaa, A.M., Aloufi, M.M., Ternati, G.K., Al-Raddady, B.H., & Al-Rufai, A., 2020. The Prevalence of Malnutrition and the Nutritional Status in Children with Cerebral Palsy and Its Causes in Madinah Maternity and Children Hospital. *Current Pediatric Research*, 24(7), pp.273–280.

Achmadi, U.F., 2013. *Kesehatan Masyarakat Teori dan Aplikasi.* Jakarta: PT Raja Grafindo Persada.

ADB Briefs., 2020. Disability and Social Protection in Asia. *Asian Development Bank Briefs,* 4(100), pp.1–7.

Arneson, C.L., Durkin, M.S., Benedict, R.E., Kirby, R.S., Yeargin-Allsopp, M., & Van Naarden, B.K., 2009. Prevalence of Cerebral Palsy: Autism and Developmental Disabilities Monitoring Network, Three Sites, United States, 2004. *Disabil Health J*, 2, pp.45–48.

Asian Development Bank., 2015. *The Social Protection Indicator for Asia: Assessing Progress (Issue July).*

Banerjee, T.K., Hazra, A., Biswas, A., Ray, J., Roy, T., Raut, D.K., Chaudhuri, A., & Das, S.K., 2009. Neurological Disorders in Children and Adolescents. *Indian Journal of Pediatrics,* 76(2), pp.139–146.

Bi, D., Chen, M., Zhang, X., Wang, H., Xia, L., Shang, Q., Li, T., Zhu, D., Blomgren, K., He, L., Wang, X., Xing, Q., & Zhu, C., 2014. The Association Between Sex-Related Interleukin-6 Gene Polymorphisms and the Risk for Cerebral Palsy. *Journal of Neuroinflammation*, 11(1), pp.1–12.

Birns, J., & Irani, T.S., 2015. Management of Spasticity. *Management of Post-Stroke Complications*, 2015, pp.227–240.

Chauhan, A., Singh, M., Jaiswal, N., Agarwal, A., Sahu, J.K., & Singh, M., 2019. Prevalence of Cerebral Palsy in Indian Children: A Systematic Review and Meta-Analysis. *Indian Journal of Pediatrics*, 86(12), pp.1124–1130.

Chen, C.M., Hsu, H.C., Chen, C.L., Chung, C.Y., Chen, K.H., & Liaw, M.Y., 2013. Predictors for Changes in Various Developmental Outcomes of Children with Cerebral Palsy-A Longitudinal Study. *Research in Developmental Disabilities*, 34(11), pp.3867–3874.

Dalal, A.K., 2010. Disability-Poverty Nexus: Psycho-Social Impediments to Participatory Development. *Psychology and Developing Societies*, 22(2), pp.409–437.

Earde, P.T., Praipruk, A., Rodpradit, P., & Seanjumla, P., 2018. Facilitators and Barriers to Performing Activities and Participation in Children with Cerebral Palsy: Caregivers' Perspective. *Pediatric Physical Therapy,* 30(1), pp.27–32.

El-Tallawy, H.N., Farghaly, W.M., Shehata, G.A., Rageh, T.A., Metwally, N.A., & Badry, R., 2014. Cerebral Palsy in AI-Quseir City, Egypt: Prevalence, Subtypes, and Risk Factors. *Neuropsychiatr Dis Treat*, 10, pp.1267–1272.

Froslev-Friis, C., Dunkhase-Heinl, U., Andersen, J. ., Stausbol-Gron, B., Hansen, A., & Game, E., 2015. Epidemiology of Cerebral Palsy in Southern Denmark. *Dan Med J,* 62, pp.A4990.

Green, L.B., & Hurvitz, E.A. 2007. Cerebral Palsy. *Physical Medicine and Rehabilitation Clinics of North America,* 18(4), pp.859–882.

He, P., Chen, G., Wang, Z., Guo, C., & Zheng, X., 2017. Children with Motor Impairment Related to Cerebral Palsy: Prevalence, Severity and Concurrent Impairments in China. *J Paediatr Child Health*, 53, pp.480–

484.

Himmelmann, K., & Uvebrant, P., 2014. The Panorama of Cerebral Palsy in Sweden XI. Changing Patterns in the Birth-Year Period 2003-2006. *Acta Paediatrics,* 103, pp.618–624.

Himpens, E., Van Den Broeck, C., Oostra, A., Calders, P., & Vanhaesebrouck, P., 2008. Prevalence, Type, Distribution, and Severity of Cerebral Palsy in Relation to Gestational Age: A Meta-Analytic Review. *Developmental Medicine and Child Neurology,* 50(5), pp.334–340.

Hirtz, D., Thurman, D.J., Gwinn-Hardy, K., Mohamed, M., Chaudhuri, A.R., & Zalutsky, R., 2007. How Common are the "Common" Neurologic Disorders? *Neurology,* 68(5), pp.326–337.

Jahan, I., Al Imam, M.H., Karim, T., Muhit, M., Hardianto, D., Das, M.C., Smithers-Sheedy, H., Badawi, N., & Khandaker, G., 2020. Epidemiology of Cerebral Palsy in Sumba Island, Indonesia. *Developmental Medicine and Child Neurology,* 62(12), pp.1414–1422.

Johnston, M.V., & Hagberg, H., 2007. Sex and the Pathogenesis of Cerebral Palsy. *Developmental Medicine and Child Neurology,* 49(1), pp.74–78.

Kakooza-Mwesige, A., Andrews, C., Peterson, S., Mangen, F.W., Eliasson, A.C., & Forssberg, H., 2017. Prevalence of Cerebral Palsy in Uganda: A Population-Based Study. *Lancet Glob Health,* 5, pp.1275–1282.

Khandaker, G., Smithers-sheedy, H., Muhit, M., Novak, I., Karim, T., Jones, C., & Badaw, N., 2019. Epidemiology of Cerebral Palsy in Bangladesh a Population-Based Surveillance. *Developmental Medicine & Child Neurology,* 61, pp.601–609.

Lang, T.C., Fuentes-Afflick, E., Gilbert, W.M., Newman, T.B., Xing, G., & Wu, Y.W., 2012. Cerebral Palsy among Asian Ethnic Subgroups. *Pediatrics,* 129(4).

Liu, J.M., Li, S., Lin, Q., & Li, Z., 1999. Prevalence of Cerebral Palsy in China. *International Journal of Epidemiology,* 28(5), pp.949–954.

Liu, J.M., Li, Z., Lin, Q., Zhao, P., Zhao, F.L., Hong, S.X., & Li, S., 2000. Cerebral Palsy and Multiple Births in China. *International Journal of Epidemiology,* 29(2), pp.292–299.

Loney, P.L., Chambers, L.W., Bennett, K.J., Roberts, J.G., & Stratford, P.W., 1998. Critical Appraisal of the Health Research Literature: Prevalence or Incidence of a Health Problem. *Chronic Diseases in Canada,* 19(4).

Nelson, K.B., & Ellenberg, J.H., 1978. Epidemiology of Cerebral Palsy. *Advances in Neurology,* 19,

pp.421–435.

Oskoui, M., Coutinho, F., Dykeman, J., Jetté, N., & Pringsheim, T., 2013. An Update on the Prevalence of Cerebral Palsy: A Systematic Review and Meta-Analysis. *Developmental Medicine and Child Neurology,* 55(6), pp.509–519.

Oskoui, M., Messerlian, C., Blair, A., Gamache, P., & Shevell, M., 2016. Variation in Cerebral Palsy Profile by Socioeconomic Status. *Dev Med Child Neurol,* 58, pp.160–166.

Pacheco, C.D.R., Picauly, I., & Sinaga, M., 2017. Health, Food Consumption, Social Economy, and Stunting Incidency in Timor Leste. *Jurnal Kesehatan Masyarakat,* 13(2), pp.261–269.

Page, M.J., McKenzie, J.E., Bossuyt, P.M., Boutron, I., Hoffmann, T.C., & Mulrow, C.D., 2021. The PRISMA 2020 Statement: An Updated Guideline for Reporting Systematic Reviews. *BMJ Open,* 372(71).

Raina, S.K., Razdan, S., & Nanda, R., 2011. Prevalence of Cerebral Palsy in Children <10 Years of Age in R.S. Pura Town of Jammu and Kashmir. *Journal of Tropical Pediatrics,* 57(4), pp.293–295.

Reeuwijk, A., van Schie, P.E.M., Becher, JG., & Kwakkel, G., 2006. Effects of Botulinum Toxin Type A on Upper Limb Function in Children with Cerebral Palsy: A Systematic Review. *Clinical Rehabilitation,* 20(5), pp.375–387.

Reilly, M., Liuzzo, K., & Blackmer, A.B., 2020. Pharmacological Management of Spasticity in Children with Cerebral Palsy. *Journal of Pediatric Health Care,* 34(5), pp.495–509.

Robertson, C.M.T., Ricci, M.F., O'Grady, K., Oskoui, M., Goez, H., & Yager, J.Y., 2017. Prevalence Estimate of Cerebral Palsy in Northern Alberta: Births, 2008-2010. *Can J Neurol Sci,* 44, pp.366–374.

Romeo, D.M., Venezia, I., Pede, E., & Brogna, C., 2022. Cerebral Palsy and Sex Differences in Children: A Narrative Review of the Literature. *Journal of Neuroscience Research,* 2021, pp.1–13.

Rosenbaum, P., Paneth, N., & Leviton, A., 2007. A Report: The Definition and Classification of Cerebral Palsy. *Dev Med Child Neurol Suppl,* 109, pp.8–14.

Sellier, E., Platt, M.J., Andersen, G.L., KraÈ geloh-Mann, I., De La Cruz, J., & Cans, C., 2016. Decreasing Prevalence in Cerebral Palsy: A Multi-Site European Population-Based Study, 1980 to 2003. *Dev Med Child Neurol,* 58, pp.85–92.

Shea, T.M.O., Preisser, J.S., Klinepeter, K.L., &

Dillard, R.G., 1998. Trends in Mortality and Cerebral Palsy in a Geographically Based Cohort of Very Low Birth Weight Neonates Born Between 1982 to 1994. *Pediatrics,* 101(4).

Smithers-sheedy, H., McIntyre, S., Gibson, C., Meehan, E., Scott, H., & Goldsmith, S., 2016. A Special Supplement: Findings from the Australian Cerebral Palsy Register, Birth Years 1993 to 2006. *Dev Med Child Neurol,* 58(2), pp.5–10.

Solaski, M., Majnemer, A., & Oskoui, M., 2014. Contribution of Socio-Economic Status on the Prevalence of Cerebral Palsy: A Systematic Search and Review. *Dev Med Child Neurol,* 56, pp.1043–1051.

Taguri, A.E., Betilman, I., Mahmud, S.M., Ahmed, A.M., Goulet, O., Galan, P., & Herceberg, S., 2008. Risk Factor for Stunting Among Under Five in Libya. *Public Health Nutrition*, 12(8), pp.1141–1149.

Tilton, A.H., 2004. Management of Spasticity in Children with Cerebral Palsy. *Seminars in Pediatric Neurology*, 11(1), pp.58–65.

Tioseco, J.A., Aly, H., Essers, J., Patel, K., & El-Mohandes, A.A.E., 2006. Male Sex and Intraventricular Hemorrhage. *Pediatric Critical Care Medicine*, 7(1), pp.40–44.

Tseng, S.H., Lee, J.Y., Chou, Y.L., Sheu, M.L.,

& Lee, Y.W., 2018. Association between Socioeconomic Status and Cerebral Palsy. *PLoS ONE*, 13(1), pp.1–9.

Vasileiadis, G.T., Thompson, R.T., Han, V.K.M., & Gelman, N., 2009. Females Follow a More "Compact" Early Human Brain Development Model than Males. A Case-Control Study of Preterm Neonates. *Pediatric Research*, 66(5), pp.551–554.

Wagle, U.R., 2017. How Much do Social Protections Matter to Poverty and Inequality? An Insight from Asian Experiences. *Global Social Policy,* 17(2).

Wu, Y.W., Xing, G., Fuentes-Afflick, E., Danielson, B., Smith, L.H., & Gilbert, W.M., 2011. Racial, Ethnic, and Socioeconomic Disparities in the Prevalence of Cerebral Palsy. *Pediatrics*, 127, pp.674–681.

Yam, W.K.L., Chan, H.S.S., Tsui, K.W., Yiu, B.P.H.L., Fong, S.S.L., Cheng, C.Y.K., & Chan, C.W., 2006. Prevalence Study of Cerebral Palsy in Hong Kong Children. *Hong Kong Medical Journal,* 12(3), pp.180–184.

Yuan, J., Wang, J., Jieqiong, M. A., Zhu, D., Zhang, Z., & Li, J., 2019. Pediatric Cerebral Palsy Prevalence and High-Risk Factors in Henan Province, Central China. *Journal of Rehabilitation Medicine,* 51(1), pp.47–53.

Jurnal Kesehatan Masyarakat

Isolated Systolic Hypertension among Diabetes Mellitus Subjects; a national cross-sectional study in Indonesia

Mahalul Azam[1✉], Fetty Nur Hidayati[1], Arulita Ika Fibriana[1], Udin Bahrudin[2], and Syed Mohamed Aljunid[3]

[1]Department of Public Health, Faculty of Sports Science, Universitas Negeri Semarang, Indonesia
[2]Department of Cardiology and Vascular Medicine, Faculty of Medicine, Diponegoro University, Semarang, Indonesia
[3]Department of Health Policy and Management, Faculty of Public Health, Kuwait University, Kuwait, Kuwait

Article Info

Abstract

Isolated systolic hypertension (ISH) reflects atherosclerosis. Studies reported hypertension prevalence among diabetes mellitus (DM); however, limited studies provided community prevalence. The present study aimed to explore ISH prevalence among DM in Indonesia. This study obtained data from the 2018 Indonesia Basic Health Survey. The DM category was determined by fasting plasma glucose (PG) level ≥126 mg/dL or 2 hours postprandial and random PG level ≥200 mg/dL or previously diagnosed by a doctor. ISH is categorized if systolic blood pressure is≥140 mmHg and diastolic blood pressure is <90 mmHg. This study also explored the subject's determinants, i.e., compliance, demography, and lipid profile. A Chi-square and Binary logistic regression were used to determine the association. The study included 3,911 DM individuals and disclosed the prevalence of ISH at 17.5%. ≥65 years old (OR=13.61 95%CI: 3.297-19.365) and 45-64 years old OR=4.59 95%CI: 3.297-6.383)), high HDL-cholesterol (OR=0.77; 95%CI: 0.626-0.936), and longer DM duration (OR=2.89; 95%CI: 2.405-3.474), all together were related to the ISH. Subjects with the oldest age category, i.e., ≥65 years old, had the highest OR. Older DM individuals with low HDL-C and longer DM duration were related to the ISH, suggesting lipid profile treatments, mainly the HDL-C, is a pivotal effort to delay ISH.

Introduction

International Diabetes Federation reports that 463 million people globally and 10.7 million people in Indonesia live with diabetes mellitus (DM), placing Indonesia in the seventh rank among countries for the number of adults with DM (International Diabetes Federation, 2019). Hypertension is the most frequent comorbidity for DM(Colosia et al., 2013; Nguyen et al., 2015; Tesfaye et al., 2019; Farahdika et al., 2015). Both hypertension and DM are the major risk factors for cardiovascular diseases due to the vascular mechanism (Petrie et al., 2018). Hypertension is associated with 30% of death and 25% of cardiovascular events among DM subjects (Chen et al., 2011). DM subjects with hypertension have seven times more likely to experience end-stage renal disease and two to four times to get myocardial infarction and stroke (Chen et al., 2011).

Hypertension occurs due to vascular resistance and increased fluid volume (Ohishi, 2018). Vascular resistance in DM subjects is related to vascular remodeling. This remodeling caused arterial stiffness, while the increase in fluid volume is related to hyperglycemia caused by resistance-induced hyperinsulinemia (Ohishi, 2018). Isolated systolic hypertension (ISH) is the most frequent form of hypertension among the elderly (Bavishi et al., 2016) and the most frequent subtype of uncontrolled hypertension (Franklin et al., 2012). People

with DM have a twice higher risk of getting ISH than those without DM (Os et al., 2006). ISH reflects widespread atherosclerosis and increases stroke risk by 11% and an increase in all-cause mortality risk by 16% (Os et al., 2006). Alongside the ISH, the pulse pressure (PP) values and mean arterial pressure (MAP) values are risk factors for cardiovascular events and all-cause mortality (Madan et al., 2019; Os et al., 2006; Selvaraj et al., 2016; Winston et al., 2013).

Based on the hospital-based data, a previous study Ephraim et al., (2016), reported that ISH prevalence among DM subjects was 37.4%, and age was the most related factor. Another study reported that ISH prevalence among DM subjects was 27.6%(Dagnew & Yeshaw, 2019); male, older age, obesity, and smoking were its risk factors (Dagnew & Yeshaw, 2019; Grebla et al., 2010). A study in Indonesia reported risk factors of hypertension among DM subjects such as age, mental health disorders, obesity, physical activities, duration of diabetes, dyslipidemia, and patient compliance (Sihombing, 2017). However, population-based data have limited information regarding ISH prevalence and risk factors among DM subjects. The current cross-sectional study's objective was to investigate the ISH prevalence and its determinants among DM individuals based in the Indonesian community setting. The determinants observed were demographic data, clinical characteristics, lifestyle, duration of DM, and medication status.

ISH is a subtype of hypertension that commonly occurs in young people and adults, and it is categorized when systolic blood pressure is≥140 mmHg and diastolic blood pressure is <90 mmHg. Yano Y. e., (2017). Hypertension is a condition that has no visible symptoms (Lilies, 2015), where high blood pressure in the arteries causes an increased risk of cardiovascular-related diseases such as stroke, heart failure, heart attack, and kidney damage. Hypertension is called the silent killer because it often does not show any symptoms for ten to twenty years and is usually only known when complications have occurred in target organs such as the heart, kidneys, brain, and eyes so that treatment is delayed and reduces life expectancy due to weakness in

organ function. Resulting in disability and even death (Oktaviarini, 2019). Table 1 and Table 2 describe the classification of hypertension and ISH.

Table 1. Classification of hypertension based on the Joint National Committee on Detection, Evaluation, and Treatment of High Blood Pressure (JNC) VIII

Category	Systolic (mmHg)	Diastolic (mmHg)
Normal	<120	<80
Prehypertension	120-139	80-90
Hypertension Stage 1	140-159	90-99
Hypertension Stage 2	>60	>100
Isolated Systolic Hypertension	≥140	<90

Source: Primary data, 2018

Table 2. ISH Itself Categorized

Grade	Systolic (mmHg)	Diastolic (mmHg)
ISH Grade 1	<160	<90
ISH Grade 2	<180	<90
ISH Grade 3	≥180	<90

Source: Primary data, 2018

ISH develops from the presence of diastolic hypertension in patients with long-term essential (primary) hypertension or increased systolic pressure in hypertension secondary to increased arterial stiffness in previously normal blood pressures. (Franklin S., 2012). Secondary causes of systolic hypertension include type 1 diabetes, osteoporosis with vascular calcification, accelerated atherosclerosis from chronic kidney disease, peripheral vascular disease, altered elastin formation during intrauterine fetal growth retardation, thyrotoxicosis, repair of coarctation of the aorta, and proximal aortic aging. Pathophysiological changes due to aging of the arterial wall that predispose elderly individuals to the occurrence of isolated systolic hypertension include endothelial dysfunction, hardening of the arteries, proinflammatory release, insensitivity to vasodilators, and elastin calcification (AlGhatrif, 2015).

In line with age and the progression of atherosclerosis, there is an increase in arterial calcium and collagen deposition associated

with the rupture of arterial elastin. The resulting decrease in arterial elasticity and compliance leads to a decrease in the lumen-to-wall ratio and increased arterial stiffness (Chobanian, 2007). These changes typically involve the predominantly large arteries and aorta. A translational study has shown that an increase in systolic blood pressure causes an increase in enzyme levels or a proinflammatory action, leading to endothelial dysfunction.

For example, matrix metalloproteinase enzymes inhibit vasodilation through endo-thelial nitric oxide degradation and increase vasoconstriction through cleavage of the vasoconstrictase enzyme (Fontana, 2012). Furthermore, matrix metalloproteinases play a role in the development of atherosclerosis, leading to intima and media thickening (Ma, 2012). Rigidity causes an increase in systolic pressure and a further decrease in diastolic pressure, creating an increase in pulse pressure and, thus, a reduced Windkessel effect (Bavishi, 2016). Pulse wave velocity used to measure arterial stiffness increases as arterial compliance decreases. High velocity will trigger the reflected wave pressure more quickly, causing ventricular-vascular mismatch, resulting in increased left ventricular pressure and systolic pressure.

Chronic diseases often co-occur in elderly patients with hypertension, such as diabetes mellitus, chronic kidney disease, hyperlipidemia, and smoking contribute to the pathological process of isolated systolic hypertension. It accelerates the occurrence of atherosclerosis and hardening of the arteries resulting in increased pressure and decreased arterial compliance. Decreased diastolic pressure and impaired diastolic relaxation, together with hardening of the arteries and reduced Windkessel function of the aorta, will cause an increase in systolic blood pressure reactivity due to volume fluctuations. Thus, increased pulse pressure and unstable systolic pressure across microvascular organs can lead to vessel damage and "ischemic outflow" of end organs.

The renin angiotensin aldosterone system (RAAS) is involved to some extent in the pathogenesis of isolated systolic hypertension through mechanisms that increase vascular thickness, stiffness, and loss of contractility, such as altering the elastin-collagen content of the arterial wall, thickening and fibrotic remodeling of the vascular intima, and inducing proliferation. Arterial smooth muscle cells (Chrysant, 1998). However, there is a gradual progressive decrease in plasma renin activity with increasing age. The renin-angiotensin-aldosterone system is modulated by several other factors, such as sodium intake and comorbidities (Bavishi, 2016).

Data from the Baltimore Longitudinal Study of Aging (BLSA) show that arterial stiffness causes an increase in systolic blood pressure in the elderly (Najjar SS., 2008), whereas an earlier increase in systolic blood pressure was associated with a tremendous increase in arterial stiffness. The organ closest to the aorta that experiences stiffness is the heart; therefore, the heart is the organ that is directly affected by isolated systolic hypertension. Increased pulse pressure is a sign of cardiac abnormalities caused by increased central arterial stiffness and wave reflection. Increased pressure in the aorta is a significant factor in developing left ventricular hypertrophy, with increased demand for coronary blood flow (Giannattasio C., 2020). In addition, increased turbulent flow causes endothelial dysfunction with a greater propensity for coronary atherosclerosis and rupture of unstable atherosclerotic plaques.

Elevated systolic blood pressure and failure of diastolic blood pressure in the elderly with isolated systolic hypertension can cause an imbalance in coronary blood supply and myocardial ischemia. Decreased diastolic blood pressure very rarely falls to critical levels (<60 mmHg), which can result in impaired coronary flow auto-regulation (Somes, 1999). The outflow of cardiac output into the rigid arterial system results in greater coronary perfusion during the systolic period, making the heart more susceptible to changes in systolic blood pressure and impaired cardiac function. In addition to arterial stiffness, the left ventricle also plays a role in developing systolic stiffness as an adaptive change in facilitating cardiac ejection and maintaining the connection of the heart to the arteries. The combination of increased cardiac flow and compromised left ventricle will eventually lead to heart failure

Methods

The present study took out secondary data from the 2018 Indonesia Basic Health Survey (Riset Kesehatan Dasar; RISKESDAS), the latest five-annual national scope cross-sectional study conducted by the National Institute of Research and Development, Ministry of Health, the Republic of Indonesia. The survey was conducted and delivered to households systematic-randomly selected from 514 districts/cities in 34 provinces. For each province and district/city, the number of proportional census blocks was determined systematically. Three hundred households, or 30.000 census blocks, were then determined to be involved in the survey. Of them, 94.2 % or 282,654 households completed the questionnaire, consisting of 1,017,290 individual subjects (Badan Penelitian dan Pengembangan Kesehatan, 2018). The study population involved subjects with DM in the RISKESDAS 2018 data. Subjects with DM were defined by fasting plasma glucose level ≥ 126 mg/dL or 2 hours postprandial and random plasma glucose level ≥ 200 mg/dL or had been confirmed by a doctor diagnosis previously. To minimize the potential of bias regarding the question of "previously had been diagnosed DM by a doctor," delivering questions about the DM medication as well as plasma glucose test was conducted.

Ethical clearance for the RISKESDAS 2018 study was obtained from the Ethics Committee, the National Institute of Health Research and Development (NIHRD), and the Ministry of Health, Republic of Indonesia. Subject with ISH was defined as those with systolic blood pressure (SBP) ≥ 140 mmHg and diastolic blood pressure (DBP) < 90 mmHg (Members et al., 2013). We categorized the individuals as non-hypertensive when meeting the criteria of optimal (<120 mmHg and <80 mmHg), normal (120 mmHg-129 mmHg and/or 80-84 mmHg), or high normal (130-139 mmHg and/or 85-89 mmHg). While non-ISH hypertension was categorized as grade 1-3 hypertension; grade 1 hypertension: 140-159 mmHg and/or 90-99 mmHg; grade 2 hypertension: 160-179 mmHg and/or 100-109 mmHg; grade 3 hypertension >180 mmHg and or ≥110 mmHg (Members et al., 2013). Based on blood pressure measurement, we also calculated pulse pressure (PP) and mean arterial pressure (MAP). PP was calculated as a result of the formula (PP = SBP –DBP), while the MAP was calculated as the formula of (MAP=((SBP+2*DBP))/3) (Members et al., 2013).

The data obtained from RISKESDAS 2018 were gender, age, urban-rural residence status, educational level, marital status, employment status, total cholesterol level, HDL-cholesterol level, triglycerides level, history of hypertension, smoking, physical activity status, alcohol consumption, body mass index (BMI), duration of DM, type of medication, and medication compliance. Characteristics of the subjects were presented as proportions since they are categorical types of data. We categorized age as ≥75, 65-74, 55-64, 45-54, and 35-44, and BMI category as overweight/obesity and normal/underweight, under the cut-off point of 27. The association between the subject's characteristics and ISH status was analyzed using the Chi-square test. The p-values <0.05 were appraised as statistically significant. The binary logistic regression was then performed to determine the relationship between determinants and ISH and find the best regression model. Parameters with a p-value <0.25 were involved in Binary logistic regression analysis. Analyses of statistics were conducted using the Statistical Package for the Social Sciences (SPSS) software (version 23.0 for Windows, IBM SPSS Inc., Chicago, IL).

Results and Discussion

Table 3. Characteristics of Subjects Based on ISH Status

Parameters	ISH			p value	OR	95%CI	
	Yes	No	Total			Lower	Lower
	n (%)	n (%)	n (%)				
Age (years old)							
≥65	244 (36.5)	425 (63.5)	669(17.1)	0.001	12.75	9..042	17.981
45-64	398 (17.7)	1846 (82.3)	2244(57.4)	0.001	4.79	3.464	6.625
15-44	43 (4.3)	955 (95.7)	998(25.5)	Reference	1		
Gender							
Female	451 (17.2)	2171 (82.8)	2622	0.489	0.95	0.821	1.093
Male	234 (18.2)	1055 (81.8)	1289				
Residence status							
Urban	370 (18)	1687 (82)	2057	0.437	1.06	0.924	1.214
Rural	315 (17)	1539 (83)	1854				
Marital status							
Un-married	23 (15.6)	124 (84.4)	147	0.619	0.89	0.607	1.303
Married	662 (17.6)	3102 (82.4)	3764				
Education level							
Low	553 (18.4)	2453 (81.6)	3006	0.009	1.26	1.059	1.502
High	132 (14.6)	773 (85.4)	905				
Employment status							
Un-employed	308 (18.8)	1331 (81.2)	1639	0.081	1.13	0.988	1.298
Employed	377 (16.6)	1895 (83.4)	2272				
Total Cholesterol level							
≥200 mg/dL	345 (18.8)	1487 (81.2)	1832	0.046	1.15	1.005	1.319
<200 mg/dL	340 (16.4)	1739 (83.6)	2079				
HDL level							
≥40 mg/dL	169 (14.8)	971 (85.2)	1140	0.005	0.80	0.679	0.934
<40 mg/dL	516 (18.6)	2255 (81.4)	2771				
LDL level							
≥100 mg/dL	591 (17.9)	2705 (2.1)	3296	0.127	1.17	0.961	1.433
<100 mg/dL	94 (15.3)	521 (84.7)	615				
Triglyceride							
≥150 mg/dL	261 (16.2)	1351 (83.8)	1612	0.075	0.88	0.763	1.010
<150 mg/dL	424 (18.4)	1875 (81.6)	2299				
History of hypertension							
Yes	250 (18.5)	1100 (81.5)	1350	0.248	1.09	0.947	1.255
No	435 (17)	2126 (83)	2561				
Smoking							
Yes	182 (18.2)	820 (81.8)	1002	0.563	1.05	0.901	1.225
No	503 (17.3)	2406 (82.7)	2909				
Physical activity status							
Sedentary	131 (21.7)	474 (78.3)	605	0.004	1.29	1.091	1.531
Active	554 (16.8)	2752 (83.2)	3306				
Alcohol consumption							
Yes	2 (5.4)	35 (94.6)	37	0.084	0.31	0.080	1.182
No	683 (17.6)	3191 (82.4)	3874				
BMI category							
Overweight/Obese	377 (18.3)	1681 (81.7)	2058	0.088	0.88	0.753	1.049
Normal/underweight	308 (16.6)	1545 (83.4)	1853				
Duration of DM							
>5 years	469 (25.1)	1398 (74.9)	1867	0.001	2.38	2.049	2.758
<5 years	216 (10.6)	1828 (89.4)	2044				

Type of DM medication							
No medication	235 (28.3)	595 (71.7)	830	0.001	2.09	1.766	2.471
OHD+insulin	158 (19.1)	670 (80.9)	828	0.001	1.41	1.164	1.703
Insulin	91 (11.8)	679 (88.2)	770	0.261	0.87	0.692	1.099
OHD	201 (13.6)	1282 (86.4)	1483	Reference	1		
Medication compliance							
No	307 (18.9)	1318 (81.1)	1625	0.062	1.14	0.997	1.310
Yes	378 (16.5)	1908 (83.5)	2286				

*Chi-square test
HDL: high density lipoprotein; LDL: low density lipoprotein; OHD: oral hypoglicaemic drugs; OR: odds ratio
Source: Primary data, 2018

Table 4. Binary Logistic Regression of ISH Risk Factors Among DM Subjects

Variables	p	OR	95% CI.	
Age 45-64	0.001	4.59	3.297	6.383
Age ≥65	0.001	13.61	9.565	19.365
High HDL cholesterol	0.009	0.77	0.626	0.936
History of hypertension	0.454	0.93	0.775	1.121
Overweight/Obese	0.12	1.26	0..091	1.499
Longer duration of DM	0.001	2.89	2.405	3.474

BMI: body mass index; HDL: high density lipoprotein; OR: odds ratio
Pseudo-R-square=0.67 (Nagelkerke)
Source: Primary data, 2018
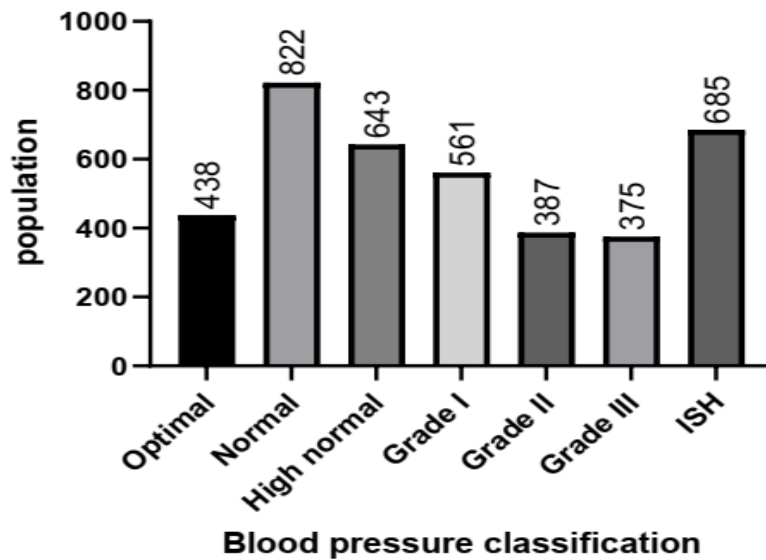
Figure 1. Frequency of Blood Pressure Classification Among DM Subjects
Optimal: <120 and <80; Normal: 120-129 and/or 80-84; High normal: 130-139 and/or 85-89; Grade I hypertension: 140-159 and/or 90-99; Grade II hypertension: 160-179 and or 100-109; Grade III hypertension: ≥180 and or ≥110; Isolated systolic hypertension (ISH): ≥140 and <90
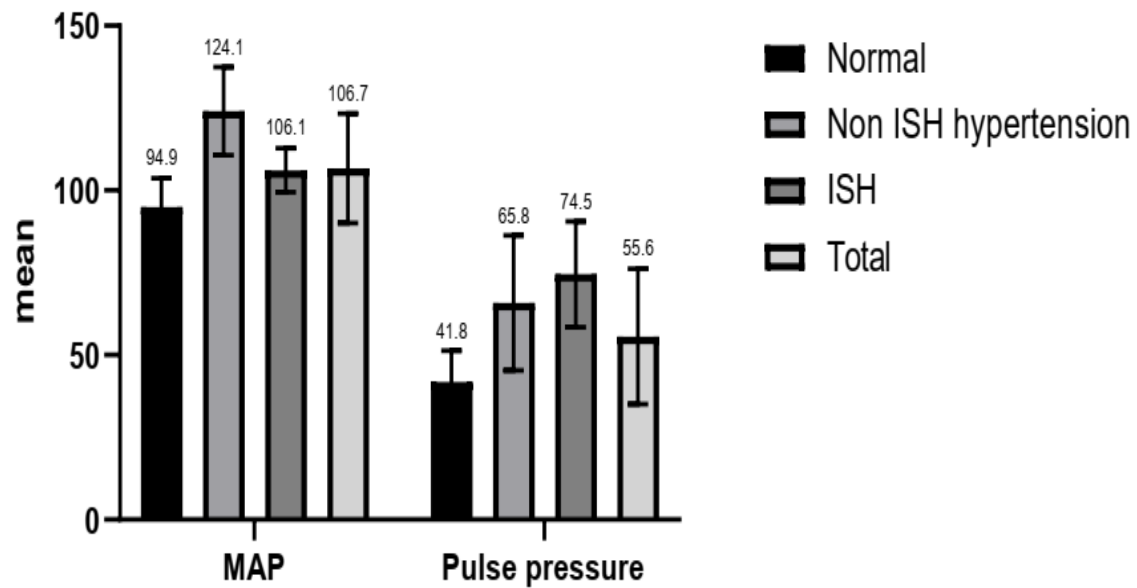
Figure 2. Mean Arterial Pressure (MAP) and Pulse Pressure Based on Hypertension Classification. ISH: Isolated Systolic Hypertension

Data from the RISKESDAS 2018 consisted of 3,911 DM subjects included in the final analysis. The subjects were 1,289 (33%) males and 2,622 (67%) females. The most frequent age category was 45-64 years old (57.4%). More than half of the subjects lived in the urban area with a low level of education and were employed in various sectors. Most of the subjects had lower total cholesterol levels, lower high-density lipoprotein (HDL) cholesterol levels, higher low-density lipoprotein (LDL) cholesterol levels, and lower triglyceride levels. Most had a history of hypertension, non-smoking, active physical activity, and fair medication compliance. The detailed subjects' characteristics are presented in Table 3.

Based on the result of blood pressure measurement, a total of 1,903 (48.7%) subjects were categorized as normal, while the rest of 2,008 (51.3%) were categorized as hypertension, whether grade 1,2,3 or ISH. ISH was the most frequent form of hypertension in the study population (Fig. 1). The highest mean MAP was in the non-ISH hypertension group, while the highest mean PP was in the ISH group (Fig. 2).

Of the total 3,911 DM subjects, 685 were identified as ISH, which indicated that the prevalence of ISH was 17.5%. Table 3 identified variables associated with the ISH.

Older subjects, low educational level, high total cholesterol level, low HDL level, active physical activity, obesity, longer duration of DM, and type of medication were associated with the ISH status among DM subjects. These variables, combined with other variables that $p \leq 0.25$, i.e., employment status, LDL level, triglyceride, history of hypertension, alcohol consumption, and medication compliance, continued to be included in the logistic regression, and the ending model of regression showed in Table 4. We found that age (OR= 13.61 95% CI: 3.297-19.365) for age category ≥65 years old and OR = 4.59 95% CI: 3.297-6.383 for age category 45-64 years old)), high HDL-cholesterol (OR=0.77; 95% CI: 0.626-0.936), and longer DM duration (OR=2.89; 95% CI: 2.405-3.474), all together were related to the ISH (Table 4). Subjects with the oldest age category, i.e., ≥65 years old, had the highest OR.

The present study reported a national scope, population based cross sectional study that involved 3,911 DM individuals in Indonesia. Of them, 685 had ISH, which showed that the ISH prevalence among DM individuals in this study was 17.5%. Based on this study population, the prevalence of ISH among DM subjects in Indonesia was lower than the prevalence of ISH among DM subjects in Ghana, i.e., 37.4% based on the out-

patient diabetes clinic in the teaching hospital of Tamale (Ephraim et al., 2016) different study populations may contribute to different prevalence. Similarly, a hospital-based study, study in Jimma, Ethiopia, found that ISH prevalence among DM patients was 27.6% (Dagnew & Yeshaw, 2019). A population-based study in the district of Chiem Hoa, Vietnam, observed the general elderly population aged >60 years old and found a prevalence of 22.9 % (Bui Van et al., 2019). Another national population-based study in the USA revealed that the prevalence of ISH in the general population was 9.4% (Liu et al., 2015). A similar result to the current study reported by a hospital-based cohort study in Italy observed ISH among type 2 DM and found a prevalence of 20.3 % (Bo et al., 2004).

The present study also added evidence that DM subjects with older age, i.e., ≥75 years old, were the most influential ISH risk factor. This finding follows the previous cohort study in Italy, which concluded that the mean age of type 2 DM subjects who experienced ISH was 74.3 years old (Bo et al., 2004). On the other hand, a study in Ethiopia reported that DM subjects aged ≥60 years old were the protective factor for ISH, while the age category of 47-55 years old was the risk factor with the highest OR, i.e., 2.63 (Dagnew & Yeshaw, 2019). Similarly, the study in Ghana showed the most frequent ISH in DM subjects aged 50-69 years old (Ephraim et al., 2016). Regarding the study population, a study in Italy and Ethiopia compared ISH to non-ISH, including other forms of hypertension, while a study in Ghana compared ISH to normal subjects (Bo et al., 2004; Dagnew & Yeshaw, 2019; Ephraim et al., 2016). The previous review concluded that ISH affects 10-20% of the elderly; SBP increases with age, while DBP rises until the age of 50 years and then decreases after that (Thijs et al., 2004). An increase in blood pressure with age is mainly associated with arterial stiffness. Degenerative processes such as calcification and alteration of arteriosclerotic structure play a pivotal role in the formation of large artery stiffness and small vessels. Small vessel stiffness leads to the condition of peripheral vascular resistance that influences the increase of both systolic and diastolic blood pressure. The existence of large artery stiffness increases systolic blood pressure and, conversely, decreases diastolic blood pressure. The acceleration of large artery stiffness after 50 years old led to a steeper increase in systolic blood pressure that caused the ISH condition (Pinto, 2007).

Lipid profile leads to the process of endothelial dysfunction that affects blood pressure. HDL cholesterol is inversely associated with hypertension, while non-HDL cholesterol has a positive association (Azam M et al., 2017; Zhan et al., 2019). The present study found that HDL was inversely associated with ISH, while in the bivariate analysis, total cholesterol showed a positive association with ISH. High HDL level, i.e., ≥40 mg/dL, was concluded as the protective factor for ISH in this study. This finding was per the Physician Health Study that reported the highest quartile of HDL level, i.e., >53 mg/dL had the lowest adjusted-RR (0.68) compared to the other quartile (Halperin. et al., 2006). A study in China also reported that HDL level was inversely related to the blood pressure and pulse-wave velocity of the brachial-ankle, an arterial stiffness development marker (Zhan et al., 2019). The oxidative activity of LDL cholesterol also influences the atherosclerotic formation structure of the vessels, which is also inhibited by HDL (Brites et al., 2017; Puri et al., 2016). However, a previous study in Japan reported a positive correlation between HDL and hypertension in apparently healthy people (Oda & Kawai, 2011). Another study revealed a positive association between HDL and hypertension in subjects with high-level circulation CD34-positive cells, a bone marrow-derived endothelial progenitor. The circulating CD-34 increases as a response to the endothelial damage, therefore masking the role of HDL as endothelial protective in healthy subjects (Shimizu et al., 2017).

The current study also found that a longer duration of DM, i.e., more than five years, was significantly associated with ISH, OR=1.82 (95% CI: 1.181-2.218). This finding adds to the previously reported evidence that revealed diabetes duration and insulin treatment status were independent predictors of ISH (Smulyan et al., 2016). The progression and duration of diabetes increase complications. Duration of diabetes is associated with arterial stiffness,

while arterial stiffness plays a pivotal role in ISH (Smulyan et al., 2016). The previous study also described the gradation of DM duration as a dose-response relationship with hypertension (Berraho et al., 2012). These findings strengthen the hypothesis that diabetes precedes arterial stiffness that causes ISH; however, another study found that the onset of diabetes and brachial-ankle pulse wave velocity coincided after a longitudinal observation, indicating a conversely condition (Y. Zhang et al., 2019). Indeed, multifactor roles contributed to arterial stiffness as a significant cause of ISH. Arterial stiffness results from degenerative processes in the extracellular matrix of elastic arteries caused by aging and many other risk factors (Palombo & Kozakova, 2016).

The final model of Binary logistic regression in this study involved a history of hypertension; however, the p-value did not meet to be considered significant. The previous history of hypertension describes the condition of individuals who tend to have a genetic predisposition (Arnett & Claas, 2018). Hypertension is a complex trait that involves multiple organs and pathways (Arnett & Claas, 2018; Lindsey et al., 2015). A comprehensive understanding of genomics, epigenomics, metabolomics, proteomics, and transcriptomics of blood pressure plays a pivotal role in the context of the previous history of hypertension (Arnett & Claas, 2018). A further study observing the detailed genetic role should be conducted to elucidate the novel hypertension pathophysiology and dissect and characterize the disorder's mechanism.

It is well established that obesity is associated with ISH (Asgari et al., 2016; Wildman et al., 2003; R. and E. R. Zhang, 2000). Obesity affects the process of inflammation, cell adhesion, and coagulation that impact in arterial stiffness (Delles et al., 2018; Wildman et al., 2003). Obesity is also related to insulin and leptin resistance that contributes to sodium retention with concomitant cardiac output (R. and E. R. Zhang, 2000). However, in this study, BMI did not significantly associate with ISH, although involved in the final model. It must be considered that the role of BMI measurement alone is inadequate for accurately predicting the disease progression in DM subjects (Murea

et al., 2018). Other parameters such as body composition, total adipose mass, visceral adiposity–accumulation of intra-abdominal fat, and muscle mass should be analyzed to describe the current condition of DM subjects (Gullaksen et al., 2019; Murea et al., 2018; Owusu et al., 2018).

Conclusion

The prevalence of ISH among Indonesian DM subjects in the present study was 17.5 %. Elderly DM subjects with low HDL-cholesterol and longer DM duration were related to the ISH, suggesting that modifying the profile of lipid, mainly the level of HDL-cholesterol, is a needful effort to detain ISH in elderly and longer DM duration individuals.

References

Arnett, D.K., & Claas, S .A., 2018. Omics of Blood Pressure and Hypertension. *Circulation Research*, 122(10), pp.1409–1419.

Asgari, S., Khalili, D., Mehrabi, Y., Kazempour-Ardebili, S., Azizi, F., & Hadaegh, F., 2016. Incidence and Risk Factors of Isolated Systolic and Diastolic Hypertension: a 10 Year Follow-Up of the Tehran Lipids and Glucose Study. *Blood Pressure,* 25(3), pp.177–183.

Azam, M., Nida, F., Handayani, O.W.K., & Fibriana, A.I., 2017. Lipid Profiles and Postprandial Glucose Status of Hypertensive Individuals with Stroke in Indonesia. *Asian Journal of Epidemiology,* 10(3), pp.116-122.

Azam, M., Setyaningsih, E., Rahayu, S.R., & Fibriana, A.I., 2019. Neutrophil-to-Lymphocyte Ratio and Exercise Intensity are Associated with Cardiac-Troponin Levels After Prolonged Cycling: the Indonesian North Coast and Tour de Borobudur 2017 Troponin Study. *Sports Sciences for Health,* 15(3), pp.585-593.

Bavishi, C., Goel, S., & Messerli, F.H., 2016. Isolated Systolic Hypertension: An Update After SPRINT. *The American Journal of Medicine*, 129(12), pp.1251–1258.

Berraho, M., El Achhab, Y., Benslimane, A., El Rhazi, K., Chikri, M., & Nejjari, C., 2012. Hypertension and Type 2 Diabetes: A Cross-Sectional Study in Morocco (EPIDIAM Study). *The Pan African Medical Journal*, 11, pp.52.

Bo, S., Ciccone, G., Grassi, G., Gancia, R., Rosato, R., Merletti, F., & Pagano, G., 2004. Isolated systolic hypertension in a cohort of type

2 diabetic patients. *Nutrition, Metabolism, and Cardiovascular Diseases, NMCD*, 14(3), pp.157–161.

Brites, F., Martin, M., Guillas, I., & Kontush, A., 2017. Antioxidative Activity of High-Density Lipoprotein (HDL): Mechanistic Insights into Potential Clinical Benefit. *BBA Clinical,* 8, pp.66–77.

Bui Van, N., Vo Hoang, L., Bui Van, T., Anh, H. N. S., Minh, H. T., Do Nam, K., Tri, T. N., Show, P. L., Nga, V. T., Thimiri Govinda Raj, D. B., & Chu, D.-T., 2019. Prevalence and Risk Factors of Hypertension in the Vietnamese Elderly. High Blood Pressure & Cardiovascular Prevention. *The Official Journal of the Italian Society of Hypertension*, 26(3), pp.239–246.

Chen, G., McAlister, F.A., Walker, R.L., Hemmelgarn, B.R., & Campbell, N.R.C., 2011. Cardiovascular Outcomes in Framingham Participants with Diabetes: The Importance of Blood Pressure. *Hypertension*, 57(5), pp.891–897.

Colosia, A.D., Palencia, R., & Khan, S., 2013. Prevalence of Hypertension and Obesity in Patients with Type 2 Diabetes Mellitus in Observational Studies: a Systematic Literature Review. *Diabetes, Metabolic Syndrome and Obesity: Targets and Therapy,* 6, pp.327–338.

Dagnew, B., & Yeshaw, Y., 2019. Predictors of Isolated Systolic Hypertension Among Type 2 Diabetes Mellitus Patients in Jimma University Specialized Hospital, Southwest Ethiopia. *BMC Research Notes,* 12(1), pp.1–7.

Delles, C., Carrick, E., Graham, D., & Nicklin, S.A., 2018. Utilizing Proteomics to Understand and Define Hypertension: Where are we and Where do We go?. *Expert Review of Proteomics*, 15(7), pp.581–592.

Ephraim, R.K.D., Saasi, A.R., Anto, E.O., & Adoba, P., 2016. Determinants of Isolated Systolic Hypertension among Diabetic Patients Visiting the Diabetic Clinic at the Tamale Teaching Hospital, Northern Ghana. *African Health Sciences*, 16(4), pp.1151–1156.

Farahdika, A., & Azam, M., 2015. Faktor Risiko Yang Berhubungan Dengan Penyakit Jantung Koroner Pada Usia Dewasa Madya (41-60 Tahun) (Studi Kasus Di Rs Umum Daerah Kota Semarang). *UJPH,* 4(2).

Franklin, S.S., Lapuerta, P., L'Italien, G.J., Wong, N.D., & Jacobs, M.J., 2012. Predominance of Isolated Systolic Hypertension Among Middle-Aged and Elderly US Hypertensives. *Hypertension*, 37(3), pp.869–874.

Grebla, R., Rodriguez, C., Borrell, L., & Pickering, T., 2010. Prevalence and Determinants of Isolated Systolic Hypertension among Young Adults. *Journal of the American Society of Hypertension*, 28(1), pp.15–23.

Gullaksen, S., Funck, K.L., Laugesen, E., Hansen, T.K., Dey, D., & Poulsen, P.L., 2019. Volumes of Coronary Plaque Disease in Relation to Body Mass Index, Waist Circumference, Truncal Fat Mass and Epicardial Adipose Tissue in Patients with Type 2 Diabetes Mellitus and Controls. *Diabetes & Vascular Disease Research*, 16(4), pp.328–336.

International Diabetes Federation., 2019. IDF Diabetes Atlas 9th Edition. *International Diabetes Federation.*

Lindsey, M.L., Mayr, M., Gomes, A.V., Delles, C., Arrell, D.K., Murphy, A.M., Lange, R.A., Costello, C.E., Jin, Y.F., Laskowitz, D.T., Sam, F., Terzic, A., Van Eyk, J., & Srinivas, P.R., 2015. Transformative Impact of Proteomics on Cardiovascular Health and Disease: A Scientific Statement from the American Heart Association. *Circulation*, 132(9), pp.852–872.

Liu, X., Rodriguez, C.J., & Wang, K., 2015. Prevalence and Trends of Isolated Systolic Hypertension among Untreated Adults in the United States. *Journal of the American Society of Hypertension, JASH*, 9(3), pp.197–205.

Madan, N., Lee, A.K., Matsushita, K., Hoogeveen, R.C., Ballantyne, C.M., Selvin, E., & McEvoy, J.W., 2019. Relation of Isolated Systolic Hypertension and Pulse Pressure to High-Sensitivity Cardiac Troponin-T and N-Terminal pro-B-Type Natriuretic Peptide in Older Adults (from the Atherosclerosis Risk in Communities Study). *The American Journal of Cardiology*, 124(2), pp.245–252.

Members, A.F., Mancia, G., Fagard, R., Narkiewicz, K., Redon, J., Zanchetti, A., Böhm, M., Christiaens, T., Cifkova, R., De Backer, G., Dominiczak, A., Galderisi, M., Grobbee, D.E., Jaarsma, T., Kirchhof, P., Kjeldsen, S.E., Laurent, S., Manolis, A.J., Nilsson, P.M., & Wood, D.A., 2013. 2013 ESH/ESC Guidelines for the management of arterial hypertension: The Task Force for the management of arterial hypertension of the European Society of Hypertension (ESH) and of the European Society of Cardiology (ESC). *European Heart Journal*, 34(28), pp.2159–2219.

Murea, M., Lenchik, L., Register, T.C., Russell, G.B., Xu, J., Smith, S.C., Bowden, D.W., Divers, J., & Freedman, B.I., 2018. Psoas and Paraspinous Muscle Index as a Predictor of Mortality in African American Men with

Type 2 Diabetes Mellitus. *Journal of Diabetes and Its Complications,* 32(6), pp.558–564.

Nguyen, C.T., Pham, N.M., Lee, A.H., & Binns, C.W., 2015. Prevalence of and Risk Factors for Type 2 Diabetes Mellitus in Vietnam: A Systematic Review. *Asia-Pacific Journal of Public Health*, 27(6), pp.588–600.

Halperin, R.O., Sesso, H.D., Ma, J., Buring, J.E., Stampfer, M.J., & Gaziano, J.M., 2006. Dyslipidemia and the Risk of Incident Hypertension in Men. *Hypertension*, 47(1), pp.45–50.

Oda, E., & Kawai, R., 2011. High-density Lipoprotein Cholesterol is Positively Associated with Hypertension in Apparently Healthy Japanese Men and Women. *British Journal of Biomedical Science*, 68(1), pp.29–33.

Ohishi, M., 2018. Hypertension with Diabetes Mellitus: Physiology and Pathology. *Hypertension Research: Official Journal of the Japanese Society of Hypertension,* 41(6), pp.389–393.

Os, I., Gudmundsdottir, H., Kjeldsen, S.E., & Oparil, S., 2006. Treatment of Isolated Systolic Hypertension in Diabetes Mellitus Type 2. *Diabetes, Obesity & Metabolism,* 8(4), pp.381–387.

Owusu, E.S.A., Samanta, M., Shaw, J.E., Majeed, A., Khunti, K., & Paul, S.K., 2018. Weight Loss and Mortality Risk in Patients with Different Adiposity at Diagnosis of Type 2 Diabetes: a Longitudinal Cohort Study. *Nutrition & Diabetes,* 8(1), pp.37.

Palombo, C., & Kozakova, M., 2016. Arterial Stiffness, Atherosclerosis and Cardiovascular Risk: Pathophysiologic Mechanisms and Emerging Clinical Indications. *Vascular Pharmacology,* 77, pp.1–7.

Petrie, J.R., Guzik, T.J., & Touyz, R.M., 2018. Diabetes, Hypertension, and Cardiovascular Disease: Clinical Insights and Vascular Mechanisms. *The Canadian Journal of Cardiology,* 34(5), pp.575–584.

Pinto, E., 2007. Blood Pressure and Ageing. *Postgraduate Medical Journal,* 83(976), pp.109–114.

Puri, R., Nissen, S.E., Shao, M., Elshazly, M.B., Kataoka, Y., Kapadia, S.R., Tuzcu, E.M., & Nicholls, S.J., 2016. Non-HDL Cholesterol and Triglycerides: Implications for Coronary Atheroma Progression and Clinical Events. *Arteriosclerosis, Thrombosis, and Vascular Biology,* 36(11), pp.2220–2228.

Selvaraj, S., Steg, P.G., Elbez, Y., Sorbets, E., Feldman, L.J., Eagle, K.A., Ohman, E.M., Blacher, J., & Bhatt, D.L., 2016. Pulse Pressure and Risk for Cardiovascular Events in Patients with Atherothrombosis: From the REACH Registry. *Journal of the American College of Cardiology,* 67(4), pp.392–403.

Shimizu, Y., Sato, S., Koyamatsu, J., Yamanashi, H., Nagayoshi, M., Kadota, K., Kawashiri, S.Y., & Maeda, T., 2017. Association between High-Density Lipoprotein-Cholesterol and Hypertension in Relation to Circulating CD34-Positive Cell Levels. *Journal of Physiological Anthropology*, 36(1), pp.1–7.

Sihombing, M., 2017. Faktor yang Berhubungan dengan Hipertensi pada Penduduk Indonesia yang Menderita Diabetes Melitus (Data Riskesdas 2013). *Buletin Penelitian Kesehatan*, 45(1), pp.53–64.

Smulyan, H., Lieber, A., & Safar, M.E., 2016. Hypertension, Diabetes Type II, and Their Association: Role of Arterial Stiffness. *American Journal of Hypertension,* 29(1), pp.5–13.

Tesfaye, B., Alebel, A., Gebrie, A., Zegeye, A., Tesema Leshargie, C., Ferede, A., Abera, H., & Alam, K., 2019. Diabetes Mellitus and Its Association with Hypertension in Ethiopia: A Systematic Review and Meta-Analysis. *Diabetes Research and Clinical Practice,* 156, pp.107838.

Thijs, L., Den Hond, E., Nawrot, T., & Staessen, J.A., 2004. Prevalence, Pathophysiology and Treatment of Isolated Systolic Hypertension in the Elderly. *Expert Review of Cardiovascular Therapy*, 2(5), pp.761–769.

Wildman, R.P., Mackey, R.H., Bostom, A., Thompson, T., & Sutton-Tyrrell, K., 2003. Measures of Obesity are Associated with Vascular Stiffness in Young and Older Adults. *Hypertension*, 42(4 I), pp.468–473.

Winston, G.J., Palmas, W., Lima, J., Polak, J.F., Bertoni, A.G., Burke, G., Eng, J., Gottesman, R., & Shea, S., 2013. Pulse Pressure and Subclinical Cardiovascular Disease in the Multi-Ethnic Study of Atherosclerosis. *American Journal of Hypertension*, 26(5), pp.636–642.

Zhan, B., Huang, X., Wang, J., Qin, X., Zhang, J., Cao, J., Song, Y., Liu, L., Li, P., Yang, R., Wu, Y., Wu, Q., Zhang, Y., Li, J., Huo, Y., Wang, B., Xu, X., Bao, H., & Cheng, X., 2019. Association Between Lipid Profiles and Arterial Stiffness in Chinese Patients with Hypertension: Insights From the CSPPT. *Angiology,* 70(6), pp.515–522.

Zhang, R.E.R., 2000. Obesity Hypertension: The Effects on Cardiovascular and Renal Systems. 13(12), pp.1308–1314.

Zhang, Y., He, P., Li, Y., Zhang, Y., Li, J., Liang, M., Wang, G., Tang, G., Song, Y., Wang, B., Liu, C., Liu, L., Cui, Y., Wang, X., Huo, Y., Xu, X., & Qin, X., 2019. Positive Association between Baseline Brachial–Ankle Pulse Wave Velocity and the Risk of New-Onset Diabetes in Hypertensive Patients. *Cardiovascular Diabetology,* 18(1), pp.111.

Compliance with the Covid-19 Protocol for Pregnant Women in Pagelaran

Parastika Anggun Fauzia[1✉], Leersia Yusi Ratnawati[2], Rina Sutjiati[3]
[1]Postgraduate Public Health Study Program University of Jember
[2]Faculty of Public Health Study University of Jember,
[3]Faculty of Dentistry University of Jember

Abstract

The COVID-19 pandemic resulted in more than 30 million deaths in 2020. Pregnant women are a vulnerable group. They tend to be at risk of contracting and experiencing complications that can affect pregnancy and fetal development. This research aims to analyze behavioral factors that influence compliance with the COVID-19 protocol for pregnant women using the health belief model approach in the working area of the Pagelaran Health Center. This research is a cross-sectional study of pregnant women in the Pagelaran health center. The sampling technique used in this study was random sampling and found 107 respondents. The analysis technique used in this study is multiple logistic regression. The research results show a significant influence between perceived susceptibility, perceived severity, perceived benefits, perceived barriers, and perceived self-efficacy with compliance. But there is no influence between cues to action on compliance. Variables included in the modeling and proven to influence pregnant women's adherence to the COVID-19 protocol include perceived severity, perceived benefits, perceived barriers, and perceived self-efficacy, with perceived severity being the most dominant variable. So it is hoped that policy maker will consider more of perceived severity, benefits, barriers, and self-efficacy.

Introduction

Since COVID-19 was first announced in Wuhan until WHO declared COVID-19 a pandemic, there have been more than 30 million deaths in 2020 (Palacios Cruz et al., 2021). It is due to the transmission of COVID-19 in the closed spaces and several cases in public spaces (Peng et al., 2022). COVID-19 can mutate and create new variants, of which there are 5 variables. Namely alpha, beta, gamma, delta, and omicron. Each variant has a different character of transmission and severity. The omicron variant has milder symptoms than the delta variant, but the transmission rate of omicron is much faster (Young et al., 2022). More protection is needed for vulnerable groups, including the elderly, disabled groups, groups with comorbidities, and pregnant women. Data on maternal mortality in the UK

increased by 20% during the pandemic (Lewis, Martin and Guzman, 2022). This is because pregnant women tend to be at risk of contracting and experiencing complications that can affect pregnancy and fetal development (Panahi, Amiri and Pouy, 2020). COVID-19 in pregnant women is associated with physiological changes in pregnancy, including increased heart rate and oxygen consumption, decreased lung capacity, and increased thromboembolic risk (Zambrano et al., 2020). Several other factors underlie the severity of COVID-19 in pregnant women, including age and previous medical history (Young et al., 2022). Pregnant women aged 35-44 years who are infected with COVID-19 are 4 times more likely to need invasive ventilation and are 2 times more at risk of dying (Zambrano et al., 2020)

Community transmission of pregnant

women is high (Panahi, Amiri and Pouy, 2020). More than 11,400 pregnant women infected with COVID-19 have to be hospitalized, 62% need treatment Intensive Care Unit (ICU), and 88% higher need invasive ventilation in pregnant women (Subbaraman, 2021). COVID-19 can increase the risk of preterm, ICU needs, neonatal unit needs, and maternal death (Subbaraman, 2021). Silasi et al., (2015), also argue that COVID-19 in pregnant women can result in IUGR (intrauterine growth restriction), premature birth, spontaneous abortion, increased risk of admission to the PICU NICU, even perinatal death.

The COVID-19 outbreak in Indonesia until May 2022 recorded 6054173 confirmed cases of COVID-19 and 2972 active cases, including cases in pregnant women (COVID-19. go. id, 2022). East Java reached 576193 confirmed cases, with 23 new daily cases and 104 active cases, with an additional 6 daily (East Java Health Office, 2022). The COVID-19 outbreak in Malang Regency over the past 10 days has seen an increase in confirmed cases of 11 new cases, 38 new suspected cases, and 55 new close contact cases (Malang District Health Office, 2022). cases of pregnant women infected with COVID-19 in Indonesia reached 9.7% of cases, with 0.2% dying (Motlagh et al., 2020). Preliminary studies conducted in the working area of the performance health center show that 71.4% of pregnant women do not comply with the COVID-19 protocol, 23.8% of pregnant women are sufficiently compliant with the COVID-19 protocol, and only 4.8% of pregnant women comply with the COVID-19 protocol.

Efforts to reduce mortality and morbidity in the mother and fetus during the pandemic have been carried out, including health protocols for mothers and newborns during a pandemic COVID-19. In practice, are still many pregnant women who do not comply with this policy. Siregar, Aritonang and Anita, (2020) stated that 57% of pregnant women were lacking in preventing COVID-19 during pregnancy. Health behavior is an individual attribute in the maintenance, recovery, and improvement of health status. Health behavior includes beliefs, motives, perceptions, values, expectations, behavior patterns, and individual habits (Gadarian, Goodman and Pepinsky, 2021).

The theory of the health belief model is an appropriate theory to explain health behavior because the health belief model explains that individuals tend to participate in health behavior if it is based on a positive perception that health is a valuable outcome, with a positive perception, it will make it easier to predict behavior with the perception of the disease, experienced, and the determinant factors affecting attitude change (Afro, Isfiya and Rochmah, 2021). The health belief model becomes a framework for analyzing behavior and identifying individual beliefs about health. The health belief model has succeeded in predicting health behavior (Barakat and Kasemy, 2020). The health belief model is also often used in several health studies, such as research by Jose et al. (2021), which states that the health belief model is significantly related to behavior change, Huang, Dai and Xu (2020), also argue that health belief has an indirect relationship with prevention behavior. The health belief model can also explain the initiation of the COVID-19 vaccination.

Based on this description, the researcher is interested in analyzing behavioral factors that affect compliance with the COVID-19 protocol for pregnant women using the health belief model approach in the Pagelaran Health Center

Method

The method in this study is observational analytic with a quantitative approach. The research design used is Cross Sectional. The dependent variable in this study is compliance with the COVID-19 protocol. The independent variables in this study are perceived susceptibility, perceived severity, perceived benefits, perceived barriers, perceived self-efficacy, and cues to action. The population in this study was 257 pregnant women in the working area of the Pagelaran Health Center. The sampling technique used is simple random sampling, where every pregnant woman has the same opportunity to be a sample, the number of samples is calculated using the Lemeshow formula, and the results are 107 respondents.

The research took time from March 2022-November 2022 in the Working Area of

the Pagelaran Health Center. Data collection used the COVID-19 protocol compliance questionnaire instrument and the health belief model questionnaire. Data analysis in this study used univariate, bivariate, and multivariate analysis, univariate analysis to describe the characteristics of the respondents and an overview of the research variables, and bivariate analysis used simple logistic regression to determine the effect of the independent variable on the dependent variable, and multivariate analysis used multiple logistic regression with the backward wald method to find out the variables that most influence compliance with the COVID-19 protocol.

Result and Discussion

This research took place in the Pagelaran Health Center in Malang Regency in September 2022, 107 pregnant women involved as respondents in this study. The data collection process was carried out within 1 month, during which the researcher visited each respondent. Then the researcher explained the purpose and description of the research, and then the willing respondents were asked to fill out the provided questionnaire accompanied by the researcher.

The research analysis uses descriptive to identify the characteristics of respondents and research variables, bivariate test with simple logistic regression to identify the effect of independent variables on the dependent variable, and multivariate test with multiple logistic regression. The following table shows the frequency distribution of the characteristics of the respondents.

Based on Table 1, out of 107 respondents, 53.3% were 15-26 years, 41.1% were 27-38 years and 5.6% were 39-49 years. 43% had a high school education equivalent, 32.7% had graduated from junior high school or equivalent, followed by 14% college graduates, and finally, elementary school graduates with 10.3%. Judging from the work of the respondents, 58.9% of the respondents worked as housewives, 29% of the respondents were private workers, and 12.1% of the respondents' jobs were self-employed. Based on the number of pregnancies, 51.4% were the first, 30.8% were second, and 17.8% were third pregnancies or more. And if seen based on the trimester of pregnancy, 40.2% of pregnancies are in the second trimester, 33.6% are in the first trimester, and 26,2% are in the third trimester.

Table 1. Distribution of Characteristics of Pregnant Women in Pagelaran Health Center 2022

Variables	Amount (n)	Percentage(%)
Age		
15-26	57	53.3%
27-38	44	41.1%
39-49	6	5.6%
Total	107	100%
Level of education		
SD equivalent	11	10.3%
Middle school equivalent	35	32.7%
high school equivalent	46	43.0%
College	15	14.0%
Total	107	100%
Variable	**Amount (n)**	**Percentage(%)**
Work		
Housewife	63	58.9%
Self-employed	13	12.1%
Private	31	29.0%
Total	107	100%
Gravida		
First	55	51.4%
Second	33	30.8%
Third or More	19	17.8%
Total	107	100%
Trimester		
First	36	33,6%
Second	43	40,2%
Third	28	26,2%
Total	107	100%

Source: Primary Data, 2022

Table 2. Distribution of Perceived Factors and Compliance of Pregnant Women at Pagelaran Health Center in 2022

Variables	Amount (n)	Percentage(%)
Perceived susceptibility		
Good	18	16.8%
Enough	50	46.7%
Not enough	39	36.4%
Total	107	100%
Perceived severity		
Good	24	22.4%
Enough	67	62.6%
Not enough	16	15.0%
Total	107	100%
Perceived benefits		
Good	15	14.0%
Enough	69	64.5%
Not enough	23	21.5%
Total	107	100%
Perceived Barrier		
Good	5	4.7%
Enough	72	67.3%
Not enough	30	28.0%
Total	107	100%
Perceived self-efficacy		
Good	11	10.3%
Enough	82	76.6%
Not enough	14	13.1%
Total	107	100%
Cues to action		
Good	6	5.6%
Enough	89	83.2%
Not enough	12	11.2%
Total	107	100%
Obedience		
Good	94	87.9%
Bad	13	12.1%
Total	107	100%

Source: Primary Data, 2022

Based on Table 2, most respondents' perceptions were adequate, with the variable perception of cues to action having the highest presentation (83.2%) and the perception of severity having the lowest (only 4.7%). Most respondents (87.9%) reported good compliance. Only 12.1% reported poor compliance.

Based on Table 3 above, the variables perceived susceptibility, perceived severity, perceived benefits, perceived barriers, and perceived self-efficacy influence obedience. It can be seen from the p-value of less than 0.05, while the cues to action variable have no effect because the p-value of 0.626 is higher than 0.05. Based on the odds ratio, the category with the highest odds ratio is perceived severity, with 17.2%, which means that pregnant women who have a good sense of perceived severity tend to be more compliant with the COVID-19 protocol.

Table 3. The Effect of Perceived on Compliance with the COVID-19 Protocol for Pregnant Women in the Pagelaran Health Center Area in 2022

Perceived	Obedience				P-Value	OR
	Good		Bad			
	Amount	%	Amount	%		
Perceived susceptibility						
Good	66	61.7%	2	1.8%	0.000	12,964
Not enough	28	26.2%	11	10.3%		
Total	94	87.9%	13	12.1%		
Perceived severity						
Good	79	73.8%	5	4.7%	0.000	17,200
Not enough	15	14.0%	8	7.5%		
Total	94	87.8%	13	12.2%		
Perceived benefits						
Good	79	73.8%	5	4.7%	0.001	8,427
Not enough	15	14.0%	8	7.5%		
Total	94	87.8%	13	12.2%		
Perceived barriers						
Good	74	69.1%	3	2.8%	0.000	12,333
Not enough	20	18.7%	10	9.3%		
Total	94	87.8%	13	12.2%		
Perceived self-efficacy						
Good	87	81.4%	6	5.6%	0.000	14,500
Not enough	7	6.5%	7	6.5%		
Total	94	100%	13	100%		
Cues to action						
Good	84	78.6%	11	10.3%	0.626	1,527
Not enough	10	9.3%	2	1.8%		
Total	94	87.9%	13	12.1%		

Source: Primary Data, 2022

Table 4. Table of Modeling Factors Affecting Compliance with the COCID-19 Protocol for Pregnant Women in the Pagelaran Health Center Working Area in 2022

Variables	B	Sig.	OR	-2 lifetime logs without variables	-2 log likelihood 5 variables	Nagelkerke R Square	Hosmer and lemeshow test	Omnibus test
perceived severity	2,494	0.002	12,110					
perceived benefits	1,583	0.064	4,869	79,157	40,241	0.583	0.258	0.000
Perceived barriers	2,239	0.015	9,380					
Perceived self-efficacy	1,870	0.033	6,491					

Source: Primary Data, 2022

Based on Table 4, variables with a significant effect on compliance with the COVID-19 protocol on the final modeling are perceived severity, perceived benefits, perceived barriers, and perceived self-efficacy. The variable most related to compliance with the COVID-19 protocol is perceived severity 12.1% (95% CI OR: 2.249-65.206) which means that pregnant women with less perceived severity are more at risk of not complying with the COVID-19 protocol 12.1% times compared to pregnant women with great perceived severity.

This modeling is a fit model, it can be seen from -2logL without variables, and after adding variables, there is a significant decrease of 38.916, which means adding variables to the model can affect the fit model. Based on the Nagelkerke R Square, the value is 0.504. It means that the independent variables in the model can explain compliance with the COVID-19 protocol by 58.3% and 41. The other 7% can be explained by factors outside the existing variables. Based on the results of the omnibus test, the p-value was 0.000 <0.05. It can be interpreted that the model formed is declared feasible because it fulfills the significance of the model. The Hosmer and Lemeshow tests show a p-value of 0.258> 0.05, which means that H0

is rejected and H7 is accepted. So the model is fitted with the data, and the model is acceptable.

Respondents in this study were 53.3% aged 15-26 years, 43.0% had a high school education level equivalent, 58.9% were housewife, 51.4% were first pregnancies, and 40.2% were second-trimester pregnancies. Age is related to preventive behavior. Older individuals and not working are more likely to apply less preventive behavior than younger individuals (Liao et al., 2019). Young mothers tend to be creative, curious about information, have a good memory, and could understand information better than older mothers. However, most pregnant women at a young age experience pregnancy disorders related to the immaturity of the reproductive organs and the immune system (Londero et al., 2019). This level of formal education can affect knowledge and decision-making. The lower the level of education, the more difficult it is to receive and understand information (Zannah, 2020). High knowledge will form proper beliefs, attitudes, and prevention practices (Anikwe et al., 2020)

Work related to adherence to health behavior relate to the availability of time owned, working individuals tend to have less time to go to health services (Tambuwun et al., 2021). working mothers were more likely to be disobedient to having their condition checked during a pandemic due to not having time. Pregnant women who have never given birth have a high-risk perception of COVID-19 (Londero et al., 2019). Individuals who do not work have less preventive behavior (Liao et al., 2019). Primiparous pregnant women have no experience dealing with pregnancy, so they have more concerns. Pregnancy and childbirth experiences can reduce perceived risk perceptions and predict preventive behavior (Sari et al., 2021). Nwafor et al., (2020) stated grande multiparous women have 3 times worse health behavior than nulliparas. Multiparous pregnant women have less behavior in preventing COVID-19 because many families can affect the economy, and it becomes difficult to implement the COVID-19 protocol (Ayele et al., 2021). Pregnant women who are positive for COVID-19 in trimesters 1 and 2 are more at risk of experiencing fetal death (IUFD) (Donders et al., 2020) because in this phase, the

organs in the fetus are formed so that the fetus is more easily exposed to the virus resulting in a negative impact on the fetus. Pregnant women infected with COVID-19 in the first trimester of pregnancy experience spontaneous abortion, which is possible due to hypoxia due to acute respiratory distress (Priyadharshini et al., 2021).

Perceived susceptibility is positively related to preventive behavior (Aghababaei et al., 2020). High perceived susceptibility will encourage individuals to do better prevention because they belief that their condition is at a high risk of disease, so perceived susceptibility will encourage preventive behavior (Schwartz and Dhaliwal, 2020). Good perceived susceptibility indicates that the individual believes they are more at risk of contracting the disease, so they take precautions. Then the better the perceived susceptibility, the better the prevention behavior (Zareipour et al., 2020). Perceived susceptibility directly related to health behavior. A research conducted by Jose et al. (2021), stated that increasing perceived susceptibility will reduce health problems. The statement above is in line with the results of this study, where there is a significant influence between perceived susceptibility on compliance with the COVID-19 protocol for pregnant women. Perceived susceptibility can also affect pregnant women's compliance by 12.9%.

Perceived severity refers to the belief in difficulties arising from a medical and social illness so that it can make people more active in carrying out prevention (Mirzaei et al., 2021). perceived severity related to individual beliefs regarding the severity of a disease, the more individuals believe in the impact of the disease, the individual will feel threatened, so they are motivated to carry out health behaviors (Claresta, Christian and Sa'id, 2021). Tong et al. (2020), research shows that perceived severity has a significant relationship with the prevention of COVID-19, which is also supported by research Al-Metwali et al. (2021), which also states that perceived severity is significantly related to receiving the COVID-19 vaccine. This statement is in line with the research results obtaining a significant influence between perceived severity on compliance with the COVID-19 protocol for pregnant women and perceived severity that

can affect compliance for pregnant women.

Perceived benefits can significantly predict infectious disease prevention behavior, as good as being a primary factor in using masks. Perceived benefits are expectations from preventive behavior. Individuals who believe behavior is safe and effective will have a positive attitude and tend to take precautions (Huang, Dai and Xu, 2020). Maharlouei et al. (2020), argues that perceived benefits have a significant relationship with prevention behavior. The relationship between perceived benefits and prevention behavior is possible because when individuals get a lot of benefits from preventing COVID-19, they tend to do all things that can prevent COVID-19. Tao et al. (2021), also state that perceived benefits have a positive relationship with willingness to vaccinate. It is also supported by individuals with high perceived benefits, who tend to be willing to receive the COVID-19 vaccine to protect themselves and others. This statement is in line with the results of this study, where there is a significant influence between perceived benefits on compliance with the COVID-19 protocol for pregnant women. Pregnant women with high perceived benefits tend to be 8.4% more obedient than pregnant women with low perceived benefits.

Perceived barriers are the strongest predictor of health behavior because they can influence the perception of the effectiveness of behavior so that it can motivate individuals to carry out health recommendations (Fall, Izaute and Chakroun-Baggioni, 2018). Individuals must be able to control perceived barriers before engaging in preventive behavior (Bashirian et al., 2020). Perceived barriers refer to a person's belief in the negative impact of changing behavior, for example, considering cost, time, convenience, and side effects. Perceived barriers are inversely related to preventive behavior. The lower the perceived barriers, the higher the possibility of individuals adopting a healthy life. Individuals with low Perceived barriers have a better response to COVID prevention, so to increase adherence, it is necessary to reduce perceived barriers. (Barakat and Kasemy, 2020) argue that perceived barriers are a vital factor because individuals must take control of barriers. Karimy et al. (2017), also significantly

mention that perceived barriers are related to Pap smear test adherence. This statement is in line with the research results, which found a significant effect between perceived barriers on compliance with the COVID-19 protocol for pregnant women. Perceived barriers can affect the compliance of pregnant women by 12.3%.

Fall, Izaute and Chakroun-Baggioni, (2018) argue that self-efficacy is a level of confidence and belief in overcoming barriers to health behavior, self-efficacy is important in overcoming perceived barriers and effective in adopting COVID-19 prevention behaviors. Because to carry out health behaviors, individuals must be confident in their ability to carry out health recommendations (Mirzaei et al.(2021). Self-Efficacy encourages individuals to adhere more to the prevention of COVID-19, with a high level of confidence that it will control individuals to adopt a healthy life. High self-efficacy will overcome barriers felt and effective in preventing COVID-19 (Shahnazi et al. (2020). Self-efficacy can significantly predict the behavior of preventing infectious diseases such as SARS-CoV, MERS, and other respiratory infections (Mirzaei et al., 2021). Research conducted by Khazaeian et al., (2021) also supports this statement by stating that self-efficacy has a positive relationship with cues to act to prevent COVID-19. This statement reinforces the research results obtained in this study that there is a significant influence between perceived self-efficacy on compliance with the COVID-19 protocol for pregnant women and perceived self-efficacy can affect pregnant women's compliance by 14.5%.

In several studies, cues to action are health behavior predictors, as in research by Li et al., (2020; Tao et al., (2021), and others. Cues to action can be influenced by individual views about beliefs about something, which they then apply. Several factors can trigger, such as environment, education, events, or from other people (Claresta, Christian and Sa'id, 2021). But Al-Sabbagh et al. (2022), held a different opinion. They stated that cues to action were not significantly related to the quarantine program. In line with this research, Afro, et. al. (2021), also cues to action are irrelevant to compliance with health protocols during a pandemic. So is research. It can result from the environment

influencing individual intentions to act. Individuals tend to obey if the environment also obeys. Public awareness regarding the law is still lacking, while the deteriorating economic conditions are also the causes of non-compliance with health protocols, as well as the indecisiveness of rules and witnesses that are reasons for individuals not to comply (Sulat et al., 2018). Most individuals tend to ignore internal factors in acting and are more easily influenced by external factors such as the mass media (Alsulaiman and Rentner, 2018). Therefore, health service providers and the mass media must provide appropriate information, especially for high-risk groups (Khazaeian et al., 2021). With so many media and organizational trends that will influence political decisions and make information more diverse which ultimately makes people confused about behavior changes that must be implemented (Jose et al., 2021). This statement supports research results that show no significant effect between perceived cues to action on compliance with the COVID-19 protocol for pregnant women.

The combination of perceived severity and perceived susceptibility will form a perceived threat, which will make individuals more careful (Mirzaei et al., 2021), with a high perceived threat will make individual health behavior better (Jose et al., 2021). If the perceived threat is not considered, then the motivation to take prevention will be low, or when an individual has low perceived susceptibility and perceived severity then information related to his condition will be ignored. The combination of perceived susceptibility and severity will cause a perceived threat in the end. The aspect of this belief will lead to action in the form of compliance with the COVID-19 protocol (Getachew et al., 2022). However, perceived susceptibility may not be included in the modeling if the individual does not experience symptoms, there is a long-term threat or no history of previous illness (Sulat et al., 2018), or there is a belief that the individual will not get sick or have never met a sufferer (Alsulaiman and Rentner, 2018).

Perceived self- efficacy, perceived barriers, and perceived benefits are the main factors in the prevention of behavior because

to understand health problems, individuals must feel the benefits of behavior, and to face obstacles, individuals must also have self- (Mirzaei et al., 2021). Shmueli (2021), also mentioned perceived benefits, perceived barriers, and perceived self-efficacy as keys in health promotion. So adopting the behavior of preventing COVID-19 requires high perceived benefits and perceived self-efficacy, while perceived barriers must be low (Mirzaei et al., 2021). Jose et al. (2021) explained that perceived barriers have a significant effect when the level of perceived barriers low and perceived self-efficacy is high so that it will easily affect perceived benefits. But when perceived self-efficacy and perceived barriers are low, perceived benefits cannot affect behavior.

Conclusion

There is a significant influence between perceived susceptibility, perceived severity, perceived benefits, perceived barriers, and perceived self-efficacy with compliance, but there is no influence between cues to action on compliance. Variables included in the modeling and proven to influence pregnant women's adherence to the COVID-19 protocol include perceived severity, perceived benefits, perceived barriers, and perceived self-efficacy, with perceived severity being the most dominant variable. Recommendations that can be implemented from this research are policy-making and counseling related to the importance of implementing the COVID-19 protocol by considering perceived severity, benefits, barriers, and self-efficacy so that explanations are more acceptable and implemented daily.

References

Afro, R.C., Isfiya, A., & Rochmah, T.N., 2021. Analysis Of Factors Affecting Health Protocols Compliance During Covid-19 Pandemic In East Java Community: Health Belief Model Approach. *Journal Of Community Mental Health And Public Policy* (CMHP), 3(1), pp.1–10.

Aghababaei, S., Soltanian, A., Refaei, M., Omidi, T., Ghelichkhani, S., & Soltani, F., 2020. Perceived Risk and Protective Behaviors Regarding COVID-19 among Iranian Pregnant Women. *Middle East Fertility*

Society Journal, 25(1).

Al-Metwali, B.Z., Al-Jumaili, A.A., Al-Alag, Z.A., & Sorofman, B., 2021. Exploring the Acceptance of COVID-19 Vaccine Among Healthcare Workers and General Population Using Health Belief Model. *Journal of Evaluation in Clinical Practice*, 27(5), pp. 1112–1122.

Al-Sabbagh, M.Q., Al-Ani, A., Mafrachi, B., Siyam, A., Isleem, U., Massad, F.I., Alsabbagh, Q., & Abufaraj, M., 2022. Predictors of Adherence with Home Quarantine During COVID-19 Crisis: the Case of Health Belief Model. *Psychology, Health and Medicine,* 27(1), pp.215–227.

Alsulaiman, S., & Rentner, T., 2018. The Health Belief Model and Preventive Measures: A Study of the Ministry of Health Campaign on Coronavirus in Saudi Arabia. *Journal of International Crisis and Risk Communication Research*, 1(1), pp.27–56.

Anikwe, C.C., Ogah, C.O., Anikwe, I.H., Okorochukwu, B.C., & Ikeoha, C.C., 2020. Coronavirus Disease 2019: Knowledge, Attitude, and Practice of Pregnant Women in a Tertiary Hospital in Abakaliki, Southeast Nigeria. *International Journal of Gynecology and Obstetrics,* 151(2), pp.197–202.

Ayele, A.D., Mihretie, G.N., Belay, H.G., Teffera, A.G., Kassa, B.G., & Amsalu, B.T., 2021. Knowledge and Practice to Prevent COVID-19 and Its Associated Factors Among Pregnant Women in Debre Tabor Town Northwest Ethiopia, a Community-Based Cross-Sectional Study. *BMC Pregnancy and Childbirth*, 21(1), pp.1–12.

Barakat, A.M., & Kasemy, Z.A., 2020. Preventive Health Behaviours During Coronavirus Disease 2019 Pandemic Based on Health Belief Model Among Egyptians. *Middle East Current Psychiatry,* 27(1), pp. 43.

Bashirian, S., Jenabi, E., Khazaei, S., Barati, M., Karimi-Shahanjarini, A., Zareian, S., Rezapur-Shahkolai, F., & Moeini, B., 2020. Factors Associated with Preventive Behaviours of COVID-19 Among Hospital Staff in Iran in 2020: an Application of the Protection Motivation Theory. *Journal of Hospital Infection*, 105(3), pp.430–433.

Claresta, A., Christian, S., & Sa'id, M., 2021. Public Obedience to Health Protocols during COVID-19 Pandemic in Indonesia: A Perspective from Health Belief Model Theory Article Info. *Journal of Social Sciences and Humanities,* 11(2), pp.2021.

Donders, F., Lonnée-Hoffmann, R., Tsiakalos, A., Mendling, W., de Oliveira, J.M., Judlin, P., Xue, F., & Donders, G.G.G., 2020. ISIDOG Recommendations Concerning COVID-19 and Pregnancy. *Diagnostics,* 10(4), pp.1–23.

Fall, E., Izaute, M., & Chakroun-Baggioni, N., 2018. How Can the Health Belief Model and Self-Determination Theory Predict Both Influenza Vaccination and Vaccination Intention？ A Longitudinal Study Among University Students. *Psychology and Health,* 33(6), pp.746–764.

Fransiska, R.D., Kusumaningtyas, D., & Gumanti, K.A., 2022. Analisis Health Belief Model dalam Perilaku Pencegahan Covid-19 pada Ibu Hamil. *Jurnal Kesehatan Vokasional,* 7(1), pp.11.

Gadarian, S.K., Goodman, S.W., & Pepinsky, T.B., 2021. Partisanship, Health Behavior, and Policy Attitudes in the Early Stages of the COVID-19 Pandemic. *PLoS ONE*, 16, pp.1–13.

Getachew, T., Lami, M., Eyeberu, A., Balis, B., Debella, A., Eshetu, B., Degefa, M., Mesfin, S., Negash, A., Bekele, H., Turiye, G., Tamiru, D., Nigussie, K., Asfaw, H., Dessie, Y., Alemu, A., & Sertsu, A., 2022. Acceptance of COVID-19 Vaccine and Associated Factors Among Health Care Workers at Public Hospitals in Eastern Ethiopia Using the Health Belief Model. *Frontiers in Public Health*, 10, pp.1–11.

Huang, X., Dai, S., & Xu, H., 2020. Predicting Tourists' Health Risk Preventative Behaviour and Travelling Satisfaction in Tibet: Combining the Theory of Planned Behaviour and Health Belief Model. *Tourism Management Perspectives*, 33.

Jose, R., Narendran, M., Bindu, A., Beevi, N., Manju, L., & Benny, P.V., 2021. Public Perception and Preparedness for the Pandemic COVID 19: A Health Belief Model Approach. *Clinical Epidemiology and Global Health*, 9, pp.41–46.

Karimy, M., Azarpira, H., & Araban, M., 2017. Using Health Belief Model Constructs to Examine Differences in Adherence to Pap Test Recommendations Among Iranian Women. *Asian Pacific Journal of Cancer Prevention,* 18(5), pp.1389–1394.

Khazaeian, S., 2021. The Health Belief Model. Cambridge Handbook of Psychology, Health and Medicine, Second Edition, pp. 97–102.

Lewis, R.K., Martin, P.P., & Guzman, B.L., 2022. COVID-19 and Vulnerable Populations. *Journal of Community Psychology,* 2022, pp.2537–2541.

Li, Q., Guan, X., Wu, P., Wang, X., Zhou, L., Tong, Y., Ren, R., Leung, K.S.M., Lau, E.H.Y., Wong,

73

J.Y., Xing, X., Xiang, N., Wu, Y., Li, C., Chen, Q., Li, D., Liu, T., Zhao, J., Liu, M., Tu, W., Chen, C., Jin, L., Yang, R., Wang, Q., Zhou, S., Wang, R., Liu, H., Luo, Y., Liu, Y., Shao, G., Li, H., Tao, Z., Yang, Y., Deng, Z., Liu, B., Ma, Z., Zhang, Y., Shi, G., Lam, T.T.Y., Wu, J.T., Gao, G.F., Cowling, B.J., Yang, B., Leung, G.M., & Feng, Z., 2020. Early Transmission Dynamics in Wuhan, China, of Novel Coronavirus–Infected Pneumonia. *New England Journal of Medicine*, 382(13), pp.1199–1207.

Liao, Q., Wu, P., Lam, W.W.T., Cowling, B.J., & Fielding, R., 2019. Trajectories of Public Psycho-Behavioural Responses Relating to Influenza A(H7N9) Over the Winter of 2014-15 in Hong Kong. *Psychology and Health*, 34(2), pp.162–180.

Londero, A.P., Rossetti, E., Pittini, C., Cagnacci, A., & Driul, L., 2019. Maternal Age and the Risk of Adverse Pregnancy Outcomes: A Retrospective Cohort Study. *BMC Pregnancy and Childbirth*, 19(1), pp.1–10.

Maharlouei, N., Asadi, N., Bazrafshan, K., Roozmeh, S., Rezaianzadeh, A., Roozegar, M.H.Z., Shaygani, F., Kharmandar, A., Honarvar, B., Hemyari, C., Omidifar, N., Zare, M., Lankarani, K.B., 2020. Knowledge and Attitude Regarding COVID-19 Among Pregnant Womenin Southwestern Iran in the Early Period of Its Outbreak: A Cross-Sectional Study. *American Journal of Tropical Medicine and Hygiene,* 103(6), pp.2368–2375.

Mirzaei, A., Kazembeigi, F., Kakaei, H., Jalilian, M., Mazloomi, S., & Nourmoradi, H., 2021. Application of Health Belief Model to Predict COVID-19-Preventive Behaviors Among a Sample of Iranian Adult Population. *Journal of Education and Health Promotion*, 10(1), pp.69.

Motlagh, A., Yamrali, M., Azghandi, S., Azadeh, P., Vaezi, M., Ashrafi, F., Zendehdel, K., Mirzaei, H., Basi, A., Rakhsha, A., Seifi, S., Tabatabaeefar, M., Elahi, A., Pirjani, P., Shoar, L.M., Nadarkhani, F., Khoshabi, M., Bahar, M., Esfahani, F., Fudazi, H., Samiei, F., Farazmand, B., Ahmari, A., Rajabpour, M.V., Janbabaei, G., Raisi, A., Ostovar, A., & Malekzadeh, R., 2020. COVID19 Prevention & Care; A Cancer Specific Guideline. *Archives of Iranian Medicine*, 23(4), pp.255–264.

Nwafor, J.I., Kenechi, J., Aniukwu., Anozie, B.O., & Ikeotuonye, A.C., 2020. Knowledge and Practice of Preventive Measures Against COVID-19 Infection Among Pregnant Women in a Low-Resource African Setting. *medRxiv,* 2020.

Palacios Cruz, M., Santos, E., Cervantes, M.A.V., & Juárez, M.L., 2021. COVID-19, a Worldwide Public Health Emergency. *Revista Clínica Española (English Edition)*, 221(1), pp.55–61.

Panahi, L., Amiri, M., & Pouy, S., 2020. Risks of Novel Coronavirus Disease (COVID-19) in Pregnancy; a Narrative Review. *Archives of Academic Emergency Medicine*, 8(1), pp.e34.

Peng, Z., Rojas, A.L.P., Kropff, E., Bahnfleth, W., Buonanno, G., Dancer, S.J., Kurnitski, J., Li, Y., Loomans, G.L.C., Marr, L.C., Morawska, L., Nazaroff, W., Noakes, C., Querol., X., Sekhar, C., Tellier, R., Greenhalgh, T., Bourouiba, L., Boerstra, A., Tang, J.W., Miller, S.L., & Jimenez, J.L., 2022. Practical Indicators for Risk of Airborne Transmission in Shared Indoor Environments and Their Application to COVID-19 Outbreaks. *Environmental Science and Technology,* 56(2), pp.1125–1137.

Priyadharshini, C.B., Priya, S., Selvameena, M., Waseemsha, S., Muthurajesh, E., & Shalini, M., 2021. Demographic Profile of COVID-19 Positive Mothers & Their Outcome in Government Rajaji hospital, Madurai, Tamilnadu – A Cross Sectional Study. *Clinical Epidemiology and Global Health*, 12, pp.100864.

Sari, D.I., Wahyuni, N., & Sucipto, C.D., 2021. Hubungan Pengetahuan, Paritas, Pekerjaan Ibu dengan Keteraturan Kunjungan Ibu Hamil untuk ANC Selama Masa Andemi Covid-19. *Jurnal Kesehatan Primer,* 6(1), pp.22–31.

Schwartz, D.A., & Dhaliwal, A., 2020. Infections in Pregnancy with Covid-19 and Other Respiratory RNA Virus Diseases are Rarely, if Ever, Transmitted to the Fetus: Experiences with Coronaviruses, Parainfluenza, Metapneumovirus Respiratory Syncytial Virus, and Influenza. *Archives of Pathology and Laboratory Medicine*, 144(8), pp.920–928.

Shahnazi, H., Ahmadi-Livani, M., Pahlavanzadeh, B., Rajabi, A., Hamrah, M.S., & Charkazi, A., 2020. Assessing Preventive Health Behaviors from COVID-19: a Cross Sectional Study with Health Belief Model in Golestan Province, Northern of Iran. *Infectious Diseases of Poverty,* 9(1), pp.1–9.

Shmueli, L., 2021. Predicting Intention to Receive COVID-19 Vaccine Among the General Population Using the Health Belief Model and the Theory of Planned Behavior Model. *BMC public health*, 21(1), pp.804.

Silasi, M., Cardenas, I., Kwon, J.Y., Racicot, K., Aldo, P., & Mor, G., 2015. Viral Infections During

Pregnancy. *American Journal of Reproductive Immunology*, 73(3), pp.199–213.

Siregar, R.N., Aritonang, J., & Anita, S., 2020. Pemahaman Ibu Hamil Tentang Upaya Pencegahan Infeksi Covid-19 Selama Kehamilan. *Journal of Healthcare Technology and Medicine*, 6(2), pp.798.

Subbaraman, N., 2021. Pregnancy and COVID: what the Data Say. *Nature,* 591(7849), pp.193–195.

Sulat, J.S., Prabandari, Y.S., Sanusi, R., Hapsari, E.D., & Santoso, B., 2018. The Validity of Health Belief Model Variables in Predicting Behavioral Change: A Scoping Review. *Health Education,* 118(6), pp.499–512.

Tambuwun, A.A., Kandou, G.D., & Nelwan, J.E., 2021. Hubungan Karakteristik Individu Dengan Kepatuhan Berobat Pada Penderita Hipertensi Di Puskesmas Wori Kabupaten Minahasa Utara. *Jurnal Kesmas,* 10(4), pp.112–121.

Tao, L., Wang, R., Han, N., Liu, J., Yuan, C., Deng, L., Han, C., Sun, F., Liu, M., & Liu, J., 2021. Acceptance of a COVID-19 Vaccine And Associated Factors Among Pregnant Women in China: a Multi-Center Cross-Sectional Study Based on Health Belief Model. *Human Vaccines and Immunotherapeutics,* 17(8), pp.2378–2388.

Tong, K.K., Chen, J.H., Yu, E.W., & Wu, A.M.S., 2020. Adherence to COVID-19 Precautionary Measures: Applying the Health Belief Model and Generalised Social Beliefs to a Probability Community Sample. *Applied Psychology: Health and Well-Being*, 12(4), pp.1205–1223.

Young, M., Crook, H., Scott, J., & Edison, P., 2022. Covid-19: Virology, Variants, and Vaccines. *BMJ Medicine*, 1(1), pp.e000040.

Zambrano, L.D., Ellington, S., Strid, P., Galang, R.R., Oduyebo, T., Tong, V.T., Woodworth, K.R., Nahabedian, J.F., Azziz-Baumgartner, E., Gilboa, S.M., & Meaney-Delman, D., 2020. Update: Characteristics of Symptomatic Women of Reproductive Age with Laboratory-Confirmed SARS-CoV-2 Infection by Pregnancy Status — United States, January 22–October 3, 2020. MMWR. *Morbidity and Mortality Weekly Report*, 69(44), pp.1641–1647.

Zannah, S.N., 2020. Hubungan Karakteristik Dan Pengetahuan Dengan Kepatuhan Upt . Puskesmas Martapura 1 Kabupaten Banjar. *Doctoral Disertation.* Universitas Islam Kaimantan.

Zareipour, M.A., Ardakani, M.F., Moradali, M.R., Jadgal, M.S., & Movahed, E.,2020. Determinants of covid-19 Prevention Behavior in the Elderly in Urmia: Application of Health Belief Model. *Open Access Macedonian Journal of Medical Sciences*, 8(T1), pp.646–650.

Compliance with the Covid-19 Protocol for Pregnant Women in Pagelaran

Parastika Anggun Fauzia[1✉], Leersia Yusi Ratnawati[2], Rina Sutjiati[3]
[1]Postgraduate Public Health Study Program University of Jember
[2]Faculty of Public Health Study University of Jember,
[3]Faculty of Dentistry University of Jember

Article Info

Abstract

The COVID-19 pandemic resulted in more than 30 million deaths in 2020. Pregnant women are a vulnerable group. They tend to be at risk of contracting and experiencing complications that can affect pregnancy and fetal development. This research aims to analyze behavioral factors that influence compliance with the COVID-19 protocol for pregnant women using the health belief model approach in the working area of the Pagelaran Health Center. This research is a cross-sectional study of pregnant women in the Pagelaran health center. The sampling technique used in this study was random sampling and found 107 respondents. The analysis technique used in this study is multiple logistic regression. The research results show a significant influence between perceived susceptibility, perceived severity, perceived benefits, perceived barriers, and perceived self-efficacy with compliance. But there is no influence between cues to action on compliance. Variables included in the modeling and proven to influence pregnant women's adherence to the COVID-19 protocol include perceived severity, perceived benefits, perceived barriers, and perceived self-efficacy, with perceived severity being the most dominant variable. So it is hoped that policy maker will consider more of perceived severity, benefits, barriers, and self-efficacy.

Introduction

Since COVID-19 was first announced in Wuhan until WHO declared COVID-19 a pandemic, there have been more than 30 million deaths in 2020 (Palacios Cruz et al., 2021). It is due to the transmission of COVID-19 in the closed spaces and several cases in public spaces (Peng et al., 2022). COVID-19 can mutate and create new variants, of which there are 5 variables. Namely alpha, beta, gamma, delta, and omicron. Each variant has a different character of transmission and severity. The omicron variant has milder symptoms than the delta variant, but the transmission rate of omicron is much faster (Young et al., 2022). More protection is needed for vulnerable groups, including the elderly, disabled groups, groups with comorbidities, and pregnant women. Data on maternal mortality in the UK

increased by 20% during the pandemic (Lewis, Martin and Guzman, 2022). This is because pregnant women tend to be at risk of contracting and experiencing complications that can affect pregnancy and fetal development (Panahi, Amiri and Pouy, 2020). COVID-19 in pregnant women is associated with physiological changes in pregnancy, including increased heart rate and oxygen consumption, decreased lung capacity, and increased thromboembolic risk (Zambrano et al., 2020). Several other factors underlie the severity of COVID-19 in pregnant women, including age and previous medical history (Young et al., 2022). Pregnant women aged 35-44 years who are infected with COVID-19 are 4 times more likely to need invasive ventilation and are 2 times more at risk of dying (Zambrano et al., 2020)

Community transmission of pregnant

women is high (Panahi, Amiri and Pouy, 2020). More than 11,400 pregnant women infected with COVID-19 have to be hospitalized, 62% need treatment Intensive Care Unit (ICU), and 88% higher need invasive ventilation in pregnant women (Subbaraman, 2021). COVID-19 can increase the risk of preterm, ICU needs, neonatal unit needs, and maternal death (Subbaraman, 2021). Silasi et al., (2015), also argue that COVID-19 in pregnant women can result in IUGR (intrauterine growth restriction), premature birth, spontaneous abortion, increased risk of admission to the PICU NICU, even perinatal death.

The COVID-19 outbreak in Indonesia until May 2022 recorded 6054173 confirmed cases of COVID-19 and 2972 active cases, including cases in pregnant women (COVID-19. go. id, 2022). East Java reached 576193 confirmed cases, with 23 new daily cases and 104 active cases, with an additional 6 daily (East Java Health Office, 2022). The COVID-19 outbreak in Malang Regency over the past 10 days has seen an increase in confirmed cases of 11 new cases, 38 new suspected cases, and 55 new close contact cases (Malang District Health Office, 2022). cases of pregnant women infected with COVID-19 in Indonesia reached 9.7% of cases, with 0.2% dying (Motlagh et al., 2020). Preliminary studies conducted in the working area of the performance health center show that 71.4% of pregnant women do not comply with the COVID-19 protocol, 23.8% of pregnant women are sufficiently compliant with the COVID-19 protocol, and only 4.8% of pregnant women comply with the COVID-19 protocol.

Efforts to reduce mortality and morbidity in the mother and fetus during the pandemic have been carried out, including health protocols for mothers and newborns during a pandemic COVID-19. In practice, are still many pregnant women who do not comply with this policy. Siregar, Aritonang and Anita, (2020) stated that 57% of pregnant women were lacking in preventing COVID-19 during pregnancy. Health behavior is an individual attribute in the maintenance, recovery, and improvement of health status. Health behavior includes beliefs, motives, perceptions, values, expectations, behavior patterns, and individual habits (Gadarian, Goodman and Pepinsky, 2021).

The theory of the health belief model is an appropriate theory to explain health behavior because the health belief model explains that individuals tend to participate in health behavior if it is based on a positive perception that health is a valuable outcome, with a positive perception, it will make it easier to predict behavior with the perception of the disease, experienced, and the determinant factors affecting attitude change (Afro, Isfiya and Rochmah, 2021). The health belief model becomes a framework for analyzing behavior and identifying individual beliefs about health. The health belief model has succeeded in predicting health behavior (Barakat and Kasemy, 2020). The health belief model is also often used in several health studies, such as research by Jose et al. (2021), which states that the health belief model is significantly related to behavior change, Huang, Dai and Xu (2020), also argue that health belief has an indirect relationship with prevention behavior. The health belief model can also explain the initiation of the COVID-19 vaccination.

Based on this description, the researcher is interested in analyzing behavioral factors that affect compliance with the COVID-19 protocol for pregnant women using the health belief model approach in the Pagelaran Health Center

Method

The method in this study is observational analytic with a quantitative approach. The research design used is Cross Sectional. The dependent variable in this study is compliance with the COVID-19 protocol. The independent variables in this study are perceived susceptibility, perceived severity, perceived benefits, perceived barriers, perceived self-efficacy, and cues to action. The population in this study was 257 pregnant women in the working area of the Pagelaran Health Center. The sampling technique used is simple random sampling, where every pregnant woman has the same opportunity to be a sample, the number of samples is calculated using the Lemeshow formula, and the results are 107 respondents.

The research took time from March 2022-November 2022 in the Working Area of

the Pagelaran Health Center. Data collection used the COVID-19 protocol compliance questionnaire instrument and the health belief model questionnaire. Data analysis in this study used univariate, bivariate, and multivariate analysis, univariate analysis to describe the characteristics of the respondents and an overview of the research variables, and bivariate analysis used simple logistic regression to determine the effect of the independent variable on the dependent variable, and multivariate analysis used multiple logistic regression with the backward wald method to find out the variables that most influence compliance with the COVID-19 protocol.

Result and Discussion

This research took place in the Pagelaran Health Center in Malang Regency in September 2022, 107 pregnant women involved as respondents in this study. The data collection process was carried out within 1 month, during which the researcher visited each respondent. Then the researcher explained the purpose and description of the research, and then the willing respondents were asked to fill out the provided questionnaire accompanied by the researcher.

The research analysis uses descriptive to identify the characteristics of respondents and research variables, bivariate test with simple logistic regression to identify the effect of independent variables on the dependent variable, and multivariate test with multiple logistic regression. The following table shows the frequency distribution of the characteristics of the respondents.

Based on Table 1, out of 107 respondents, 53.3% were 15-26 years, 41.1% were 27-38 years and 5.6% were 39-49 years. 43% had a high school education equivalent, 32.7% had graduated from junior high school or equivalent, followed by 14% college graduates, and finally, elementary school graduates with 10.3%. Judging from the work of the respondents, 58.9% of the respondents worked as housewives, 29% of the respondents were private workers, and 12.1% of the respondents' jobs were self-employed. Based on the number of pregnancies, 51.4% were the first, 30.8% were second, and 17.8% were third pregnancies or more. And if seen based on the trimester of pregnancy, 40.2% of pregnancies are in the second trimester, 33.6% are in the first trimester, and 26,2% are in the third trimester.

Table 1. Distribution of Characteristics of Pregnant Women in Pagelaran Health Center 2022

Variables	Amount (n)	Percentage(%)
Age		
15-26	57	53.3%
27-38	44	41.1%
39-49	6	5.6%
Total	107	100%
Level of education		
SD equivalent	11	10.3%
Middle school equivalent	35	32.7%
high school equivalent	46	43.0%
College	15	14.0%
Total	107	100%
Variable	**Amount (n)**	**Percentage(%)**
Work		
Housewife	63	58.9%
Self-employed	13	12.1%
Private	31	29.0%
Total	107	100%
Gravida		
First	55	51.4%
Second	33	30.8%
Third or More	19	17.8%
Total	107	100%
Trimester		
First	36	33,6%
Second	43	40,2%
Third	28	26,2%
Total	107	100%

Source: Primary Data, 2022

Table 2. Distribution of Perceived Factors and Compliance of Pregnant Women at Pagelaran Health Center in 2022

Variables	Amount (n)	Percentage(%)
Perceived susceptibility		
Good	18	16.8%
Enough	50	46.7%
Not enough	39	36.4%
Total	107	100%
Perceived severity		
Good	24	22.4%
Enough	67	62.6%
Not enough	16	15.0%
Total	107	100%
Perceived benefits		
Good	15	14.0%
Enough	69	64.5%
Not enough	23	21.5%
Total	107	100%
Perceived Barrier		
Good	5	4.7%
Enough	72	67.3%
Not enough	30	28.0%
Total	107	100%
Perceived self-efficacy		
Good	11	10.3%
Enough	82	76.6%
Not enough	14	13.1%
Total	107	100%
Cues to action		
Good	6	5.6%
Enough	89	83.2%
Not enough	12	11.2%
Total	107	100%
Obedience		
Good	94	87.9%
Bad	13	12.1%
Total	107	100%

Source: Primary Data, 2022

Based on Table 2, most respondents' perceptions were adequate, with the variable perception of cues to action having the highest presentation (83.2%) and the perception of severity having the lowest (only 4.7%). Most respondents (87.9%) reported good compliance. Only 12.1% reported poor compliance.

Based on Table 3 above, the variables perceived susceptibility, perceived severity, perceived benefits, perceived barriers, and perceived self-efficacy influence obedience. It can be seen from the p-value of less than 0.05, while the cues to action variable have no effect because the p-value of 0.626 is higher than 0.05. Based on the odds ratio, the category with the highest odds ratio is perceived severity, with 17.2%, which means that pregnant women who have a good sense of perceived severity tend to be more compliant with the COVID-19 protocol.

Table 3. The Effect of Perceived on Compliance with the COVID-19 Protocol for Pregnant Women in the Pagelaran Health Center Area in 2022

Perceived	Obedience				P-Value	OR
	Good		Bad			
	Amount	%	Amount	%		
Perceived susceptibility						
Good	66	61.7%	2	1.8%	0.000	12,964
Not enough	28	26.2%	11	10.3%		
Total	94	87.9%	13	12.1%		
Perceived severity						
Good	79	73.8%	5	4.7%	0.000	17,200
Not enough	15	14.0%	8	7.5%		
Total	94	87.8%	13	12.2%		
Perceived benefits						
Good	79	73.8%	5	4.7%	0.001	8,427
Not enough	15	14.0%	8	7.5%		
Total	94	87.8%	13	12.2%		
Perceived barriers						
Good	74	69.1%	3	2.8%	0.000	12,333
Not enough	20	18.7%	10	9.3%		
Total	94	87.8%	13	12.2%		
Perceived self-efficacy						
Good	87	81.4%	6	5.6%	0.000	14,500
Not enough	7	6.5%	7	6.5%		
Total	94	100%	13	100%		
Cues to action						
Good	84	78.6%	11	10.3%	0.626	1,527
Not enough	10	9.3%	2	1.8%		
Total	94	87.9%	13	12.1%		

Source: Primary Data, 2022

Table 4. Table of Modeling Factors Affecting Compliance with the COCID-19 Protocol for Pregnant Women in the Pagelaran Health Center Working Area in 2022

Variables	B	Sig.	OR	-2 lifetime logs without variables	-2 log likelihood 5 variables	Nagelkerke R Square	Hosmer and lemeshow test	Omnibus test
perceived severity	2,494	0.002	12,110					
perceived benefits	1,583	0.064	4,869	79,157	40,241	0.583	0.258	0.000
Perceived barriers	2,239	0.015	9,380					
Perceived self-efficacy	1,870	0.033	6,491					

Source: Primary Data, 2022

Based on Table 4, variables with a significant effect on compliance with the COVID-19 protocol on the final modeling are perceived severity, perceived benefits, perceived barriers, and perceived self-efficacy. The variable most related to compliance with the COVID-19 protocol is perceived severity 12.1% (95% CI OR: 2.249-65.206) which means that pregnant women with less perceived severity are more at risk of not complying with the COVID-19 protocol 12.1% times compared to pregnant women with great perceived severity.

This modeling is a fit model, it can be seen from -2logL without variables, and after adding variables, there is a significant decrease of 38.916, which means adding variables to the model can affect the fit model. Based on the Nagelkerke R Square, the value is 0.504. It means that the independent variables in the model can explain compliance with the COVID-19 protocol by 58.3% and 41. The other 7% can be explained by factors outside the existing variables. Based on the results of the omnibus test, the p-value was 0.000 <0.05. It can be interpreted that the model formed is declared feasible because it fulfills the significance of the model. The Hosmer and Lemeshow tests show a p-value of 0.258> 0.05, which means that H0

is rejected and H7 is accepted. So the model is fitted with the data, and the model is acceptable.

Respondents in this study were 53.3% aged 15-26 years, 43.0% had a high school education level equivalent, 58.9% were housewife, 51.4% were first pregnancies, and 40.2% were second-trimester pregnancies. Age is related to preventive behavior. Older individuals and not working are more likely to apply less preventive behavior than younger individuals (Liao et al., 2019). Young mothers tend to be creative, curious about information, have a good memory, and could understand information better than older mothers. However, most pregnant women at a young age experience pregnancy disorders related to the immaturity of the reproductive organs and the immune system (Londero et al., 2019). This level of formal education can affect knowledge and decision-making. The lower the level of education, the more difficult it is to receive and understand information (Zannah, 2020). High knowledge will form proper beliefs, attitudes, and prevention practices (Anikwe et al., 2020)

Work related to adherence to health behavior relate to the availability of time owned, working individuals tend to have less time to go to health services (Tambuwun et al., 2021). working mothers were more likely to be disobedient to having their condition checked during a pandemic due to not having time. Pregnant women who have never given birth have a high-risk perception of COVID-19 (Londero et al., 2019). Individuals who do not work have less preventive behavior (Liao et al., 2019). Primiparous pregnant women have no experience dealing with pregnancy, so they have more concerns. Pregnancy and childbirth experiences can reduce perceived risk perceptions and predict preventive behavior (Sari et al., 2021). Nwafor et al., (2020) stated grande multiparous women have 3 times worse health behavior than nulliparas. Multiparous pregnant women have less behavior in preventing COVID-19 because many families can affect the economy, and it becomes difficult to implement the COVID-19 protocol (Ayele et al., 2021). Pregnant women who are positive for COVID-19 in trimesters 1 and 2 are more at risk of experiencing fetal death (IUFD) (Donders et al., 2020) because in this phase, the

organs in the fetus are formed so that the fetus is more easily exposed to the virus resulting in a negative impact on the fetus. Pregnant women infected with COVID-19 in the first trimester of pregnancy experience spontaneous abortion, which is possible due to hypoxia due to acute respiratory distress (Priyadharshini et al., 2021).

Perceived susceptibility is positively related to preventive behavior (Aghababaei et al., 2020). High perceived susceptibility will encourage individuals to do better prevention because they belief that their condition is at a high risk of disease, so perceived susceptibility will encourage preventive behavior (Schwartz and Dhaliwal, 2020). Good perceived susceptibility indicates that the individual believes they are more at risk of contracting the disease, so they take precautions. Then the better the perceived susceptibility, the better the prevention behavior (Zareipour et al., 2020). Perceived susceptibility directly related to health behavior. A research conducted by Jose et al. (2021), stated that increasing perceived susceptibility will reduce health problems. The statement above is in line with the results of this study, where there is a significant influence between perceived susceptibility on compliance with the COVID-19 protocol for pregnant women. Perceived susceptibility can also affect pregnant women's compliance by 12.9%.

Perceived severity refers to the belief in difficulties arising from a medical and social illness so that it can make people more active in carrying out prevention (Mirzaei et al., 2021). perceived severity related to individual beliefs regarding the severity of a disease, the more individuals believe in the impact of the disease, the individual will feel threatened, so they are motivated to carry out health behaviors (Claresta, Christian and Sa'id, 2021). Tong et al. (2020), research shows that perceived severity has a significant relationship with the prevention of COVID-19, which is also supported by research Al-Metwali et al. (2021), which also states that perceived severity is significantly related to receiving the COVID-19 vaccine. This statement is in line with the research results obtaining a significant influence between perceived severity on compliance with the COVID-19 protocol for pregnant women and perceived severity that

can affect compliance for pregnant women.

Perceived benefits can significantly predict infectious disease prevention behavior, as good as being a primary factor in using masks. Perceived benefits are expectations from preventive behavior. Individuals who believe behavior is safe and effective will have a positive attitude and tend to take precautions (Huang, Dai and Xu, 2020). Maharlouei et al. (2020), argues that perceived benefits have a significant relationship with prevention behavior. The relationship between perceived benefits and prevention behavior is possible because when individuals get a lot of benefits from preventing COVID-19, they tend to do all things that can prevent COVID-19. Tao et al. (2021), also state that perceived benefits have a positive relationship with willingness to vaccinate. It is also supported by individuals with high perceived benefits, who tend to be willing to receive the COVID-19 vaccine to protect themselves and others. This statement is in line with the results of this study, where there is a significant influence between perceived benefits on compliance with the COVID-19 protocol for pregnant women. Pregnant women with high perceived benefits tend to be 8.4% more obedient than pregnant women with low perceived benefits.

Perceived barriers are the strongest predictor of health behavior because they can influence the perception of the effectiveness of behavior so that it can motivate individuals to carry out health recommendations (Fall, Izaute and Chakroun-Baggioni, 2018). Individuals must be able to control perceived barriers before engaging in preventive behavior (Bashirian et al., 2020). Perceived barriers refer to a person's belief in the negative impact of changing behavior, for example, considering cost, time, convenience, and side effects. Perceived barriers are inversely related to preventive behavior. The lower the perceived barriers, the higher the possibility of individuals adopting a healthy life. Individuals with low Perceived barriers have a better response to COVID prevention, so to increase adherence, it is necessary to reduce perceived barriers. (Barakat and Kasemy, 2020) argue that perceived barriers are a vital factor because individuals must take control of barriers. Karimy et al. (2017), also significantly

mention that perceived barriers are related to Pap smear test adherence. This statement is in line with the research results, which found a significant effect between perceived barriers on compliance with the COVID-19 protocol for pregnant women. Perceived barriers can affect the compliance of pregnant women by 12.3%.

Fall, Izaute and Chakroun-Baggioni, (2018) argue that self-efficacy is a level of confidence and belief in overcoming barriers to health behavior, self-efficacy is important in overcoming perceived barriers and effective in adopting COVID-19 prevention behaviors. Because to carry out health behaviors, individuals must be confident in their ability to carry out health recommendations (Mirzaei et al.(2021). Self-Efficacy encourages individuals to adhere more to the prevention of COVID-19, with a high level of confidence that it will control individuals to adopt a healthy life. High self-efficacy will overcome barriers felt and effective in preventing COVID-19 (Shahnazi et al. (2020). Self-efficacy can significantly predict the behavior of preventing infectious diseases such as SARS-CoV, MERS, and other respiratory infections (Mirzaei et al., 2021). Research conducted by Khazaeian et al., (2021) also supports this statement by stating that self-efficacy has a positive relationship with cues to act to prevent COVID-19. This statement reinforces the research results obtained in this study that there is a significant influence between perceived self-efficacy on compliance with the COVID-19 protocol for pregnant women and perceived self-efficacy can affect pregnant women's compliance by 14.5%.

In several studies, cues to action are health behavior predictors, as in research by Li et al., (2020; Tao et al., (2021), and others. Cues to action can be influenced by individual views about beliefs about something, which they then apply. Several factors can trigger, such as environment, education, events, or from other people (Claresta, Christian and Sa'id, 2021). But Al-Sabbagh et al. (2022), held a different opinion. They stated that cues to action were not significantly related to the quarantine program. In line with this research, Afro, et. al. (2021), also cues to action are irrelevant to compliance with health protocols during a pandemic. So is research. It can result from the environment

influencing individual intentions to act. Individuals tend to obey if the environment also obeys. Public awareness regarding the law is still lacking, while the deteriorating economic conditions are also the causes of non-compliance with health protocols, as well as the indecisiveness of rules and witnesses that are reasons for individuals not to comply (Sulat et al., 2018). Most individuals tend to ignore internal factors in acting and are more easily influenced by external factors such as the mass media (Alsulaiman and Rentner, 2018). Therefore, health service providers and the mass media must provide appropriate information, especially for high-risk groups (Khazaeian et al., 2021). With so many media and organizational trends that will influence political decisions and make information more diverse which ultimately makes people confused about behavior changes that must be implemented (Jose et al., 2021). This statement supports research results that show no significant effect between perceived cues to action on compliance with the COVID-19 protocol for pregnant women.

The combination of perceived severity and perceived susceptibility will form a perceived threat, which will make individuals more careful (Mirzaei et al., 2021), with a high perceived threat will make individual health behavior better (Jose et al., 2021). If the perceived threat is not considered, then the motivation to take prevention will be low, or when an individual has low perceived susceptibility and perceived severity then information related to his condition will be ignored. The combination of perceived susceptibility and severity will cause a perceived threat in the end. The aspect of this belief will lead to action in the form of compliance with the COVID-19 protocol (Getachew et al., 2022). However, perceived susceptibility may not be included in the modeling if the individual does not experience symptoms, there is a long-term threat or no history of previous illness (Sulat et al., 2018), or there is a belief that the individual will not get sick or have never met a sufferer (Alsulaiman and Rentner, 2018).

Perceived self- efficacy, perceived barriers, and perceived benefits are the main factors in the prevention of behavior because

to understand health problems, individuals must feel the benefits of behavior, and to face obstacles, individuals must also have self- (Mirzaei et al., 2021). Shmueli (2021), also mentioned perceived benefits, perceived barriers, and perceived self-efficacy as keys in health promotion. So adopting the behavior of preventing COVID-19 requires high perceived benefits and perceived self-efficacy, while perceived barriers must be low (Mirzaei et al., 2021). Jose et al. (2021) explained that perceived barriers have a significant effect when the level of perceived barriers low and perceived self-efficacy is high so that it will easily affect perceived benefits. But when perceived self-efficacy and perceived barriers are low, perceived benefits cannot affect behavior.

Conclusion

There is a significant influence between perceived susceptibility, perceived severity, perceived benefits, perceived barriers, and perceived self-efficacy with compliance, but there is no influence between cues to action on compliance. Variables included in the modeling and proven to influence pregnant women's adherence to the COVID-19 protocol include perceived severity, perceived benefits, perceived barriers, and perceived self-efficacy, with perceived severity being the most dominant variable. Recommendations that can be implemented from this research are policy-making and counseling related to the importance of implementing the COVID-19 protocol by considering perceived severity, benefits, barriers, and self-efficacy so that explanations are more acceptable and implemented daily.

References

Afro, R.C., Isfiya, A., & Rochmah, T.N., 2021. Analysis Of Factors Affecting Health Protocols Compliance During Covid-19 Pandemic In East Java Community: Health Belief Model Approach. *Journal Of Community Mental Health And Public Policy* (CMHP), 3(1), pp.1–10.

Aghababaei, S., Soltanian, A., Refaei, M., Omidi, T., Ghelichkhani, S., & Soltani, F., 2020. Perceived Risk and Protective Behaviors Regarding COVID-19 among Iranian Pregnant Women. *Middle East Fertility*

Society Journal, 25(1).

Al-Metwali, B.Z., Al-Jumaili, A.A., Al-Alag, Z.A., & Sorofman, B., 2021. Exploring the Acceptance of COVID-19 Vaccine Among Healthcare Workers and General Population Using Health Belief Model. *Journal of Evaluation in Clinical Practice*, 27(5), pp. 1112–1122.

Al-Sabbagh, M.Q., Al-Ani, A., Mafrachi, B., Siyam, A., Isleem, U., Massad, F.I., Alsabbagh, Q., & Abufaraj, M., 2022. Predictors of Adherence with Home Quarantine During COVID-19 Crisis: the Case of Health Belief Model. *Psychology, Health and Medicine,* 27(1), pp.215–227.

Alsulaiman, S., & Rentner, T., 2018. The Health Belief Model and Preventive Measures: A Study of the Ministry of Health Campaign on Coronavirus in Saudi Arabia. *Journal of International Crisis and Risk Communication Research*, 1(1), pp.27–56.

Anikwe, C.C., Ogah, C.O., Anikwe, I.H., Okorochukwu, B.C., & Ikeoha, C.C., 2020. Coronavirus Disease 2019: Knowledge, Attitude, and Practice of Pregnant Women in a Tertiary Hospital in Abakaliki, Southeast Nigeria. *International Journal of Gynecology and Obstetrics,* 151(2), pp.197–202.

Ayele, A.D., Mihretie, G.N., Belay, H.G., Teffera, A.G., Kassa, B.G., & Amsalu, B.T., 2021. Knowledge and Practice to Prevent COVID-19 and Its Associated Factors Among Pregnant Women in Debre Tabor Town Northwest Ethiopia, a Community-Based Cross-Sectional Study. *BMC Pregnancy and Childbirth*, 21(1), pp.1–12.

Barakat, A.M., & Kasemy, Z.A., 2020. Preventive Health Behaviours During Coronavirus Disease 2019 Pandemic Based on Health Belief Model Among Egyptians. *Middle East Current Psychiatry,* 27(1), pp. 43.

Bashirian, S., Jenabi, E., Khazaei, S., Barati, M., Karimi-Shahanjarini, A., Zareian, S., Rezapur-Shahkolai, F., & Moeini, B., 2020. Factors Associated with Preventive Behaviours of COVID-19 Among Hospital Staff in Iran in 2020: an Application of the Protection Motivation Theory. *Journal of Hospital Infection*, 105(3), pp.430–433.

Claresta, A., Christian, S., & Sa'id, M., 2021. Public Obedience to Health Protocols during COVID-19 Pandemic in Indonesia: A Perspective from Health Belief Model Theory Article Info. *Journal of Social Sciences and Humanities,* 11(2), pp.2021.

Donders, F., Lonnée-Hoffmann, R., Tsiakalos, A., Mendling, W., de Oliveira, J.M., Judlin, P.,

Xue, F., & Donders, G.G.G., 2020. ISIDOG Recommendations Concerning COVID-19 and Pregnancy. *Diagnostics,* 10(4), pp.1–23.

Fall, E., Izaute, M., & Chakroun-Baggioni, N., 2018. How Can the Health Belief Model and Self-Determination Theory Predict Both Influenza Vaccination and Vaccination Intention ? A Longitudinal Study Among University Students. *Psychology and Health,* 33(6), pp.746–764.

Fransiska, R.D., Kusumaningtyas, D., & Gumanti, K.A., 2022. Analisis Health Belief Model dalam Perilaku Pencegahan Covid-19 pada Ibu Hamil. *Jurnal Kesehatan Vokasional,* 7(1), pp.11.

Gadarian, S.K., Goodman, S.W., & Pepinsky, T.B., 2021. Partisanship, Health Behavior, and Policy Attitudes in the Early Stages of the COVID-19 Pandemic. *PLoS ONE*, 16, pp.1–13.

Getachew, T., Lami, M., Eyeberu, A., Balis, B., Debella, A., Eshetu, B., Degefa, M., Mesfin, S., Negash, A., Bekele, H., Turiye, G., Tamiru, D., Nigussie, K., Asfaw, H., Dessie, Y., Alemu, A., & Sertsu, A., 2022. Acceptance of COVID-19 Vaccine and Associated Factors Among Health Care Workers at Public Hospitals in Eastern Ethiopia Using the Health Belief Model. *Frontiers in Public Health*, 10, pp.1–11.

Huang, X., Dai, S., & Xu, H., 2020. Predicting Tourists' Health Risk Preventative Behaviour and Travelling Satisfaction in Tibet: Combining the Theory of Planned Behaviour and Health Belief Model. *Tourism Management Perspectives*, 33.

Jose, R., Narendran, M., Bindu, A., Beevi, N., Manju, L., & Benny, P.V., 2021. Public Perception and Preparedness for the Pandemic COVID 19: A Health Belief Model Approach. *Clinical Epidemiology and Global Health*, 9, pp.41–46.

Karimy, M., Azarpira, H., & Araban, M., 2017. Using Health Belief Model Constructs to Examine Differences in Adherence to Pap Test Recommendations Among Iranian Women. *Asian Pacific Journal of Cancer Prevention,* 18(5), pp.1389–1394.

Khazaeian, S., 2021. The Health Belief Model. Cambridge Handbook of Psychology, Health and Medicine, Second Edition, pp. 97–102.

Lewis, R.K., Martin, P.P., & Guzman, B.L., 2022. COVID-19 and Vulnerable Populations. *Journal of Community Psychology,* 2022, pp.2537–2541.

Li, Q., Guan, X., Wu, P., Wang, X., Zhou, L., Tong, Y., Ren, R., Leung, K.S.M., Lau, E.H.Y., Wong,

J.Y., Xing, X., Xiang, N., Wu, Y., Li, C., Chen, Q., Li, D., Liu, T., Zhao, J., Liu, M., Tu, W., Chen, C., Jin, L., Yang, R., Wang, Q., Zhou, S., Wang, R., Liu, H., Luo, Y., Liu, Y., Shao, G., Li, H., Tao, Z., Yang, Y., Deng, Z., Liu, B., Ma, Z., Zhang, Y., Shi, G., Lam, T.T.Y., Wu, J.T., Gao, G.F., Cowling, B.J., Yang, B., Leung, G.M., & Feng, Z., 2020. Early Transmission Dynamics in Wuhan, China, of Novel Coronavirus–Infected Pneumonia. *New England Journal of Medicine*, 382(13), pp.1199–1207.

Liao, Q., Wu, P., Lam, W.W.T., Cowling, B.J., & Fielding, R., 2019. Trajectories of Public Psycho-Behavioural Responses Relating to Influenza A(H7N9) Over the Winter of 2014-15 in Hong Kong. *Psychology and Health*, 34(2), pp.162–180.

Londero, A.P., Rossetti, E., Pittini, C., Cagnacci, A., & Driul, L., 2019. Maternal Age and the Risk of Adverse Pregnancy Outcomes: A Retrospective Cohort Study. *BMC Pregnancy and Childbirth*, 19(1), pp.1–10.

Maharlouei, N., Asadi, N., Bazrafshan, K., Roozmeh, S., Rezaianzadeh, A., Roozegar, M.H.Z., Shaygani, F., Kharmandar, A., Honarvar, B., Hemyari, C., Omidifar, N., Zare, M., Lankarani, K.B., 2020. Knowledge and Attitude Regarding COVID-19 Among Pregnant Womenin Southwestern Iran in the Early Period of Its Outbreak: A Cross-Sectional Study. *American Journal of Tropical Medicine and Hygiene*, 103(6), pp.2368–2375.

Mirzaei, A., Kazembeigi, F., Kakaei, H., Jalilian, M., Mazloomi, S., & Nourmoradi, H., 2021. Application of Health Belief Model to Predict COVID-19-Preventive Behaviors Among a Sample of Iranian Adult Population. *Journal of Education and Health Promotion*, 10(1), pp.69.

Motlagh, A., Yamrali, M., Azghandi, S., Azadeh, P., Vaezi, M., Ashrafi, F., Zendehdel, K., Mirzaei, H., Basi, A., Rakhsha, A., Seifi, S., Tabatabaeefar, M., Elahi, A., Pirjani, P., Shoar, L.M., Nadarkhani, F., Khoshabi, M., Bahar, M., Esfahani, F., Fudazi, H., Samiei, F., Farazmand, B., Ahmari, A., Rajabpour, M.V., Janbabaei, G., Raisi, A., Ostovar, A., & Malekzadeh, R., 2020. COVID19 Prevention & Care; A Cancer Specific Guideline. *Archives of Iranian Medicine*, 23(4), pp.255–264.

Nwafor, J.I., Kenechi, J., Aniukwu., Anozie, B.O., & Ikeotuonye, A.C., 2020. Knowledge and Practice of Preventive Measures Against COVID-19 Infection Among Pregnant Women in a Low-Resource African Setting. *medRxiv,* 2020.

Palacios Cruz, M., Santos, E., Cervantes, M.A.V., & Juárez, M.L., 2021. COVID-19, a Worldwide Public Health Emergency. *Revista Clínica Española (English Edition)*, 221(1), pp.55–61.

Panahi, L., Amiri, M., & Pouy, S., 2020. Risks of Novel Coronavirus Disease (COVID-19) in Pregnancy; a Narrative Review. *Archives of Academic Emergency Medicine*, 8(1), pp.e34.

Peng, Z., Rojas, A.L.P., Kropff, E., Bahnfleth, W., Buonanno, G., Dancer, S.J., Kurnitski, J., Li, Y., Loomans, G.L.C., Marr, L.C., Morawska, L., Nazaroff, W., Noakes, C., Querol., X., Sekhar, C., Tellier, R., Greenhalgh, T., Bourouiba, L., Boerstra, A., Tang, J.W., Miller, S.L., & Jimenez, J.L., 2022. Practical Indicators for Risk of Airborne Transmission in Shared Indoor Environments and Their Application to COVID-19 Outbreaks. *Environmental Science and Technology,* 56(2), pp.1125–1137.

Priyadharshini, C.B., Priya, S., Selvameena, M., Waseemsha, S., Muthurajesh, E., & Shalini, M., 2021. Demographic Profile of COVID-19 Positive Mothers & Their Outcome in Government Rajaji hospital, Madurai, Tamilnadu – A Cross Sectional Study. *Clinical Epidemiology and Global Health*, 12, pp.100864.

Sari, D.I., Wahyuni, N., & Sucipto, C.D., 2021. Hubungan Pengetahuan, Paritas, Pekerjaan Ibu dengan Keteraturan Kunjungan Ibu Hamil untuk ANC Selama Masa Andemi Covid-19. *Jurnal Kesehatan Primer,* 6(1), pp.22–31.

Schwartz, D.A., & Dhaliwal, A., 2020. Infections in Pregnancy with Covid-19 and Other Respiratory RNA Virus Diseases are Rarely, if Ever, Transmitted to the Fetus: Experiences with Coronaviruses, Parainfluenza, Metapneumovirus Respiratory Syncytial Virus, and Influenza. *Archives of Pathology and Laboratory Medicine*, 144(8), pp.920–928.

Shahnazi, H., Ahmadi-Livani, M., Pahlavanzadeh, B., Rajabi, A., Hamrah, M.S., & Charkazi, A., 2020. Assessing Preventive Health Behaviors from COVID-19: a Cross Sectional Study with Health Belief Model in Golestan Province, Northern of Iran. *Infectious Diseases of Poverty,* 9(1), pp.1–9.

Shmueli, L., 2021. Predicting Intention to Receive COVID-19 Vaccine Among the General Population Using the Health Belief Model and the Theory of Planned Behavior Model. *BMC public health*, 21(1), pp.804.

Silasi, M., Cardenas, I., Kwon, J.Y., Racicot, K., Aldo, P., & Mor, G., 2015. Viral Infections During

Pregnancy. *American Journal of Reproductive Immunology*, 73(3), pp.199–213.

Siregar, R.N., Aritonang, J., & Anita, S., 2020. Pemahaman Ibu Hamil Tentang Upaya Pencegahan Infeksi Covid-19 Selama Kehamilan. *Journal of Healthcare Technology and Medicine*, 6(2), pp.798.

Subbaraman, N., 2021. Pregnancy and COVID: what the Data Say. *Nature,* 591(7849), pp.193–195.

Sulat, J.S., Prabandari, Y.S., Sanusi, R., Hapsari, E.D., & Santoso, B., 2018. The Validity of Health Belief Model Variables in Predicting Behavioral Change: A Scoping Review. *Health Education,* 118(6), pp.499–512.

Tambuwun, A.A., Kandou, G.D., & Nelwan, J.E., 2021. Hubungan Karakteristik Individu Dengan Kepatuhan Berobat Pada Penderita Hipertensi Di Puskesmas Wori Kabupaten Minahasa Utara. *Jurnal Kesmas,* 10(4), pp.112–121.

Tao, L., Wang, R., Han, N., Liu, J., Yuan, C., Deng, L., Han, C., Sun, F., Liu, M., & Liu, J., 2021. Acceptance of a COVID-19 Vaccine And Associated Factors Among Pregnant Women in China: a Multi-Center Cross-Sectional Study Based on Health Belief Model. *Human Vaccines and Immunotherapeutics,* 17(8), pp.2378–2388.

Tong, K.K., Chen, J.H., Yu, E.W., & Wu, A.M.S., 2020. Adherence to COVID-19 Precautionary Measures: Applying the Health Belief Model and Generalised Social Beliefs to a Probability Community Sample. *Applied Psychology: Health and Well-Being*, 12(4), pp.1205–1223.

Young, M., Crook, H., Scott, J., & Edison, P., 2022. Covid-19: Virology, Variants, and Vaccines. *BMJ Medicine*, 1(1), pp.e000040.

Zambrano, L.D., Ellington, S., Strid, P., Galang, R.R., Oduyebo, T., Tong, V.T., Woodworth, K.R., Nahabedian, J.F., Azziz-Baumgartner, E., Gilboa, S.M., & Meaney-Delman, D., 2020. Update: Characteristics of Symptomatic Women of Reproductive Age with Laboratory-Confirmed SARS-CoV-2 Infection by Pregnancy Status — United States, January 22–October 3, 2020. MMWR. *Morbidity and Mortality Weekly Report*, 69(44), pp.1641–1647.

Zannah, S.N., 2020. Hubungan Karakteristik Dan Pengetahuan Dengan Kepatuhan Upt . Puskesmas Martapura 1 Kabupaten Banjar. *Doctoral Disertation.* Universitas Islam Kaimantan.

Zareipour, M.A., Ardakani, M.F., Moradali, M.R., Jadgal, M.S., & Movahed, E.,2020. Determinants of covid-19 Prevention Behavior in the Elderly in Urmia: Application of Health Belief Model. *Open Access Macedonian Journal of Medical Sciences*, 8(T1), pp.646–650.

Compliance with the Covid-19 Protocol for Pregnant Women in Pagelaran

Parastika Anggun Fauzia[1✉], Leersia Yusi Ratnawati[2], Rina Sutjiati[3]
[1]Postgraduate Public Health Study Program University of Jember
[2]Faculty of Public Health Study University of Jember,
[3]Faculty of Dentistry University of Jember

Abstract

The COVID-19 pandemic resulted in more than 30 million deaths in 2020. Pregnant women are a vulnerable group. They tend to be at risk of contracting and experiencing complications that can affect pregnancy and fetal development. This research aims to analyze behavioral factors that influence compliance with the COVID-19 protocol for pregnant women using the health belief model approach in the working area of the Pagelaran Health Center. This research is a cross-sectional study of pregnant women in the Pagelaran health center. The sampling technique used in this study was random sampling and found 107 respondents. The analysis technique used in this study is multiple logistic regression. The research results show a significant influence between perceived susceptibility, perceived severity, perceived benefits, perceived barriers, and perceived self-efficacy with compliance. But there is no influence between cues to action on compliance. Variables included in the modeling and proven to influence pregnant women's adherence to the COVID-19 protocol include perceived severity, perceived benefits, perceived barriers, and perceived self-efficacy, with perceived severity being the most dominant variable. So it is hoped that policy maker will consider more of perceived severity, benefits, barriers, and self-efficacy.

Introduction

Since COVID-19 was first announced in Wuhan until WHO declared COVID-19 a pandemic, there have been more than 30 million deaths in 2020 (Palacios Cruz et al., 2021). It is due to the transmission of COVID-19 in the closed spaces and several cases in public spaces (Peng et al., 2022). COVID-19 can mutate and create new variants, of which there are 5 variables. Namely alpha, beta, gamma, delta, and omicron. Each variant has a different character of transmission and severity. The omicron variant has milder symptoms than the delta variant, but the transmission rate of omicron is much faster (Young et al., 2022). More protection is needed for vulnerable groups, including the elderly, disabled groups, groups with comorbidities, and pregnant women. Data on maternal mortality in the UK

increased by 20% during the pandemic (Lewis, Martin and Guzman, 2022). This is because pregnant women tend to be at risk of contracting and experiencing complications that can affect pregnancy and fetal development (Panahi, Amiri and Pouy, 2020). COVID-19 in pregnant women is associated with physiological changes in pregnancy, including increased heart rate and oxygen consumption, decreased lung capacity, and increased thromboembolic risk (Zambrano et al., 2020). Several other factors underlie the severity of COVID-19 in pregnant women, including age and previous medical history (Young et al., 2022). Pregnant women aged 35-44 years who are infected with COVID-19 are 4 times more likely to need invasive ventilation and are 2 times more at risk of dying (Zambrano et al., 2020)

Community transmission of pregnant

women is high (Panahi, Amiri and Pouy, 2020). More than 11,400 pregnant women infected with COVID-19 have to be hospitalized, 62% need treatment Intensive Care Unit (ICU), and 88% higher need invasive ventilation in pregnant women (Subbaraman, 2021). COVID-19 can increase the risk of preterm, ICU needs, neonatal unit needs, and maternal death (Subbaraman, 2021). Silasi et al., (2015), also argue that COVID-19 in pregnant women can result in IUGR (intrauterine growth restriction), premature birth, spontaneous abortion, increased risk of admission to the PICU NICU, even perinatal death.

The COVID-19 outbreak in Indonesia until May 2022 recorded 6054173 confirmed cases of COVID-19 and 2972 active cases, including cases in pregnant women (COVID-19. go. id, 2022). East Java reached 576193 confirmed cases, with 23 new daily cases and 104 active cases, with an additional 6 daily (East Java Health Office, 2022). The COVID-19 outbreak in Malang Regency over the past 10 days has seen an increase in confirmed cases of 11 new cases, 38 new suspected cases, and 55 new close contact cases (Malang District Health Office, 2022). cases of pregnant women infected with COVID-19 in Indonesia reached 9.7% of cases, with 0.2% dying (Motlagh et al., 2020). Preliminary studies conducted in the working area of the performance health center show that 71.4% of pregnant women do not comply with the COVID-19 protocol, 23.8% of pregnant women are sufficiently compliant with the COVID-19 protocol, and only 4.8% of pregnant women comply with the COVID-19 protocol.

Efforts to reduce mortality and morbidity in the mother and fetus during the pandemic have been carried out, including health protocols for mothers and newborns during a pandemic COVID-19. In practice, are still many pregnant women who do not comply with this policy. Siregar, Aritonang and Anita, (2020) stated that 57% of pregnant women were lacking in preventing COVID-19 during pregnancy. Health behavior is an individual attribute in the maintenance, recovery, and improvement of health status. Health behavior includes beliefs, motives, perceptions, values, expectations, behavior patterns, and individual habits (Gadarian, Goodman and Pepinsky, 2021).

The theory of the health belief model is an appropriate theory to explain health behavior because the health belief model explains that individuals tend to participate in health behavior if it is based on a positive perception that health is a valuable outcome, with a positive perception, it will make it easier to predict behavior with the perception of the disease, experienced, and the determinant factors affecting attitude change (Afro, Isfiya and Rochmah, 2021). The health belief model becomes a framework for analyzing behavior and identifying individual beliefs about health. The health belief model has succeeded in predicting health behavior (Barakat and Kasemy, 2020). The health belief model is also often used in several health studies, such as research by Jose et al. (2021), which states that the health belief model is significantly related to behavior change, Huang, Dai and Xu (2020), also argue that health belief has an indirect relationship with prevention behavior. The health belief model can also explain the initiation of the COVID-19 vaccination.

Based on this description, the researcher is interested in analyzing behavioral factors that affect compliance with the COVID-19 protocol for pregnant women using the health belief model approach in the Pagelaran Health Center

Method

The method in this study is observational analytic with a quantitative approach. The research design used is Cross Sectional. The dependent variable in this study is compliance with the COVID-19 protocol. The independent variables in this study are perceived susceptibility, perceived severity, perceived benefits, perceived barriers, perceived self-efficacy, and cues to action. The population in this study was 257 pregnant women in the working area of the Pagelaran Health Center. The sampling technique used is simple random sampling, where every pregnant woman has the same opportunity to be a sample, the number of samples is calculated using the Lemeshow formula, and the results are 107 respondents.

The research took time from March 2022-November 2022 in the Working Area of

the Pagelaran Health Center. Data collection used the COVID-19 protocol compliance questionnaire instrument and the health belief model questionnaire. Data analysis in this study used univariate, bivariate, and multivariate analysis, univariate analysis to describe the characteristics of the respondents and an overview of the research variables, and bivariate analysis used simple logistic regression to determine the effect of the independent variable on the dependent variable, and multivariate analysis used multiple logistic regression with the backward wald method to find out the variables that most influence compliance with the COVID-19 protocol.

Result and Discussion

This research took place in the Pagelaran Health Center in Malang Regency in September 2022, 107 pregnant women involved as respondents in this study. The data collection process was carried out within 1 month, during which the researcher visited each respondent. Then the researcher explained the purpose and description of the research, and then the willing respondents were asked to fill out the provided questionnaire accompanied by the researcher.

The research analysis uses descriptive to identify the characteristics of respondents and research variables, bivariate test with simple logistic regression to identify the effect of independent variables on the dependent variable, and multivariate test with multiple logistic regression. The following table shows the frequency distribution of the characteristics of the respondents.

Based on Table 1, out of 107 respondents, 53.3% were 15-26 years, 41.1% were 27-38 years and 5.6% were 39-49 years. 43% had a high school education equivalent, 32.7% had graduated from junior high school or equivalent, followed by 14% college graduates, and finally, elementary school graduates with 10.3%. Judging from the work of the respondents, 58.9% of the respondents worked as housewives, 29% of the respondents were private workers, and 12.1% of the respondents' jobs were self-employed. Based on the number of pregnancies, 51.4% were the first, 30.8% were second, and 17.8% were third pregnancies or more. And if seen based on the trimester of pregnancy, 40.2% of pregnancies are in the second trimester, 33.6% are in the first trimester, and 26,2% are in the third trimester.

Table 1. Distribution of Characteristics of Pregnant Women in Pagelaran Health Center 2022

Variables	Amount (n)	Percentage(%)
Age		
15-26	57	53.3%
27-38	44	41.1%
39-49	6	5.6%
Total	107	100%
Level of education		
SD equivalent	11	10.3%
Middle school equivalent	35	32.7%
high school equivalent	46	43.0%
College	15	14.0%
Total	107	100%
Variable	**Amount (n)**	**Percentage(%)**
Work		
Housewife	63	58.9%
Self-employed	13	12.1%
Private	31	29.0%
Total	107	100%
Gravida		
First	55	51.4%
Second	33	30.8%
Third or More	19	17.8%
Total	107	100%
Trimester		
First	36	33,6%
Second	43	40,2%
Third	28	26,2%
Total	107	100%

Source: Primary Data, 2022

Table 2. Distribution of Perceived Factors and Compliance of Pregnant Women at Pagelaran Health Center in 2022

Variables	Amount (n)	Percentage(%)
Perceived susceptibility		
Good	18	16.8%
Enough	50	46.7%
Not enough	39	36.4%
Total	107	100%
Perceived severity		
Good	24	22.4%
Enough	67	62.6%
Not enough	16	15.0%
Total	107	100%
Perceived benefits		
Good	15	14.0%
Enough	69	64.5%
Not enough	23	21.5%
Total	107	100%
Perceived Barrier		
Good	5	4.7%
Enough	72	67.3%
Not enough	30	28.0%
Total	107	100%
Perceived self-efficacy		
Good	11	10.3%
Enough	82	76.6%
Not enough	14	13.1%
Total	107	100%
Cues to action		
Good	6	5.6%
Enough	89	83.2%
Not enough	12	11.2%
Total	107	100%
Obedience		
Good	94	87.9%
Bad	13	12.1%
Total	107	100%

Source: Primary Data, 2022

Based on Table 2, most respondents' perceptions were adequate, with the variable perception of cues to action having the highest presentation (83.2%) and the perception of severity having the lowest (only 4.7%). Most respondents (87.9%) reported good compliance. Only 12.1% reported poor compliance.

Based on Table 3 above, the variables perceived susceptibility, perceived severity, perceived benefits, perceived barriers, and perceived self-efficacy influence obedience. It can be seen from the p-value of less than 0.05, while the cues to action variable have no effect because the p-value of 0.626 is higher than 0.05. Based on the odds ratio, the category with the highest odds ratio is perceived severity, with 17.2%, which means that pregnant women who have a good sense of perceived severity tend to be more compliant with the COVID-19 protocol.

Table 3. The Effect of Perceived on Compliance with the COVID-19 Protocol for Pregnant Women in the Pagelaran Health Center Area in 2022

Perceived	Obedience				P-Value	OR
	Good		Bad			
	Amount	%	Amount	%		
Perceived susceptibility						
Good	66	61.7%	2	1.8%	0.000	12,964
Not enough	28	26.2%	11	10.3%		
Total	94	87.9%	13	12.1%		
Perceived severity						
Good	79	73.8%	5	4.7%	0.000	17,200
Not enough	15	14.0%	8	7.5%		
Total	94	87.8%	13	12.2%		
Perceived benefits						
Good	79	73.8%	5	4.7%	0.001	8,427
Not enough	15	14.0%	8	7.5%		
Total	94	87.8%	13	12.2%		
Perceived barriers						
Good	74	69.1%	3	2.8%	0.000	12,333
Not enough	20	18.7%	10	9.3%		
Total	94	87.8%	13	12.2%		
Perceived self-efficacy						
Good	87	81.4%	6	5.6%	0.000	14,500
Not enough	7	6.5%	7	6.5%		
Total	94	100%	13	100%		
Cues to action						
Good	84	78.6%	11	10.3%	0.626	1,527
Not enough	10	9.3%	2	1.8%		
Total	94	87.9%	13	12.1%		

Source: Primary Data, 2022

Table 4. Table of Modeling Factors Affecting Compliance with the COCID-19 Protocol for Pregnant Women in the Pagelaran Health Center Working Area in 2022

Variables	B	Sig.	OR	-2 lifetime logs without variables	-2 log likelihood 5 variables	Nagelkerke R Square	Hosmer and lemeshow test	Omnibus test
perceived severity	2,494	0.002	12,110					
perceived benefits	1,583	0.064	4,869	79,157	40,241	0.583	0.258	0.000
Perceived barriers	2,239	0.015	9,380					
Perceived self-efficacy	1,870	0.033	6,491					

Source: Primary Data, 2022

Based on Table 4, variables with a significant effect on compliance with the COVID-19 protocol on the final modeling are perceived severity, perceived benefits, perceived barriers, and perceived self-efficacy. The variable most related to compliance with the COVID-19 protocol is perceived severity 12.1% (95% CI OR: 2.249-65.206) which means that pregnant women with less perceived severity are more at risk of not complying with the COVID-19 protocol 12.1% times compared to pregnant women with great perceived severity.

This modeling is a fit model, it can be seen from -2logL without variables, and after adding variables, there is a significant decrease of 38.916, which means adding variables to the model can affect the fit model. Based on the Nagelkerke R Square, the value is 0.504. It means that the independent variables in the model can explain compliance with the COVID-19 protocol by 58.3% and 41. The other 7% can be explained by factors outside the existing variables. Based on the results of the omnibus test, the p-value was 0.000 <0.05. It can be interpreted that the model formed is declared feasible because it fulfills the significance of the model. The Hosmer and Lemeshow tests show a p-value of 0.258> 0.05, which means that H0

is rejected and H7 is accepted. So the model is fitted with the data, and the model is acceptable.

Respondents in this study were 53.3% aged 15-26 years, 43.0% had a high school education level equivalent, 58.9% were housewife, 51.4% were first pregnancies, and 40.2% were second-trimester pregnancies. Age is related to preventive behavior. Older individuals and not working are more likely to apply less preventive behavior than younger individuals (Liao et al., 2019). Young mothers tend to be creative, curious about information, have a good memory, and could understand information better than older mothers. However, most pregnant women at a young age experience pregnancy disorders related to the immaturity of the reproductive organs and the immune system (Londero et al., 2019). This level of formal education can affect knowledge and decision-making. The lower the level of education, the more difficult it is to receive and understand information (Zannah, 2020). High knowledge will form proper beliefs, attitudes, and prevention practices (Anikwe et al., 2020)

Work related to adherence to health behavior relate to the availability of time owned, working individuals tend to have less time to go to health services (Tambuwun et al., 2021). working mothers were more likely to be disobedient to having their condition checked during a pandemic due to not having time. Pregnant women who have never given birth have a high-risk perception of COVID-19 (Londero et al., 2019). Individuals who do not work have less preventive behavior (Liao et al., 2019). Primiparous pregnant women have no experience dealing with pregnancy, so they have more concerns. Pregnancy and childbirth experiences can reduce perceived risk perceptions and predict preventive behavior (Sari et al., 2021). Nwafor et al., (2020) stated grande multiparous women have 3 times worse health behavior than nulliparas. Multiparous pregnant women have less behavior in preventing COVID-19 because many families can affect the economy, and it becomes difficult to implement the COVID-19 protocol (Ayele et al., 2021). Pregnant women who are positive for COVID-19 in trimesters 1 and 2 are more at risk of experiencing fetal death (IUFD) (Donders et al., 2020) because in this phase, the

organs in the fetus are formed so that the fetus is more easily exposed to the virus resulting in a negative impact on the fetus. Pregnant women infected with COVID-19 in the first trimester of pregnancy experience spontaneous abortion, which is possible due to hypoxia due to acute respiratory distress (Priyadharshini et al., 2021).

Perceived susceptibility is positively related to preventive behavior (Aghababaei et al., 2020). High perceived susceptibility will encourage individuals to do better prevention because they belief that their condition is at a high risk of disease, so perceived susceptibility will encourage preventive behavior (Schwartz and Dhaliwal, 2020). Good perceived susceptibility indicates that the individual believes they are more at risk of contracting the disease, so they take precautions. Then the better the perceived susceptibility, the better the prevention behavior (Zareipour et al., 2020). Perceived susceptibility directly related to health behavior. A research conducted by Jose et al. (2021), stated that increasing perceived susceptibility will reduce health problems. The statement above is in line with the results of this study, where there is a significant influence between perceived susceptibility on compliance with the COVID-19 protocol for pregnant women. Perceived susceptibility can also affect pregnant women's compliance by 12.9%.

Perceived severity refers to the belief in difficulties arising from a medical and social illness so that it can make people more active in carrying out prevention (Mirzaei et al., 2021). perceived severity related to individual beliefs regarding the severity of a disease, the more individuals believe in the impact of the disease, the individual will feel threatened, so they are motivated to carry out health behaviors (Claresta, Christian and Sa'id, 2021). Tong et al. (2020), research shows that perceived severity has a significant relationship with the prevention of COVID-19, which is also supported by research Al-Metwali et al. (2021), which also states that perceived severity is significantly related to receiving the COVID-19 vaccine. This statement is in line with the research results obtaining a significant influence between perceived severity on compliance with the COVID-19 protocol for pregnant women and perceived severity that

can affect compliance for pregnant women.

Perceived benefits can significantly predict infectious disease prevention behavior, as good as being a primary factor in using masks. Perceived benefits are expectations from preventive behavior. Individuals who believe behavior is safe and effective will have a positive attitude and tend to take precautions (Huang, Dai and Xu, 2020). Maharlouei et al. (2020), argues that perceived benefits have a significant relationship with prevention behavior. The relationship between perceived benefits and prevention behavior is possible because when individuals get a lot of benefits from preventing COVID-19, they tend to do all things that can prevent COVID-19. Tao et al. (2021), also state that perceived benefits have a positive relationship with willingness to vaccinate. It is also supported by individuals with high perceived benefits, who tend to be willing to receive the COVID-19 vaccine to protect themselves and others. This statement is in line with the results of this study, where there is a significant influence between perceived benefits on compliance with the COVID-19 protocol for pregnant women. Pregnant women with high perceived benefits tend to be 8.4% more obedient than pregnant women with low perceived benefits.

Perceived barriers are the strongest predictor of health behavior because they can influence the perception of the effectiveness of behavior so that it can motivate individuals to carry out health recommendations (Fall, Izaute and Chakroun-Baggioni, 2018). Individuals must be able to control perceived barriers before engaging in preventive behavior (Bashirian et al., 2020). Perceived barriers refer to a person's belief in the negative impact of changing behavior, for example, considering cost, time, convenience, and side effects. Perceived barriers are inversely related to preventive behavior. The lower the perceived barriers, the higher the possibility of individuals adopting a healthy life. Individuals with low Perceived barriers have a better response to COVID prevention, so to increase adherence, it is necessary to reduce perceived barriers. (Barakat and Kasemy, 2020) argue that perceived barriers are a vital factor because individuals must take control of barriers. Karimy et al. (2017), also significantly

mention that perceived barriers are related to Pap smear test adherence. This statement is in line with the research results, which found a significant effect between perceived barriers on compliance with the COVID-19 protocol for pregnant women. Perceived barriers can affect the compliance of pregnant women by 12.3%.

Fall, Izaute and Chakroun-Baggioni, (2018) argue that self-efficacy is a level of confidence and belief in overcoming barriers to health behavior, self-efficacy is important in overcoming perceived barriers and effective in adopting COVID-19 prevention behaviors. Because to carry out health behaviors, indivi-duals must be confident in their ability to carry out health recommendations (Mirzaei et al.(2021). Self-Efficacy encourages individuals to adhere more to the prevention of COVID-19, with a high level of confidence that it will control individuals to adopt a healthy life. High self-efficacy will overcome barriers felt and effective in preventing COVID-19 (Shahnazi et al. (2020). Self-efficacy can significantly predict the behavior of preventing infectious diseases such as SARS-CoV, MERS, and other respiratory infections (Mirzaei et al., 2021). Research conducted by Khazaeian et al., (2021) also supports this statement by stating that self-efficacy has a positive relationship with cues to act to prevent COVID-19. This statement reinforces the research results obtained in this study that there is a significant influence between perceived self-efficacy on compliance with the COVID-19 protocol for pregnant women and perceived self-efficacy can affect pregnant women's compliance by 14.5%.

In several studies, cues to action are health behavior predictors, as in research by Li et al., (2020; Tao et al., (2021), and others. Cues to action can be influenced by individual views about beliefs about something, which they then apply. Several factors can trigger, such as environment, education, events, or from other people (Claresta, Christian and Sa'id, 2021). But Al-Sabbagh et al. (2022), held a different opinion. They stated that cues to action were not significantly related to the quarantine program. In line with this research, Afro, et. al. (2021), also cues to action are irrelevant to compliance with health protocols during a pandemic. So is research. It can result from the environment

influencing individual intentions to act. Individuals tend to obey if the environment also obeys. Public awareness regarding the law is still lacking, while the deteriorating economic conditions are also the causes of non-compliance with health protocols, as well as the indecisiveness of rules and witnesses that are reasons for individuals not to comply (Sulat et al., 2018). Most individuals tend to ignore internal factors in acting and are more easily influenced by external factors such as the mass media (Alsulaiman and Rentner, 2018). Therefore, health service providers and the mass media must provide appropriate information, especially for high-risk groups (Khazaeian et al., 2021). With so many media and organizational trends that will influence political decisions and make information more diverse which ultimately makes people confused about behavior changes that must be implemented (Jose et al., 2021). This statement supports research results that show no significant effect between perceived cues to action on compliance with the COVID-19 protocol for pregnant women.

The combination of perceived severity and perceived susceptibility will form a perceived threat, which will make individuals more careful (Mirzaei et al., 2021), with a high perceived threat will make individual health behavior better (Jose et al., 2021). If the perceived threat is not considered, then the motivation to take prevention will be low, or when an individual has low perceived susceptibility and perceived severity then information related to his condition will be ignored. The combination of perceived susceptibility and severity will cause a perceived threat in the end. The aspect of this belief will lead to action in the form of compliance with the COVID-19 protocol (Getachew et al., 2022). However, perceived susceptibility may not be included in the modeling if the individual does not experience symptoms, there is a long-term threat or no history of previous illness (Sulat et al., 2018), or there is a belief that the individual will not get sick or have never met a sufferer (Alsulaiman and Rentner, 2018).

Perceived self-efficacy, perceived barriers, and perceived benefits are the main factors in the prevention of behavior because

to understand health problems, individuals must feel the benefits of behavior, and to face obstacles, individuals must also have self-(Mirzaei et al., 2021). Shmueli (2021), also mentioned perceived benefits, perceived barriers, and perceived self-efficacy as keys in health promotion. So adopting the behavior of preventing COVID-19 requires high perceived benefits and perceived self-efficacy, while perceived barriers must be low (Mirzaei et al., 2021). Jose et al. (2021) explained that perceived barriers have a significant effect when the level of perceived barriers low and perceived self-efficacy is high so that it will easily affect perceived benefits. But when perceived self-efficacy and perceived barriers are low, perceived benefits cannot affect behavior.

Conclusion

There is a significant influence between perceived susceptibility, perceived severity, perceived benefits, perceived barriers, and perceived self-efficacy with compliance, but there is no influence between cues to action on compliance. Variables included in the modeling and proven to influence pregnant women's adherence to the COVID-19 protocol include perceived severity, perceived benefits, perceived barriers, and perceived self-efficacy, with perceived severity being the most dominant variable. Recommendations that can be implemented from this research are policy-making and counseling related to the importance of implementing the COVID-19 protocol by considering perceived severity, benefits, barriers, and self-efficacy so that explanations are more acceptable and implemented daily.

References

Afro, R.C., Isfiya, A., & Rochmah, T.N., 2021. Analysis Of Factors Affecting Health Protocols Compliance During Covid-19 Pandemic In East Java Community: Health Belief Model Approach. *Journal Of Community Mental Health And Public Policy* (CMHP), 3(1), pp.1–10.

Aghababaei, S., Soltanian, A., Refaei, M., Omidi, T., Ghelichkhani, S., & Soltani, F., 2020. Perceived Risk and Protective Behaviors Regarding COVID-19 among Iranian Pregnant Women. *Middle East Fertility*

Society Journal, 25(1).

Al-Metwali, B.Z., Al-Jumaili, A.A., Al-Alag, Z.A., & Sorofman, B., 2021. Exploring the Acceptance of COVID-19 Vaccine Among Healthcare Workers and General Population Using Health Belief Model. *Journal of Evaluation in Clinical Practice*, 27(5), pp. 1112–1122.

Al-Sabbagh, M.Q., Al-Ani, A., Mafrachi, B., Siyam, A., Isleem, U., Massad, F.I., Alsabbagh, Q., & Abufaraj, M., 2022. Predictors of Adherence with Home Quarantine During COVID-19 Crisis: the Case of Health Belief Model. *Psychology, Health and Medicine,* 27(1), pp.215–227.

Alsulaiman, S., & Rentner, T., 2018. The Health Belief Model and Preventive Measures: A Study of the Ministry of Health Campaign on Coronavirus in Saudi Arabia. *Journal of International Crisis and Risk Communication Research*, 1(1), pp.27–56.

Anikwe, C.C., Ogah, C.O., Anikwe, I.H., Okorochukwu, B.C., & Ikeoha, C.C., 2020. Coronavirus Disease 2019: Knowledge, Attitude, and Practice of Pregnant Women in a Tertiary Hospital in Abakaliki, Southeast Nigeria. *International Journal of Gynecology and Obstetrics,* 151(2), pp.197–202.

Ayele, A.D., Mihretie, G.N., Belay, H.G., Teffera, A.G., Kassa, B.G., & Amsalu, B.T., 2021. Knowledge and Practice to Prevent COVID-19 and Its Associated Factors Among Pregnant Women in Debre Tabor Town Northwest Ethiopia, a Community-Based Cross-Sectional Study. *BMC Pregnancy and Childbirth*, 21(1), pp.1–12.

Barakat, A.M., & Kasemy, Z.A., 2020. Preventive Health Behaviours During Coronavirus Disease 2019 Pandemic Based on Health Belief Model Among Egyptians. *Middle East Current Psychiatry,* 27(1), pp. 43.

Bashirian, S., Jenabi, E., Khazaei, S., Barati, M., Karimi-Shahanjarini, A., Zareian, S., Rezapur-Shahkolai, F., & Moeini, B., 2020. Factors Associated with Preventive Behaviours of COVID-19 Among Hospital Staff in Iran in 2020: an Application of the Protection Motivation Theory. *Journal of Hospital Infection*, 105(3), pp.430–433.

Claresta, A., Christian, S., & Sa'id, M., 2021. Public Obedience to Health Protocols during COVID-19 Pandemic in Indonesia: A Perspective from Health Belief Model Theory Article Info. *Journal of Social Sciences and Humanities,* 11(2), pp.2021.

Donders, F., Lonnée-Hoffmann, R., Tsiakalos, A., Mendling, W., de Oliveira, J.M., Judlin, P., Xue, F., & Donders, G.G.G., 2020. ISIDOG Recommendations Concerning COVID-19 and Pregnancy. *Diagnostics,* 10(4), pp.1–23.

Fall, E., Izaute, M., & Chakroun-Baggioni, N., 2018. How Can the Health Belief Model and Self-Determination Theory Predict Both Influenza Vaccination and Vaccination Intention ? A Longitudinal Study Among University Students. *Psychology and Health,* 33(6), pp.746–764.

Fransiska, R.D., Kusumaningtyas, D., & Gumanti, K.A., 2022. Analisis Health Belief Model dalam Perilaku Pencegahan Covid-19 pada Ibu Hamil. *Jurnal Kesehatan Vokasional,* 7(1), pp.11.

Gadarian, S.K., Goodman, S.W., & Pepinsky, T.B., 2021. Partisanship, Health Behavior, and Policy Attitudes in the Early Stages of the COVID-19 Pandemic. *PLoS ONE*, 16, pp.1–13.

Getachew, T., Lami, M., Eyeberu, A., Balis, B., Debella, A., Eshetu, B., Degefa, M., Mesfin, S., Negash, A., Bekele, H., Turiye, G., Tamiru, D., Nigussie, K., Asfaw, H., Dessie, Y., Alemu, A., & Sertsu, A., 2022. Acceptance of COVID-19 Vaccine and Associated Factors Among Health Care Workers at Public Hospitals in Eastern Ethiopia Using the Health Belief Model. *Frontiers in Public Health*, 10, pp.1–11.

Huang, X., Dai, S., & Xu, H., 2020. Predicting Tourists' Health Risk Preventative Behaviour and Travelling Satisfaction in Tibet: Combining the Theory of Planned Behaviour and Health Belief Model. *Tourism Management Perspectives*, 33.

Jose, R., Narendran, M., Bindu, A., Beevi, N., Manju, L., & Benny, P.V., 2021. Public Perception and Preparedness for the Pandemic COVID 19: A Health Belief Model Approach. *Clinical Epidemiology and Global Health*, 9, pp.41–46.

Karimy, M., Azarpira, H., & Araban, M., 2017. Using Health Belief Model Constructs to Examine Differences in Adherence to Pap Test Recommendations Among Iranian Women. *Asian Pacific Journal of Cancer Prevention,* 18(5), pp.1389–1394.

Khazaeian, S., 2021. The Health Belief Model. Cambridge Handbook of Psychology, Health and Medicine, Second Edition, pp. 97–102.

Lewis, R.K., Martin, P.P., & Guzman, B.L., 2022. COVID-19 and Vulnerable Populations. *Journal of Community Psychology,* 2022, pp.2537–2541.

Li, Q., Guan, X., Wu, P., Wang, X., Zhou, L., Tong, Y., Ren, R., Leung, K.S.M., Lau, E.H.Y., Wong,

J.Y., Xing, X., Xiang, N., Wu, Y., Li, C., Chen, Q., Li, D., Liu, T., Zhao, J., Liu, M., Tu, W., Chen, C., Jin, L., Yang, R., Wang, Q., Zhou, S., Wang, R., Liu, H., Luo, Y., Liu, Y., Shao, G., Li, H., Tao, Z., Yang, Y., Deng, Z., Liu, B., Ma, Z., Zhang, Y., Shi, G., Lam, T.T.Y., Wu, J.T., Gao, G.F., Cowling, B.J., Yang, B., Leung, G.M., & Feng, Z., 2020. Early Transmission Dynamics in Wuhan, China, of Novel Coronavirus–Infected Pneumonia. *New England Journal of Medicine*, 382(13), pp.1199–1207.

Liao, Q., Wu, P., Lam, W.W.T., Cowling, B.J., & Fielding, R., 2019. Trajectories of Public Psycho-Behavioural Responses Relating to Influenza A(H7N9) Over the Winter of 2014-15 in Hong Kong. *Psychology and Health*, 34(2), pp.162–180.

Londero, A.P., Rossetti, E., Pittini, C., Cagnacci, A., & Driul, L., 2019. Maternal Age and the Risk of Adverse Pregnancy Outcomes: A Retrospective Cohort Study. *BMC Pregnancy and Childbirth*, 19(1), pp.1–10.

Maharlouei, N., Asadi, N., Bazrafshan, K., Roozmeh, S., Rezaianzadeh, A., Roozegar, M.H.Z., Shaygani, F., Kharmandar, A., Honarvar, B., Hemyari, C., Omidifar, N., Zare, M., Lankarani, K.B., 2020. Knowledge and Attitude Regarding COVID-19 Among Pregnant Womenin Southwestern Iran in the Early Period of Its Outbreak: A Cross-Sectional Study. *American Journal of Tropical Medicine and Hygiene,* 103(6), pp.2368–2375.

Mirzaei, A., Kazembeigi, F., Kakaei, H., Jalilian, M., Mazloomi, S., & Nourmoradi, H., 2021. Application of Health Belief Model to Predict COVID-19-Preventive Behaviors Among a Sample of Iranian Adult Population. *Journal of Education and Health Promotion*, 10(1), pp.69.

Motlagh, A., Yamrali, M., Azghandi, S., Azadeh, P., Vaezi, M., Ashrafi, F., Zendehdel, K., Mirzaei, H., Basi, A., Rakhsha, A., Seifi, S., Tabatabaeefar, M., Elahi, A., Pirjani, P., Shoar, L.M., Nadarkhani, F., Khoshabi, M., Bahar, M., Esfahani, F., Fudazi, H., Samiei, F., Farazmand, B., Ahmari, A., Rajabpour, M.V., Janbabaei, G., Raisi, A., Ostovar, A., & Malekzadeh, R., 2020. COVID19 Prevention & Care; A Cancer Specific Guideline. *Archives of Iranian Medicine*, 23(4), pp.255–264.

Nwafor, J.I., Kenechi, J., Aniukwu., Anozie, B.O., & Ikeotuonye, A.C., 2020. Knowledge and Practice of Preventive Measures Against COVID-19 Infection Among Pregnant Women in a Low-Resource African Setting. *medRxiv,* 2020.

Palacios Cruz, M., Santos, E., Cervantes, M.A.V., & Juárez, M.L., 2021. COVID-19, a Worldwide Public Health Emergency. *Revista Clínica Española (English Edition)*, 221(1), pp.55–61.

Panahi, L., Amiri, M., & Pouy, S., 2020. Risks of Novel Coronavirus Disease (COVID-19) in Pregnancy; a Narrative Review. *Archives of Academic Emergency Medicine*, 8(1), pp.e34.

Peng, Z., Rojas, A.L.P., Kropff, E., Bahnfleth, W., Buonanno, G., Dancer, S.J., Kurnitski, J., Li, Y., Loomans, G.L.C., Marr, L.C., Morawska, L., Nazaroff, W., Noakes, C., Querol., X., Sekhar, C., Tellier, R., Greenhalgh, T., Bourouiba, L., Boerstra, A., Tang, J.W., Miller, S.L., & Jimenez, J.L., 2022. Practical Indicators for Risk of Airborne Transmission in Shared Indoor Environments and Their Application to COVID-19 Outbreaks. *Environmental Science and Technology,* 56(2), pp.1125–1137.

Priyadharshini, C.B., Priya, S., Selvameena, M., Waseemsha, S., Muthurajesh, E., & Shalini, M., 2021. Demographic Profile of COVID-19 Positive Mothers & Their Outcome in Government Rajaji hospital, Madurai, Tamilnadu – A Cross Sectional Study. *Clinical Epidemiology and Global Health*, 12, pp.100864.

Sari, D.I., Wahyuni, N., & Sucipto, C.D., 2021. Hubungan Pengetahuan, Paritas, Pekerjaan Ibu dengan Keteraturan Kunjungan Ibu Hamil untuk ANC Selama Masa Andemi Covid-19. *Jurnal Kesehatan Primer,* 6(1), pp.22–31.

Schwartz, D.A., & Dhaliwal, A., 2020. Infections in Pregnancy with Covid-19 and Other Respiratory RNA Virus Diseases are Rarely, if Ever, Transmitted to the Fetus: Experiences with Coronaviruses, Parainfluenza, Metapneumovirus Respiratory Syncytial Virus, and Influenza. *Archives of Pathology and Laboratory Medicine*, 144(8), pp.920–928.

Shahnazi, H., Ahmadi-Livani, M., Pahlavanzadeh, B., Rajabi, A., Hamrah, M.S., & Charkazi, A., 2020. Assessing Preventive Health Behaviors from COVID-19: a Cross Sectional Study with Health Belief Model in Golestan Province, Northern of Iran. *Infectious Diseases of Poverty,* 9(1), pp.1–9.

Shmueli, L., 2021. Predicting Intention to Receive COVID-19 Vaccine Among the General Population Using the Health Belief Model and the Theory of Planned Behavior Model. *BMC public health*, 21(1), pp.804.

Silasi, M., Cardenas, I., Kwon, J.Y., Racicot, K., Aldo, P., & Mor, G., 2015. Viral Infections During

Pregnancy. *American Journal of Reproductive Immunology*, 73(3), pp.199–213.

Siregar, R.N., Aritonang, J., & Anita, S., 2020. Pemahaman Ibu Hamil Tentang Upaya Pencegahan Infeksi Covid-19 Selama Kehamilan. *Journal of Healthcare Technology and Medicine*, 6(2), pp.798.

Subbaraman, N., 2021. Pregnancy and COVID: what the Data Say. *Nature,* 591(7849), pp.193–195.

Sulat, J.S., Prabandari, Y.S., Sanusi, R., Hapsari, E.D., & Santoso, B., 2018. The Validity of Health Belief Model Variables in Predicting Behavioral Change: A Scoping Review. *Health Education,* 118(6), pp.499–512.

Tambuwun, A.A., Kandou, G.D., & Nelwan, J.E., 2021. Hubungan Karakteristik Individu Dengan Kepatuhan Berobat Pada Penderita Hipertensi Di Puskesmas Wori Kabupaten Minahasa Utara. *Jurnal Kesmas,* 10(4), pp.112–121.

Tao, L., Wang, R., Han, N., Liu, J., Yuan, C., Deng, L., Han, C., Sun, F., Liu, M., & Liu, J., 2021. Acceptance of a COVID-19 Vaccine And Associated Factors Among Pregnant Women in China: a Multi-Center Cross-Sectional Study Based on Health Belief Model. *Human Vaccines and Immunotherapeutics,* 17(8), pp.2378–2388.

Tong, K.K., Chen, J.H., Yu, E.W., & Wu, A.M.S., 2020. Adherence to COVID-19 Precautionary Measures: Applying the Health Belief Model and Generalised Social Beliefs to a Probability Community Sample. *Applied Psychology: Health and Well-Being*, 12(4), pp.1205–1223.

Young, M., Crook, H., Scott, J., & Edison, P., 2022. Covid-19: Virology, Variants, and Vaccines. *BMJ Medicine*, 1(1), pp.e000040.

Zambrano, L.D., Ellington, S., Strid, P., Galang, R.R., Oduyebo, T., Tong, V.T., Woodworth, K.R., Nahabedian, J.F., Azziz-Baumgartner, E., Gilboa, S.M., & Meaney-Delman, D., 2020. Update: Characteristics of Symptomatic Women of Reproductive Age with Laboratory-Confirmed SARS-CoV-2 Infection by Pregnancy Status — United States, January 22–October 3, 2020. MMWR. *Morbidity and Mortality Weekly Report*, 69(44), pp.1641–1647.

Zannah, S.N., 2020. Hubungan Karakteristik Dan Pengetahuan Dengan Kepatuhan Upt . Puskesmas Martapura 1 Kabupaten Banjar. *Doctoral Disertation.* Universitas Islam Kaimantan.

Zareipour, M.A., Ardakani, M.F., Moradali, M.R., Jadgal, M.S., & Movahed, E.,2020. Determinants of covid-19 Prevention Behavior in the Elderly in Urmia: Application of Health Belief Model. *Open Access Macedonian Journal of Medical Sciences*, 8(T1), pp.646–650.

Mental Health Education for Pregnant Women during the COVID-19 Pandemic in Surakarta, Indonesia

Yuli Kusumawati[1✉], Widyawati Widyawati[2], Fatwa Sari Tetra Dewi[3]

[1]Department of Public Health, Faculty of Health Sciences, Universitas Muhammadiyah Surakarta, Central Java, Indonesia.
[2]Department of Paediatrics and Maternity Nursing, Faculty of Medicine, Public Health and Nursing, Universitas Gadjah Mada, Yogyakarta, Indonesia
[3]Department of Health Behaviour, Environment and Social Medicine, Faculty of Medicine, Public Health and Nursing, Universitas Gadjah Mada, Yogyakarta, Indonesia

Article Info

Abstract

The main factors increasing the risk of depression are pregnant women's lack of knowledge about recognizing signs and symptoms, early detection, and prevention efforts. The purpose of this study is to examine the impact of mental health education on pregnant Indonesian women's knowledge and self-efficacy during the COVID-19 pandemic. A quasi-experimental study was conducted. Pregnant women in four Surakarta primary health care facilities received antenatal care using Basic Emergency Obstetric Neonatal Care. The inclusion criteria for the sample were 127 pregnant women with a gestational age of 24-36 weeks, no family history of mental disorders, a singleton pregnancy, and participation in the intervention from beginning to end. The study excluded pregnant women who experienced complications during their pregnancy. Sample sizes for the intervention and control groups were 67 and 60 pregnant women, respectively. Personal psychoeducation intervention was provided by trained midwives during antenatal care. During the intervention, materials were presented in modules, and videos were shared through WhatsApp groups and discussions. The Edinburgh Postpartum Depression Scale was used to assess depressive symptoms. The data were analyzed using the paired t-test and independent t-test. Following the intervention, the mean score for knowledge and self-efficacy increased. Depressive symptom scores decreased following the intervention and were significantly different from the control group. Mental health education interventions for pregnant women using modules and videos can improve pregnant women's knowledge and self-efficacy in preventing antenatal and postnatal depression.

Introduction

In the world, people have experienced changes in life since the COVID-19 pandemic in the Chinese city of Wuhan in December 2019. Fear and worry about the transmission of COVID-19 add to stressors in society and affect mental health problems, especially in women. Along with confirmed cases of COVID-19 increasing during the pandemic, the prevalence of perinatal depression is increased (Sun et al., 2020). Most of the transmission of COVID-19 occurs in the third trimester of pregnancy (Centers for Disease Control and Prevention, 2020). Fear of accessing antenatal care (ANC) services during the pandemic has resulted in limited time for further ANC visits for healthy pregnancies(Almeida et al., 2020).

Mental disorders, particularly depression, affect approximately 10% of pregnant women and 13% of postpartum women worldwide. In developing countries the figure is even higher, with 15.6% pregnant and 19.8% postpartum (WHO, 2017). This condition has worsened since the COVID-19 pandemic. During the

COVID-19 pandemic, depression was prevalent in 31% of pregnant women, and postpartum depression was prevalent in 22%. (Yan, Ding, & Guo, 2020). During the COVID-19 pandemic, the prevalence of crisis and depression in pregnant women in Turkey reached 64.5% and 56.3%, respectively (Kahyaoglu Sut & Kucukkaya, 2020).

The lack of knowledge of pregnant women to identify signs and symptoms of depression causes them to be unable to carry out early detection and prevention. Medical risks in pregnancy are higher among pregnant women during the COVID-19 pandemic. High levels of stress and depression are mental health problems due to the COVID-19 pandemic and are even worse in late pregnancy (Medina-Jimenez et al., 2020).

During pregnancy, women experience physical changes, and hormonal functions that result in psychological conditions. However, pregnant women do not aware of the condition well, especially their mood during pregnancy. During antenatal care (ANC), midwives often convey physical changes and possible complaints. Adaptation failure to pregnancy conditions provides their own experiences of pressure, loss, and even depression during pregnancy(The Experience of Psychological Distress, Depression, and Anxiety during Pregnancy: A Meta-Synthesis of Qualitative Research, 2015). Changes in the psychological condition of pregnant women that are less implemented can interfere with the physical health of the mother and her fetus (Firouzan, et.al, 2020; Rotheram-Borus, Tomlinson, Roux, & Stein, 2015; A. Staneva, Bogossian, Pritchard, & Wittkowski, 2015; Stein et al., 2014). A history of mental disorders and domestic violence are risk factors for perinatal depression (Tsai et al., 2016). Life pressure and incidence have a significant relationship with maternal depression during the antenatal and postpartum periods (Flach et al., 2011). Maternal age is very young, low socioeconomic status and lack of social support increase the risk of maternal depression (Vigod et al., 2016).

Pregnant women were anxious and worried about contracting the covid disease. It could increase the risk of pregnant women have mental health disorders, such as anxiety and depression. Limited social activities and access to health services during the pandemic, caused anxiety and depressive symptoms to go undetected. Lack of knowledge about mental health disorders in the perinatal period encourages the need for mental health education, symptoms, screening, and management during pregnancy to prevent more severe conditions (Fairbrother et al., 2015). High-risk groups for mental health issues during the pandemic include women who are pregnant, postpartum, have suffered partner abuse, have had a miscarriage, or all of the above. It is possible to actively reach out to these group of women to prevent, detect, and provide early intervention (Almeida et al., 2020). Therefore, the purpose of this study is to evaluate the efficiency of interventions in mental health education in raising pregnant women's knowledge and self-efficacy in preventing depression.

Methods

This quasi - experimental study used the non - equivalent control group design. Pregnant women who received ANC in four primary health care (PHC) settings in Surakarta, a province in central Indonesia with Basic Emergency Obstetric and Neonatal Care (BEONC), were included in this study, with Sibela and Gajahan PHCs serving as intervention sites and Banyuanyar and Pajang PHCs serving as control sites. Random assignment of the selected PHCs into the intervention and control groups was carried out. The sample was 127 pregnant women with inclusion criteria: those who did ANC at the BEONC health center, gestational age 24-36 weeks, pregnant women who were willing to follow the intervention from the beginning to the end of the study, had no family history of mental disorders, and singleton pregnancy. The exclusion criteria were pregnant women who experienced pregnancy complications, confirmed with COVID-19 and did not complete the intervention process. Participants who did not complete the data and were unable to clarify the data were included in the dropout criteria. The number of samples in the intervention and control groups were 67 and 60 people, respectively. Figure 1 shows a flowchart of the subject recruitment process.
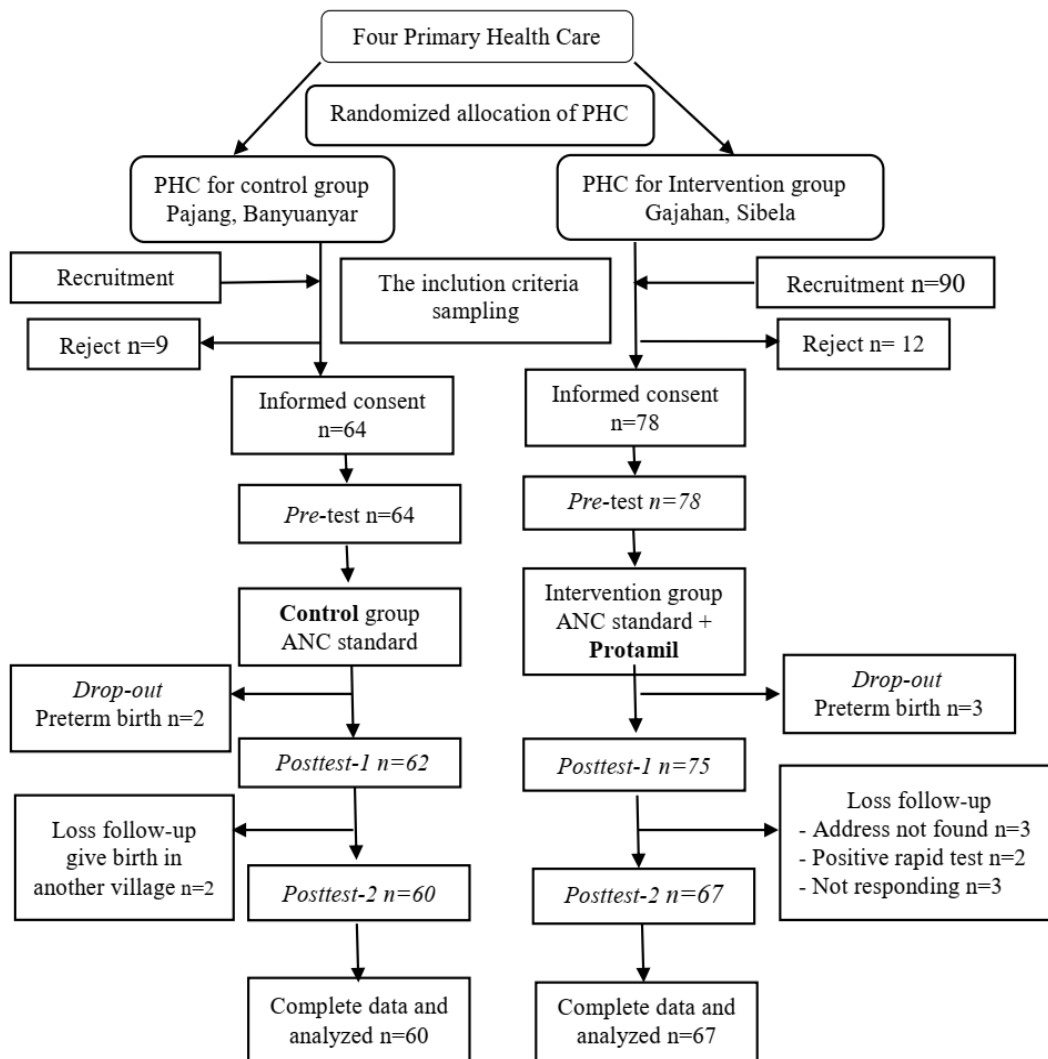
FIGURE 1. Flow chart of the recruitment process

The data collected using a mental health knowledge questionnaire and a self-efficacy questionnaire made by the researchers. The questionnaires comprised demographic questions such as age, education level, employment status, and economic status. The knowledge instrument consisted of 20 questions designed as 'correct' and 'wrong' answer choices. The results of the validity test of the knowledge questionnaire used point-biserial correlation. 20 of the 23 items were declared valid (p-value < 0.05). Three invalid items were dropped. The Kuder-Richardson 20 (KR-20) method was used to assess reliability with a value of 0.717. Therefore, the reliability of the knowledge questionnaire was confirmed (Kusumawati et al., 2021).

The self-efficacy questionnaire consisted of 26 questions designed as answer choices assessed based on a Likert scale (inappropriate=1, somewhat inappropriate=2, somewhat appropriate=3, and appropriate=4). Questions were assessed by a total score of answers. The validity test of the self-efficacy questionnaire used Pearson's product-moment correlation with a coefficient correlation of $r > 0.163$ (p-value < 0.05) on 26 items, and 4 invalid items were deleted. The reliability test used the Cronbach alpha method with a value of 0.71, and the self-efficacy questionnaire was confirmed to be reliable. Depressive symptoms were measured by EPDS(Cox et al., 1987; Hutauruk, 2011).

In this study, mental health education

for pregnant women is called Protamil. The Protamil education intervention took time after entering the new normal period of the COVID-19 pandemic. Pregnant women who agreed to be respondents signed an informed consent after receiving an explanation. Furthermore, the participant filled out the pretest questionnaire. Protamil was carried out in personal psychoeducation by trained midwives when pregnant women perform antenatal care (ANC) at the PHC. Protamil education uses health protocols, namely maintaining physical distance, wearing masks and personal protective equipment (PPE). After a physical examination of pregnancy during ANC, midwifes educate each pregnant woman face-to-face personally for 10-20 minutes.

Educational materials were also provided through media modules, can be brought home and read again with her husband. Protamil video media were displayed on smartphones and distributed to participants' smartphones to be watched back at home. The researchers created a WhatsApp group (WAG) for participants and midwives to facilitate a question-and-answer discussion after the Protamil education process. The posttest was measured two weeks after the next ANC intervention. The baseline conditions, as measured by the mean pretest score of knowledge, self-efficacy, and EPDS, revealed no significant difference between the intervention and control groups (p-value> 0.05), indicating that the two groups were comparable. For categorical data, descriptive analysis displayed the mean score, standard deviation, median, range of data, and proportions. The chi-square, paired t-test, and independent t-test, were used in the analysis, with a significance level of 0.05.

Result and Discussion

The characteristics of pregnant women in the Protamil and control groups are shown in Table 1. Most pregnant women are of reproductive age (20-35 years). There were pregnant women in both the intervention and control groups, with 9% and 3.3%, respectively, who were under the age of 20. Pregnant women in the intervention and control groups were 16 and 19 years old, respectively. In the intervention and control groups, the mean

standard deviation (SD) of pregnant women age was 28.2 6.3 and 28.8 4.8, respectively. Pregnant women in the intervention group (44.8%) and the control group (60.0%) had the highest level of education. According to basic education standards, half of the intervention group (43.2%) was a primary and junior high school graduate, while most of the control group (90%) was a high school and university graduate. Most of the pregnant women were housewives. 70.0% were in the intervention group and 56.7% were in the control group. The characteristics of respondents in the intervention and control groups are similar, except for differences in educational level (p 0.05).

Table 2 shows the mean pretest knowledge score in the intervention group of 12.57 3.17 and the control group of 13.27 2.42. The intervention group's mean knowledge score increased to 13.97 2.94 after two weeks of the Protamil (maternal mental health promotion) intervention. The paired t-test comparing mean knowledge scores revealed a statistically significant difference between mean knowledge scores before and after the Protamil intervention (p-value = 0.000). In the control group, the mean pretest and post-test scores after the intervention were nearly identical, or there was no significant increase. The paired t-test results showed no significant difference between the pretest and post-test (p-value > 0.05).

Table 2 indicates that the mean initial self-efficacy score in the intervention group (75.27 ± 8.34) and the control group (76.58 ± 10.14) was not significantly different $(p > 0.162)$. In contrast, in the intervention group, there was a significant increase in the mean self-efficacy score of 2.07 (p-value = 0.043) after two weeks of the Protamil intervention. Unfortunately, in the control group, there was a slight decrease in mean self-efficacy scores after the intervention. Based on the results of the paired t-test, there was no significant difference in the mean score of self-efficacy between the pretest and posttest scores (p-value = 0.483). We found a significant effect of Protamil education on the mental health knowledge of pregnant women with a moderate effect size (0.47) and on the self-efficacy of pregnant women in preventing depression with a small effect size (0.34). The

paired t-test results concluded that there was a significant difference in the mean score of depression before and after the intervention (p-value = 0.045). In addition, after two weeks of Protamil intervention, the mean EPDS score decreased by 0.84.

TABLE 1. The Characteristics of Pregnant Women in the Intervention and Control Groups

Characteristics	Groups				p-value
	Intervention		Control		
	n=67	(%)	n=60	(%)	
Age (year)					
< 20	6	9.0	2	3.3	0.189
20-35	51	76.1	53	88.3	
>35	10	14.9	5	8.3	
Education level					
Basic education (basic – primary school)	29	43.2	8	10.0	**0.0004**
Intermediate (high school-university)	38	56.8	52	90.0	
Employment					0.232
Housewife	48	70.0	36	56.7	
Employee	19	30.0	24	43.3	
Gravida					
Primigravida	26	38.8	26	43.3	0.736
Multigravida	41	53.2	34	54.3	
Parity					
Nullipara dan primipara	48	71.6	48	80.0	0.372
Multypara	19	28.4	12	20.0	
planned/wanted pregnancy					
Yes	50	74.6	46	76.7	0.952
No	17	25.4	14	23.3	
Poor Obstetric History					
Miscarriage	6	0.09	5	8.33	0.819
Low birth weight	1	0.01	2	3.33	
Stillbirth	1	0.01	0	0.00	
No	9	88.1	53	88.4	
EPDS (antenatal)					
≥ 13 (Depression)	14	20.9	11	18.381.7	0.889
< 13 (Normally)	53	79.1	49		

[a] *Chi-square test*
Source: Primary Data, 2022

TABEL 2. The Results of the Mean Score of Knowledge and Self-Efficacy in the Intervention and (*n* = 67) and Control Groups (*n* = 60)

Variable	Pretest Mean±SD	Posttest Mean±SD	*p*-value	Delta mean Post-pre	Mean difference	SD pooled	Effect size
Knowledge							
Intervention	12.57±3.17	13.97±2.94	**0.000**[a]	1.40±2.9	1.236	2.61	0.47
control	13.27±2.42	13.43±2.81	0.582[a]	0.17±2.3			
p-value[b]	0.162[b]			**0.010**			
Self-Efficacy							
Intervention	75.27±8.34	77.34±9.37	**0.043**[a]	2.07±8.2	2.791	8.05	0.34
control	76.58±10.14	75.87±9.33	0.483[a]	-0.72±7.9			
p-value[b]	0.425[b]			**0.053**			
Score EPDS							
Intervention	10.06±3.93	9.22±4.17	**0.045**[a]	-0.84 ± 3.3	-0.602	3.06	0.19
Control	9.23±3.48	9.00±3.84	0.527[a]	-0.23 ± 2.8			
p-value[b]	0.211[b]			0.279[a]			

[a]*Paired t-test,*   [b]*Independent t test*
Source: Primary Data, 2022

Surakarta's health services for pregnant women have never included education or mental health counseling. There is no data on the prevalence of mental health disorders in pregnant women, but in a preliminary study conducted before the COVID-19 pandemic, 13.3% experienced depression (EPDS>=13). The prevalence of antenatal depression increased to 24.5% during the COVID-19 pandemic. This finding is consistent with the findings of a systematic review, which found an increased prevalence of depression and anxiety in pregnant women in Asian and Western countries during the COVID-19 pandemic (Rahimi et al., 2020). The pandemic of COVID-19 raises the risk of depression and anxiety in pregnant and perinatal women (Hessami et al., 2020; Rahimi et al., 2020). Lockdown and social isolation have a significant impact on depression scores. A lower level of social support was linked to a higher prevalence rate (Rahimi et al., 2020).

The current study indicates that Protamil (maternal mental health promotion) education can improve maternal mental health knowledge scores two weeks after the intervention. The WhatsApp Group (WAG) was created as a means to discuss the material presented because the time for educational interventions at PHC during the pandemic is very limited, and it also aims to reduce the risk of COVID-19 transmission. We recorded the results of consultations for pregnant women in the intervention group. The response of midwives to WAG in the control group was also recorded by the researchers.

The mean knowledge score increased two weeks after the Protamil intervention. In summary, the Protamil intervention was effective in increasing pregnant women's mental health knowledge. This study's findings are consistent with the findings of Park et al's systematic review, which found that psycho-educational interventions have an impact on improving maternal mental health, albeit with a small effect size (Park et al., 2020). In this study, the effect size of the intervention on knowledge was found to be moderate, probably due to differences in the education level of the participants. The education level of pregnant women may have influenced the outcome of the

intervention. The level of education is related to the ease or difficulty of accessing information, receiving, and understanding the information. Women with higher education are better in independently try to access needed information. On the other hand, women with less education depend more on health service providers for health information. In line with previous research in Australia, low education and income are associated with low mental health literacy (Reavley & Jorm, 2011). The higher education level of the control group participants made them more active and independent in seeking mental health information.

The increase in mental health knowledge occurred because of the Protamil education that was delivered by midwives. This improvement can also occur because pregnant women are actively reading the modules provided. According to recommendations, the educational and counseling interventions that midwives provide when providing ANC services can prevent perinatal depression(Curry et al., 2019). However, during the COVID-19 pandemic, the ANC service time at the PHC was shorter. The ANC services provided are shorter, so pregnant women may not fully understand the Protamil education delivered. Providing modules with photo illustrations helps pregnant women to better understand. The video media shared via smartphones also supports increasing knowledge of pregnant women. Smartphones are currently an attractive audiovisual media choice for delivering psycho-educational material to participants in the form of text and images(Luxton et al., 2011).

Based on unstructured interviews in the intervention group, pregnant women had mental health knowledge, pregnancy depression disorder, and their effects after watching videos. Videos with illustrated stories make materials easy to understand. We had never received any mental health information during pregnancy, especially pregnancy depression, its impact on the baby, and how to prevent and treat it. It is in line with the findings of research in Australia that the level of general public knowledge about postnatal mental health is higher than during the prenatal period. Surprisingly, only about a quarter (25%) of respondents could show the negative impact of prenatal anxiety/ depression

on fetal development(Kingston et al., 2014). This shows that the public's attention to mental health is more during the postpartum period than during pregnancy.

Protamil intervention can increase literacy and provide better mental health knowledge. Protamil and ANC standard education differed statistically in the increase in knowledge scores up to the puerperium period. There is a difference in the mean delta value of 0.082 between the intervention and control groups. Protamil is important to be implemented continuously in MCH services to detect changes in physical and mental health conditions during pregnancy. It means that pregnant women will find it easier to find solutions and overcome problems if they understand them correctly.

Protamil seeks to improve the mental health literacy of pregnant women. Based on the previous findings, the materials presented during the intervention were about recognizing pregnant women with depressive disorders, identifying causes, risk factors, and how to deal with depression independently, asking for family support, and finding appropriate help according to the needs and expectations of pregnant women (Guy, Sterling, Walker, & Harrison, 2014; Jorm & Kelly, 2007; Reavley & Jorm, 2011).

Videos help deliver attractive and accessible mental health education materials. Video content that matches the needs and desires of users becomes the foundation for changing health behavior. Video content can have a long-term impact on the message given, although it depends on the ability of the recipient to identify the content presented(Adam et al., 2019). Based on the research results, the provision of information or educational materials using video media can be recommended for use in ANC services at the primary health care to increase the understanding of pregnant women and their families about mental health. The provision of psychoeducation is carried out by trained personnel and is supported by modules and videos that are easy to understand and in accordance with the respondent's needs. The module provided can accompany the Handbook on Maternal and Child Health (MCH) to guide the importance of mental health during pregnancy and childbirth.

Improved mental health knowledge was seen in the intervention group, followed by increased self-efficacy after two weeks of intervention and follow-up during the puerperium. At baseline, the intervention group had lower self-efficacy. It is very likely to be affected by the COVID-19 pandemic, which causes pregnant women to lack confidence in dealing with pregnancy problems.

After two weeks of the Protamil intervention, there was an increase in the self-efficacy of pregnant women. This study is in line with the results of research in Turkey, where antenatal education, in general, can increase self-efficacy in dealing with childbirth, perceived support, and social control in childbirth(Gökçe İsbir et al., 2016). Self-efficacy shows confidence in their ability to cope with everything that affects their life(Bandura, 2006; Eaton, 2008). We argue that self-efficacy can reduce stress and an individual's susceptibility to depression. According to Bandura, individuals with low self-efficacy tend to experience higher levels of stress and depression (Snyder, 2012). In this study, self-efficacy was effective in overcoming depressive symptoms during pregnancy and preventing postpartum depression, as evidenced by their good emotional and mood control. Pregnant women argue that they can confidently deal with physical complaints, especially pain, go through labor smoothly, ask for help and support from their husbands/families, and seek help if they experience problems.

Protamil provides Support and Self-Confidence modules delivered by midwives. An illustration of self-confidence is also shown in the video, so Protamil is expected to increase the self-efficacy of pregnant women after the intervention. At the end of treatment, there was a significant difference in self-efficacy scores between the intervention and control groups in favor of intervention group. Clinically, the Protamil intervention impacted self-efficacy with a small effect size.

Research conducted by Francis et al. found that less educated adults with depressive symptoms who received literacy education programs showed an increase in self-efficacy and a decrease in depressive symptoms(Fakunle

et al., 2014). Thus, to improve self-efficacy, continuous education is needed. After a two-week Protamil intervention, there was an increase in the self-efficacy of pregnant women. The results of this study are in line with the results of research in Turkey, where antenatal education, in general, can increase self-efficacy in dealing with childbirth, enhance perceptions of social support, and improve control of labour(Gökçe İsbir et al., 2016).

In the control group, pregnant women's self-efficacy scores decreased slightly after the intervention. In the posttest, the control group entered the COVID-19 pandemic period. Pandemic conditions cause anxiety and fear, so confidence to solve problems and face childbirth decreases. Also, it is possible to obtain outside information or share experiences with peers and family, sometimes reducing the confidence of the mother to go through labor, especially to deal with the pain and fear of having surgical childbirth.

Higher education makes pregnant women more confident about getting better delivery services. Women with higher education have better self-efficacy in coping and adapting. However, this study is not in line with previous research in Australia which concluded that there is an inconsistent relationship between education level and self-efficacy (Schwartz et al., 2015). Adequate psychosocial adaptation is associated with high self-efficacy scores (Sieber et al., 2006). Thus, research with a more intensive method is needed to provide Protamil education during ANC by involving peers so that it can increase self-efficacy in pregnant women. High self-efficacy in overcoming problems, dealing with childbirth, caring for children, and seeking help can prevent depression during pregnancy and puerperium.

The mean depression score in pregnant women who followed the intervention at baseline was higher than the control group. However, the difference was not statistically significant. Based on the research in China, after the announcement of the COVID-19 pandemic, pregnant women were judged to have a statistically higher level of depressive symptoms than before the COVID-19 pandemic(Wu et al., 2020). Similarly, the COVID-19 pandemic conditions add to the stressor of pregnant women, increase fears and worries about childbirth, and the fear of transmitting COVID-19 to mothers and their babies(Preis et al., 2020).

Protamil education can reduce depression scores in the intervention group. However, the decline was not a definite consequence of Protamil's education. For women with unwanted/unplanned pregnancies in the intervention group, the reduction in depressive symptom scores was not significant. Unwanted pregnancies increase the risk of depression because they are not ready to give birth (Ayano et al., 2019; Getinet et al., 2018), coupled with stressors due to anxiety and fear of COVID-19 transmission(King et al., 2019; Lebel et al., 2020). This decrease can occur naturally due to the decrease in the hormone estradiol after childbirth. However, the drastic decline from very high status to hypo gonad during the early postpartum period may be associated with decreased mood. Concerning the etiology/causes of depression, this condition is associated with increased levels of serotonin transfer which can result in decreased serotonin levels(Brummelte & Galea, 2016).

The obstacle to Protamil education during the pandemic was the limited space for discussion due to physical distance. The shorter ANC service time resulted in limited time for intervention and discussion. Facilitator responses during the discussion forums through WhatsApp Group (WAG) were recorded, only a few received responses from facilitators. However, researchers always ask about the news and condition of pregnant women every three days. Discussion group members also raise questions or make complaints. In this context, pregnant women feel more care and support.

The implications of the Protamil must be given continuously to affect decreasing the mean EPDS score. By the results of previous studies, midwives' repeated brief counseling interventions can reduce depression scores in women who have experienced childbirth trauma. Brief counseling interventions by midwives emphasize the social support approach and overcome limitations in special psychological and psychiatric services in PHC(Asadzadeh et al., 2020).

Conclusion

The Protamil mental health education intervention can help decrease the risk of depression symptoms in women during pregnancy. Statistically, there was an increase in knowledge and self-efficacy, but it was not statistically significant. Clinically, we report no incidence of antenatal depression following the Protamil intervention.

Acknowledgement

References

Adam, M., McMahon, S.A., Prober, C., & Bärnighausen, T., 2019. Human-Centered Design of Video-Based Health Education: An Iterative, Collaborative, Community-Based Approach. *Journal of Medical Internet Research,* 21(1), pp.e12128.

Almeida, M., Shrestha, A.D., Stojanac, D., & Miller, L. J., 2020. The Impact of the COVID-19 Pandemic on Women's Mental Health. *Archives of Women's Mental Health,* 23(6), pp.741–748.

Asadzadeh, L., Jafari, E., Kharaghani, R., & Taremian, F., 2020. Effectiveness of Midwife-Led Brief Counseling Intervention on Post-Traumatic Stress Disorder, Depression, and Anxiety Symptoms of Women Experiencing a Traumatic Childbirth: a Randomized Controlled Trial. *BMC Pregnancy and Chilbirth,* 1, pp.1–9.

Ayano, G., Tesfaw, G., & Shumet, S., 2019. Prevalence and Determinants of Antenatal Depression in Ethiopia: A Systematic Review and Meta-Analysis. *PLoS ONE,* 14(2).

Bandura, A., 2006. Guide for Constructing Self-Efficacy Scales. *Self-efficacy Beliefs of Adolescents*, pp.307–337.

Brummelte, S., & Galea, L.A.M.M., 2016. Postpartum Depression: Etiology, Treatment and Consequences for Maternal Care. *Hormones and Behavior*, 77, pp.153–166.

Centers for Disease Control and Prevention., 2020. *Data on COVID-19 during Pregnancy: Birth and Infant Outcomes Map of Jurisdictions Reporting Birth and Infant Outcome Data as of November 2020, Issue November.*

Cox, J.L., Holden, J.M., & Sagovsky, R., 1987. Edinburgh Postnatal Depression Scale 1 (EPDS) Instructions for using the Edinburgh Postnatal Depression Scale. *British Journal of Psychiatry Source Postpartum Depression N Engl J Med*, 150(3), pp.782–786.

Curry, S.J., Krist, A.H., Owens, D.K., Barry, M.J., Caughey, A.B., Davidson, K.W., Doubeni, C.A., Epling, J.W., Grossman, D.C., Kemper, A.R., Kubik, M., Landefeld, C.S., Mangione, C.M., Silverstein, M., Simon, M.A., Tseng, C.-W., & Wong, J.B., 2019. Interventions to Prevent Perinatal Depression. *JAMA*, 321(6), pp.580.

Eaton, M.M., 2008. Self-efficacy in First-Time Mothers. Dissertation Abstracts International, 69(1), pp.392A.

Fairbrother, N., Young, A. H., Janssen, P., Antony, M.M., & Tucker, E., 2015. Depression and Anxiety During the Perinatal Period. *BMC Psychiatry*, 15(1).

Fakunle, G.A., Ana, G.R., & Ayede, A.I., 2014. Environmental Risk Factors for Acute Respiratory Infections in Hospitalized Children Under 5 Years of Age in Ibadan, Nigeria. *Paediatrics and International Child Health,* 34(2), pp.120–124.

Firouzan, L., Kharaghani, R., Zenoozian, S., Moloodi, R., & Jafari, E., 2020. Effectiveness of a Psycho-Education Intervention by Midwives (BILIEF protocol) on Childbirth Fear and Childbirth Self-Efficacy in Fearful First Time Pregnant Women: a Randomized Controlled Trial. *Research Square*, 2020, pp.1–14.

Flach, C., Leese, M., Heron, J., Evans, J., Feder, G., Sharp, D., & Howard, L.M., 2011. Antenatal Domestic Violence, Maternal Mental Health and Subsequent Child Behaviour: A Cohort Study. *BJOG: An International Journal of Obstetrics and Gynaecology,* 118(11), pp.1383–1391.

Francis, L., Weiss, B.D., Senf, J.H., Heist, K., & Hargraves, R., 2007. Does Literacy Education Improve Symptoms of Depression and Self-Efficacy in Individuals with Low Literacy and Depressive Symptoms? A Preliminary Investigation. *Journal of the American Board of Family Medicine*, 20(1), pp.23–27.

Getinet, W., Amare, T., Boru, B., Shumet, S., Worku, W., & Azale, T., 2018. Prevalence and Risk Factors for Antenatal Depression in Ethiopia: Systematic Review. *Depression Research and Treatment*, 2018.

Gökçe İsbir, G., İnci, F., Önal, H., & Yıldız, P.D., 2016. The Effects of Antenatal Education on Fear of Childbirth, Maternal Self-Efficacy and Post-Traumatic Stress Disorder (PTSD) Symptoms Following Childbirth: an Experimental Study. *Applied Nursing Research*, 32, pp.227–232.

Guy, S., Sterling, B.S., Walker, L.O., & Harrison, T.C., 2014. Mental Health Literacy and Postpartum Depression: A Qualitative Description of Views of Lower Income Women. *Archives of Psychiatric Nursing*, 28(4), pp.256–262.

Hessami, K., Romanelli, C., Chiurazzi, M., & Cozzolino, M., 2020. COVID-19 Pandemic and Maternal Mental Health: A Systematic Review and Meta-Analysis. *Journal of Maternal-Fetal and Neonatal Medicine*. 2020.

Hutauruk, I., 2011. Indonesian Version of the Edinburgh Postnatal Depression Scale: Cross-Cultural Adaptation and Validation. *Jurnal Ilmiah Psikologi Gunadarma*, 5(2), pp.98480.

Jorm, A.F., & Kelly, C.M., 2007. Improving the Public's Understanding and Response to Mental Disorders. *Australian Psychologist*, 42(2), pp.81–89.

Kahyaoglu Sut, H., & Kucukkaya, B., 2020. Anxiety, Depression, and Related Factors in Pregnant Women During the COVID-19 Pandemic in Turkey: A Web-Based Cross-Sectional Study. *Perspectives in Psychiatric Care*, 2020.

King, L.S., Feddoes, D.E., Kirshenbaum, J.S., Humphreys, K.L., & Gotlib, I.H., 2019. *Pregnancy During the Pandemic: The Impact of COVID-19-Related Stress on Risk for Prenatal Depression*, 53(9), pp.1689–1699.

Kingston, D.E., Mcdonald, S., Austin, M.-P., Hegadoren, K., Lasiuk, G., & Tough, S., 2014. The Public's Views of Mental Health in Pregnant and Postpartum Women: a Population-Based Study. *BMC Pregnancy and Childbirth*, 14(1), pp.84.

Kusumawati, Y., Widyawati, W., & Dewi, F.S.T., 2021. Development and Validation of a Survey to Evaluate Mental Health Knowledge: The Casus of Indonesioan Pregnant Women. *Open Access Macedonian Journal of Medical Sciences*, 9(E), pp.1–10.

Lebel, C., MacKinnon, A., Bagshawe, M., Tomfohr-Madsen, L., & Giesbrecht, G., 2020. Elevated Depression and Anxiety Symptoms Among Pregnant Individuals During the COVID-19 Pandemic. *Journal of Affective Disorders*, 277, pp.5–13.

Luxton, D.D., McCann, R.A., Bush, N.E., Mishkind, M.C., & Reger, G.M., 2011. mHealth for Mental Health: Integrating Smartphone Technology in Behavioral Healthcare. *Professional Psychology: Research and Practice*, 42(6), pp.505–512.

Medina-Jimenez, V., Bermudez-Rojas, M. de la L., Murillo-Bargas, H., Rivera-Camarillo, A.C., Muñoz-Acosta, J., Ramirez-Abarca, T.G., Esparza-Valencia, D.M., Angeles-Torres, A.C., Lara-Avila, L., Hernandez-Muñoz, V.A., Madrigal-Tejeda, F.J., Estudillo-Jimenez, G.E., Jacobo-Enciso, L.M., Torres-Torres, J., Espino-y-Sosa, S., Baltazar-Martinez, M., Villanueva-Calleja, J., Nava-Sanchez, A.E., Mendoza-Carrera, C.E., Elvira, C., César, A.T., Cuauhtemoc, C.G., Martinez-Portilla, R.J., 2020. The Impact of the COVID-19 Pandemic on Depression and Stress Levels in Pregnant Women: a National Survey During the COVID-19 Pandemic in Mexico. *Journal of Maternal-Fetal and Neonatal Medicine*, 35(23), pp.1–3.

Park, S., Kim, J., Oh, J., & Ahn, S., 2020. Effects of Psychoeducation on the Mental Health and Relationships of Pregnant Couples: A Systemic Review and Meta-Analysis. *International Journal of Nursing Studies*, 104, pp.103439.

Preis, H., Mahaffey, B., Heiselman, C., & Lobel, M., 2020. Pandemic-Related Pregnancy Stress and Anxiety Among Women Pregnant During the Coronavirus Disease 2019 Pandemic. *American Journal of Obstetrics & Gynecology MFM*, 2(3), pp.100155.

Rahimi, R., Dolatabadi, Z., Moeindarbary, S., Behzadfar, S., Ghasemi, N. F., Tafrishi, R., & Kamali, M., 2020. A Systematic Review of the Prevalence of Mental Health Disorders in Pregnant Women during the COVID-19 Pandemic. *Systematic Review*, 8(11), pp.12397–12407.

Reavley, N.J., & Jorm, A.F., 2011. Recognition of Mental Disorders and Beliefs about Treatment and Outcome: Findings from an Australian National Survey of Mental Health Literacy and Stigma. *Australian & New Zealand Journal of Psychiatry*, 45(11), pp.947–956.

Rotheram-Borus, M.J., Tomlinson, M., Roux, I.L., & Stein, J.A., 2015. Alcohol Use, Partner Violence, and Depression: A Cluster Randomized Controlled Trial Among Urban South African Mothers Over 3 Years. *American Journal of Preventive Medicine*, 49(5).

Schwartz, L., Toohill, J., Creedy, D.K., Baird, K., Gamble, J., & Fenwick, J., 2015. Factors

Associated with Childbirth Self-Efficacy in Australian Childbearing Women. *BMC Pregnancy and Childbirth*, 15(1), pp.29.

Sieber, S., Germann, N., Barbir, A., & Ehlert, U., 2006. Emotional Well-Being and Predictors of Birth-Anxiety, Self-Efficacy, and Psychosocial Adaptation in Healthy Pregnant Women. *Acta Obstetricia et Gynecologica Scandinavica*, 85(10), pp.1200–1207.

Snyder, F.J., 2012. *Brief Introduction to the Theory of Triadic Influence*.

Staneva, A.A., Bogossian, F., & Wittkowski, A., 2015. *The Experience of Psychological Distress, Depression, and Anxiety During Pregnancy: A Meta-Synthesis of Qualitative Research, Midwifery,* 31(6).

Staneva, A., Bogossian, F., Pritchard, M., & Wittkowski, A., 2015. The Effects of Maternal Depression, Anxiety, and Perceived Stress During Pregnancy on Preterm Birth: A Systematic Review. *Women and Birth,* 28(3), pp.179–193.

Stein, A., Pearson, R.M., Goodman, S.H., Rapa, E., Rahman, A., McCallum, M., Howard, L.M., & Pariante, C.M., 2014. Effects of Perinatal Mental Disorders on the Fetus and Child, *The Lancet*, 384.

Sun, G., Wang, F., & Cheng, Y., 2020. Perinatal Depresiion During the COVID-19 Pandemic in Wuhan, China. *The Lancet Psychiatry,* 2020.

Tsai, A.C., Tomlinson, M., Comulada, W.S., & Rotheram-Borus, M.J., 2016. Intimate Partner Violence and Depression Symptom Severity among South African Women during Pregnancy and Postpartum: Population-Based Prospective Cohort Study. *PLoS Medicine*, 13(1).

Vigod, S.N., Wilson, C.A., & Howard, L.M., 2016. Depression in Pregnancy. *British Medical Journal*, 2016, pp.4912–504.

WHO., 2017. *Obesity and Overweight*.

Wu, Y., Zhang, C., Liu, H., Duan, C., Li, C., Fan, C., Fan, J., Li, H., Chen, L., Xu, H., Li, X., & Guo, Y., 2020. Perinatal Depressive and Anxiety Symptoms of Pregnantwomen During the Coronavirus Disease 2019 Outbreak inChina. *American Journal of Obstetrics&Gynecology*, 240.

Angraini Model as Effort to Early Detection of Chronic Energy Deficiency in Pregnancy

Dian Isti Angraini[1✉], Delmi Sulastri[2], Hardisman[3], Yusrawati[4]

[1]Doctoral Program of Public Health, Faculty of Medicine, Andalas University/ Department of Community Medicine and Public Health, Faculty of Medicine, Lampung University, Indonesia.
[2]Department of Nutrition, Faculty of Medicine, Andalas University, Indonesia
[3]Department of Public Health and Community Medicine, Faculty of Medicine, Andalas University, Indonesia
[4]Department of Obstetrics and Gynecology, Faculty of Medicine, Andalas University, Indonesia

Article Info

Abstract

The prevalence of chronic energy deficiency in pregnant women in Indonesia is still high. This condition is one of the unresolved nutritional problems such as stunting. This study aims to develop the Angraini Model, as an effort to early detection of chronic energy deficiency in pregnancy. This research is a quantitative study with a case-control design on 190 CED and non-CED pregnant women in the city of Bandar Lampung. The research took time from October 2018 to July 2021. The data used in this study are 18 indicators and 7 latent variables. Latent variables consist of socioeconomic (education, employment, income, knowledge), culture (age, parity, food taboo), BMI (prepregnancy BMI), laboratory (anemia, iron status, protein status), food intake (energy, protein, fat carbohydrates, iron), weight gain during pregnancy (pregnancy weight gain), and CED (chronic energy deficiency). Data were analyzed using a structural equation model (SEM) with Lisrel software and then built into a web-based expert system. The results of the SEM analysis stated that food intake, laboratory values, and weight gain during pregnancy directly affect the incidence of CED. socioeconomic variables (knowledge, education, employment, and income), culture (age, parity, and food taboo), and prepregnancy BMI indirectly affect the incidence of CED through food intake variables. The model obtained based on SEM analysis is then built in a web-based expert system with the address modelangraini.com. The Angraini model is a web-based expert system that can be used to detect early CED in pregnant women for health workers in primary healthcare facilities.

Introduction

Chronic energy deficiency (CED) is a steady-state at which a person is in energy balance, although at a "cost" either in terms of health risk or as an impairment of functions and health. Chronic energy deficiency can also be defined based on body mass index (BMI) as <18.5 kg/m2 (Dagne, 2021). The prevalence of chronic energy deficiency (CED) in pregnant women in Africa is 23,5% (Desyibelew and Dadi, 2019), in pregnant and lactating women in Rayitu District, Ethiopia is 24% (Gebre et al., 2018), in women of childbearing age (> 18 years) in the city of Midnapore, West Bengal, India by 46,8% (Bose et al., 2007), and in postpartum women (< 1-year giving birth) in the slums of Amritsar city, Punjab, India by 21, 4% (Devgun, Mahajan and Gill, 2014).

The 2018 Indonesia Basic Health Research show that in Indonesia, the prevalence of CED in pregnant women is 17,3%, while in non-pregnant women is 14,5%. The prevalence of CED in pregnant and non-pregnant women in Lampung province is 13,6% and 12,8%. The prevalence of CED in pregnant women in the city of Bandar Lampung is 17,3% greater than the prevalence of CED in Lampung province and several big cities on the island of Sumatra

such as Palembang city (15,7%), Pekanbaru city (13,5%), Padang city (14,7%), the city of Medan (9,1%), the city of Jambi (9,03%), and the city of Banda Aceh (12,83%) (Kemenkes RI, 2018).

Pregnant women with CED will be at risk of giving birth to LBW babies, which, if not handled properly, will be at risk of experiencing stunting (Maulina, Alma and Nurrochmah, 2021). Stunting is a condition in which toddlers have less length or height compared to age and is a chronic nutritional problem (WHO, 2019). Stunting will have short and long-term impacts, including disrupting brain development, intelligence, impaired physical growth, and metabolic disorders in the body as well as increasing the risk of developing degenerative diseases, thereby reducing the quality of the nation's next generation (Prendergast and Humphrey, 2014). Specific nutrition intervention efforts for short toddlers are focused on the 1.000 First Days of Life group, namely Pregnant Women, Breastfeeding Mothers, and Children 0-23 months, because the most effective prevention of short toddlers is carried out on 1,000 HPK (Kemenkes RI, 2018).

The factors determining the CED status of a woman of childbearing age, whether pregnant or not, consist of direct, indirect, basic, and main issues. Direct factors include food intake and illness (infectious diseases, anemia, protein deficiency). Indirect factors include food availability, environment (family, environmental hygiene, culture), history of disease/health, health services, obstetrical status/parity, education, and mother's knowledge (UNICEF, 2015). Programs to address CED in Indonesia are currently in the form of managing pregnant women who have experienced CED by administering recovery food supplementation and administering iron tablets to treat anemia. Existing programs are aimed at overcoming CED problems that have already occurred. There are no programs or activities aimed at early detection of CED from upstream so that pregnant women with CED can be prevented. Reducing CED in women of childbearing age, especially pregnant women, is the key to improving the health of pregnant women and children.

Management of pregnant women with CED must start before they become pregnant (future bride), even from the age of teenage girls. These countermeasures require cross-program coordination through reproductive health education activities for adolescent girls through the School Health Program and Adolescent Caring Health Services, future bride counseling, integrated antenatal care (Integrated Antenatal Services) and need cross-sectoral, organizational support, professionals, community leaders, NGOs, and other institutions (Kemenkes RI, 2018).

Efforts for early detection of future bride women or expectant pregnant women require a model for predicting the risk of CED in pregnant women. This prediction model is built from factors that cause CED, both directly and indirectly, such as food intake (energy, protein, carbohydrates, fat, iron), disease (anemia, iron status, protein status), weight gain during pregnancy, prepregnancy BMI, education, knowledge, family income, work, and abstinence culture, which are then applied to the expert system. The expert system application for early detection of CED in pregnant women is called the ANGRAINI model, which can be used easily and helps doctors, nutritionists, or midwives in predicting CED in pregnant women in primary health care.

Methods

This study is quantitative with a case-control design. This study aims to develop a CED prediction model for pregnant women in Bandar Lampung City and apply it to a web-based expert system. This study was done from October 2018 to July 2021, located in Bandar Lampung City. The sample size was 95 pregnant women with CED and 95 pregnant women non-CED and counted using matched pairs case-control formula. The samples were taken using Multistage Random Sampling.

The inclusion criteria for the case group include mid-upper arm circumference <23.5 cm and being willing to take part in the study, while the inclusion criteria for the control group include mid-upper arm circumference > 23.5 cm and being willing to participate. The exclusion criteria include pregnant women who have a history of malignancy, suffer or have a history of diabetes mellitus, and suffer or have a

history of chronic infectious diseases.

This research consists of 18 indicators and 7 latent variables. Latent variables consist of socioeconomic (education, employment, income, knowledge), culture (age, parity, food taboo), BMI (prepregnancy BMI), laboratory (anemia, iron status, protein status), food intake (energy, protein, fat carbohydrates, iron), weight gain during pregnancy (pregnancy weight gain) and CED (chronic energy deficiency). Data on education, employment, income, age, parity, and weight gain in pregnancy by interviews. Data on knowledge and food taboo were obtained by completing a validated questionnaire accompanied by an enumerator. Body Mass Index data is obtained by measuring body weight and height. Anemia data was obtained by examining hemoglobin using the cyanmeth-haemoglobin method and reading it with a spectrophotometer. Data on iron status were obtained by examining serum ferritin using the ELISA method. Data on protein status were obtained by examining serum albumin using the bromine cresol green method. Chronic energy deficiency data is obtained by measuring the circumference of the mid-upper arm.

Development of a CED prediction model for pregnant women through SEM (structural equation modeling) analysis with Lisrel software, which is then applied in a web-based expert system. Development of a prediction model for CED in pregnant women on a web-based expert system according to the specifications with the help of IT experts called the Angraini Model. The Angraini model was developed to be accessible online via the modelangraini.com address. The Angraini model developed was validated by three experts, namely an IT expert (technology and informatics) as a media expert, an educational media expert (professor in the field of education) as an expert in media products, and a professor in the field of nutrition as a material expert. Furthermore, the model was tested on 33 pregnant women who were carried out in 5 health centers in the city of Bandar Lampung (Kedaton, Satelit, Gedong Air, Campang Raya, and Panjang Health Centers).

Results and Discussion

The predictive model development for chronic energy deficiency (CED) in pregnant women is based on structural equation modeling (SEM) analysis. Structural equation modeling analysis was built from 18 indicators and 7 latent variables. Latent variables consist of socioeconomic, culture, BMI, laboratory, food intake, weight gain during pregnancy, and CED (chronic energy deficiency). Socioeconomic latent variables are constructed from 4 indicators, namely SOS1 (Education), SOS2 (work), SOS3 (income), and SOS4 (knowledge). The cultural latent variable is constructed from 3 indicators, namely BUD1 (age), BUD2 (parity), and BUD3 (food taboo). The latent BMI variable was constructed from 1 indicator, namely BMI1 (BMI before pregnancy). The latent variable of food intake is constructed from 5 indicators, namely E1 (energy intake), E2 (carbohydrate intake), E3 (protein intake), E4 (fat intake), and E5 (iron intake). Laboratory latent variables were constructed from 3 indicators, namely LAB1 (anemia), LAB2 (protein status), and LAB3 (iron status). The latent variable for weight gain during pregnancy is constructed from 1 indicator, namely BB1 (weight gain during pregnancy). The latent variable of CED (chronic energy deficiency) is built from 1 indicator, namely KEK1 (incidence of CED). In the SEM analysis, CED is directly constructed from the latent variables of food intake and lab. Socioeconomic and cultural latent variables contribute to CED variables indirectly, namely through the latent variable of food intake. The results of the SEM analysis are presented in Figure 1.

The SEM analysis shows the value of chi-square = 166,46; df=98, p value=0,055, RMSEA=0,0432. The requirements for good SEM data are that they must pass CFA (confirmatory factor analysis) and the goodness of fit model. A good confirmatory factor analysis (CFA) can be seen from a comparison of the chi-square value with df, the p-value, and the RMSEA value. Based on the results obtained in the model above, only the comparison of the chi-square value with the degree of freedom (df), the p-value, and the RMSEA value fulfills the

requirements. The results of the SEM analysis also show that several indicators have a loading factor above 0,5, which means they are quite good at measuring the latent factor. Among them, there is an indicator of body weight against body weight latent factor; indicators of energy, carbohydrates, fats, proteins, and iron on food intake latent factors, as well as CED indicators on the latent factor of Chronic Energy Deficiency. Meanwhile, even though the other indicators have a loading factor of less than 0,5, these indicators still correlate with the latent factor.

The value of the goodness of fit model shows that the value of the goodness of fit index (GFI) is 0,963; the root mean square error of approximation (RMSEA) value of 0,0432; comparative fit index (CFI) value of 1,000; the adjusted goodness of fit index (AGFI) value was 0,948 and the normed fit index (NFI) value was 1,000. If one or two of the fit criteria for the model have been met, the model has been declared fit. From the various fit indicator, the proposed measurement model is fit because all indicators of Goodness of Fit are met.
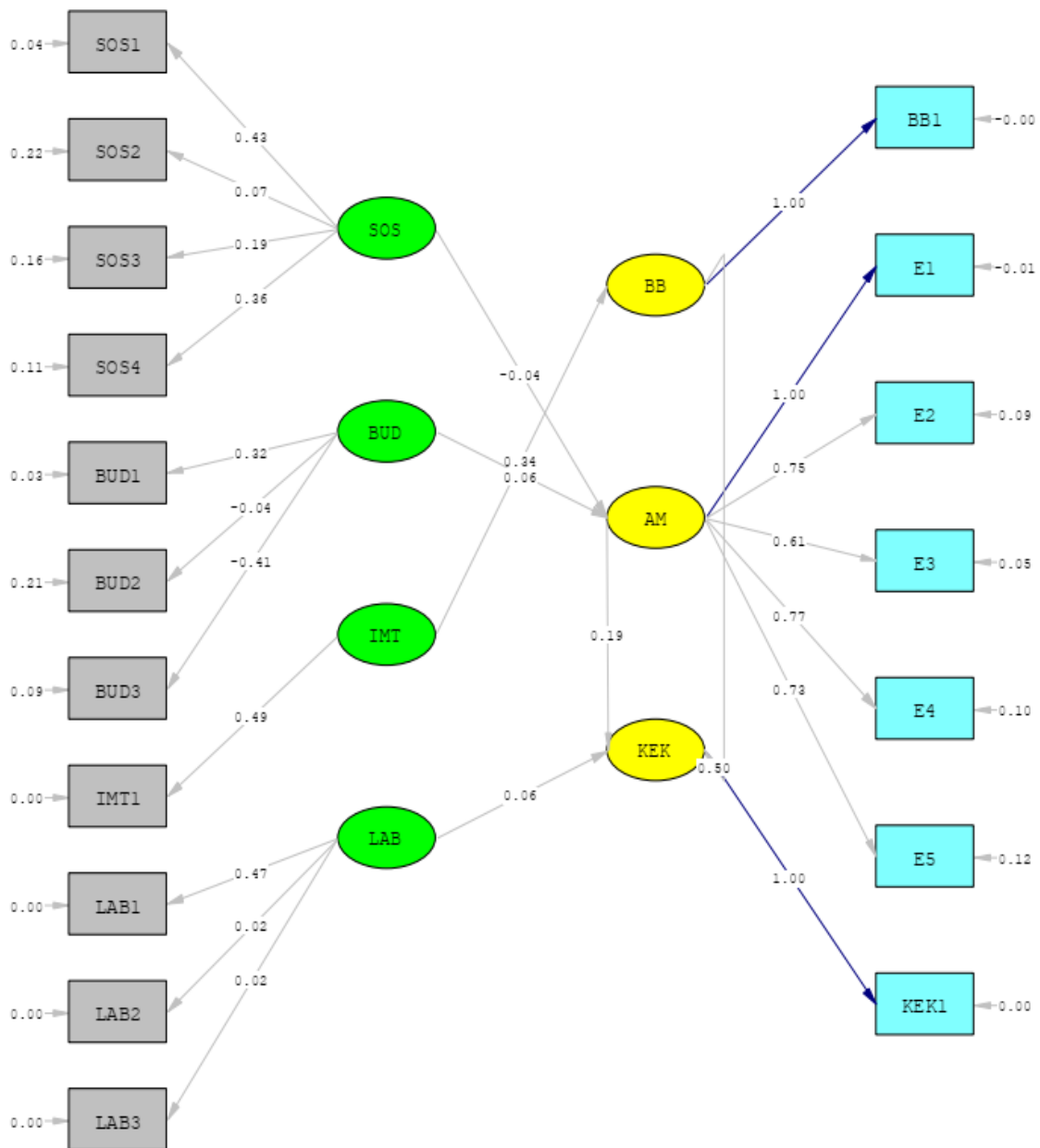

Figure 1. SEM Analysis Model for Predicting Chronic Energy Deficiency in Pregnant Women

The results of the SEM analysis stated that food intake, laboratory values, and weight gain during pregnancy directly affect the incidence of CED. Food intake, laboratory values, and weight gain during pregnancy have a positive relationship with the incidence of CED. Low food intake (energy, protein, carbohydrates, fat, and iron) will cause CED (b=0,19), low laboratory values (anemia, low protein status, and low iron status) will cause CED events (b= 0,06), and less weight gain during pregnancy will lead to CED (b = 0,5).

Food intake is measured based on indicators of food intake (energy, protein, carbohydrates, fat, and iron), socioeconomic (knowledge, education, employment, and income), and culture (age, parity, and food taboo). Thus, the socioeconomic variables (knowledge, education, employment, and income) and culture (age, parity, and food taboo) indirectly affect the incidence of CED through the variable food intake. Laboratory variables were measured based on indicators of hemoglobin values (anemia), serum albumin (protein status), and serum ferritin (iron status). The variable of weight gain during pregnancy is measured based on the variables of weight gain during pregnancy and BMI before pregnancy, so the variable of BMI before pregnancy has an indirect effect on the incidence of CED through the variable of weight gain during pregnancy.

Intake of energy, protein, fat, carbo-hydrates, iron, and cultural variables had a positive effect on food intake (b=1,00; b=0,75; b=0,6; b=0,77; b=0,73; b = 0,06), while socio-economic variables have a negative effect (b = -0,04). Low intake of energy, protein, fat, carbohydrates, and iron, as well as cultural factors (age at risk, low parity, and food taboo), cause CED. Low socioeconomic factors (lack of knowledge, basic education, work, and income less than regional minimum wage) do not cause KEK. Education, occupation, income, and knowledge positively affect socioeconomic variables (b=0,43; b=0,07; b=0,19; b=0,36). Age positively affects cultural variables (b=0,32), while parity and food taboo have a negative effect; b=-0,04; b=-0,41). The results of the SEM analysis of the factors that contribute to the prediction of CED in pregnant women are presented in Table 1.

The prediction model for chronic energy deficiency (CED) in pregnant women based on SEM analysis is: CED = 0,19 {1,00 inadequate energy intake + 0,75 inadequate carbohydrate intake + 0,61 inadequate protein intake + 0,77 inadequate fat intake + 0,73 inadequate iron intake) – 0,04 (0,43 basic education + 0,07 work + 0,36 poor of knowledge + 0,19 income less than regional minimum wage)) + 0,06 (0,32 risky age – 0,04 low parity – 0,41 food taboo)} + 0,06 {0,47 anemia + 0,02 low protein status + 0,02 low iron status} + 0,5 {1,00 low of weight gain + 0,34 low of BMI before pregnancy}.

Increased energy in pregnant women is used for the growth and development of the fetus, placenta, and maintenance of health. Pregnant women who consume food with several calories below the recommended adequacy for a long time will result from a risk of CED, which can cause the fetus to grow imperfectly. Energy intake requirements in pregnancy match the demands of resting metabolism, physical activity, and tissue growth. Energy balance in pregnancy is. Therefore, it is defined as energy intake equal to energy expenditure plus energy storage. A detailed understanding of these components and their changes throughout gestation can inform energy intake recommendations for minimizing the risk of poor pregnancy outcomes (Most et al., 2019). Energy should be balanced, otherwise, it will have a detrimental effect on the body. Energy deficiency occurs when energy consumption through food is less than the energy expended (Hill, Wyatt and Peters, 2013). As a result, the body weight is less than the body weight should be (ideal). If it occurs in infants and children, it will interfere with growth. Whereas if it occurs in adults will damage the tissue and experience weight loss (Hill, Wyatt and Peters, 2012).

Inadequate intake of nutrients both before and during pregnancy can cause pregnant women to be malnourished (Mousa, Naqash and Lim, 2019). The needs of pregnant women are greater than those of non-pregnant women. Pregnant women's energy needs should be added according to gestational age (Desyibelew & Dadi, 2019). The energy needs of pregnant women in the first trimester are added by 180 kcal/day. In the second trimester they are added by 300 kcal/day, and in the

third trimester, they are added by 300 kcal/day. The energy gain is used for the growth and development of the fetus, placenta, and maintenance of health. Pregnant women who consume food with several calories below the recommended adequacy for years will result in a risk of CED, which can cause the fetus to grow imperfectly (Most et al., 2019).

Protein functions as a building material for the body's structural functions (collagen and elastin), and as a regulator (the formation of hormones and enzymes). Protein also functions as a carrier for specific proteins and as a mediator in the immune response (Bandzerewicz and Gadomska-Gajadhur, 2022). Meeting the protein needs of pregnant women is vital because healthy fetal growth depends on the availability of adequate protein

from the mother (Desyibelew & Dadi, 2019). Protein is the basic building material needed for the formation of enzymes, antibodies, muscles, and collagen. Collagen is used as a framework for skin, bones, blood vessels, and other body tissues. During pregnancy, the mother consumes enough protein to meet the increasing needs of herself and the developing fetus. Protein is a source of energy after glycogen, a catalyst for biochemical reactions in the body, and a constituent of cell and tissue structures (Marangoni et al., 2016). Therefore, individuals must get adequate protein intake because protein deficiency will harm an individual, especially pre-conceptional women, pregnant women, and adolescent women (Darnton-Hill and Mkparu, 2015).

Table 1. Results of SEM Analysis of Factors That Play a Role in Predicting Chronic Energy Deficiency in Pregnant Women

Dependent Variables	Independent Variables	b
Structural		
Direct Influence		
Chronic Energy Deficiency	←Food Intake	0,19
	←Laboratory	0,06
	←Weight gain during pregnancy	0,5
Indirect Influence		
Food Intake	←Socioeconomic	-0,04
	←Culture	0,06
Weight gain during pregnancy	←Weight gain	1,00
	←BMI before pregnancy	0,34
Measurements		
Food intake	←Inadequate energy intake	1,00
	←Inadequate protein intake	0,61
	←Inadequate carbohydrate intake	0,75
	←Inadequate fat intake	0,77
	←Inadequate iron intake	0,73
Socioeconomic	←Poor knowledge	0,36
	←Basic Education	0,43
	←Occupation (work)	0,07
	←Income less than regional minimum wage	0,19
Culture	←Risky age	0,32
	←Low parity	-0,04
	←Food taboo	-0,41
Laboratory	←Anemia	0,47
	←Low protein status	0,02
	←Low iron status	0,02

N observations = 190
Chi ^{2} = 166,4
p=0,00554
RMSEA=0,0432
GFI=0,948
CFI=1,000
Source: Results of SEM analysis using Lisrel, 2021

Consumption of carbohydrates as the biggest energy contributor must be adjusted to the needs of the body. In addition to excessive intake, which will lead to excess weight, if the intake is lacking, there will be a state of protein-energy deficiency (Henselmans et al., 2022). Lack of energy in the body will cause changes in carbohydrates, proteins, or fats to become energy sources so that the main functions of these three nutrients will decrease. If this change lasts for a long time, there will be changes in body weight and tissue damage. Energy in the human body can arise due to the burning of carbohydrates, proteins, and fats, so humans need sufficient food substances to fulfill their energy adequacy (Desyibelew & Dadi, 2019).

The increased need for iron during pregnancy is compounded by the occurrence of pregnancy at too young an age. It is because, in pregnancy, at a very young age, there is still growth that requires more nutrients (Abu-Ouf and Jan, 2015). Meanwhile, with the physiological condition of pregnancy, there will be demands for other needs to meet the baby growth. This condition causes vulnerability to the fulfillment of nutrients which will have an impact on competition between mothers and their babies (Amir, Susetyowati & Fatmawati, 2018).

Maternal weight gain during pregnancy is directly correlated with the incidence of CED because they both describe the adequacy of pregnant women's food intake during pregnancy (Mousa, Naqash and Lim, 2019). Gaining less pregnant weight will cause the risk of stunted fetal growth (intrauterine growth retardation/ IUGR, low birth weight/ LBW) and premature (Blake et al., 2016). The results of Lathifah's research (2019) on 80 pregnant women in Panjang, Bandar Lampung city, found that inappropriate weight gain for pregnant women was associated with low birth weight (LBW) (p=0,002). The nutritional status of pregnant women determines the weight of babies born. The nutritional adequacy of pregnant women can be seen from their weight gain during pregnancy. Low or inappropriate maternal weight gain has a high risk of giving birth to an LBW baby.

A mother's pre-pregnancy BMI is considered to be able to show the nutritional quality of the mother in the pre-pregnancy period as well as indicate the availability of nutrients in the mother's body tissue before pregnancy which will have an impact on the mother's health and fetal growth while in the womb (Bonakdar et al., 2019). The risk of giving birth to an under-weight baby for gestational age decreases along with an increase in BMI before entering pregnancy. Body Mass Index before pregnancy is the most appropriate research to predict the quality of babies born (Ningrum & Cahyaningrum, 2018).

The pregnant women's education level will affect their knowledge about nutrition and health during pregnancy. Knowledge of good nutrition during pregnancy will shape the eating behavior of pregnant women so that they have adequate food intake according to their needs (Mohammadi et al., 2022). The housewives' formal education often has a positive relationship with the development of consumption patterns in the family. Education will affect a mother's knowledge, especially related to health. Mothers with good nutritional knowledge will choose foods that are more nutritious than those that are less nutritious (Muliawati, 2012). Mother's knowledge of high caution signs is not due to age, education, gravida, family support, or sources of information. Women have good knowledge about the cautious signs of pregnancy because they participate in pregnant woman classes in which they gain knowledge (Rina and Meliati, 2020).

A person's occupation can directly describe income, social status, education, and health problems. Occupation can measure socioeconomic status as well as health problems and conditions in which a person works. Women in rural areas mostly work as unpaid family workers. These facts show that women are only used as human resources needed to meet market needs for the consideration of the country's economy and not for the benefit of women. Therefore, women are the "entrance gate" to improving family welfare (Najoan and Manampiring., 2011). Pregnant women who work have less time to prepare food which affects the amount of food consumed. So it affects the nutritional status of pregnant women.

Young age is related to a woman's

readiness to get pregnant, both physically and mentally, thus affecting her food intake. According to Haryani, Darmono & Rakhmawatie (2013), pregnant women less than 20 years old are biologically not optimal, tend to be emotionally unstable, and mentally immature. So they are prone to shocks which results in a lack of attention to meeting the needs of nutrients during pregnancy. Parity is one of the factors causing CED in pregnant women. Parity is the number of children born to a mother. Parity is divided into nulliparas, primiparas, multiparas and grandemultiparas (Mgaya et al., 2013). Nullipara is a woman who has never given birth to a fetus, primipara is a woman who has given birth to a fetus once, multipara is a woman who has given birth to a fetus >1x, and grande-multipara is a woman who has given birth to a fetus >5x (Manuaba et al., 2012; Chakona & Shackleton, 2019).

Food taboos are food ingredients or dishes that individuals in a society are not allowed to eat for cultural reasons. Some abstinence patterns are only adhered to by a section of society or by a larger section of the population. Another diet only applies to groups within some populations and a particular time (Chakona and Shackleton, 2019). If the taboo pattern applies to the entire population and throughout their lives, malnutrition tends not to develop as if the taboo only applies to some groups of people during one stage of the cycle (Susanti, Rusnoto and Asiyah, 2013).

This prediction model is then applied to a web-based expert system that meets specifications. The development of this program is continued with the implementation phase to build the program with programming languages and databases as well as other tools needed. This program was developed using the PHP programming language and MySQL database. In this phase, a database is formed along with the tables needed to store the data used in the simulation. The main functions and program support are also developed according to the software design defined in the design phase.

This prediction model is an online expert system accessed at modelangraini.com, which starts with filling in identity, socioeconomic and cultural data, nutritional knowledge questionnaires, abstinence from eating questionnaires, food intake data for the last 24 hours (nutrition), laboratory values and conclusions and suggestions. The conclusion contains a description of each indicator, and the conclusion is CED risk. The risk/ not at risk of CED was concluded from the final value of the calculation with a cut-off point of 0,28 (the mean score for the calculation of the group of pregnant women who are not CED) that is not at risk of CED (final score <0,28) and risk of CED (final score> 0,28). Chronic energy deficiency risk is divided into 3, namely low risk (final score > 0,28 – 0,66), moderate risk (final score > 0,67 – 1,04), and high risk (final score > 1,04).

The final part of this prediction model is the suggestion section, given according to the results of the prediction model description. The Angraini model was tested on 33 pregnant women in 5 health centers in Bandar Lampung. From the results of the trial implementation of the use of the Angraini model as a prediction model for CED in pregnant women, the results showed that 9 people (27,27%) were not at risk of CED, 4 people (12,12%) were at low risk of CED, 1 person (3,03%) was at risk being CED and 19 people (57,58%) were at high risk of CED. Based on the results of monitoring and evaluation 2 months after the trial, pregnant women who were not at risk of CED were 10 people (30,31%), at low risk were 4 people (12,12%), at moderate risk were 7 people (21,21%) and high risk as many as 12 people (36,36%). The results of trials and evaluations of the implementation of the Angraini Model to predict CED in pregnant women are presented in Table 2.

Table 2. Results of Testing and Evaluation of the Implementation of the Angraini Model as a Prediction Model for Chronic Energy Deficiency (CED) in Pregnant Women

KEK risk	Trials		Evaluation	
	f	%	f	%
No Risk	9	27,27	10	30,31
Low Risk	4	12,12	4	12,12
Moderate Risk	1	3,03	7	21,21
High Risk	19	57,58	12	36,36

Source: Result of Frequency Distribution the Implementation of the Angraini Model, 2021

A predictive model for chronic energy deficiency (Angraini Model) in pregnant women, was developed through a web-based expert system. An expert system is a system that seeks to adopt human knowledge into computers so that computers can solve problems usually done by experts. A considerably good expert system is designed to solve a particular problem by imitating the work of experts. With the development of an expert system, ordinary people can solve quite complex problems that can only be solved with the help of experts. For experts, it will also help their activities as highly experienced assistants. The expertise transfer from experts to computers and then to other people who are not experts is the main goal of expert systems. This process requires 4 activities, namely: additional knowledge, knowledge representation, knowledge inference, and transfer of knowledge to users. Knowledge stored on a computer is referred to as a knowledge base (Kusumadewi, 2013). Maternal nutrition status may influence the level of maternal and infant morbidity, where it may contribute to the high allocation of health financing (Kurniawan, Sistiarani and Hariyadi, 2017).

The predictive model for chronic energy deficiency (Angraini model) in pregnant women, is expected to be able to imitate the work of health experts in the early detection of the risk of chronic energy deficiency in pregnant women. With this expert system, health workers (doctors, midwives, nutrition workers) at primary health care services can carry out initial screening and evaluation of the risk of chronic energy deficiency (CED) in pregnant women, starting from the first time they come to the health service facility until the end of their pregnancy. This expert system is also expected to be able to assist in the eating behavior of pregnant women to avoid the risk of chronic energy deficiency (CED).

Artificial intelligence is one of the fastest-developing areas of science that covers a remarkably wide range of problems to be solved. It has found practical application in many areas of human activity. As well as in medicine. The use of expert systems or artificial intelligence in the field of medicine and health at this time is vital. With the existence of early detection tools in the form of expert systems or artificial intelligence can facilitate screening activities or early detection of risks for individual health problems so that they can be quickly identified and immediately intervened in prevention or treatment programs (Pac, Mikutskaya and Mulawka, 2021).

Expert systems or other artificial intelligence applications in the health sector already exist. Examples are the Permata Bunda simulator which is used to detect or screen for risk under the red line in toddlers, the Regita Model to detect early the risk of complications of pregnancy and childbirth, SOBAR's software (Screening of Behavior and Risk) Model for Cervical Cancer Prevention Classification to detect early risk of cervical cancer for women of childbearing age, the game application Titeer (Tie in smartphone Teen pregnancy prevention Revolution) as an instrument and promotional media used in youth health service programs, and so on. The existence of a web-based expert system as an instrument for predicting chronic energy deficiency in pregnant women (Angraini Model) can add to the digital society platform reference in the field of public health, which is expected to be able to improve public health status.

Conclusion

Angraini's model, as an early detection tool for CED in pregnant women, can help health workers such as doctors, midwives, and

nutritionists at primary care health facilities. Angraini models are available online, open, and free access via modelangraini.com. The Angraini model can be used to improve the eating behavior of pregnant women so that it can reduce the risk of CED in pregnancy and stunting in toddlers. With this model, it is hoped that it can overcome and prevent nutritional problems in Indonesia.

References

Abu-Ouf, N.M., & Jan, M.M., 2015. The Impact of Maternal Iron Deficiency and Iron Deficiency Anemia on Child's Health. *Saudi Medical Journal,* 36(2), pp.146–149.

Amir, S., Susetyowati., & Farmawati, A., 2018. Social Demographic Characteristics and Consumption of Iron in Pregnant Women Based on Data from the 2014 Total Diet Study (SDT) in Indonesia. *JGKI*, 15(2), pp.59-65.

Bandzerewicz, A., & Gadomska-Gajadhur, A., 2022. *Into the Tissues: Extracellular Matrix and Its Artificial Substitutes: Cell Signalling Mechanisms', Cells*, 2022.

Blake, R.A., Park, S., Baltazar, P., Ayaso, E.B., Monterde, D.B.S., Acosta, L.P., Plveda, R.M., Tallo, V., & Friedman, J.F., 2016. LBW and SGA Impact Longitudinal Growth and Nutritional Status of Filipino Infants. *PLoS ONE*, 11(7).

Bonakdar, S.A., Motlagh, A.R.D., Bagherniya, M., Ranjbar, G., Daryabeygi-Khotbehsara, R., Mohajeri, S.A.R., & Safarian, M., 2019. Pre-pregnancy Body Mass Index and Maternal Nutrition in Relation to Infant Birth Size. *Clinical Nutrition Research*, 8(2), pp.129.

Bose, K., Bisai, S., Das, P., Dikshit, S., & Pradhan, S.,2007. Relationship of Income with Anthropometric Indicators of Chronic Energy Deficiency among Adult Female Slum Dwellers of Midnapore Town. *Journal of Human Ecology,* 22(2), pp.171–176.

Chakona, G., & Shackleton, C., 2019. Food Taboos and Cultural Beliefs Influence Food Choice and Dietary Preferences among Pregnant Women in the Eastern Cape, South Africa. *Nutrients,* 11(11).

Darnton-Hill, I., & Mkparu, U.C., 2015. Micronutrients in Pregnancy in Low- and Middle-Income Countries. *Nutrients*, 2015. pp.1744–1768.

Dagne, S., Menber, Y., Wassihun, Y., Dires, G., Abera, A., Adane, S., Linger, M., & Haile, Z.T., 2021. Chronic Energy Deficiency and Its Determinant Factors among Adults Aged 18–59 Years in Ethiopia: A Cross-Sectional Study. *Journal of Nutrition and Metabolism*, 20(21), pp.1-8.

Desyibelew, H.D., & Dadi, A.F., 2019. Burden and Determinants of Malnutrition Among Pregnant Women in Africa: A Systematic Review and Meta-Analysis. *PLoS ONE*, 2019.

Devgun, P., Mahajan, S., & Gill, K., 2014. Prevalence of Chronic Energy Deficiency and Socio Demographic Profile of Women in Slums of Amritsar city, Punjab, India. *International Journal of Research Health Science,* 2(2), pp.527–532.

Gebre, B., Biadgilign, S., Taddese, Z., Legesse, T., & Letebo, M., 2018. Determinants of Malnutrition Among Pregnant and Lactating Women Under Humanitarian Setting in Ethiopia. *BMC Nutrition*, 4(1).

Haryani, F.D., Darmono, S.S., & Rakhmawatie, M.D., 2013. Correlation between Characteristics, Level of Energy Consumption, Level of Protein Consumption, and Frequency of Pregnancy Checks with Weight Gain in the Second Trimester of Pregnant Women. *Jurnal Kedokteran Muhammadiyah*, 1(2), pp.32-41.

Henselmans, M., Bjørnsen, T., Hedderman, R., Vårvik, F.T., 2022. The Effect of Carbohydrate Intake on Strength and Resistance Training Performance: A Systematic Review. *Nutrients*, 2022.

Hill, J.O., Wyatt, H.R., & Peters, J.C., 2012. Energy Balance and Obesity. *Circulation,* 126(1), pp.126–132.

Hill, J.O., Wyatt, H.R., & Peters, J.C., 2013. The Importance of Energy Balance. *European Endocrinology,* 9(2), pp.111–115.

Lathifah, N.S., 2019. Relationship of Maternal Weight Gain During Pregnancy to Baby's Weight at Birth at Bps Wirahayu Panjang Bandar Lampung. *Jurnal Ilmu Kedokteran Dan Kesehatan,* 6(4), pp.274-279.

Kurniawan, A., Sistiarani, C., & Hariyadi, B., 2017. Early Detection of High Risk Pregnancy. *Jurnal Kesehatan Masyarakat,* 12(2), pp.96–103.

Marangoni, F., Cetin, I., Verduci, E., Canzone, G., Giovannini, M., Scollo, P., Corsello, G., & Poli, A., 2016. Maternal Diet and Nutrient Requirements in Pregnancy and Breastfeeding. An Italian Consensus Document. *Nutrients,* 2016.

Maulina, E.E.T., Alma, L.R., & Nurrochmah, S., 2021. Relationship of Chronic Energy Deficiency, Birthweight and Exclusive Breastfeeding with Stunting in Kedungrejo Village, Pakis District, Malang. *KnE Life Sciences*, 2021,

pp.102-114.

Mgaya, A.H., Massawe, S.N., Kidanto, H.L., & Mgaya, H.N., 2013. Grand Multiparity: is It Still a Risk in Pregnancy?. *BMC Pregnancy and Chilbirth,* 13(24), pp.1–8.

Kementerian Kesehatan Republik Indonesia (Kemenkes RI)., 2018. *Hasil Riset Kesehatan Dasar (RISKESDAS) Indonesia 2018*. Jakarta: Kemenkes RI.

Mohammadi, A., Effati-Daryani, F., Ghelichkhani, F., Zarei, S., & Mirghafourvand, M.,. 2022. Effective Factors on Nutrition Behaviors of Pregnant Women Based on the Beliefs, Attitudes, Subjective Norms, and Enabling Factors Model: A Cross-Sectional Study. *Journal of Education and Health Promotion*, 11(1), pp.12.

Most, J., Dervis, S., Haman, F., Adamo, K.B., & Redman, L.M., 2019. Energy Intake Requirements in Pregnancy. *Nutrients*, 2019.

Mousa, A., Naqash, A., & Lim, S., 2019. Macronutrient and Micronutrient Intake During Pregnancy: An Overview Of Recent Evidence. *Nutrients*, 2019.

Muliawati S., 2012. Factors Causing Chronic Energy Lack of Pregnant Women at the Sambi Health Center, Sambi District, Boyolali Regency in 2012. *Jurnal Ilmiah Rekam Medis dan Informatika Kesehatan,* 3(3).

Najoan, J.A., & Manampiring, A.E., 2011. Relationship with Socio-Economic Level With Chronic Energy Deficiency in Pregnant Women in West Kombos Village, Singkil District, Manado City. *Laporan Penelitian.* Fakultas Kedokteran Universitas Samratulangi, Manado.

Ningrum, E.W., & Cahyaningrum, E.D., 2018. Pre-Pregnancy Nutritional Status Affects Birth Weight and Body Length. MEDISAINS: *Jurnal Ilmiah Ilmu-ilmu Kesehatan,* 16(2), pp.89-94.

Pac, M., Mikutskaya, I., & Mulawka, J., 2021. Knowledge Discovery from Medical Data and Development of an Expert System in Immunology. *Entropy,* 23(6).

Prendergast, A.J., & Humphrey, J.H., 2014. The Stunting Syndrome In Developing Countries. *Paediatrics and International Child Health*, 34(4), pp.250-265.

Rina, D.A., & Meliati, L., 2020. The Implementation of Healthy Food Diet for High-Risk Pregnant Woman (Amaris) Class on The Level of Knowledge and Attitude of Pregnant Woman. *Jurnal Kesehatan Masyarakat,* 16(2), pp.182–191.

Susanti, A., Rusnoto., & Asiyah, N., 2013. Food Taboo Culture, Economic Status and Nutrition Knowledge of Pregnant Women in Third Trimester Pregnant Women with Nutritional Status. *JIKK*, 4(1), pp.1–9.

United Nations Children's Fund (UNICEF)., 2015. *UNICEF's Approach to Scaling Up Nutrition for Mother and Their Children. Nutrition Section, Programme Division United Nations Children's Fund (UNICEF)*. New York: UNICEF.

World Health Organization (WHO)., 2019. *Stunting In A Nutshell.*

The Incidence of Hypertension in Internal Polyclinic in Latemmamala Hospital Soppeng

Ida Leida Maria[1✉], Maftur Al Rafi[1], Rismayanti Hafidz[1], Firman[2]

[1]Departement of Epidemology, Faculty of Public Health, Hasanuddin University, Makassar, Indonesia
[2]Faculty Of Vocational Studies, Hasanuddin University, Indonesia

Article Info

Abstract

Hypertension, otherwise known as high blood pressure, is a condition that describes blood pressure significantly in the interval above 140/90 mmHG, which results in the death of 9.4 million people every year worldwide, with the incidence of the problem increasing over time. According to WHO, it is predicted that 1.28 billion or about 42% of people worldwide are diagnosed with hypertension, and the results of the 2018 Riskesdas suggest that the prevalence of hypertension in Indonesia increased to 34.1% from 25.8% in 2013. The type of research used is analytic observational with a cross-sectional study approach. The population in this study were all visitors recorded in the Internal Medicine Clinic register book at Latemmamala Hospital from January to December 2021, namely 707 people. The sampling technique used was simple random sampling with a total sample size of 148 people. This study finds that nutritional status (p=0.002), total cholesterol levels (p=0.000), abdominal circumference size (=0.000), and family history (p=0.000) had a relationship with the incidence of hypertension. As well as, type of work (p=0.078), marital status (p=0.916), stress level (p=0.079), smoking habits (p=0.261), and physical activity (p=0.376) have no relationship with the incidence of hypertension. This study shows a relationship between nutritional status, cholesterol levels, abdominal circumference size, and family history of hypertension. It is highly recommended for people with hypertension adopt a healthy lifestyle, such as maintaining a diet and regular physical activity to keep their blood pressure under control.

Introduction

It is predicted that 1.28 billion or about 42% of people worldwide are diagnosed with hypertension, where every 2 or 3 of them live in countries with middle to lower economic income. Yet 46% of them are not aware of it. Thus, hypertension is the leading cause of death worldwide (WHO, 2021). It affects 9.4 million people annually worldwide, and the incidence is increasing. It is estimated that hypertension cases, especially in developing countries, will increase by 80% from 639 million cases in 2000 to 1.15 billion by 2025. This prediction is based on the increase in the total population today. In addition, it is also based on the increase in the number of people with hypertension every year (Pramana, 2016).

While among all regions based on WHO regions in 2013, the highest prevalence of events was found in the African continent (46%), and the lowest was found in the Americas (35%). Meanwhile, in the Southeast Asia region alone, approximately 36% of adults suffer from hypertension (Ayukhaliza, 2020). In Indonesia alone, the population over 18 years and over shows a prevalence of 25.8% (Pramana, 2016). Then, the prevalence of hypertension increased again in 2018 by 34.1%, where the sufferers were mostly female residents, whose percentage reached 36.85%. As for the distribution by province, South Kalimantan ranks first as the province contributing the highest incidence of hypertension reaching 44.1%, while the province contributing the lowest incidence of

hypertension is Papua which only amounted to 22.2% (Riskesdas, 2018).

In Soppeng Regency, non-communicable diseases (NCDs) are the most dominating diseases in healthcare facilities, both hospitals and health centers. The most common disease is hypertension. This disease is always included in the category of the 3 highest diseases every year. Data from the Soppeng District Health Office found that essential hypertension occupied the highest position with the highest number of cases, reaching 24,778 cases with a percentage of 20% of the category of the 10 highest diseases in Soppeng (Soppeng District Health Office, 2019).

Hypertension is caused by two types of factors, unchangeable and changeable. The unchangeable factors include age, gender, and race. Meanwhile, changeable factors are closely related to a person's lifestyle, such as obesity, nutrition, alcohol consumption, lack of exercise, excessive salt consumption, family factors, and smoking habits (Setyanda et al., 2015). The process of hypertension experienced by a person is based on risk factors in each individual. For example, if a person has a nutritional status expressed in a high BMI number, it will increase the risk of developing hypertension. It is associated with high cardiac output and vascular resistance in the body. Individuals with high BMI have different vascular resistance than people with normal BMI. In addition, a person's high BMI over time can lead to an increase in blood pressure due to a strong increase in the renin-angiotensin-aldosterone mechanism (Gosal, 2020).

Then, the employment status factor has a 3.2 times chance of contributing to hypertension. It is because employment status is closely related to a person's economic level. Where, as is known, several types of diseases also arise in individuals who have middle to lower incomes as well as the level of stress that can arise from the job (Spruill et al., 2019). In line with this, socio-demographic factors that also affect the incidence of hypertension are marital status. It is based on the fact that people who do not have a life partner or live alone have a related health status and have the potential to experience stress (Lebuso & De Wet- Billings, 2022).

In addition, cholesterol levels also affect the incidence of hypertension. High cholesterol levels will lead to atherosclerosis which has the potential to clog arteries. The accumulation of cholesterol will result in the hardening of the arterial ducts. Then, the arteries will experience stiffness, and their flexibility will disappear. Thus, it will interfere with the function of these arteries in controlling blood pressure. As a result, hypertension will occur (Hidayati et al., 2020). Obesity factors such as central obesity also influence the incidence of hypertension. It is because the fat content in the body of an obese person can cause blockages in blood vessels, increasing the risk of a gradual increase in blood pressure (Pramana, 2016).

Family History also affects hypertension. It is because hypertension is closely related to genetic factors. These factors affect several genes that play a role in vascular regulatory reactions and also sodium regulation in the kidneys. So, if someone has a history of hypertension in their family, it will allow them to experience hypertension when compared to people who do not have a history of hypertension in their family (Taslima & Husna, 2017).

The state of stress is caused by the body's inability to respond to the demands of the burden it experiences. These demands can come from various aspects such as work, environment, and factors from the body (Nurdiansyah et al., 2020). Then, smoking habits against hypertension also play a vital role. The nicotine content in cigarettes will cause the accumulation of atherosclerotic plaque in the blood vessels, which disrupts it. If this situation occurs, it will certainly have the potential for someone to suffer from hypertension (Setyanda et al., 2015).

Another factor that contributes to the incidence of hypertension is low physical activity. It happens because if a person has less physical activity, there will be increased activation of one type of nerve, namely the sympathetic nerve, which affects the activation of renin - angiotensin- aldosterone (RAA), which results in increased secretion of the renin enzyme. Increased renin enzyme will cause an increase in angiotensin II and aldosterone, resulting in vasoconstriction and an increase in intravascular volume, which increases blood

pressure (Ilmaniar et al., 2021).

Latemmamala Hospital is a health service referral center in Soppeng Regency, which has a high number of people with hypertension. Based on data sourced from Hospital Medical Records in the 2019-2021 interval, the total incidence of hypertension reached 1551 cases. Where the most in 2019 were 766 cases and again increased to 484 cases in 2021, which had previously decreased in incidence in 2018 with only 301 cases (Latemmamala, 2021).

Therefore, researchers are interested in choosing this location as a place of research. This study will try to examine in more depth how far the attachment of the variables previously studied is, in addition to the addition of new variables in this study, which have also never been studied in the facility waiter in addition to the addition of new variables in this study that have also never been studied in health care facilities before, such as in terms of nutritional status including Body Mass Index (BMI), and Abdominal Circumference Size. In addition, socio-demographic aspects include marital status and employment status. In addition, this study has not been done before because researchers tested variables that

Methods

The type of research used is an observational analytic quantitative approach with a cross-sectional study design. This research was conducted at the Internal Medicine Clinic of Latemmamala Hospital, Soppeng Regency. It took time from January to December 2021. The population in this study were all patients visiting the Internal Medicine Clinic of Latemmamala Hospital, Soppeng Regency, totaling 707 patients. The sample was 148 patients. The sampling technique used simple random sampling. Data collection using instruments in this study used the Perceived Stress Scale (PSS) questionnaire, Global Physical Activity Quitionare (GPAQ), and medical records as secondary data instruments. The data were analyzed using the univariate analysis method and bivariate analysis with the chi-square test approach. The data that has been analyzed will then be presented in the form of tables, namely frequency distribution tables (one-way tabulation) and cross-tabulation (two-way-tabulation). The presentation of data in the form of narratives will also be used to discuss the interpretation of the results.

Result and Discussion

Based on Table 1, respondents who have hypertension status are mostly female patients as many as 33 people (41.25%), and the least are male patients who are only 23 people (33.82%). Table 2 shows that four variables are related, namely nutritional status (p= 0.002), cholesterol levels (p= 0.000), abdominal circumference size p= 0.000), and family history (p= 0.000). Table 3 shows that the variable that has the most influence on the incidence of hypertension in Latemmamala Hospital, Soppeng Regency is the cholesterol level, with an OR value of 6.991. It indicates that patients who have high cholesterol levels have a 6.991 times chance of causing hypertension.

Table 1. Distribution of Hypertension Status in Internal Medicine Poly Patients at Latemmamala Hospital, Soppeng Regency

| Gender | Hypertension Status | | | | | |
| | No Hypertension | | Hypertension | | Total | |
	n	%	n	%	n	%
Male	45	66,17	23	33,82	68	100,00
Famale	47	58,75	33	41,25	80	100,00
Total	**92**	62,16	**56**	37,83	148	100,00

Source: primary data, 2021

Table 2. Bivariate Analysis

Independent Variables	Hypertension Status				Total		P Value
	No Hypertension		Hypertension				
	n	%	n	%	n	%	
Nutritional Status							
Thin	3	42.85	4	57,14	7	100.00	
Normal	52	77,61	15	22.38	67	100.00	0.002
Fat	37	50.00	37	50.00	74	100.00	
Occupation							
Private	36	64,28	20	35,71	56	100.00	
Civil servant	12	66,67	6	33,33	18	100.00	0.078
Not Work	44	59,45	30	40,54	74	100.00	
Marital Status							
Married	60	61.85	37	38,14	97	100.00	
Not Married	32	62,74	19	37,25	51	100.00	0.916
Total Cholesterol Levels							
Low	70	76.08	22	23.91	92	100.00	
High	22	39,28	34	60,71	56	100.00	0.000
Size of Circumference Stomach							
Not Normal	51	51.00	49	49.00	100	100.00	
Normal	41	85.41	7	14.58	48	100.00	0.000
Family History							
Has History	30	36,14	53	63.85	83	100.00	
No History	62	95.38	3	4.61	65	100.00	0.000
Stress Level							
Low	2	50.00	2	50.00	4	100.00	
Moderate	87	64,92	47	35.07	134	100.00	0.079
High	3	30.00	7	70.00	10	100.00	
Habit Smoke							
Non Smoker	61	58,65	43	41.34	104	100.00	
Heavy	21	65,62	11	34,37	32	100.00	0.261
Currently	5	71,42	2	28.57	7	100.00	
Moderate	5	100.00	0	0.00	5	100.00	
Physical Activity							
Not enough	28	57,14	21	42	49	100.00	
Enough	64	64,64	35	35,35	99	100.00	0.376

Source: primary data, 2021

Table 3. Multivariate Analysis

Variables	B	Sig.	OR	95% CI
Nutritional Status	0.000	0.999	1,000	0.339 - 2.954
Cholesterol levels	1,945	0.000	6,991	2.396 - 20.396
Stomach Size Circumference	-1921	0.014	0.032	0.339 - 2.954
Family History	-3814	0.000	0.022	0.005 – 0.089

Source: primary data, 2021

From this study, the most hypertension status is found in patients who are male compared to female. Where most women who experience hypertension are those who have menopause.16 This is closely related to changes in estrogen hormone concentrations which drastically decrease so that more women are at risk of hypertension. The role of hormone estrogen in premenopausal women plays a role in protectingblood vessels from damage (Kusumawaty et al., 2016). Nutritional Status is a condition that shows equilibrium between the nutrients that enter the body by the needs of the individual. The balance is measured through growth variables, including body weight and height.18 The results of statistical tests show

a relationship between nutritional status and the incidence of hypertension in the Internal Medicine Clinic of Latemmamala Hospital. As for this study, 37 people (50.00%) included in the nutritional status of obesity who suffer from hypertension and 52 people (77.61%) in normal nutritional status who are not hypertensive. So, the researcher's argumentation stated that the comparison of people with normal nutritional status tends to be more who are not hypertensive than people who are obese. The percentage of hypertension experienced by respondents who are overweight (obesity) occurs because of the imbalance between the incoming energy that exceeds the energy coming out of the body that occurs within a certain period. If this condition is left unchecked, it can be considered a vital predictor for diseases related to hypertension (Ali et al., 2022).

Based on the results of statistical tests to see the relationship between the type of work and the incidence of hypertension, the p-value is 0.078, which means that there is no relationship between the type of work and the incidence of hypertension in patients at the Internal Medicine Clinic of Latemmamala Hospital, Soppeng Regency. This study did not relate because most respondents were in the non-working category, where the respondents' jobs are as housewives and retirees. So it can affect the results of the study. In addition, this study also found that both working and non-working respondents had high hypertension status. Therefore, regardless of working or not working, a person still has the potential to suffer from hypertension due to other exposure factors that affect the type of work a person does. For example, those who work can experience work stress or lack of income, or for individuals who do not work, the onset of hypertension can come from a lack of physical activity (Ilmaniar et al., 2021; Wibowo et al., 2021).

Marital status is a situation where they have lived together and have been legally recognized by the community around them (Badan Pusat Statistik RI, 2012). Based on the results of the Chi-Square test conducted on the marital status variable with the incidence of hypertension, the test results obtained (p = 0.916), concluded that it did not get the results on the relationship between marital status and

the incidence of hypertension in patients at the Internal Medicine Clinic of Latemmamala Hospital, Soppeng Regency. A total of 37 people (38.14%) of respondents who have a partner or in this case married status suffer from hypertension, and there are 60 people (61.85%) who also have no partner status (unmarried / divorced/divorced dead) who are not hypertensive. The existence of a similar proportion between married and unmarried status allegedly causes (Kirnawati et al., 2021). Then, the same results in various other studies. For example, at the main health care center in the northern part of Nablus City, West Bank Palestine where it was found that there was no association between marital status and the incidence of hypertension in people seeking treatment at the health facility with a value of (p=0.104) (Tuoyire & Ayetey, 2019).

According to the researcher's argument, if viewed literally, marital status is a factor that is not constant or can change so that it does not directly affect a person's hypertension status. It is because a person can get divorced in the future and then get married again several times. In addition, the increase in women who decide to become career women causes them not to marry. Thus, despite the various research results obtained, the marital status variable is still interesting to study (Nainggolan & Nainggolan, 2021).

Based on the results of statistical tests to see the relationship between total cholesterol levels and the incidence of hypertension, the value (p=0.000) means that there is a significant relationship between total cholesterol levels and the incidence of hypertension. Total cholesterol with the incidence of hypertension in patients at the Internal Medicine Poly Latemmamala Hospital Soppeng Regency. The results of this study are as conducted by (Trimarco et al., 2022), stating high cholesterol levels can increase cardiovascular risk in patients with hypertension. Based on multivariate analysis, we can know that cholesterol levels have an influence of 6.991 times on the incidence of hypertension. Then, another study also found a p-value <0.05 in the results of the test of the relationship between total cholesterol levels and both types of blood pressure, both systole and diastole, which were obtained (p=0.002) and

117

(p=0.001) respectively (Fierdania & Handayani, 2022).

The high level of total cholesterol that causes hypertension is closely related to the condition of hardened arteries. Plaque that accumulates on the walls of arterial vessels will cause narrowing. If this condition occurs, it will reduce the ability of arterial vessels to stretch. In addition, lifestyle factors such as poor diet (often consuming fatty foods or containing high cholesterol) will result in hypercholesterolemia, the accumulation of cholesterol that enters through food will break down in blood vessels into plaque. It can lead to hypertension (Naim et al., 2019).

Waist circumference is a measure used as an alternative to determining body fat distribution. In addition, it can also be used in evaluating a person's excess nutrition (Mulyasari & Pontang, 2018). Based on the results of statistical tests to see the relationship between abdominal circumference size and the incidence of hypertension, the value (p=0.000) means that there is a significant relationship between abdominal circumference size and the incidence of hypertension in patients at the Internal Medicine Clinic of Latemmamala Hospital, Soppeng Regency. There were 49 (49.00%) respondents with abnormal abdominal size who suffered from hypertension, and 41 people (85.41%) who had standard abdominal size who did not suffer from hypertension. The measurement of abdominal circumference aims to detect aspects of abdominal obesity, better known as central obesity. This situation will provide an overview of the accumulation of fat that occurs in the abdominal cavity. The greater the size of the abdominal circumference shows excessive levels of fat accumulation in the abdomen (Spruill et al., 2019).

Family history in genetics is defined as the presence of genetic factors and a history of disease in the family. It can identify a person with a higher risk of developing a disease (Tozo et al., 2022). Where it can also be experienced by family members for generations. There were 53 people (63.85%) respondents who had a family history of hypertension, and there were 62 people (95.38%) who did not have a family history of not suffering from hypertension. After conducting statistical tests to see the

relationship between abdominal circumference size and the incidence of hypertension, the results showed that the value (p=0.000), which means that there is a significant relationship between family history and the incidence of hypertension in patients at the Internal Medicine Clinic of Latemmamala Hospital, Soppeng Regency. These results are consistent with other studies conducted in Riau and Bandar Lampung. Where, the p-value <0.05 was obtained, namely (p=0.000) after the Chi-Square bivariate test between hypertension and family history. So, it can be concluded that there is a significance between family history variables and the incidence of hypertension (Andriyani et al., 2021; Erma Kasumayanti, 2020). The gene factor in human chromosomes is closely related to several genes that trigger hypertension. The presence of gene determinants in certain families can cause someone in the family to suffer from hypertension. Where individuals who have a family history of hypertension will be at twice the risk of people who do not have a history of hypertension (Musfirah & Hartati, 2021). Based on the results of statistical tests to see the relationship between stress levels and the incidence of hypertension, it was found that the value (p=0.079) means that there is no significant relationship between stress and the incidence of hypertension in patients at the Internal Medicine Clinic of Latemmamala Hospital, Soppeng Regency. There were 47 (35.07%) respondents who had mild stress levels suffering from hypertension, and there were 87 people (64.92%) who also had mild levels who did not experience hypertension.

However, the inconsistency found in the research with the existing theory may be because most of the respondents obtained in this study are not working, or in this case, housewives and retirees. Thus, those who do not work tend not to find significant burdens. As is known, excessive burden can cause stress. It can come from various factors, including one's job. A common type of stress arising from work is psychosocial stress. An increase in sympathetic nerve activity and malfunctioning of the adrenal hypothalamus-pituitary for people experiencing psychosocial stress will make blood pressure become persistent which leads to an increase in blood pressure. Acute

stress can induce a transient elevation of blood pressure (BP) (Elsaid et al., 2021). The researcher's argument is that it means it is not experienced by people who do not work. This is because people who do not work are less mentally and physically involved in living their lives because the demands/loads of work are not there.

Based on the results of statistical tests to see the relationship between smoking habits and the incidence of hypertension, the results show that the value (p=0.261), which means that there is no significant relationship between smoking habits and the incidence of hypertension in patients at the Internal Medicine Clinic of Latemmamala Hospital, Soppeng Regency. There were 43 (41.34%) respondents who had non-smokers suffering from hypertension, and there were 61 people (58.65%) who were also non-smokers who did not suffer from hypertension. Then the inconsistency in another study found that there was no relationship between smoking habits in terms of the number of cigarettes smoked per day with the occurrence of hypertension in Surabaya. Where the results obtained are (p=0.150) (Lusno et al., 2020). A greater proportion of non-smokers compared to smokers (both heavy, moderate, and light) was found in this study. It is because generally more respondents were female. In theory, the prevalence of smokers is more prevalent in men. This factor is motivated by the culture that develops in society that smoking among men is something that is natural and no longer taboo or in other words, more significant in men (Kim et al., 2018).

Based on the results of statistical tests to see the relationship between physical activity and the incidence of hypertension, the results show that the value (p=0.376) meaning no significant relationship between physical activity measures and the incidence of hypertension in patients at the Internal Medicine Clinic of Latemmamala Hospital, Soppeng Regency. A total of 35 (35.35%) respondents had sufficient physical activity and suffered from hypertension, and 64 people (64.64%) with less physical activity did not suffer from hypertension. The suitability of the study found no relationship between physical activity and blood pressure in 150 adults in West Bandung Regency with test results (p=0.521) (Sihotang & Elon, 2020). Then, two other studies also found no significance between the physical activity variable and the incidence of hypertension. The amount of p-value obtained after the test concluded the same thing, namely physical activity was not associated with the incidence of hypertension. The p-values obtained are (p=0.160) and (p=0.297) respectively (Ramadhani, 2021; Yuri Ekaningrum et al., 2021). In addition, research conducted in the Netherlands also found no relationship between blood pressure and the total intensity of physical activity performed by a person with a value of (p=0.548) (ten Velde et al., 2021).

Conclusions

Based on research on factors related to the incidence of hypertension in the Internal Medicine Clinic of Latemmamala Hospital, Soppeng Regency, several conclusions were drawn, namely the relationship between nutritional status, cholesterol levels, abdominal circumference size, and family history of hypertension in the Internal Medicine Clinic of Latemmamala Hospital, Soppeng Regency. The research suggestion is that people with hypertension who already have risk factors, such as obese nutritional status and an abnormal abdominal circumference size or have central obesity, should further increase their physical activity, such as exercising regularly and not doing sedentary activities so that these two factors can be controlled. In addition, limiting fatty intake or alow-fat diet so that cholesterol can be controlled. As well as, implementing a CERDIK lifestyle, including regular health checks, not smoking, regular physical activity, a diet with balanced nutrition, adequate rest, and managing stress.

References

Ali, N., Mahmud, F., Akter, S.A., Islam, S., Sumon, A.H., Barman, D.N., & Islam, F., 2022. The Prevalence of General Obesity, Abdominal Obesity, and Hypertension and Its Related Risk Factors Among Young Adult Students in Bangladesh. *Journal of Clinical Hypertension*, 24(10), pp.1339–1349.

Andriyani, L.N., Fauziah, M., Chusnan, M., & Latifah, N., 2021. Determinants of

Hypertension among Pregnant Women in Bekasi City, West Java. *Journal of Medicine and Health*, 17(2), pp.170-176.

Indonesian Central Bureau of Statistics., 2012. *Statistical Referral Information System - View Variables.*

Elsaid, N., Saied, A., Kandil, H., Soliman, A., Taher, F., Hadi, M., Giridharan, G., Jennings, R., Casanova, M., Keynton, R., & El-Baz, A., 2021. Impact of Stress and Hypertension on the Cerebrovasculature. *Frontiers in Bioscience - Landmark*, 26(12), pp.1643-1652.

Erma Kasumayanti, M., 2020. Factors Associated with the Incidence of Hypertension in Productive Age in Pulau Jambu Village, Kuok Health Center UPTD Working Area. *Jurnal Ners*, 4(23), pp.47-55.

Fierdania, Y., & Handayani, P.A., 2022. Hubungan Kadar Kolesterol Dengan Tekanan Darah Pada Pekerja di PT.X Tahun 2020. *Jurnal Kesehatan Masyarakat,* 10(1), pp.8–15.

Gosal, D., Firmansyah, Y., & Ernawati., 2020. Effect of Body Mass Index on Blood Pressure Classification in Productive Age Population in Medan City. *Meditek Medical Journal,* 26(3), pp.103-110.

Hidayati, S., Kumalasari, M.L.F., Kusumawati, E., & Andyarini, E.N., 2020. Relationship of Cholesterol Rates With Hypertension in Faculty Of Psychology and Health of UIN Sunan Ampel. *Indonesian Journal for Health Sciences*, 4(1), pp.10.

Ilmaniar, I.D., Nugraha, A.F., & Sulistyowati, E., 2021. Influence of Physical Activity Level with Hypertension Prevalence in the Community in Malang Regency. *Journal of Community Medicine*, 9(1).

Kim, B.J., Seo, D.C., Kim, B.S., & Kang, J.H., 2018. Relationship between Cotinine-Verified Smoking Status and Incidence of Hypertension in Korean Adults. *Circulation Journal,* 82(6), pp.1659–1665.

Kirnawati, A., Susumaningrum, L.A., Rasni, H., Susanto, T., & Kholida, D., 2021. Relationship between Spiritual Level and Religiousness with Blood Pressure in Hypertensive Elderly. *Jkep*, 6(1), pp.26-39.

Kusumawaty, J., Hidayat, N., & Ginanjar, E., 2016. Factors Related Events Sex with Hypertension in Elderly Work Area Health District Lakbok Ciamis. *Mutiara Medika Journal*, 16(2), pp.46-51.

Latemmamala, R., 2021. *Renstra of RSUD Latemmamala Soppeng Regency 2016-2021 Period.* Documents of RSUD Latemmamala Kab. Soppeng, pp.1-76.

Lebuso, M., & De Wet- Billings, N., 2022. The Prevalence and Socio-Demographic Correlates of Hypertension among Women (15–49 years) in Lesotho: a Descriptive Analysis. *BMC Public Health*, 22(1), pp.1–8.

Lusno, M.F.D., Haksama, S., Wulandari, A., & Sriram, S., 2020. Association between Smoking and Hypertension as a Disease Burden in Sidoarjo : a Case-Control Study. *International Journal of Applied Biology*, 4(2), pp.9–16.

Mulyasari, I., & Pontang, G.S., 2018. Waist Circumference and Waist-to-Height Ratio as Indicators for Excess Adiposity in Adolescents. *Jurnal Gizi Dan Pangan*, 13(3), pp.131–136.

Musfirah, M., & Hartati, A.N., 2021. Factors Associated with the Incidence of Hypertension at the North Polong Bangkeng Health Center, North Polong Bangkeng District, Takalar Regency. *PREPOTIVE: Journal of Public Health*, 5(1), pp.56-67.

Naim, R., Sulastri., & Sri, H.S., 2019. An Overview of the Results of Checking Cholesterol Levels in Hypertensive Patients at RSUD Sheikh Yusuf Gowa District. *Laboran Media*, 9, pp.33-38.

Nainggolan, O., & Nainggolan, E., 2021. Happiness and its Relationship with Hypertension in Indonesia: Analysis of Indonesian Family Life Survey Data. *Health Research and Development Media*, 63, pp.171-182.

Nurdiansyah, T.E., Amalia., & Suhendra, A., 2020. The Relationship of Obesity and Stress Levels with the Incidence of Hypertension at Mayjend Regional Hospital. HM. Ryacudu Kotabumi Regional Hospital, North Lampung. *Journal of Indonesian Nursing Science (JIKPI)*, 1(1), pp.1-8.

Pramana, L.D.Y., 2016. Factors Associated with Hypertension Level in the Working Area of Demak II Health Center. *Thesis, Universitas Muhammadiyah Semarang,* pp.1-67.

Ramadhani, M., 2021. Factors Affecting the Occurrence of Hypertension in the Community in Kampung Bedagai Kota Pinang. *Medicine,* 4(1), pp.52.

Setyanda, Y.O.G., Sulastri, D., & Lestari, Y., 2015. The Relationship of Smoking with the Incidence of Hypertension in Men 35-65 Years of Age in Padang City. *Andalas Health Journal,* 4(2).

Sihotang, M., & Elon, Y., 2020. Relationship between Physical Activity and Blood Pressure in Adults. *Chmk Nursing Scientific Journal*, 4, pp.199-204.

Spruill, T.M., Butler, M.J., Thomas, S.J., Tajeu, G.S., Kalinowski, J., Castañeda, S.F., Langford,

A.T., Abdalla, M., Blackshear, C., Allison, M., Ogedegbe, G., Sims, M., & Shimbo, D., 2019. Association Between High Perceived Stress Over Time and Incident Hypertension in Black Adults: Findings From the Jackson Heart Study. *Journal of the American Heart Association,* 8(21).

Taslima, T., & Husna, A., 2017. Relationship between Family History and Lifestyle with Hypertension in the Elderly at Kuta Alam Health Center Banda Aceh. *Journal of Healthcare Technology and Medicine,* 3(1), pp.121.

Ten Velde, G., Plasqui, G., Willeboordse, M., Winkens, B., & Vreugdenhil, A., 2021. Associations between Physical Activity, Sedentary Time and Cardiovascular Risk Factors among Dutch Children. *PLoS ONE,* 16, pp.1–13.

Tozo, T.A.A., Gisi, M.L., Brand, C., Moreira, C.M.M., Pereira, B.O., & Leite, N., 2022. Family History of Arterial Hypertension and Central Adiposity: Impact on Blood Pressure in Schoolchildren. *BMC Pediatrics,* 22(1), pp.1–9.

Trimarco, V., Izzo, R., Morisco, C., Mone, P., Virginia Manzi, M., Falco, A., Pacella, D., Gallo, P., Lembo, M., Santulli, G., & Trimarco, B., 2022. High HDL (High-Density Lipoprotein) Cholesterol Increases Cardiovascular Risk in Hypertensive Patients. *Hypertension*, 79(10), pp.2355–2363.

Tuoyire, D.A., & Ayetey, H., 2019. Gender Differences in the Association Between Marital Status and Hypertension in Ghana. *Journal of Biosocial Science*, 51(3), pp.313–334.

Wibowo, D.J., Daeng, A.A., & Sulistyowati, E., 2021. The Effect of Psychic Stress on the Prevalence of Hypertension in Malang Regency Community. *Journal of Bio Complementary Medicine*, 8(1), pp.1-9.

Yuri Ekaningrum, A., 2021. The Relationship of Sodium Intake, Fat, Mental Emotional Disorders, and Lifestyle with Hypertension in Adults in Jakarta. *Journal of Nutrition College,* 10(2), pp.82-92.

Analysis of Nurse Work Stress Factors During the COVID-19 Pandemic

Umi Fatikhatul Luthfiyah[1✉], Chriswardani Suryawati[1], Antono Suryoputro[2]

[1]Master of Public Health, Faculty of Public Health, Diponegoro University, Semarang, Indonesia
[2]Master of Health Promotion, Faculty of Public Health, Diponegoro University, Semarang, Indonesia

Article Info

Abstract

Based on the preliminary study at Prof dr. Soekandar Hospital, it was found that out of 30 nurses, 50% of them found it often difficult to relax and feel tired often. In addition, the results show that 76.90% of them feel very drained of energy. This study aimed to determine the relationship between personal and organizational factors and the occurrence of work stress for nurses during the COVID-19 pandemic at Prof. dr. Soekandar Hospital. This research was a quantitative observational study using a cross-sectional study design. The number of samples in this study amounted to 145 respondents using a purposive sampling technique. Data analysis used the Pearson test and linear regression. The events of work stress for nurses were unaffected by work shifts. The variables that affect the incidence of work stress are social support, workload, work shift, and the policies on the use of PPE. Based on the results of the multivariate test, 41.2% of nurses' work stress was influenced by social support, workload, work shifts, and policies on the use of PPE. Variables that simultaneously affect the incidence of work stress for nurses are workload and nurses' work shifts.

Introduction

Health workers are responsible for a vital role in improving the quality of health services to the community (Hartzler et al., 2018). According to a policy analysis of the health worker labor market, both hospitals and health centers require additional nursing staff. Tthe country will need an additional 1,500 doctors and 2,500 nurses to manage the surge of COVID-19 patients (Mahendradhata et al., 2021). Nurses are the spearhead of hospital health services, where nurses will carry out nursing care in outpatient, inpatient, and emergency services (Asjanti et al., 2021). The role of a nurse is significant for a health service because nurses are health workers who interact with patients the longest. For this reason, various hospital efforts are needed to maintain a nurse's performance (Washilah et al., 2021).

RSUD Prof. dr. Soekandar Mojokerto Regency is a type B hospital in East Java that offers comprehensive health services. Prof. dr.

Soekandar Hospital, Mojokerto Regency, is one of the COVID-19 referral hospitals in East Java. Based on data from the Mojokerto District Health Office, Prof. dr. Soekandar hospital has the highest Bed Occupancy Rate (BOR) for COVID-19 Isolation in 2021 in Mojokerto Regency, where this value reaches 98%. Based on the data, 257 employees were exposed to COVID-19 over three years, with 5 dying and 252 declared cured. Where from the existing data, 60% of those who died from COVID-19 were the nursing staff.

Government policies related to sudden and special restrictions on COVID-19 may cause unwanted situations. This condition can harm the emotional, cognitive, and behavioral levels (Hermahayu et al., 2022). Psychological exposure to the Covid-19 outbreak differs from individual traumatic events in terms of the temporal nature of the exposure, where the Covid-19 outbreak has been an ongoing exposure for every member of society (Endika

& Azam, 2021). Various research results also state that health workers who handle COVID-19 in hospitals show that 97.57% of nurses experienced work stress during the peak of the Coronavirus outbreak. More than half (59.76%) of (98) nurses experienced moderate levels of work stress (Jeyapaul et al., 2021). 64.6% of nurses at Pelamonia Makassar Hospital also experienced work stress during the COVID-19 pandemic (Salcha & Juliani, 2021). In carrying out their work, nurses not only deal with patients but also with patients' families, patient friends, coworkers with fellow nurses, relate to doctors and regulations in the workplace and workload which is sometimes considered to be incompatible with their physical, psychological and emotional conditions (Sarafis et al., 2016). This high workload increases work stress for health workers (Maziyya et al., 2021). Nurses' work stress often occurs even before the COVID-19 pandemic. It can be shown in the research of Sulistyawati et al. (2019), stating 87.1% of nurses experienced moderate work stress, with the majority of respondents with a working period of 6 months to 3 years experiencing moderate work stress (Sulistyawati et al., 2019). This research is also per Hardiansyah et al., (2019) stating 56.63% are at a high-stress level (Hadiansyah et al., 2019).

In providing health services to the community, Prof dr. Soekandar Hospital, Mojokerto Regency, was assisted by 222 nurses at the hospital. Based on the preliminary study conducted by the researcher by distributing questionnaires to nurses at RSUD Prof. dr. Soekandar, it was found that out of 30 nurses, 50% of them found it often difficult to relax. It also impacts 50% of the nurses who feel tired often. In addition, the results show that out of 30 nurses, in carrying out their work 76.90% feel very drained of energy. Based on a preliminary study conducted in the Human Resource Management section of Prof dr. Soekandar Hospital, Mojokerto Regency, it is known that so far, the Human Resource Management of Prof dr. Soekandar Hospital, Mojokerto Regency, has never analyzed the stress levels of health workers, especially nursing staff. It is undoubtedly contrary to mental health guidelines issued by the World Health Organization (WHO), the Indonesian

Ministry of Health, and the Indonesian Doctors Association. (World Health Organization (WHO), 2014). In supporting the efforts issued by WHO, the Indonesian Ministry of Health, and PB IDI, this study focuses on analyzing the factors of work stress for nurses at Prof dr. Soekandar Hospital, Mojokerto Regency, guided by Robbins and Judge's theory which says that personal and organizational factors can cause the causes of work stress.

Method

This research was a quantitative study with a cross-sectional approach. This study's population consisted of all 222 nurses at Prof. dr. Soekandar Hospital. Calculation of the sample size in this study used the Slovin formula with a confidence level of 5%, so the total sample was 145 nurse respondents with the inclusion criteria of nurses who have worked since or before the COVID-19 pandemic. Nurses who were conducting training and nurses who were on leave at the time the research was conducted were the exclusion criteria in this study. Data collection took time in October-December 2022 at Prof. dr. Soekandar Hospital.

The dependent variable in this study was the work stress of nurses at Prof dr. Soekandar, Mojokerto Regency. The independent variables in this study were sources of work stress, including personal and organizational factors, where personal factors include years of service, and social support, while organizational factors include workload, work shifts, and policies on Personal Protective Equipment (PPE). Data collection was carried out by direct interviews with respondents using a questionnaire that has been tested for validity and reliability. The stages of data analysis include editing, coding, processing, cleaning, and tabulating. The analysis used in this study included univariate analysis, bivariate analysis using the Pearson test, and multivariate analysis using multiple linear regression at a significance level of $p<0.05$. Processing of research data using the help of SPSS software. The analyzed data is presented in the form of narrative tables. This research has received ethical approval from the KEPK of the Faculty of Public Health, Diponegoro University, with No: 366/EA/KEPK-FKM/2022.

Results and Discussions

The total sample of the study was 145 nurses. The characteristics of the respondents are in Table 1, where 4.8% of male respondents experienced heavy work stress, and 14.5% of female respondents experienced heavy work stress. 15.2% of respondents with married marital status experienced heavy work stress. Age average age of the respondents was 34.1 ± 7.5 years, with the majority educational level of 44.1% being in the Nursing Profession. 60% of respondents said that they had never confirmed positive for COVID-19. The majority of heavy work stress occurs at the age of ≤34, with a percentage of 12.4%. The majority of educational levels experiencing heavy work stress are at the D1/D3 education level. In addition, 12.4% of nurses who confirmed positive for COVID-19 experienced heavy work stress.

Tabel 1. Frequency Distribution of Respondents based on Demographic Characteristics and Work Stress Distribution based on Demographic Characteristics

Characteristics of Respondents	Mean ± SD	Number of Respondents		Work Stress					
				low		Moderrate		Heavy	
		f	%	f	%	f	%	f	%
Gender				9	6,2	27	18,6	7	4,8
Male		43	29,7	23	15,9	58	40	21	14,5
Female		102	70,3						
Marital Status									
Yes		119	82,1	27	18,6	70	48,3	22	15,2
No		26	17,9	5	3,4	15	10,3	6	4,1
Age	34,1 ± 7,5								
a. ≤34		76	52,4	17	11,7	41	28,3	18	12,4
b. >34		69	47,6	15	10,3	44	30,3	10	6,9
Education Level									
a. D3		63	43,4	10	6,9	38	26,2	15	10,3
b. D4/S1		18	12,4	3	2,1	10	6,9	5	3,4
c. Profesi Ners		64	44,1	19	13,1	37	25,5	8	5,5
Positive Confirmation of COVID-19									
a. Yes		58	40	10	6,9	38	26,2	10	6,9
b. No		87	60	22	15,2	47	32,4	18	12,4

Source: Primary Data, 2022

Table 2. Frequency Distribution of Respondents Based on Independent Variables and Bivariate and Multivariate Analysis Results

Characteristics of Respondents	Work Stress						Bivariate Analysis		Multivariate Analysis		
	Low		Moderate		Heavy		P Value	R	Regression Coefficient	P Value	Coefficient Determination
Period of Work											
≤9 years	19	13,1	40	27,6	18	12,4	0,375	-0,074	Not continued		
>9 years	13	9	45	31	10	6,9					
Social Support											
Low	9	6,2	52	35,9	26	17,9	0,001	-0,277	-0,044	0,895	
High	23	15,9	33	22,8	2	1,4					
Workload											
Low	28	19,3	45	31,0	13	9,0	0,000	0,562	0,913	0,000	
Heavy	4	2,8	40	27,6	15	10,3					
Work Shift											0,412
Bad	23	15,9	50	34,5	23	15,9	0,000	-0,418	-2,173	0,000	
Good	9	6,2	35	24,1	5	3,4					
The PPE Use Policy											
Bad	13	9,0	63	43,4	24	16,6	0,000	-0,326	-0941	0,174	
Good	19	13,1	22	15,2	4	2,8					

Source: Primary Data, 2022

The results of the univariate analysis in Table 2 showed that Respondents with a working period of ≤9 years experienced heavy work stress of 12.4%. The respondents' low level of social support experienced heavy work stress of 17.9%. 10.3% of respondents with heavy workloads also experienced heavy levels of work stress. 15.9% of respondents said a poor shift work system also experienced heavy work stress levels. 16.6% of respondents said the poor personal protective equipment (PPE) policy system also experienced severe work stress.

The variable period of work (p = 0, 375) was also not related to the incidence of nurse work stress during the COVID-19 Pandemic at Prof. dr. Soekandar Hospital. Research by Hendy et al., (2020) said that the work period is not related to the incidence of nurse work stress during the COVID-19 Pandemic (Hendy et al., 2020). Nurses with a working period of more than 10 years show a lower average stress level because experienced nurses are more dedicated and more enthusiastic, so responsiveness at work is also high (Ali et al., 2022; Çemberci et al., 2022). It certainly impacts the relationship between the nurse's work period and the work stress that occurs.

The social support variable showed that there was a significant relationship between social support and the incidence of nurse work stress (P=0.001) with the correlation coefficient strength belonging to the category "Weak" (R= -0.277) and negative values, which means that the higher the level of social support, the lower the work stress experienced by nurses. This social support is an essential motivating factor or predictor factor for nurses during the COVID-19 Pandemic (Issa et al., 2022). Support from nurse managers, senior staff, and co-workers are also influencing how nurses cope with the challenges of the COVID-19 Pandemic (Son et al., 2022). It is per the statement of Cohen and Wills (1985), who said that the function of social support can help individuals be able to deal with and overcome the causes of work stress (Anggraini & Nanda, 2021). A nurse can adapt to the work stress she experiences with the help of the social support she receives. It shows that social support has a protective role in reducing the incidence of work stress to improve nurses' quality of life

and job satisfaction (Karadaş & Duran, 2021).

The workload variable showed that there was a significant relationship between workload and the incidence of nurse work stress (P=0.000), with the correlation coefficient strength included in the category of "Strong Enough" (R= 0.562) and was positive, which means that the heavier the workload, the higher the work stress experienced by the nurse. Several studies support the relationship between workload and work stress experienced by nurses. Research by Ali et al. (2022), shows that more than 80% of respondents experience a high level of work stress due to the increased workload experienced by nurses (Ali et al., 2022). Alipurman & Sastrawan (2022), also said that 45.5% of nurses experience heavy workloads, which affects the occurrence of heavy work stress during the COVID-19 Pandemic. This study showed that heavy workloads would have a 5.5 times higher effect on nurses' work stress events (Alipurman & Sastrawan, 2022). It can be because during the COVID-19 Pandemic, nurses work intensively in high-risk areas so that it can reduce motivation and increase work stress experienced. This incident can certainly negatively affect the performance of nurses (Ardıç et al., 2022).

The work shift variable shows that there is a significant relationship between the work shift variable and the nurse's work stress incidence (P=0.000) with the correlation coefficient strength belonging to the category of "Strong Enough" (R= -0.418) and is negative, which means that the better the hospital work shift system, the lower the work stress experienced by the nurse. Several studies have shown a negative correlation between work shifts and the incidence of nurse work stress. The impact of an unfavorable shift work system's impact can affect nurses' physical and psychological health. Several studies have concluded that work shifts are the primary source of work stress that affects the human circadian system, resulting in psychosocial, psychological, and physiological problems. It shows that a high level of work stress will increase psychological pressure and reduce job satisfaction among nurses, affecting work performance and turnover (Dodia & Parashar, 2020). Nursing management should ensure better scheduling of shift work to have

an impact on improving nurse performance and personal health status so that it will enhance the quality of patient care as well (Lin et al., 2014).

The policy variable for the use of Personal Protective Equipment (PPE) showed that there was a significant relationship between the Personal Protective Equipment (PPE) Use Policy and the incidence of nurse work stress (P=0.000) with the correlation coefficient strength belonging to the "Weak" category (R= -0.326) and negative values which means that the better the Personal Protective Equipment (PPE) Use Policy system, the lower the work stress experienced by nurses. The negative relationship direction value means to be a negative predictor of the incidence of nurse work stress. It is in line with the research of Hendy et al., (2020), which emphasizes that the better the supply of Personal Protective Equipment (PPE), the lower the incidence of nurses' work stress during the COVID-19 Pandemic (Hendy et al., 2020). The availability of Personal Protective Equipment will eliminate nurses' fear of providing nursing care to all types of patients, whether covid-19 suspect patients or not. It will certainly have an impact on the pressure of nurses at work so that it becomes a supporting factor for nurses' work stress (Ahorsu et al., 2022).

Table 2 shows that the strength of the direction of the relationship between variables also affected the relationship of variables simultaneously. Simultaneously, the variables affecting the incidence of work stress during the COVID-19 Pandemic at Prof. dr. Soekandar Hospital was a workload variable (P=0.000; Regression Coefficient =0.913). The value showed that if the nurse's workload increased by 1%, then the work stress value also increased by 0.913, assuming other variables were considered constant. Work shift variable (P=0.000; Regression Coefficient =-2,173) also affected the incidence of nurse work stress during the COVID-19 Pandemic at RSUD Prof. dr. Soekandar. The value showed that if the nurse's work shifts system better by 1% and the work stress value also decreased by 2,173, assuming other variables were considered constant. In Table 2, the value of the coefficient of determination or R Square was 0.412 or equal to 41.2%. This figure shows that 41.2%

of the incidence of nurse work stress at Prof. dr. Soekandar Hospital was influenced by the variables Social Support, Workload and Work Shifts, and Personal Protective Equipment (PPE) Use Policy. Meanwhile, 58.8% were affected by variables that were not studied.

Heavy workload has a significant relationship with work stress, which can cause health problems for nurses, decreasing nurse caring behavior and reducing the quality of service (Rizkianti & Haryani, 2020). The influence of workload on work stress events can be seen from physical, psychological, and behavioral aspects. An increase in the number of nurses based on patient ratios, job description clarity, autonomy, and supervisor support can help nurses handle the workload they are experiencing (Adriani et al., 2022).

The work shift variable is also a significant variable simultaneously with the nurse's job stress variable. The division of work shifts that do not pay attention to the quality of rest from nurses can cause emotional and mental exhaustion, disruption of normal sleeping and waking hours, depression, and several diseases. In addition, patient health and safety will also decrease due to the impact obtained from a poor shift work system (Hoedl et al., 2021). Changes in work shift patterns that are lighter and shorter are needed to support health problems experienced by health workers (Iswanto, 2020). Changes in workload and work shift systems that do not support nurses' work will affect nurse performance. There are significant differences in the performance of nurses before and after the COVID-19 pandemic, where these results harmed nurse performance (Herwanto et al., 2021). The statement above shows that hospitals need special attention to follow up on workload and work shifts that apply in hospitals.

Conclusion

Personal factors that influenced the incidence of work stress for nurses during the COVID-19 Pandemic in Prof. dr. Soekandar Hospital were social support variables. Organizational factors that influence the incidence of work stress for nurses during the COVID-19 Pandemic in Mojokerto Regency are workload, work shifts, and policies on Personal Protective Equipment (PPE). More attention is needed

to improve the social support given to nurses in improving their job performance, both emotional support, instrumental support, appreciation support, and informational support. Routine analysis of workload is also needed, which includes analysis of workload in terms of physical aspects, psychological aspects, and working time for nurses so that it can be used as material for re-planning or HR mutation if needed. In addition, it is necessary to review the work shift system and policies on using Personal Protective Equipment (PPE) implemented in Prof. dr. Soekandar Hospital.

Acknowledgment

References

Adriani, P., Triana, N.Y., & Prabandari, R., 2022. The Effect of Workload on Work Stress of Nurses in Hospital. *JHeS (Journal of Health Studies)*, 6(2), pp.50–59.

Ahorsu, D.K., Lin, C.Y., Marznaki, Z.H., & Pakpour, H.A., 2022. The Association Between Fear of COVID-19 and Mental Health: The Mediating Roles of Burnout and Job Stress Among Emergency Nursing Staff. *Nursing Open,* 9(2), pp.1147–1154.

Ali, H., Fatemi, Y., Ali, D., Hamasha, M., & Hamasha, S., 2022. Investigating Frontline Nurse Stress: Perceptions of Job Demands, Organizational Support, and Social Support During the Current COVID-19 Pandemic. *Frontiers in Public Health*, 10, pp.1457.

Alipurman, A., & Sastrawan, S., 2022. Relationship Of Workload With Work Stress Among Nurses During The Covid-19 Pandemic In East Lombok District. *Journal of Vocational Health Studies,* 6(1), pp.41–45.

Anggraini, I.P., & Nanda, D.P., 2021. Effects of Social Support Toward Working Stress of The Nurses of X Hospital. *STRADA Jurnal Ilmiah Kesehatan,* 10(1), pp.1127–1137.

Ardıç, M., Ünal, Ö., & Türktemiz, H., 2022. The Effect of Stress Levels of Nurses on Performance During the COVID-19 Pandemic: the Mediating Role of Motivation. *Journal of Research in Nursing,* 27(4), pp.330–340.

Asjanti, L., Irbantoro, D., & Rahmani, D., 2021.

Nurse Workload: What Factors Influence? *Jurnal Kedokteran Brawijaya*, 31, pp.60–65.

Çemberci, M., Civelek, M.E., Ertemel, A.V., & Cömert, P.N., 2022. The Relationship of Work Engagement with Job Experience, Marital Status and Having Children Among Flexible Workers After the Covid-19 Pandemic. *PLOS ONE*, 17(11), pp.e0276784.

Dodia, P., & Parashar, N., 2020. Shift-Work Job Stress, Psychological Distress, and Job Satisfaction Among Employees. *International Journal of Indian Psychology*, 8(3).

Endika, O.M.G., & Azam, M., 2021. Post-traumatic Stress Disorder and Depression during COVID-19 Pandemic among Students: Study at Universitas Negeri Semarang. *KEMAS: Jurnal Kesehatan Masyarakat,* 17(2), pp.293–305.

Hadiansyah, T., Pragholapati, A., & Aprianto, D.P., 2019. Job Stress Description of Nurses Working in Emergency Units. *Jurnal Keperawatan BSI*, 7(2), pp.50–58.

Hartzler, A.L., Tuzzio, L., Hsu, C., & Wagner, E.H., 2018. Roles and Functions of Community Health Workers in Primary Care. *Annals of Family Medicine,* 16(3), pp.240.

Hendy, A., Abozeid, A., Sallam, G., Fattah, H.A.A., Abdelkader, F.A., & Reshia., 2020. Predictive Factors Affecting Stress Among Nurses Providing Care at COVID-19 Isolation Hospitals at Egypt. *Nursing Open*, 8(8), pp.498–503.

Hermahayu, F.R., & Candra, A.R.D., 2022. The Psychological Impact of Covid 19 Restrictions on Athletes. *KEMAS: Jurnal Kesehatan Masyarakat*, 18(1), pp.130–138.

Herwanto, H., Kusumapradja, R., & Kadir, A., 2021. the COVID-19 Pandemic and the Performance of Hospital Health Workers. *Tarumanagara Medical Journal*, 3(2), pp.336–345.

Hoedl, M., Silvia ,B., Doris, E., Bauer, S., & Eglseer, D., 2021. Influence of Nursing Staff Working Hours on Stress Levels During the COVID-19 Pandemic A Cross-Sectional Online Survey. *HeilberufeScience*, 12(4), pp.92–98.

Issa, W.B., Nusair, H.A., AlTamimi, A., Rababa, M., Saqan, R., Hijazi, H., Al-Marzouqi, A., Rahman, H.A., & Naing, L., 2022. Posttraumatic Stress Disorders and Influencing Factors During the COVID-19 Pandemic: A Cross-Sectional Study of Frontline Nurses. *International Nursing Review,* 69(3), pp.285–293.

Iswanto, A.H., 2020. Innovative Work Shift for Health Workers in the Health Service Providers in

Handling Covid-19 Cases. *Kesmas: Jurnal Kesehatan Masyarakat Nasional (National Public Health Journal)*, 15(2), pp.18–23.

Jeyapaul, S., Asiri, H.M.T., Makther, N.M., Asiri, H.A.A.A., Aqili, F.A.M., Alammari, & M, A.H., 2021. Perceived Job Stress and COVID-19 Pandemic Related Stress Predictors Among Nurses Working in Saudi Arabia. *Nursing Open*, 8(1), pp.201–211.

Karadaş, A., & Duran, S., 2021. *The Effect of Social Support on Work Stress in Health Workers During the Pandemic: The Mediation Role of Resilience.*

Lin, S.H., Liao, W.C., Chen, M.Y., & Fan, J.Y., 2014. The Impact of Shift Work on Nurses' Job Stress, Sleep Quality and Self-Perceived Health Status. *Journal of Nursing Management,* 22(5), pp.604–612.

Mahendradhata, Y., Andayani, N.L. P.E., Hasri, E.T., Arifi, M.D., Siahaan, R.G.M., Solikha, D.A., & Ali, P.B., 2021. The Capacity of the Indonesian Healthcare System to Respond to COVID-19. *Frontiers in Public Health,* 9, pp.887.

Maziyya, A.A., Islam, N.R.Q., & Nisa, H., 2021. Relationship between Workload, Work-Family Conflict, and Work Stress on Workers in the Java Island Region during the COVID-19 Pandemic in 2022. *Health Research and Development Media*, 31(4), pp.337–346.

Rizkianti, I., & Haryani, A., 2020. The Relationship Between Workload and Work Stress With Caring Behavior Of Nurses in Inpatient Rooms. *Jurnal Aisyah : Jurnal Ilmu Kesehatan,* 5(2), pp.159–166.

Salcha, M.A., & Juliani, A., 2021. Work Stress for Covid-19 Nurses at Pelamonia Hospital Makassar City. *Miracle Journal of Public Health*, 4(1), pp.123–131.

Sarafis, P., Rousaki, E., Tsounis, A., Malliarou, M., Lahana, L., Bamidis, P., Niakas, D., & Papastavrou, E., 2016. The Impact of Occupational Stress On Nurses' Caring Behaviors and Their Health Related Quality of Life. *BMC Nursing*, 15(1).

Son, Y.-J., Lee, H., & Jang, S.J., 2022. Work Stress and Perceived Organisational Support on Young Korean Nurses' Care for COVID-19 Patients. *Australian College of Nursing*, 1(1), pp.1–7.

Sulistyawati, N.N.N., Purnawati, S., & Muliarta, I.M., 2019. Description of Nurse Work Stress Levels with Shift work at the Karangasem Hospital Emergency Room. *E-Jurnal Medika*, 8(1), pp.1–6.

Washilah, W., Melani, S., & Hidayat, A.A., 2021. Improving The Nursing Performance At Hospital Through Factors Analysis. *International Journal of Scientific and Tecnology Research*, 9(3).

World Health Organization (WHO)., 2014. *Hospital Preparedness for Epidemics. World Health Organization (WHO).*

Impact of PM10 Exposure and Socio-Demographic Aspect With Lung Function Disorders

Siti Rachmawati[1], Iwan Suryadi[2✉], Juherah[2], Abdur Rivai[2], Nurlaila Fitriani[3],
Fathoni Firmansyah[4], Rina Zum Ratun[5]
[1]1Environmental Science Departement, Universitas Sebelas Maret, Indonesia
[2]Enviromental Health Departement, Poltekkes Kemenkes Makassar, Indonesia
[3]Faculty of Nursing, Universitas Hasanuddin, Surakarta, Central Java, Indonesia
[4]Student of Diploma 4 Occupational Health And Safety, Universitas Sebelas Maret, Indonesia
[5]Occupational Health and Safety Departement, Stikes Mitra Husada, Indonesia

Article Info

Abstract

The concentration of $PM_{2.5}$ and PM_{10} particles is a major problem and the primary environmental health risk that causes premature death. This study aims to examine the effect of PM_{10} exposure and socio-demographic aspects on lung function disorders of bus Terminal workers exposed to traffic emissions. This research used a cross-sectional approach. The population is 96 people, and 50 became samples according to the purposive sampling criteria. The measurement of lung vital capacity is by spirometry. The high-volume air sampler was applied to measure dust concentration, and the questionnaire was used to assess individual characteristics. The independent variables of this research are PM_{10} concentration, age, smoking behavior, working period, type of work, education, use of masks, and body weight. The dependent variable is impaired lung function. The bivariate analysis showed that exposure to PM_{10}, smoking behavior, years of service, and use of masks were significant for impaired lung function. The result of multivariate analysis of dust is the most relevant to the lung vital capacity. In conclusion, dust concentrations are classified above the Threshold Limit Value (TLV), so government should control the source of dust exposure.

Introduction

Air pollution due to the massive use of fossil fuels has received significant attention recently (Zhang et al., 2010; Anenberg et al., 2012; Rao et al., 2013). The World Health Organization (WHO) estimates that around one million premature deaths are caused by outdoor air pollution worldwide each year. Delicate particulate matter with a diameter smaller than 2.5 (PM2.5) is one of the main contributors (Lelieveld et al., 2015; Zhang et al., 2016). Based on the global disease burden database found that PM2.5-related deaths in 2010 were 3.15 million people per year worldwide, 1.61–4.81 million deaths per year at a 95% confidence interval, with cerebrovascular disease (CEV),

accounted for 42% (1.31 million) of total premature deaths and 34% (1.08 million) due to ischemic heart disease (IHD). The study also found that outdoor air pollution's contribution to sudden death will double (6.6 million) by 2050.

Air pollution is a significant risk factor for global public health well into the 21st century. Many research studies have revealed the relationship between disease risk and air pollution. There is a strong correlation between morbidity and mortality in various risk groups (Bowe et al, 2017). Air pollution is responsible for the deaths of seven million people worldwide each year. Among air pollutants, particulate matter (PM) is considered the most harmful

---

substance released from various biogenic and anthropogenic sources or generated by secondary reactions occurring in the atmosphere. (Khaefi et al., 2017; Omidi et al., 2018; Ghasemi et al., 2019). PM2.5 and PM10 Have different physicochemical properties, the ratio between delicate particulate matter and coarse particulate matter between PM2.5 and PM10 can provide more details about particulate sources, origination processes, and human health impacts (Camilo, Becerra and Rojas, 2015; Johnston et al., 2019; Tahery et al., 2021). Coarse particulate matter (PM10) can enter deep into the respiratory tract, causing severe respiratory illness. However, PM2.5, because of its smaller size, can pass through the respiratory tract and accumulate in the lungs, causing various respiratory diseases and lung cancer (Lu et al., 2015; Geravandi et al., 2017; Park et al., 2018).

According to the literature, increased concentrations of PM are associated with increased morbidity and mortality in the EU population, as a result of which PM2.5 reduces the average life span by up to 8.6 months. (Orru, Maasikmets and Lai, 2010). Furthermore, according to the different studies, a decrease in the concentration level of PM2.5 by 10 $\mu g\ m{-3}$ can increase the lifetime by 0.61 years (Apte et al., 2018; Qi et al., 2020). PM2.5 is more toxic than PM10 because it induces inflammation and oxidative stress. These tiny PM2.5 particles are of particular concern because when inhaled, they can penetrate deep into the alveoli, where they can be stored and absorbed. These excellent particles are believed to have some more aggressive health implications than larger particles (Valavanidis and Fiotakis, 2014). Several studies have established particulate matter exposure as the source of various health problems, including premature death in people with heart or lung disease, nonfatal heart attacks, irregular heartbeats, severe asthma, decreased lung function, and increased respiratory symptoms such as respiratory tract irritation. Air, cough, or difficulty breathing (Cadelis, Tourres and Molinie, 2014).

According to the Environmental Protection Agency (EPA), particles are categorized based on their penetration capacity into coarse particles (PM10) with an aerodynamic diameter of 10 μm and fine particles (PM2.5) with an aerodynamic diameter of 2.5 μm. PM mainly comes from many sources, including road dust, agricultural dust, riverbeds, construction sites, mining operations, and similar activities (Reizer and Juda-rezler, 2016; Katarzyna et al., 2021). Traffic is the main source of PM, mainly from wear and tear of vehicle components such as brakes and tires as well as road dust suspension (Mbelambela et al., 2017; Shelly et al., 2019). Tirtonadi Bus Terminal is one of the places with a high emission load from the vehicle bus Terminal that exits the bus Terminal every day. Passenger activities, vehicle exhausts, bus repairs, and bus engines that are not turned off during reception at Tirtonadi Bus Terminal will produce particulate dust emissions.

Methods

The study used an analytic observational design with a cross- sectional research approach to explain the differences between the dependent and independent variables, in this study measuring research variables at the same time. The sample selection was by simple random sampling technique from a total population of 54 respondents who had previously been subjected to inclusion and exclusion criteria to obtain a homogeneous sample. Inclusion criteria include productive workers aged 17-60 and cleaning, maintenance, security, and traffic control officers. From this sampling, the researcher obtained a sample of 50 respondents.

The independent variable in this study was the concentration of TSP dust, age, years of service, exercise habits, and smoking behavior, while the dependent variable was impaired lung function. Measurement of dust levels in the work environment was measured in 2 sectors, namely the western sector and the eastern sector, using the High Volume Air Sampler (HVAS) tool. The gravimetric method is used to get the dust concentration, by using a sample filter before and after. The procedure for measuring environmental dust refers to SNI 16-7058-2004. Other variables such as age, years of service, sports habits, and smoking behavior were assessed using a questionnaire. Pulmonary function tests were carried out

on a total of 50 workers. Measurement using spirometry is a tool used to determine the percentage of Forced Vital Capacity (FVC) and Forced Expiratory Volume / Forced Expiratory Volume / Forced Expiratory Volume / Forced Expiratory Volume in the first second (FEV1).

Study participants were first introduced to the principles of the spirometer, surgery, and pulmonary function testing procedures. The spirometer recorded subjects such as age, test date, height, name, and weight. Ethical clearance is used to avoid possible contraindications before the start of spirometry. Spirometry is performed standing using a nose clip while the subject takes complete inspiration and a rapid, forceful expiration on the instrument's mouthpiece. Weak and invalid inspiratory and expiratory attempts were excluded. Pulmonary function measurement is carried out with three readings, choosing the best result from these measurements. Only one investigator recorded and conducted all of the subject interviews to minimize variability between investigators. FVC (forced vital capacity), FEV1 (forced expiratory volume in 1 second), PEFR (peak expiratory flow rate in liters/sec and FEV1/FVC recorded in an automated spirometer following all standard protocols (Kesavachandran et al., 2006; Adei et al. ., 2011). Spirogram in the printed form directly downloaded from the spirometer, and data recorded in an excel sheet. To assess and evaluate the respiratory health of workers, LFT readings were recorded from the spirogram and self-reported respiratory health symptoms from a comparison of categories of impaired lung function. The vital capacity of the lungs is classified into four: normal, obstructive, restrictive, and mixed. based on %FVC and %FEV1 Normal lung function if % FVC ≥ 80% and % FEV1 ≥ 70% and obstructive disorders if % FVC > 80% and % FEV1 <70%, restrictive disorders if % FVC <80% and % FEV1 ≥ 70 %, mixed disorder if % FVC <80% and % FEV1 <70%.

This analysis is used to see the description and characteristics of each independent and dependent variable. The research variables were analyzed using the characteristic frequency distribution of each research variable. Bivariate analysis is used on two variables suspected of having a relationship or mutual correlation.

Bivariate analysis used Spearman's correlation test for work environment dust variables with impaired lung function and multivariate analysis to determine which variable had the most influence among variables with a P-value <0.25.

Results and Discussion

Tirtonadi Bus Terminal is one of the biggest stations in Central Java which is located in Surakarta City. The Tirtonadi Terminal has been operating since 1976. In 2009, theTirtonadi Bus Terminal underwent a major renovation. In 2016, the Minister of Transportation, Budi Karya Sumadi re-inaugurated the Tirtonadi Type A Passenger Terminal, equipped with main, supporting, and general facilities to guarantee security, safety, and comfort for its users.

Tirtonadi bus terminal serves public passenger vehicles for Rural Transportation (ADES), City Transportation (AK), Inter-City Within Provinces (AKDP), and Inter-City Inter-Provinces (AKAP). The Tirtonadi Terminal operates 24 hours because it is a connecting route for bus transportation from within and outside the province, including East Java, West Java, and Yogyakarta to Sumatra. Tirtonadi Terminal Bus also provides rest facilities that can accommodate 70 buses. The capacity of buses that transit every day reaches 1,500 units of bus fleets and increases up to three times during holidays or long holidays from both AKDP and AKAP transportation.

Arrival and departure zones have been separated at Tirtonadi Terminal Bus. The arrival of the bus, which includes AKDP and AKAP, in dropping passengers in one drop-off zone, after the bus drops off passengers, the bus goes straight to the departure zone. The existing condition of the Tirtonadi Terminal is currently designed and divided into two areas, namely the West and East Terminals. This division facilitates the arrangement of departures to the West and East. It is also the basis for orientation for prospective passengers to go to the departure waiting area according to the ticket.

The western terminal serves passengers to major cities located west of Surakarta City, such as Semarang, Yogyakarta, and West Java to

Lampung, with daily bus volume reaching 500 buses. The eastern terminal serves passengers to major cities in the east, such as Karanganyar and Sragen, to regencies and cities in East Java, with daily bus volume reaching 1,000 buses. The west area of Tirtonadi Terminal Bus has a semi-open ceiling design that allows emissions from buses to be wasted into the environment and not accumulate there. The east area has a ceiling design covered by concrete, so emissions from buses still accumulate in that area.

Generally, Tirtonadi Bus Terminal workers are 24-55 years with an average age of 44. Most of the education is at the High Education level. All these two variables did not show a significant effect on impaired lung function. The smoking behavior variable for most respondents was in the still smoking category with 62%, the average working period variable had been working for 19 years, the average body weight was 64 kg, and the type of work most worked in the traffic department. The results of the bivariate test showed that smoking behavior and length of service were significant for impaired lung function. However, the work is significant for the results of the FVC spirometry test, as shown in Table 1.

Table 1. Sociodemographic Aspects of Respondents with Lung Function Dissorders

Variables	Unit	Total (N= 50)	p-Value (%pred FVC)	P-value (%pred FEV1)	p-value (%pred FEV1/FVC)	Lung Function Dissorders Category
Age	Mean (SD)	44,02 (10,328)	0,204	0,715	0,091	0,418
Education	Lower Education (%)	7 (14%)				
	Middle Education (%)	24 (48%)	0,979	0,355	0,478	0,324
	High Education(%)	19 (38%)				
Smoking Status	Curent (%)	31 (62%)				
	Former (%)	12 (24%)	0,001	0,001	0,049	0,000
	Never (%)	7 (14%)				
Working Period	Mean (SD)	19,62 (9,17)	0,044	0,0317	0,047	0,043
Weight	Mean (SD)	64,26 (6,90)	0,295	0,818	0,848	0,736
Type of Work	Security (%)	12 (24%)				
	Traffic (%)	25 (50%)	0,024	0,494	0,84	0,081
	Safety (%)	13 (26%)				
Use mask	Yes	9 (18%)	0,148	0,004	0,645	0,002
	No	41 (82%)				

Source: Primary Data, 2022

Table 2. Frequency Distribution of Lung Function Disorders

Variables	Normal (%)	Restrictive (%)	Obstructive (%)	Mixed (%)
Lung Function Disorders	17 (34%)	19 (38%)	3 (6%)	11 (22%)

Source: Primary Data, 2022

Table 2 shows the frequency distribution of lung function where there are 19 (38%) respondents with restrictive disorders, 3 (6%) with obstructive disorders, 11 (22%) with mixed disorders, and 17 (34%) respondents who do not experience lung function disorders of 50 respondents. Table 3 shows the bivariate test between PM10 concentrations and impaired lung function where there is a significant effect with the FVC, FEV1 spirometry test, and impaired lung function, but not significant with the FEV1/FVC spirometry test.

Table 3. Effect of PM$_{10}$ Concentration on Lung Function Disorders

Variables			p-Value (%pred FVC)	P-value (%pred FEV1)	p-value (%pred FEV1/FVC)	Lung Function Disorders Category
PM$_{10}$ Concentration	Max	302,00	0,003	0,001	0,168	0,003
	Min	89,74				
	Mean	196,22				
	SD	107,56				

Source: Primary Data, 2022

Table 4. Multivariate test of independent and dependent variables.

Model		Anova Test		Determination Coefficient Test		Regression Coefficient	Sig.
		F	Significant	R-Squar	Adjusted R-Square		
1	(Constant)	9,265	0,000	0,440	0,404		.470
	Working Period					.117	.342
	Smoking Status					-.340	.011
	Used Mask					.280	.044
	PM$_{10}$ Concentration					.352	.005
2	(Constant)	12,068	0,000				.558
	Smoking Status					-.310	.017
	Used Mask					.333	.010
	PM$_{10}$ Concentration					.381	.002

a. Dependent Variable : Lung Function Disorders

Source: Primary Data, 2022

Based on the table, smoking behavior, use of masks, PM10 concentrations, and years of service simultaneously influence lung function disorders (p-value <0.05). The proportion of the influence of the independent variable on the dependent variable is 40.4% (R-Square = 0.404), while the rest is influenced by other variables not included in the regression test. Based on the regression coefficient value, the PM10 concentration variable affects lung function disorders compared to the variables of years of service, male smoking behavior, and use of masks. It is because the PM10 concentration regression coefficient value is greater than the other regression coefficients. The calculation results of the multiple regression coefficients above show the value of the PM10 concentration coefficient of 0.381 so that it can predict 38.1% of lung function disorders.

Most PM sources in Southeast Asia come from vehicle emissions, industrial pollution, and secondary aerosols as the dominating sources (Singh et al., 2017). Vehicle activity, industrial by-products and re-suspension of crustal soil are the main factors contributed by anthropogenic activity of particulate pollutant emissions in the environment (Hazarika and Srivastava, 2016; Bodor and Bodor, 2022; Fadel, Afif and Courcot, 2022).. Tirtonadi Bus Terminal is one of the bus stations with high vehicle activity, so PM10 production is more significant. Urban air pollution has health effects on the public and workers, especially those working in dense traffic environments and small roadside industries. Vehicle exhaust is the worst type of exhaust because it is emitted on the ground near respiratory levels, and provides maximum exposure to humans, the health problems of which include decreased lung function due to exposure at work (Ahmad et al., 2016).

Particles that are toxic to magrofag can be stimulating the formation of new macrophages. Forming and destruction of macrophages continue to play a vital role in the forming of collagen connective tissue and the deposition of hyaline in the connective tissue that forms fibrosis. This fibrosis occurs in the lung parenchyma, which is the alveoli and wall intertestial connective tissue. As a

result, pulmonary fibrosis will decrease lung tissue elasticity (shifting lung tissue) and rising impaired lung development, namely restriction. Obstruction disorder is a pulmonary disorder characterized by barriers to airflow in the respiratory tract that are irreversible. In this study, 3 respondents (6%) experienced obstruction. Narrowing of the airways and disruption in airflow therein will affect the work of breathing. FEV1 will always decrease in respondents who experience obstruction and can be a large amount, whereas FVC cannot be reduced. A mixture of restrictions and obstruction occurs due to pathological processes which reduce lung volume, capacity, and flow, and the presence narrowing of the respiratory tract and the presence of landfill breathing by particulates (Suryadi et al, 2021)

In recent years, high concentrations of PM10 can be caused by dust production and the development of transportation facilities and industrial processes. Based on the results of different studies, reducing PM10 concentrations reduces the number of COPD cases. Research by Khaefi shows an increase in COPD due to PM10 increase, climate change, and geographical aspects (Khaefi et al., 2017; Ryswyk et al., 2021). This study showed high concentrations of PM10 in the western sector due to the greater volume of vehicles and higher traffic activity because it is an inter-provincial transportation route.

This study found that impaired lung function in exposed occupations can be ascribed to exposure to smoke and high fuel and solvent vapors levels that can cause well-defined systemic pulmonary inflammation. Decreased lung function values may indicate underlying lung dysfunction due to inhalation of polluted air caused by car exhausts and fuel vapors. Emissions and movement of vehicles contribute to around 60–70% of total air pollution, which decreased lung function values in this study, our lifestyle, and smoking behavior. Many studies cite similar respiratory health symptoms as standard among exposed populations due to workplace exposures. (Ahmad et al., 2016; Wu et al., 2019; Wang et al., 2021).

Exposure to air pollution in the long term can cause continuous inflammatory reactions, leading to repeated tissue damage and repair processes, which will cause extensive tracheal structural damage and a more severe impact on lung function. It may be the reason why long-term exposure is more serious. The effects of long-term exposure should also be of concern to us, but the short-term effects of pollution cannot be ignored (Sah et al., 2019; Zhang et al., 2022). Our findings show that PM10 concentrations account for 40% of lung function impairment.

Given the demographic changes that have yet to be extensively researched, we must increase our understanding of the factors that influence health outcomes in older adults. Therefore, we attempted to determine the association of various sociodemographic factors with lung function, primarily in adults. The results of our study show that decreases in FVC, FEV1, FEV1/FVC, and the general category of impaired lung function are more likely to be associated with smoking behavior, use of masks, length of service, and type of work. Overall, the clear and well-known determinants of lung function, namely age, sex, height, weight, smoking, and respiratory disease, account for most of the variation in the lung function measures studied. It is by research by Mchugh et al., which shows sociodemographic factors are factors that influence lung function disorders (Johannessen et al., 2010; Mchugh et al., 2020).

Given the solid potential confounding by tobacco use in the association between lung function and subclinical atherosclerosis, adjustment for tobacco use was insufficient to control for this factor, and a substantial degree of residual confounding cannot be ignored. Therefore, a relationship tracing was carried out grouped by smoking status, including those who never (Gonzalez et al., 2022). Smoking can reduce lung function because the substances contained in cigarettes are addictive substances that can damage human organs, including the lungs. Smoking can cause changes in function and structure and lung tissue, and smoking habits can accelerate the decline in lung function. Cigarette smoke can stimulate mucus secretion, while nicotine paralyzes the respiratory tract's ciliary hairs, which filter air entering the breath.

PM10 exposure due to air pollution

from motor vehicle emissions has a significant relationship with a negative impact on vital lung capacity. An increase in PM10 pollution concentration causes respondents to be more at risk of experiencing disturbances in lung vital capacity (Thi et al., 2018; Gowda and Thenambigai, 2020). Other health risks, such as COHb, can also result from exposure to other pollutants, such as CO (Rachmawati et al, 2022). The effects of air pollution and lung function can vary by gender, genetics, smoking status, diet, medications, and obesity.

Conclusion

This study found that apart from exposure to PM10, other factors, such as sociodemography, affect pulmonary function disorders. The increase in PM10 concentrations is caused by motor vehicle exhaust because the research location is one of the centers of air pollution. Sociodemographic aspects also have significant contributions, such as the type of work that is directly related to direct exposure to pollutants, smoking habits, and years of service which are related to the length of exposure

References

Ahmad, I., Rehan, M., Balkhyour, M., & Abbas, M., 2016, Review of Environmental Pollution and Health Risks at Motor Vehicle Repair Workshops : Challenges and Perspectives for Saudi Arabia. *International Journal of Agricultural and Environmental Research,* 2(1).

Anenberg, S.C., Schwartz, J., Shindell, D., Amann, M., Faluvegi, G., Klimont, Z., Janssens-maenhout, G., Pozzoli, L., Dingenen, R. Van, Vignati, E., & Emberson, L., 2012. Global Air Quality and Health Co-benefits of Mitigating Near-Term Climate Change through Methane and Black Carbon Emission Controls. *Environmental Health Perspective*, 120(6).

Apte, J.S., Brauer, M., Cohen, A.J., Ezzati, M., & Pope, C.A., 2018. Ambient PM 2.5 Reduces Global and Regional Life Expectancy. *Environmental Science & Technology Letters*, 5.

Bodor, K., & Bodor, Z., 2022. The Human Health Risk Assessment of Particulate Air Pollution (PM 2.5 and PM 10 in Romania. *Toxycology Report*, 9.

Cadelis, G., Tourres, R., & Molinie, J., 2017. Associations of Ambient Coarse Particulate Matter, Nitrogen Dioxide, and Carbon Monoxide with the Risk of Kidney Disease: A Cohort Study. *The Lancet Planetary Health*, 1(7).

Cadelis, G., Tourres, R., & Molinie, J., 2014, Short-Term Effects of the Particulate Pollutants Contained in Saharan Dust on the Visits of Children to the Emergency Department due to Asthmatic Conditions in Guadeloupe (French Archipelago of the Caribbean). *Plos One* 9(3).

Camilo, L., Becerra, B., & Rojas, N., 2015, Influence of Precipitation Scavenging on the PM2.5PM10 Ratio at the Kennedy Locality of Bogotá, Colombia. *Revista Facultad de Ingeniería*, 7.

Fadel, M., Afif, C., & Courcot, D., 2022, Human Health Risk Assessment for PAHs, Phthalates , Elements, PCDD/ Fs , and DL-PCBs in PM 2.5 and for NMVOCs in two East-Mediterranean Urban Sites Under Industrial Influence. *Atmospheric Pollution Research*, 13.

Geravandi, S., Sicard, P., Khaniabadi, Y.O., Marco, A., De Ghomeishi, A., Goudarzi, G., & Mahboubi, M., 2017 , A Comparative Study of Hospital Admissions for Respiratory Diseases During Normal and Dusty Days in Iran. *Environ Sci Pollut Res,* 24(22).

Ghasemi, F.F., Dobaradaran, S., Saeedi, R., Nabipour, I., & Nazmara, S., 2019, Levels and Ecological and Health Risk Assessment of PM 2.5 -Bound Heavy Metals in the Northern Part of the Persian Gulf. *Environmental Science and Pollution Research*, 26(36).

Gonzalez, J., Gracia-lavedan, E., Silvia, G., Barril, S., Godoy, P., Berm, M., Betriu, A., Fern, E., Lecube, A., Pamplona, R., Purroy, F., Farr, C., Barb, F., & Torres, G., 2022, Lung Function Impairment is Related to Subclinical Atherosclerosis Only in Active Smokers. *Journal of Vascular Disease,* 1(1).

Gowda, G., & Thenambigai, R., 2020. A Study on Respiratory Morbidities and Pulmonary Functions among Traffic Policemen in Bengaluru City. *Indian Journal of Community Medicine*, 45(1).

Hazarika, N., & Srivastava, A., 2017. Estimation of Risk Factor of Elements and PAHs in Size-Differentiated Particles in the National Capital Region of India. *Air Quality, Atmosphere & Health*, 10(4).

Johannessen, A., Omenaas, E.R., Bakke, P.S., & Gulsvik, A., 2010. Socioeconomic Risk Factors for Lung Function Decline in a General Population. *Eur Respir J,* 36(3).

J Johnston, H.J., Mueller, W., Steinle, S., Vardoulakis,

S., Tantrakarnapa, K., Loh, M., & Cherrie, J.W., 2019. How Harmful Is Particulate Matter Emitted from Biomass Burning ? A Thailand Perspective. *Current Pollution Reports*, 5(4).

Katarzyna, J., Magdalena, R., Jean-paul, O., Juda-rezler, K., Reizer, M., & Oudinet, J., 2021. Determination and Analysis of PM10 Source Apportionment Urban Areas: The Case of Wintertime 2006. *Atmospheric Environment*, 45(36).

Khaefi, M., Geravandi, S., Hassani, G., Yari, A.R., Soltani, F., Dobaradaran, S., Moogahi, S., & Mohammadi, M.J., 2017, Association of Particulate Matter Impact on Prevalence of Chronic Obstructive Pulmonary Disease in Ahvaz, Southwest Iran during 2009 – 2013. *Aerosol and Air Quality Research,* 17(1).

Lelieveld, J., Evans, J.S., Fnais, M., Giannadaki, D., & Pozzer, A., 2015. The Contribution of Outdoor Air Pollution Sources to Premature Mortality on a Global Scale. *Nature*, 25(1).

Lu, F., Xu, D., Cheng, Y., Dong, S., Guo, C., & Jiang, X., 2015. Systematic Review and Meta-Analysis of the Adverse Health Effects of Ambient PM 2.5 and PM 10 Pollution in the Chinese Population. *Environmental Research,* 136(1).

Mbelambela, E.P., Hirota, R., Eitoku, M., Muchanga, S.M.J., Kiyosawa, H., Yasumitsu-Lovell, K., Lawanga, O.L., & Suganuma, N., 2017. Occupation Exposed to Road-Traffic Emissions and Respiratory Health Among Congolese Transit Workers, Particularly Bus Conductors, in Kinshasa: A Cross-Sectional Study. *Environmental Health and Preventive Medicine*, 22(1).

Mchugh, J., Duong, M., Ma, J., Dales, R.E., Bassim, C.W., & Verschoor, C.P., 2020. Clinical Trial Paper A Comprehensive Analysis of Factors Related to Lung Function in Older Adults: Cross-sectional Findings from the Canadian Longitudinal Study on Aging. *Respiratory Medicine,* 173(1).

Omidi, Y., Sicard, P., Taiwo, A.M., & Marco, A.D., 2018. Modeling of Particulate Matter Dispersion from a Cement Plant: Upwind- downwind Case Study. *Journal of Environmental Chemical Engineering*, 6(2).

Orru, H., Maasikmets, M., & Lai, T., 2010. Health Impacts of Particulate Matter in Five Major Estonian Towns: Main Sources of Exposure and Local Differences. *Air Quality, Atmosphere & Health*, 4.

Park, M., Joo, H.S., Lee, K., Jang, M., Kim, S.D., Kim, I., Borlaza, L.J.S., Lim, H., Shin, H., Chung, K.H., Choi, Y., Park, S.G., Bae, M., Lee, J., Song, H., & Park, K., 2018. Differential Toxicities of Fine Particulate Matters from Various Sources. *Nature,* 8.

Qi, J., Id, Z.R., Qian, Z.M., Yin, P., Yang, Y., Id, K.A., Wang, L., & Id, H.L., 2020. Potential Gains in Life Expectancy by Attaining Daily Ambient Fine Particulate Matter Pollution Standards in Mainland China: A Modeling Study Based on Nationwide Data, *Plos Medicine*, 1(1).

Rachmawati, S., Iwan. S., Ferlin, A.S., & Fathoni. F.. 2022. Working Period and CO Exposure Relationship with Changes Levels COHb of Bus Terminal Officer. *Kemas,* 18(2).

Rao, S., Pachauri, S., Dentener, F., Kinney, P., Klimont, Z., Riahi, K., & Schoepp, W., 2013. Better Air for Better Health: Forging Synergies in Policies for Energy Access, Climate Change and Air Pollution. *Global Environmental Change*, 23(5).

Reizer, M., & Juda-Rezler, K., 2016. Explaining the High PM 10 Concentrations Observed in Polish Urban Areas. *Air Quality, Atmosphere & Health*, 1(1).

Ryswyk, K., Van Evans, G.J., Kulka, R., Sun, L., Sabaliauskas, K., Rouleau, M., Anastasopolos, A.T., Wallace, L., & Weichenthal, S., 2021. Personal Exposures to Traffic-Related Air Pollution in Three Canadian Bus Transit Systems: the Urban Transportation Exposure Study. *Journal of Exposure Science & Environmental Epidemiology*, 31.

Sah, D., Verma, P.K., Kandikonda, M.K., & Lakhani, A., 2019. Urban Climate Pollution Characteristics, Human Health Risk Through Multiple Exposure Pathways, and Source Apportionment of Heavy Metals in PM 10 at Indo-Gangetic Site. *Urban Climate,* 27.

Shelly, S.Y., Malik, H.J., Ali, Z., Manzoor, F., Nasir, Z.A. and Biosci, I.J., 2019. Lung Morbidity of Traffic Wardens Exposed to Chronic Vehicular Pollution in Lahore, Pakistan. *International Journal of Biosciences,* 14(5).

Singh, N., Murari, V., Kumar, M., Barman, S.C., & Banerjee, T., 2017. Fine Particulates Over South Asia: Review and meta-analysis of PM 2.5 Source Apportionment Through Receptor Model. *Environmental Pollution*, 223.

Suryadi, I., Aditama, P.N., Nurlaila, F., & Siti, R., 2021. The Determinant of Lung Function Disorders of The Textile Industry Spinning Section. *Kemas,* 17(4).

Tahery, N., Geravandi, S., Goudarzi, G., Shahriyari, H.A., & Jalali, S., 2021. Estimation of PM 10 Pollutant and Its Effect on Total

Mortality (TM), Hospitalizations Due to Cardiovascular Diseases (HACD), and Respiratory Disease. *Environmental Science and Pollution Research,* 28.

Thi, L., Ngoc, N., Kim, M., Khac, V., Bui, H., Park, D., & Lee, Y., 2018. Particulate Matter Exposure of Passengers at Bus Stations: A Review. *International Journal of Environmental Research And Public Health*, 15(12).

Valavanidis, A., & Fiotakis, K., 2008. Airborne Particulate Matter and Human Health: Toxicological Assessment and Importance of Size and Composition of Particles for Oxidative Damage and Carcinogenic Mechanisms. *J Environ Sci Health C Environ Carcinog Ecotoxicol Rev,* 26(8).

Wang, X., Xu, Z., Su, H., Chak, H., Song, Y., & Zheng, H., 2021. Science of the Total Environment Pneumonia: The Smaller Particle, the Greater Short-term Impact ?'. *Science of the Total Environment*, 772.

Wu, Q., Han, L., Xu, M., Zhang, H., Ding, B., & Zhu, B., 2019. Effects of Occupational Exposure to Dust on Chest Radiograph, Pulmonary Function, Blood Pressure and Electrocardiogram Among Coal Miners in an Eastern Province, China. *BMC Public Health*, 19(1).

Zhang, D., Aunan, K., Martin, H., Larssen, S., Liu, J., & Zhang, D., 2010. The Assessment of Health Damage Caused by Air Pollution and Its Implication for Policy Making in Taiyuan, Shanxi, China. *Energy Policy*, 38(1).

Zhang, S., Worrell, E., Crijns-graus, W., Krol, M., Bruine, M., De Geng, G., Wagner, F., & Cofala, J., 2016. Modeling Energy Efficiency to Improve Air Quality and Health Effects of China's Cement Industry. *Applied Energy*, 184.

Zhang, W., Ma, R., Wang, Y., Jiang, N., Zhang, Y., & Li, T., 2022. The Relationship Between Particulate Matter and Lung Function of Children: A Systematic Review and Meta-analysis.*Environmental Pollution,* 309(7).

Meta-Analysis and Systematic Review: Risk Factors of Measles Incidence in Indonesia (2012 – 2021)

Fairuz Haniyah Ramadhani[1✉], R. Azizah[2], Juliana Jalaludin[3], Santi Martini[4], Lilis Sulistyorini[2]
[1]Master of Environmental Health, Departement of Environmental Health, Faculty of Public Health, Universitas Airlangga, Surabaya, Indonesia
[2]Departement of Environmental Health, Faculty of Public Health, Universitas Airlangga, Indonesia
[3]Departement of Environmental & Occupational Health, Faculty of Medicine & Health Sciences, Universiti Putra Malaysia, Malaysia
[4]Epidemiology Division, Department of Epidemiology, Biostatistics, Population Studies and Health Promotion, Faculty of Public Health, Universitas Airlangga, Indonesia

Article Info

Abstract

Measles is a highly contagious disease caused by the morbillivirus. According to WHO data, measles is one of the worldwide leading causes of death in children and infants. Indonesia is one of the ten countries with the most significant measles cases worldwide. Cases in Indonesia have increased due to a decrease in immunization coverage in Indonesia during the pandemic. Besides low immunization coverage, other factors that influence the incidence of measles in Indonesia are nutritional status, mother's knowledge, and occupancy density. This study aims to analyze the risk factors of immunization status, nutritional status, Mother's knowledge, and occupancy density for measles in Indonesia. This study used a meta-analysis method. The data sources used are Google Scholar, Pubmed, and Science Direct, from 2012-2021. The research articles found in this study are 148 articles. The report is then selected by screening to choose the year and research method and continued selection using inclusion criteria. Thus, the articles analyzed in this article are 23 research articles. The results showed that the variable immunization status, nutritional status, Mother knowledge, and occupancy density have risk factors for the incidence of measles in Indonesia. The result of measuring the pooled OR value sequentially from immunization status, nutritional status, mother's knowledge, and occupancy density is e1.26=3.53; e0.72= 2.05; e1.36= 3.82; e1.34= 3.89. The variable with the highest risk factor value for measles incidence in Indonesia is the occupancy density, followed by the Mother's knowledge; immunization status; and nutritional status.

Introduction

Measles is a highly contagious disease caused by the morbillivirus. The virus begins to infect when the measles virus uses the H-protein to infect the cell target (Rasool et al., 2018). The measles virus genome is a single chain of unsegmented RNA. The incubation time of measles is 7 – 12 days. Symptoms of the disease are fever, rash on maculopapular erythematous, cough, and conjunctivitis. Complications commonly occur in people with measles are pneumonia, otitis media, platelets, diarrhea, and brain inflammation (Donadel et al., 2021).

In 2018 WHO reported that there were 140,000 deaths globally from measles. Most of the deaths occurred in children under the age of 5 years. Indonesia is one of the 10 countries with the highest number of measles cases worldwide. The number of measles cases in Indonesia is 1,211 until October 12, 2022 (CDC), and it occupies the 9th country with the

most measles cases worldwide.

The spread of measles in the community through coughing, sneezing, and personal contact with sufferers. The measles virus is still active and contagious even though it is in the air or on the surface of objects for up to 2 hours. The CDC (2022) says that about 9 out of 10 unprotected people will be infected with people who get measles. According to WHO, the COVID-19 pandemic has caused many countries to forget about measles programs. Data from CDC shows that nearly 41 countries have forgotten about measles and other diseases during the pandemic. It leads to a greater risk of spreading worldwide, including in Indonesia. The laboratory results of the Ministry of Health in Indonesia stated that there was a 15-fold increase in cases of measles confirmed in 2022 compared to 2021. This data was followed by a decrease in the achievement of measles-rubella immunization in Indonesia in 2020 and 2021, namely 65.3% and 58.5%. Indonesia was unable to achieve its predetermined immunization targets, even achieving lower than the previous two years in 2018 and 2019.

Risk factors that influence the incidence of measles in an area are immunization coverage and contact between communities (Nguyen et al., 2022). Until now, immunization is still a matter of debate in the community. People's hesitancy to immunization is influenced by many things the fear of the risk of immunization, religious beliefs, or values that contradict those of the individual or society. Measles immunization is carried out when the child is 9 months – 15 years old (Kementerian Kesehatan Indonesia, 2022). At this age, the child does not yet have the ability and authority to control his health and body. Therefore, parents have a vital role in the immunization status of their children. Parents must have sufficient knowledge about immunization and the risks that can be obtained if the child does not get a complete immunization (Conis, 2019). Mother is one of the key factors in a child vaccination coverage (Harapan et al., 2021). Contact between exposed individuals to healthy individuals can increase the risk of measles transmission (Qin et al., 2019). Transmission of measles spreads through the air, so human density somewhere becomes one of the vital factors in the spread of

the measles virus. Therefore, people affected by measles must self-isolate (Torner et al., 2021).

Nutritional status influences the incidence of measles. There is a complex relationship between nutritional status and pain in humans. Malnutrition increased the mortality rate of measles disease(Salman et al., 2022). Nutritional status is always associated with the incidence of disease in the human body. The illness causes humans to cause a decrease in nutritional status, but on the contrary, it is also the same if humans lack nutritional status, it will be easy to get the disease (Schneider, 2022). The risk factors causing measles are very diverse, especially in Indonesia, an archipelagic country with a large population. The purpose of this study was to analyze the risk factors for immunization status, nutritional status, Mother knowledge, and occupancy density for the occurrence of measles in Indonesia. This study analyzes research articles discussing the risk factors for measles in Indonesia.

Method

This research is quantitative research with the Meta-analysis method. This method analyzes several research data in articles combined into one. The data is then summarized and analyzed to give rise to the effect size value (Hari Basuki Notobroto, 2019). The research article used in this study is an article that discusses the risk factors for measles in Indonesia. Data sources from this study used Google Scholar (2012 – 2021), Pubmed (2012 – 2021), and Science Direct (2012 – 2021). The selection of keywords used in this study used the PICO (Population, Intervention, Comparison/Control, Outcome) method (Methley et al., 2014 & Pollock & Berge, 2018). The keyword population used is "Indonesia" to describe Indonesians affected by measles. The intervention keyword used is "risk factor" to find variables that are risk factors for measles. The control and outcome keywords used in this study were "measles" and "no measles" or "measles" and "non-measles". The combination of keywords used in this study was "risk factors" and "measles" and "Indonesia"; "risk factor" and "measles" and "Indonesia". Then the article is screened and sorted again using inclusion criteria. The PRISMA flow chart in this study showed in Figure 1.
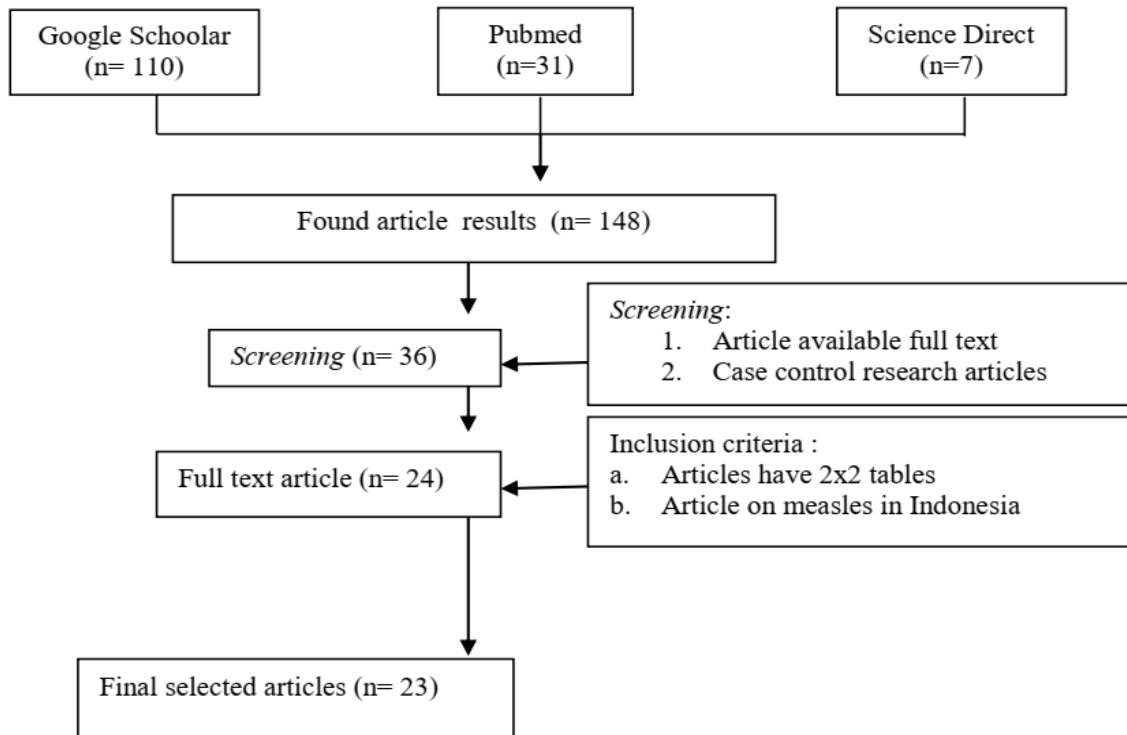
Figure 1. PRISMA Flow Chart Risk Factors for Immunization Status, Nutritional Status, Mother Knowledge, and Occupancy Density for the Incidence of Measles in Indonesia

The collected data is then analyzed using classic meta-analysis and processed with the JASP application. The technical stages of data analysis used at first are data collection/abstraction. Data is collected in the state-of-the-art table for screening. Then the selected data is entered into Comma Separated Values (CSV) and then entered into the application. Data analysis was performed in JASP Version 0.16.3.0 application. Data is collected in the state-of-the-art table for screening. Then the selected data is entered into Comma Separated Values (CSV) and the application. Egger or Bias Tests are analyzed with the same application. This data analysis was used to look at biases in the study. Data can be analyzed in Egger's test and funnel plot tables. After that, the data was analyzed using a sensitivity test with the same application. This test is used to see if the data is relatively stable to changes. This study compared the data using fixed effect models and random effect models.

This study uses pooled odd ratio analysis with the Mentel – Heaenszel method with two methods. Namely for fixed effect models using Mentel-Haesnzel and for analysis with random effect models using DerSimonian-land. The alpha (α) value used is 0.05. In the determination of homogeneous and hete-rogeneous variation, it is determined by p analysis and compared with α values. The data of the research article is declared homogeneous if the p-value is > α, then the opposite is the case that the data is heterogeneous if the p-value is < α. Homogeneous data will be analyzed with fixed effect models, and heterogeneous data will be analyzed using random effect models. The interpretation of the OR value is expressed in the following statement: Variables with an estimated OR > 1 with a Confident Interval (CI) not passing the number 1, can be interpreted that these variables are risk factors for measles in Indonesia; Variables with an estimate of OR < 1 and Confident Interval (CI) do not pass the number 1, so it is stated that these variables are a protective factor of each variable related to the incidence of measles in Indonesia; and Variables with an estimate of OR = 1 and Confidence Interval (CI) do not pass the number 1 then the variables have no relationship with the incidence of measles in Indonesia

Result and Discussion

The number of articles found in the study

was 148 articles. Articles that are not available are full text and not researched using case-control and then carried out elimination. After that, another elimination was carried out for articles that did not meet the inclusion criteria of this study. The results of searching the research article literature from the data source came from predetermined keywords, and the data found as many as 148 research articles. After the screening stage, the data were eliminated into 36 research articles. Furthermore, a selection was made with inclusion criteria so that the final result of the articles used was 23 research articles. The research article is then analyzed to find its statistical value. The result of the Meta-Analysis and Eggers Test in Tables 1 and 2, respectively, are as follows.

Table 1. Meta-Analysis of Risk Factors for Immunization Status, Nutritional Status, Occupancy Density, and Mother Knowledge of the Incidence of Measles in Indonesia

Research Variables	N	p-value
Immunization Status	25	< 0.01
Nutritional Status	11	< 0.01
Mother's Knowledge	10	0.015
Occupancy Density	9	0.187

Based on the results in Table 1, the p-value of the heterogeneity test is smaller than the α value (0.05), which is p= < 0.001. These results suggest that the variation of the research articles used is heterogeneous. Therefore, this analysis uses the Restricted ML method. Same as for immunization status, the p-value for variable nutritional status of this analysis is greater than the α value (0.05), where p= < 0.001. Based on these results, it can be concluded that the research articles used in this analysis are heterogeneous. Therefore, the analysis used is a restricted ML method too. Similar to the two variables before, the p-value of the mother's knowledge of the heterogeneity test is smaller than the α value which is p= 0.015. These results suggest that variations in research are used in heterogeneous Mother

knowledge analysis. Therefore, the study uses the Restricted ML method too. Meanwhile, the results of the analysis heterogeneity of occupancy density data in Table 1 show that the data need to use a homogeneous model. The p-value of this heterogynous analysis is 0.187, which means that the data is more than the α value of 0.05. So data analysis on residential density variables uses the Fixed Effects Method.

Table 2. Egger's Test Variabel Immunization Status, Nutritional Status, Occupancy Density, and Mother Knowledge of the Incidence of Measles in Indonesia

Research Variables	N	z	p-value
Immunization Status	25	0.33	0.74
Nutritional Status	11	-0.86	0.39
Mother's Knowledge	10	-0.29	0.78
Occupancy Density	9	2.03	0.04

The Egger's test in Table 2 shows that the p-value of variable immunization is 0.744. This value is greater than the α value (0.05), so it can be said that there is no research bias in this analysis. If it is figured on illustrated, there will be seen from the symmetrical effect size around the mean. Same as before, the results of egger's test of variable nutritional status showed that the p-value is higher than α (0.05), i.e. p= 0.39. Based on these results, there is no bias in this analysis. It means that the distribution of effect size is symmetrical to the mean. The p Egger's test value of the Mother knowledge variable is 0.775. The value is more than α (0.05), so we can conclude no publication bias in this analysis. The result can give us an illustration that the distribution effect size is symmetrical with the research mean. Unlike other variables, the value of Egger's test in Table 2 indicates that the p-value is greater than the < α value (0.05) which is 0.043. So it can be concluded that there is a research bias in this analysis. If the plot effect size distribution is figured in an illustration, the plot will not be symmetrical to the mean value.

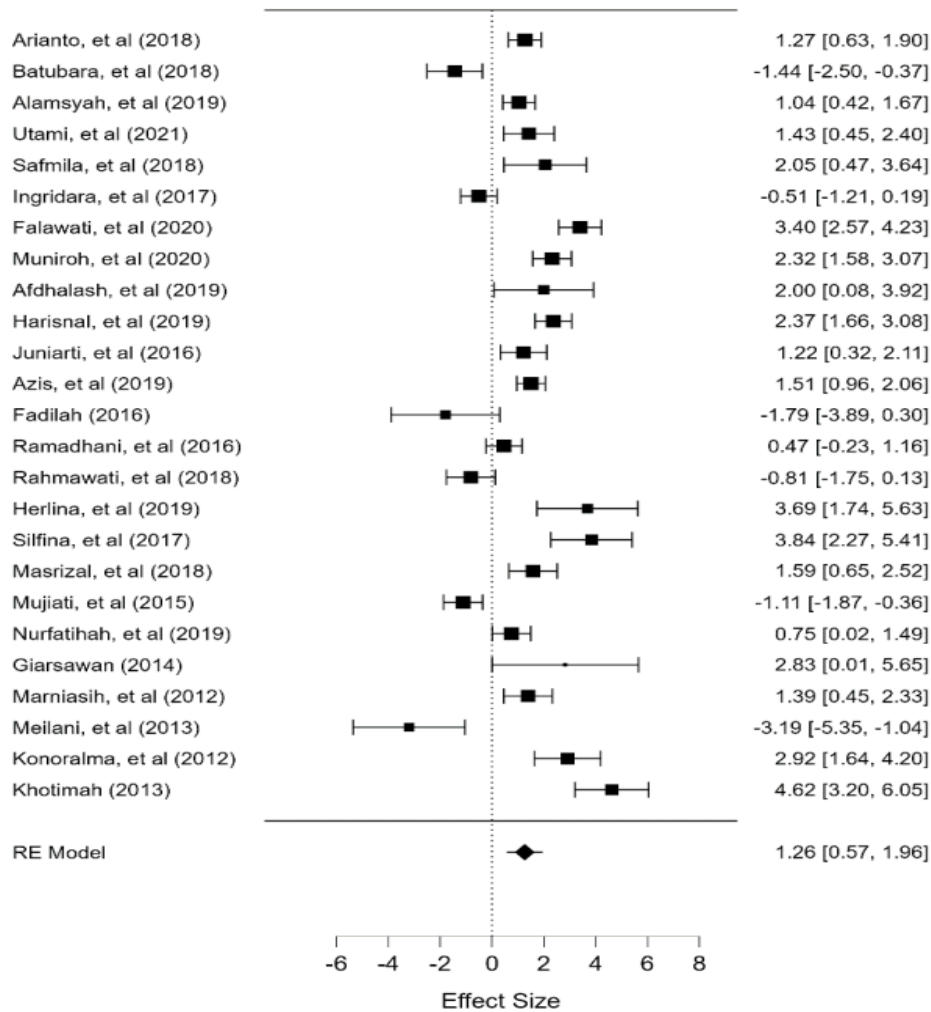| Study	Effect Size [95% CI]
Arianto, et al (2018)	1.27 [0.63, 1.90]
Batubara, et al (2018)	-1.44 [-2.50, -0.37]
Alamsyah, et al (2019)	1.04 [0.42, 1.67]
Utami, et al (2021)	1.43 [0.45, 2.40]
Safmila, et al (2018)	2.05 [0.47, 3.64]
Ingridara, et al (2017)	-0.51 [-1.21, 0.19]
Falawati, et al (2020)	3.40 [2.57, 4.23]
Muniroh, et al (2020)	2.32 [1.58, 3.07]
Afdhalash, et al (2019)	2.00 [0.08, 3.92]
Harisnal, et al (2019)	2.37 [1.66, 3.08]
Juniarti, et al (2016)	1.22 [0.32, 2.11]
Azis, et al (2019)	1.51 [0.96, 2.06]
Fadilah (2016)	-1.79 [-3.89, 0.30]
Ramadhani, et al (2016)	0.47 [-0.23, 1.16]
Rahmawati, et al (2018)	-0.81 [-1.75, 0.13]
Herlina, et al (2019)	3.69 [1.74, 5.63]
Silfina, et al (2017)	3.84 [2.27, 5.41]
Masrizal, et al (2018)	1.59 [0.65, 2.52]
Mujiati, et al (2015)	-1.11 [-1.87, -0.36]
Nurfatihah, et al (2019)	0.75 [0.02, 1.49]
Giarsawan (2014)	2.83 [0.01, 5.65]
Marniasih, et al (2012)	1.39 [0.45, 2.33]
Meilani, et al (2013)	-3.19 [-5.35, -1.04]
Konoralma, et al (2012)	2.92 [1.64, 4.20]
Khotimah (2013)	4.62 [3.20, 6.05]
RE Model	1.26 [0.57, 1.96]

Figure 2. Forest plot Risk Factors for Immunization Status for Measles Disease Incidence in Indonesia

The results from the forest plot shown in Figure 2 show that the Odd Ratio (OR) value depicted in the model's Restricted ML (RE) value is 1.26 with a 95% Confident Interval (CI) range of 0.57 – 1.96. The result is then entered into the equation of the pooled OR value, and a result of e1.26=3.53 is obtained. Based on these results, we concluded that immunization status has a risk influence of 3.53 times on the incidence of measles in Indonesia. The value of this risk is higher than previous research conducted by Morgan, et al. in 2016. In the study, the pooled OR value found was 0.58 (Morgan et al., 2016). Immunization status affects the incidence of measles in Indonesia. The results of this meta-analysis measurement show that the immunization variable has a 3.53 times risk of measles in Indonesia. Measles immunization is one of the preventive efforts

to avoid measles. The immunization status is closely related to the incidence of measles in Indonesia. Immunization is one of the efforts to increase immunity. Immunization is effective to decrease measles cases (Bose et al., 2022). Before vaccination, measles fatalities significantly increased pediatric mortality, especially for children under five. Around 95% of children who receive the vaccine at 12 months of age and 98% who receive it at 15 months of age generate anti-measles antibodies (Peart Akindele, 2022). Indonesians who do not get immunization are proven to have higher risk factors for developing measles. This study is per the meta-analysis research conducted by Morgan et. al (2016), which states that immunization is at risk of measles. Immunization affects immunoglobin G (IgG) (Ichimura et al., 2022). Antibody IgG is an antiviral against the measles virus, and its

titers were affected by immunization (Bose et al., 2022).

Socioeconomic status plays a vital role in immunization status in Indonesia (Hope et al., 2021). Measles immunization in Indonesia is provided free of charge by the Indonesian government to the general public. However, even though it is given free of charge, immunization is usually obtained for free at the Puskesmas, while the Puskesmas have limited working hours. Parents with low socioeconomic status tend to be more reluctant to vaccinate

a child. It is related to the pattern of working hours of parents with low economic status who tend to have a more busy work schedule and do not match the puskesmas schedule, so they do not have time to take children to the health center. Parents with sufficient income, despite having a busy schedule, still have a high probability of having a caregiver for their child who can deliver the child to get the vaccine or they will go to a paid immunization location that has flexible time.
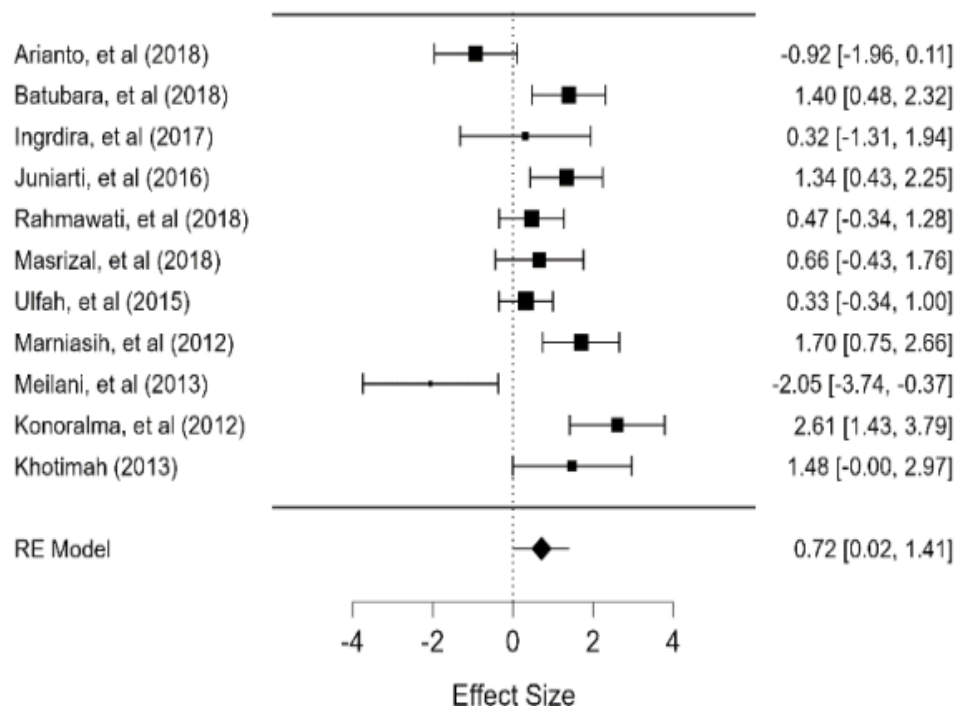

Figure 3. Forest plot Risk Factors for Nutritional Status for the Incidence of Measles in Indonesia

The forest plot image shown in Figure 3 shows that the RE (OR) number in this analysis is 0.72 with a 95% CI range of 0.02 – 1.41. Based on these results, the pooled OR score of this analysis is $e^{0.72}= 2.05$. Based on these results, nutritional status has a risk influence of 2.05 times on the incidence of measles in Indonesia. The results of the analysis of this study prove that nutritional status is one of the risk factors for the incidence of measles, with a risk value of 2.05 times. Research by Rahmawati, et. Al (2018) mentioned that nutritional status has a risk of 2.11 for measles. This result is linear with the analysis results obtained in this analysis. Several other research articles show results that align with this study, which shows that nutritional

status influences the incidence of measles in Indonesia (Rahmawati et al., 2018). The study in the Republic Democratic of Chongo also shows that chlid with malnutrition has a significant association with measles. It may be a sign of past low nutritional status, linked to a decline in cell-mediated immunity, and is known to affect children's vulnerability to infectious infections (Ashbaugh et al., 2020). Nutritional status is an indirect factor in the occurrence of measles. Immunity after immunization is influenced by nutritional status. In addition to affecting post-immunization immunity, nutritional status also plays a vital role in forming immunity. Aside crucial for preserving healthy and regular bodily functions, nutrients are also needed to boost

143

immunity and protect against viral infections (Thirumdas et al., 2021). Almost all immune systems are impacted by protein-energy deficiency. An effective immune response depends on micronutrients, and immune function is reduced by deficits in one or more micronutrients (Calder & Yaqoob, 2020). The study on Sub-sahara Africa showed that the vast majority of those impacted are pastoralists, whose food instability results in widespread

malnutrition. To combat measles, it is essential to enhance nutritional conditions (Nchasi et al., 2022). There are still few international articles that discuss the risk factors for nutritional status with the incidence of measles, and there is not even a meta-analysis that discusses this. Based on the analysis in this study, nutritional status has a considerable risk factor for the incidence of measles in Indonesia.
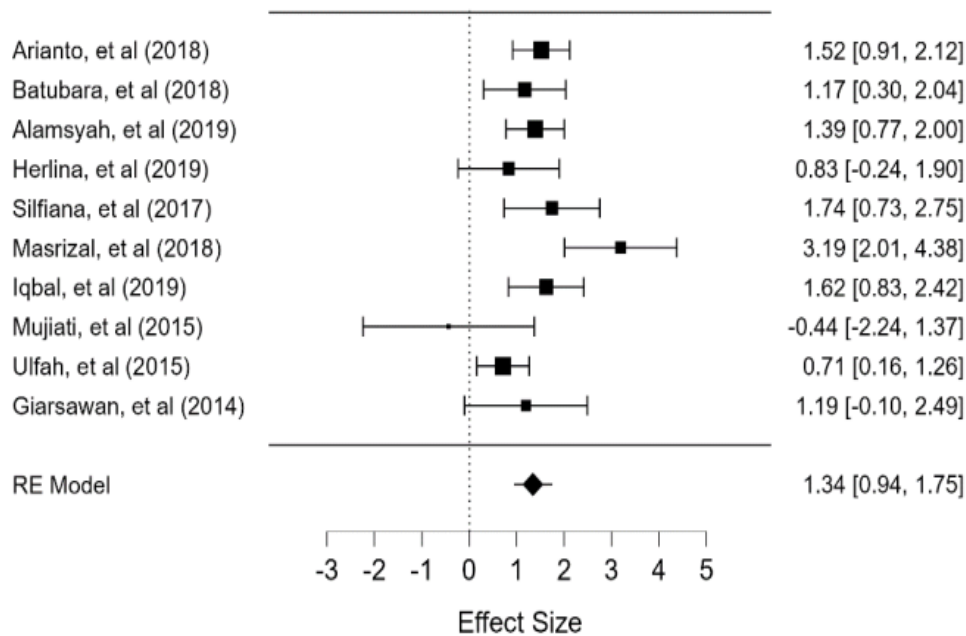

Figure 4. Forest Plot Risk Factors for Mother Knowledge on the Incidence of Measles in Indonesia

The RE value in Figure 4 showed that the OR estimation from the Mother knowledge risk factor analysis of measles incidence was 1.34 with a 95% CI range of 0.94 – 1.75. Based on these results, the pooled OR value obtained is e1.34 = 3.82. These results mean that the Mother knowledge variable has a risk influence of 3.82 on the incidence of measles in Indonesia.

The results of this study show that Mother knowledge affects the incidence of measles and has a risk of 3.82 times the incidence of measles in Indonesia. Knowledge is a condition in which a person knows and has a sensitivity to an event. Knowledge or cognitive's factors is the dominant factor in the determination of attitudes and behaviors. Knowledge affects things. The higher the mother's knowledge of a disease, will be accompanied by the increase in the mother's behavior and attitude in efforts to

prevent and control the disease. The study from the Philippines found that mothers with a high degree of knowledge had a favorable attitude and appropriate behaviors toward children's vaccination (Arceo et al., 2021). The results of this study are in line with research conducted by Muluneh (2022), which states that there is a relationship between mothers' knowledge of measles incidence. Four risk factors make infants suffer from measles, and one of them is a mother with no maternal education (Bettampadi et al., 2021).

Mother knowledge is closely related to the level of education of mothers and their age (Yufika et al., 2020) Mothers without educational background or just primary education had fewer children with a second dose vaccine than a mother who has higher education level (Goshu Muluneh et al., 2022). Mothers with a

higher level of education, such as a diploma, tend to be more courageous and not afraid of immunization compared to mothers with low education. Meanwhile, mothers with higher education have better analytical skills. On the contrary, mothers with low education tend to be easily influenced by others (Mohd Azizi et al., 2017). It can be understood that mothers with higher education are more likely to be exposed to knowledge about immunization than mothers with low education. In addition, Mothers who have received more education are more likely to actively seek medical attention, adhere to nutritional guidelines, and use health services. They are also better able to identify serious conditions affecting children's health, follow immunization requirements, actively seek prenatal care, and receive postnatal care services that increase the likelihood of their child's health (Amoah & Asamoah, 2022).
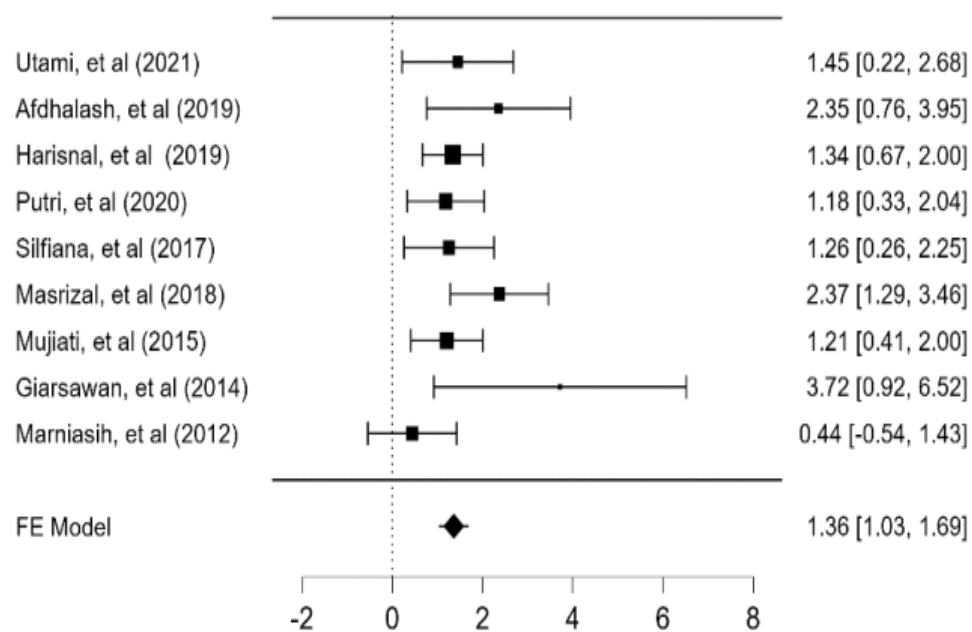

Figure 5. Forest Plot Risk Factors for Occupancy Density for Measles Disease Incidence in Indonesia

The analysis results with the forest plot in Figure 5 showed that the Fixed Effect Model value was 1.36 with a 95% Confident Interval (CI) value of 1.03-1.69. The pooled OR value from the forest plot analysis results is e1.36= 3.89. Based on the pooled OR analysis, occupancy density has a 3.89 times risk of measles incidence. This analysis can also mean that people who have houses with poor occupancy density or do not comply with regulations set by the government have a 3.89 times risk of being infected with measles.

Measles is one of the infectious diseases through air transmission (Nardell & Nathavitharana, 2023). Occupancy density is one of the factors that affect the air quality in the home space. The ideal condition of a house is when the size of the house meets the Indonesian standard of 8 m2 / person. So that when the house does not meet the standard standards, it is said to have poor occupancy density. In the analysis, the results were obtained that there was a significant relationship between the variable occupancy density and the incidence of measles in Indonesia, with a pooled OR risk value of 3.40. Otherwise, the analysis in this study had shortcomings, namely that there was a research bias described in the funnel plot and Egger's test. This bias is likely because the articles used are homogeneous and less varied.

Indonesia is one of the most populous countries in the world. Although it has a large area, the population distribution is still uneven and is still centered in the Java region. Urban areas in Java have a very dense population, so the land houses are limited. People with lower-middle-class socioeconomic conditions are forced to live in narrow locations. This condition

145

causes occupancy density, so it is not suitable for habitation. The presence of good ventilation can minimize this condition. Good ventilation is proven to reduce the risk of airborne disease infection. These two factors, occupancy density and ventilation, when combined well, can be one of the solutions to control the spread of airborne disease (Zhang et al., 2021).

A healthy building is a building built to promote and serve the well-being of occupants. A good strategy in building management is the key to provide good indoor air quality (Vergerio & Becchio, 2022). One of the ways is to pay attention to manage the occupancy density. A building must ensure that the building area is following the number of occupants of the house in one room. A study from a hospital in China showed that occupancy density highly affects indoor PM25 concentrations, and it shows how crucial the number of people inside is to the interior atmosphere (Zhou & Yang, 2022). We need to increase our knowledge of how buildings affect occupant health as well as the elements that support occupant health in buildings. We need to understand the health effects of building design, construction, usage, operation, and maintenance is crucial given that we spend the majority of our time inside our homes, schools, workplaces, and other indoor spaces (Nardell & Nathavitharana, 2023).

Conclusions

Measles is still a challenge for Indonesia, especially in the post-pandemic period. This research analyses some of the risk factors faced by Indonesians to be free from measles. The result shows that the variable with the highest risk factor for measles incidence in Indonesia is the variable occupancy density, followed by Mother knowledge; immunization status; and nutritional status. The disadvantage of this study is that there is one variable that has a research bias, namely the occupancy density variable. In contrast, the other variable does not have a research bias. More research needs to be done on the influence of risk factors for residential density on the incidence of measles in Indonesia. In addition, it is necessary to increase the coverage of measles immunization and nutrition in the community. Parents, especially mothers, need to increase their knowledge of measles and support government programs called measles-rubella immunization to avoid infection with measles. One of the way is enhancing primary health care facilities to improve the proportion of moms who are well-versed in immunization and address other concerns surrounding childhood vaccination

References

Amoah, A., & Asamoah, M.K., 2022. Child Survival: the Role of a Mother's Education. *Heliyon,* 8(11), pp.e11403.

Arceo, E., Dizon, J.C., Chavez, M., Cordero, P.K., de Leon, M.R., de Luna, J., de Vera, T.F., Jose, J., Manalo, L.-D., & Tiongco, R.E., 2021. Knowledge, Attitude, and Practices of Mothers from a Rural Community in Pampanga, Philippines Toward Childhood Immunization: A Cross Sectional Survey. *Vacunas (English Edition),* 22(3), pp.183–188. https://doi.org/10.1016/j.vacune.2021.10.010

Ashbaugh, H.R., Cherry, J.D., Hoff, N.A., Doshi, R.H., Alfonso, V.H., Gadoth, A., Mukadi, P., Higgins, S.G., Budd, R., Randall, C., Mwamba, G.N., Okitolonda-Wemakoy, E., Muyembe-Tamfum, J.J., Gerber, S.K., & Rimoin, A.W., 2020. Measles Antibody Levels Among Vaccinated and Unvaccinated Children 6–59 Months of Age in the Democratic Republic of the Congo, 2013–2014. *Vaccine,* 38(9), pp.2258–2265.

Bettampadi, D., Carlson, B.F., & Mathew, J.L., 2021. Impact of Multiple Risk Factors on Vaccination Inequities: Analysis in Indian Infants Over 2 Decades. *American Journal of Preventive Medicine*, 60(1), pp.S34–S43.

Bose, A.S., Rai, P., Gupta, B.P., Pradhan, R., Lacoul, M., Shakya, S., Shrestha, D., Gautam, A., Bhandari, B., Shrestha, B., Tinkari, B.S., Jha, R., Khanal, B., Shrestha, P., Bhusal, S., & Gautam, J.S., 2022. Nepal Measles Outbreak Response Immunization during COVID-19: A Risk-Based Intervention Strategy. *Vaccine,* 40(20), pp.2884–2893.

Calder, P.C., & Yaqoob, P., 2020. *Immune Response. Present Knowledge in Nutrition.* Elsevier Inc.

Conis, E., 2019. Measles and the Modern History of Vaccination. *Public Health Reports,* 134(2), pp.118–125.

Donadel, M., Stanescu, A., Pistol, A., Stewart, B., Butu, C., Jankovic, D., Paunescu, B., & Zimmerman, L., 2021. Risk Factors for Measles Deaths Among Children During a Nationwide Measles Outbreak – Romania, 2016–2018. *BMC Infectious Diseases*, 21(1).

Goshu Muluneh, A., Woldemariam, M.M., Tigabu, B., Getie, F.M., Molla, K.G., & Animut, Y., 2022. Less than One-Fifth of Ethiopian Children were Vaccinated for Measles Second Dose; Evidence from the Ethiopian Mini Demographic and Health Survey 2019. *Vaccine,*: X(12), pp.100217.

Harapan, H., Shields, N., Kachoria, A.G., Shotwell, A., & Wagner, A.L., 2021. Religion and Measles Vaccination in Indonesia, 1991–2017. *American Journal of Preventive Medicine*, 60(1), pp.S44–S52.

Ichimura, Y., Yamauchi, M., Yoshida, N., Miyano, S., Komada, K., Thandar, M.M., Tiwara, S., Mita, T., Hombhanje, F.W., Mori, Y., Takeda, M., & Hachiya, M., 2022. Effectiveness of Immunization Activities on Measles and Rubella Immunity Among Individuals in East Sepik, Papua New Guinea: A Cross-Sectional Study. *IJID Regions*, 3, pp.84–88.

Methley, A.M., Campbell, S., Chew-Graham, C., McNally, R., & Cheraghi-Sohi, S., 2014. PICO, PICOS and SPIDER: A Comparison Study of Specificity and Sensitivity in Three Search Tools for Qualitative Systematic Reviews. *BMC Health Services Research,* 14(1).

Mohd Azizi, F.S., Kew, Y., & Moy, F.M., 2017. Vaccine Hesitancy Among Parents in a Multi-Ethnic Country, Malaysia. *Vaccine*, 35(22), pp.2955–2961.

Morgan, E., Halliday, S.R., Campbell, G.R., Cardwell, C.R., & Patterson, C.C., 2016. Vaccinations and Childhood Type 1 Diabetes Mellitus: A Meta-Analysis of Observational Studies. *Diabetologia*, 59(2), pp.237–243.

Nardell, E., & Nathavitharana, R., 2023. Air Disinfection in Measles Transmission Hotspots Seeing Your Older Inpatient in Better Times. *The Lancet,* 394(10203), pp.1009–1010.

Nchasi, G., Paul, I.K., Sospeter, S.B., Mallya, M.R., Ruaichi, J., & Malunga, J., 2022. Measles Outbreak in Sub-Saharan Africa Amidst COVID-19: A Rising Concern, Efforts, Challenges, and Future Recommendations. *Annals of Medicine and Surgery,* 81, pp.104264.

Nguyen, T.H.T., Nguyen, T.V., Luong, Q.C., Ho, T.V., Faes, C., & Hens, N., 2022. Understanding the Transmission Dynamics of a Large-Scale Measles Outbreak in Southern Vietnam. *International Journal of Infectious Diseases*, 122, pp.1009–1017.

Peart Akindele, N., 2022. Updates in the Epidemiology, Approaches to Vaccine Coverage and Current Outbreaks of Measles. *Infectious Disease Clinics of North America,* 36(1), pp.39–48.

Pollock, A., & Berge, E., 2018. How to do a Systematic Review. *International Journal of Stroke*, 13(2), pp.138–156.

Qin, S., Ding, Y., Yan, R., & He, H., 2019. Measles in Zhejiang, China, 2004-2017: Population Density and Proportion of Floating Populations Effects on Measles Epidemic. *Health Security,* 17(3), pp.193–199.

Rahmawati, L., Ma'rufi, I., & Wahyuningtyias, F., 2018. Nutrition Status as Determinant of Incidence of Measles in Jember Regency. *Health Notions,* 2(1).

Rasool, M.H., Rafiq, A., Nawaz, M.Z., Shafique, M., & Saqalein, M., 2018. Sero-Epidemiology and Risk Factor Analysis of Measles among Children in Pakistan. *Polish Journal of Microbiology,* 67(2), pp.227–231.

Salman, Y., Shaeen, S.K., Khan, H.A., Islam, Z., & Essar, M.Y., 2022. The Effect of Child Malnourishment on Measles Spread Amidst the COVID-19 Pandemic in Afghanistan. *Annals of Medicine and Surgery*, 78, pp.0–2.

Schneider, E.B., 2022. The Effect of Nutritional Status on Historical Infectious Disease Morbidity: Evidence from the London Foundling Hospital, 1892-1919. *History of the Family*, 2022.

Thirumdas, R., Kothakota, A., Pandiselvam, R., Bahrami, A., & Barba, F.J., 2021. Role of Food Nutrients and Supplementation in Fighting Against Viral Infections and Boosting Immunity: A Review. *Trends in Food Science and Technology,* 110, pp.66–77.

Torner, N., Ferràs, J., Curto, L., Rebull, J., Sol, J., Costa, J., Mosquera, M.M., Izquierdo, C., Martínez, A., & Jané, M., 2021. Measles Outbreak Related to Healthcare Transmission. *Vacunas*, 22(1), pp.20–27.

Vergerio, G., & Becchio, C., 2022. Pursuing Occupants' Health and Well-Being in Building Management: Definition of New Metrics Based on Indoor Air Parameters. *Building and Environment,* 223, pp.109447.

Yufika, A., Wagner, A.L., Nawawi, Y., Wahyuniati, N., Anwar, S., Yusri, F., Haryanti, N., Wijayanti, N.P., Rizal, R., Fitriani, D., Maulida, N.F., Syahriza, M., Ikram, I., Fandoko, T.P., Syahadah, M., Asrizal, F.W., Aletta, A., Haryanto, S., Jamil, K.F., Mudatsir, M., & Harapan, H., 2020. Parents' Hesitancy Towards Vaccination in Indonesia: A Cross-Sectional Study in Indonesia. *Vaccine,* 38(11), pp.2592–2599.

Zhang, S., Ai, Z., & Lin, Z., 2021. Occupancy-Aided Ventilation for Both Airborne Infection Risk Control and Work Productivity. *Building and Environment*, 188.

Zhou, Y., & Yang, G., 2022. Science of the Total Environment A Predictive Model of Indoor PM 2.5 Considering Occupancy Level in a Hospital Outpatient Hall. *Science of the Total Environment,* 844, pp.157233.

Meta-Analysis and Systematic Review: Risk Factors of Measles Incidence in Indonesia (2012 – 2021)

Fairuz Haniyah Ramadhani[1✉], R. Azizah[2], Juliana Jalaludin[3], Santi Martini[4], Lilis Sulistyorini[2]

[1]Master of Environmental Health, Departement of Environmental Health, Faculty of Public Health, Universitas Airlangga, Surabaya, Indonesia

[2]Departement of Environmental Health, Faculty of Public Health, Universitas Airlangga, Indonesia

[3]Departement of Environmental & Occupational Health, Faculty of Medicine & Health Sciences, Universiti Putra Malaysia, Malaysia

[4]Epidemiology Division, Department of Epidemiology, Biostatistics, Population Studies and Health Promotion, Faculty of Public Health, Universitas Airlangga, Indonesia

Article Info

Abstract

Measles is a highly contagious disease caused by the morbillivirus. According to WHO data, measles is one of the worldwide leading causes of death in children and infants. Indonesia is one of the ten countries with the most significant measles cases worldwide. Cases in Indonesia have increased due to a decrease in immunization coverage in Indonesia during the pandemic. Besides low immunization coverage, other factors that influence the incidence of measles in Indonesia are nutritional status, mother's knowledge, and occupancy density. This study aims to analyze the risk factors of immunization status, nutritional status, Mother's knowledge, and occupancy density for measles in Indonesia. This study used a meta-analysis method. The data sources used are Google Scholar, Pubmed, and Science Direct, from 2012-2021. The research articles found in this study are 148 articles. The report is then selected by screening to choose the year and research method and continued selection using inclusion criteria. Thus, the articles analyzed in this article are 23 research articles. The results showed that the variable immunization status, nutritional status, Mother knowledge, and occupancy density have risk factors for the incidence of measles in Indonesia. The result of measuring the pooled OR value sequentially from immunization status, nutritional status, mother's knowledge, and occupancy density is e1.26=3.53; e0.72= 2.05; e1.36= 3.82; e1.34= 3.89. The variable with the highest risk factor value for measles incidence in Indonesia is the occupancy density, followed by the Mother's knowledge; immunization status; and nutritional status.

Introduction

Measles is a highly contagious disease caused by the morbillivirus. The virus begins to infect when the measles virus uses the H-protein to infect the cell target (Rasool et al., 2018). The measles virus genome is a single chain of unsegmented RNA. The incubation time of measles is 7 – 12 days. Symptoms of the disease are fever, rash on maculopapular erythematous, cough, and conjunctivitis. Complications commonly occur in people with measles are pneumonia, otitis media, platelets, diarrhea, and brain inflammation (Donadel et al., 2021).

In 2018 WHO reported that there were 140,000 deaths globally from measles. Most of the deaths occurred in children under the age of 5 years. Indonesia is one of the 10 countries with the highest number of measles cases worldwide. The number of measles cases in Indonesia is 1,211 until October 12, 2022 (CDC), and it occupies the 9th country with the

most measles cases worldwide.

The spread of measles in the community through coughing, sneezing, and personal contact with sufferers. The measles virus is still active and contagious even though it is in the air or on the surface of objects for up to 2 hours. The CDC (2022) says that about 9 out of 10 unprotected people will be infected with people who get measles. According to WHO, the COVID-19 pandemic has caused many countries to forget about measles programs. Data from CDC shows that nearly 41 countries have forgotten about measles and other diseases during the pandemic. It leads to a greater risk of spreading worldwide, including in Indonesia. The laboratory results of the Ministry of Health in Indonesia stated that there was a 15-fold increase in cases of measles confirmed in 2022 compared to 2021. This data was followed by a decrease in the achievement of measles-rubella immunization in Indonesia in 2020 and 2021, namely 65.3% and 58.5%. Indonesia was unable to achieve its predetermined immunization targets, even achieving lower than the previous two years in 2018 and 2019.

Risk factors that influence the incidence of measles in an area are immunization coverage and contact between communities (Nguyen et al., 2022). Until now, immunization is still a matter of debate in the community. People's hesitancy to immunization is influenced by many things the fear of the risk of immunization, religious beliefs, or values that contradict those of the individual or society. Measles immunization is carried out when the child is 9 months – 15 years old (Kementerian Kesehatan Indonesia, 2022). At this age, the child does not yet have the ability and authority to control his health and body. Therefore, parents have a vital role in the immunization status of their children. Parents must have sufficient knowledge about immunization and the risks that can be obtained if the child does not get a complete immunization (Conis, 2019). Mother is one of the key factors in a child vaccination coverage (Harapan et al., 2021). Contact between exposed individuals to healthy individuals can increase the risk of measles transmission (Qin et al., 2019). Transmission of measles spreads through the air, so human density somewhere becomes one of the vital factors in the spread of

the measles virus. Therefore, people affected by measles must self-isolate (Torner et al., 2021).

Nutritional status influences the incidence of measles. There is a complex relationship between nutritional status and pain in humans. Malnutrition increased the mortality rate of measles disease(Salman et al., 2022). Nutritional status is always associated with the incidence of disease in the human body. The illness causes humans to cause a decrease in nutritional status, but on the contrary, it is also the same if humans lack nutritional status, it will be easy to get the disease (Schneider, 2022). The risk factors causing measles are very diverse, especially in Indonesia, an archipelagic country with a large population. The purpose of this study was to analyze the risk factors for immunization status, nutritional status, Mother knowledge, and occupancy density for the occurrence of measles in Indonesia. This study analyzes research articles discussing the risk factors for measles in Indonesia.

Method

This research is quantitative research with the Meta-analysis method. This method analyzes several research data in articles combined into one. The data is then summarized and analyzed to give rise to the effect size value (Hari Basuki Notobroto, 2019). The research article used in this study is an article that discusses the risk factors for measles in Indonesia. Data sources from this study used Google Scholar (2012 – 2021), Pubmed (2012 – 2021), and Science Direct (2012 – 2021). The selection of keywords used in this study used the PICO (Population, Intervention, Comparison/Control, Outcome) method (Methley et al., 2014 & Pollock & Berge, 2018). The keyword population used is "Indonesia" to describe Indonesians affected by measles. The intervention keyword used is "risk factor" to find variables that are risk factors for measles. The control and outcome keywords used in this study were "measles" and "no measles" or "measles" and "non-measles". The combination of keywords used in this study was "risk factors" and "measles" and "Indonesia"; "risk factor" and "measles" and "Indonesia". Then the article is screened and sorted again using inclusion criteria. The PRISMA flow chart in this study showed in Figure 1.
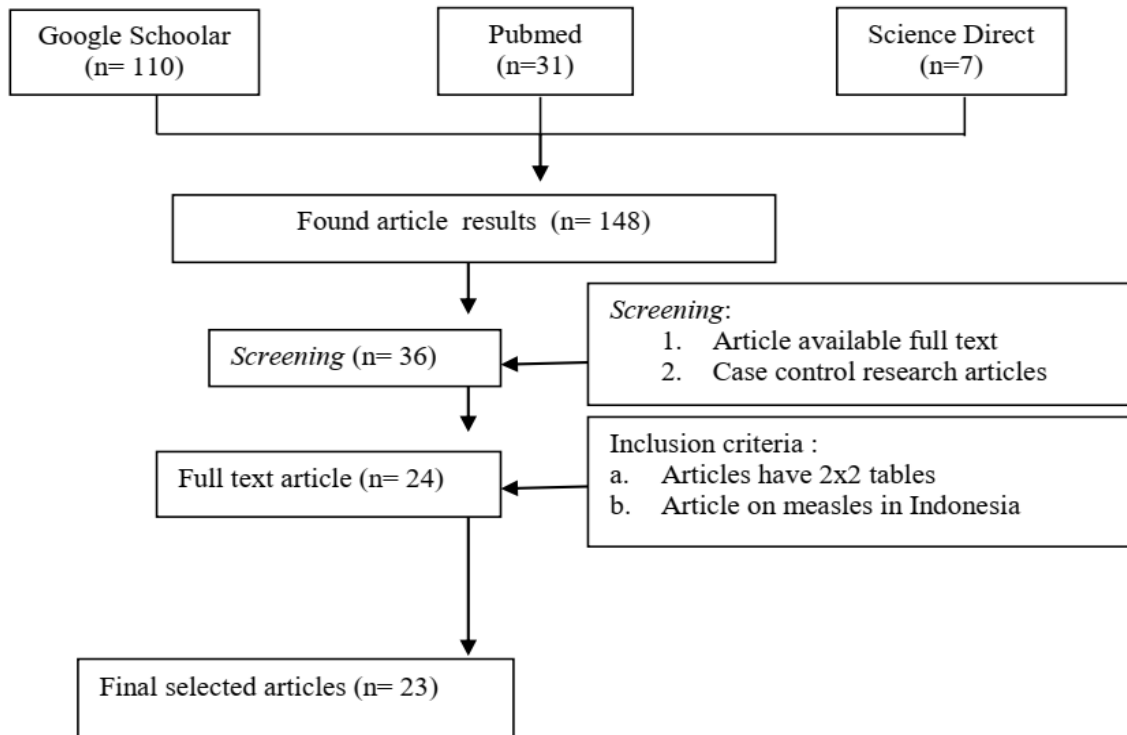
Figure 1. PRISMA Flow Chart Risk Factors for Immunization Status, Nutritional Status, Mother Knowledge, and Occupancy Density for the Incidence of Measles in Indonesia

The collected data is then analyzed using classic meta-analysis and processed with the JASP application. The technical stages of data analysis used at first are data collection/abstraction. Data is collected in the state-of-the-art table for screening. Then the selected data is entered into Comma Separated Values (CSV) and then entered into the application. Data analysis was performed in JASP Version 0.16.3.0 application. Data is collected in the state-of-the-art table for screening. Then the selected data is entered into Comma Separated Values (CSV) and the application. Egger or Bias Tests are analyzed with the same application. This data analysis was used to look at biases in the study. Data can be analyzed in Egger's test and funnel plot tables. After that, the data was analyzed using a sensitivity test with the same application. This test is used to see if the data is relatively stable to changes. This study compared the data using fixed effect models and random effect models.

This study uses pooled odd ratio analysis with the Mentel – Heaenszel method with two methods. Namely for fixed effect models using Mentel-Haesnzel and for analysis with random effect models using DerSimonian-land. The alpha (α) value used is 0.05. In the determination of homogeneous and heterogeneous variation, it is determined by p analysis and compared with α values. The data of the research article is declared homogeneous if the p-value is > α, then the opposite is the case that the data is heterogeneous if the p-value is < α. Homogeneous data will be analyzed with fixed effect models, and heterogeneous data will be analyzed using random effect models. The interpretation of the OR value is expressed in the following statement: Variables with an estimated OR > 1 with a Confident Interval (CI) not passing the number 1, can be interpreted that these variables are risk factors for measles in Indonesia; Variables with an estimate of OR < 1 and Confident Interval (CI) do not pass the number 1, so it is stated that these variables are a protective factor of each variable related to the incidence of measles in Indonesia; and Variables with an estimate of OR = 1 and Confidence Interval (CI) do not pass the number 1 then the variables have no relationship with the incidence of measles in Indonesia

Result and Discussion

The number of articles found in the study

was 148 articles. Articles that are not available are full text and not researched using case-control and then carried out elimination. After that, another elimination was carried out for articles that did not meet the inclusion criteria of this study. The results of searching the research article literature from the data source came from predetermined keywords, and the data found as many as 148 research articles. After the screening stage, the data were eliminated into 36 research articles. Furthermore, a selection was made with inclusion criteria so that the final result of the articles used was 23 research articles. The research article is then analyzed to find its statistical value. The result of the Meta-Analysis and Eggers Test in Tables 1 and 2, respectively, are as follows.

Table 1. Meta-Analysis of Risk Factors for Immunization Status, Nutritional Status, Occupancy Density, and Mother Knowledge of the Incidence of Measles in Indonesia

Research Variables	N	p-value
Immunization Status	25	< 0.01
Nutritional Status	11	< 0.01
Mother's Knowledge	10	0.015
Occupancy Density	9	0.187

Based on the results in Table 1, the p-value of the heterogeneity test is smaller than the α value (0.05), which is p= < 0.001. These results suggest that the variation of the research articles used is heterogeneous. Therefore, this analysis uses the Restricted ML method. Same as for immunization status, the p-value for variable nutritional status of this analysis is greater than the α value (0.05), where p= < 0.001. Based on these results, it can be concluded that the research articles used in this analysis are heterogeneous. Therefore, the analysis used is a restricted ML method too. Similar to the two variables before, the p-value of the mother's knowledge of the heterogeneity test is smaller than the α value which is p= 0.015. These results suggest that variations in research are used in heterogeneous Mother

knowledge analysis. Therefore, the study uses the Restricted ML method too. Meanwhile, the results of the analysis heterogeneity of occupancy density data in Table 1 show that the data need to use a homogeneous model. The p-value of this heterogynous analysis is 0.187, which means that the data is more than the α value of 0.05. So data analysis on residential density variables uses the Fixed Effects Method.

Table 2. Egger's Test Variabel Immunization Status, Nutritional Status, Occupancy Density, and Mother Knowledge of the Incidence of Measles in Indonesia

Research Variables	N	z	p-value
Immunization Status	25	0.33	0.74
Nutritional Status	11	-0.86	0.39
Mother's Knowledge	10	-0.29	0.78
Occupancy Density	9	2.03	0.04

The Egger's test in Table 2 shows that the p-value of variable immunization is 0.744. This value is greater than the α value (0.05), so it can be said that there is no research bias in this analysis. If it is figured on illustrated, there will be seen from the symmetrical effect size around the mean. Same as before, the results of egger's test of variable nutritional status showed that the p-value is higher than α (0.05), i.e. p= 0.39. Based on these results, there is no bias in this analysis. It means that the distribution of effect size is symmetrical to the mean. The p Egger's test value of the Mother knowledge variable is 0.775. The value is more than α (0.05), so we can conclude no publication bias in this analysis. The result can give us an illustration that the distribution effect size is symmetrical with the research mean. Unlike other variables, the value of Egger's test in Table 2 indicates that the p-value is greater than the < α value (0.05) which is 0.043. So it can be concluded that there is a research bias in this analysis. If the plot effect size distribution is figured in an illustration, the plot will not be symmetrical to the mean value.

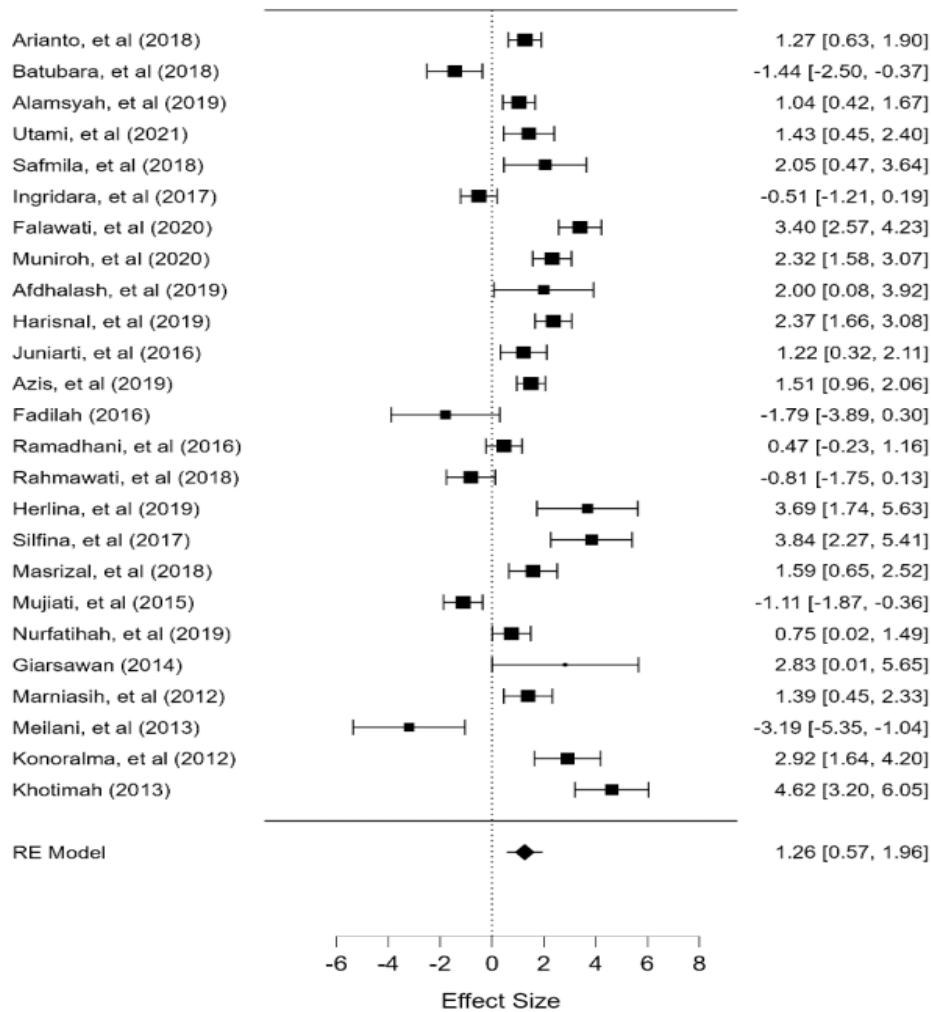| Arianto, et al (2018) | 1.27 [0.63, 1.90] |
Batubara, et al (2018)	-1.44 [-2.50, -0.37]
Alamsyah, et al (2019)	1.04 [0.42, 1.67]
Utami, et al (2021)	1.43 [0.45, 2.40]
Safmila, et al (2018)	2.05 [0.47, 3.64]
Ingridara, et al (2017)	-0.51 [-1.21, 0.19]
Falawati, et al (2020)	3.40 [2.57, 4.23]
Muniroh, et al (2020)	2.32 [1.58, 3.07]
Afdhalash, et al (2019)	2.00 [0.08, 3.92]
Harisnal, et al (2019)	2.37 [1.66, 3.08]
Juniarti, et al (2016)	1.22 [0.32, 2.11]
Azis, et al (2019)	1.51 [0.96, 2.06]
Fadilah (2016)	-1.79 [-3.89, 0.30]
Ramadhani, et al (2016)	0.47 [-0.23, 1.16]
Rahmawati, et al (2018)	-0.81 [-1.75, 0.13]
Herlina, et al (2019)	3.69 [1.74, 5.63]
Silfina, et al (2017)	3.84 [2.27, 5.41]
Masrizal, et al (2018)	1.59 [0.65, 2.52]
Mujiati, et al (2015)	-1.11 [-1.87, -0.36]
Nurfatihah, et al (2019)	0.75 [0.02, 1.49]
Giarsawan (2014)	2.83 [0.01, 5.65]
Marniasih, et al (2012)	1.39 [0.45, 2.33]
Meilani, et al (2013)	-3.19 [-5.35, -1.04]
Konoralma, et al (2012)	2.92 [1.64, 4.20]
Khotimah (2013)	4.62 [3.20, 6.05]
RE Model	1.26 [0.57, 1.96]

Figure 2. Forest plot Risk Factors for Immunization Status for Measles Disease Incidence in Indonesia

The results from the forest plot shown in Figure 2 show that the Odd Ratio (OR) value depicted in the model's Restricted ML (RE) value is 1.26 with a 95% Confident Interval (CI) range of 0.57 – 1.96. The result is then entered into the equation of the pooled OR value, and a result of e1.26=3.53 is obtained. Based on these results, we concluded that immunization status has a risk influence of 3.53 times on the incidence of measles in Indonesia. The value of this risk is higher than previous research conducted by Morgan, et al. in 2016. In the study, the pooled OR value found was 0.58 (Morgan et al., 2016). Immunization status affects the incidence of measles in Indonesia. The results of this meta-analysis measurement show that the immunization variable has a 3.53 times risk of measles in Indonesia. Measles immunization is one of the preventive efforts

to avoid measles. The immunization status is closely related to the incidence of measles in Indonesia. Immunization is one of the efforts to increase immunity. Immunization is effective to decrease measles cases (Bose et al., 2022). Before vaccination, measles fatalities significantly increased pediatric mortality, especially for children under five. Around 95% of children who receive the vaccine at 12 months of age and 98% who receive it at 15 months of age generate anti-measles antibodies (Peart Akindele, 2022). Indonesians who do not get immunization are proven to have higher risk factors for developing measles. This study is per the meta-analysis research conducted by Morgan et. al (2016), which states that immunization is at risk of measles. Immunization affects immunoglobin G (IgG) (Ichimura et al., 2022). Antibody IgG is an antiviral against the measles virus, and its

titers were affected by immunization (Bose et al., 2022).

Socioeconomic status plays a vital role in immunization status in Indonesia (Hope et al., 2021). Measles immunization in Indonesia is provided free of charge by the Indonesian government to the general public. However, even though it is given free of charge, immunization is usually obtained for free at the Puskesmas, while the Puskesmas have limited working hours. Parents with low socioeconomic status tend to be more reluctant to vaccinate

a child. It is related to the pattern of working hours of parents with low economic status who tend to have a more busy work schedule and do not match the puskesmas schedule, so they do not have time to take children to the health center. Parents with sufficient income, despite having a busy schedule, still have a high probability of having a caregiver for their child who can deliver the child to get the vaccine or they will go to a paid immunization location that has flexible time.
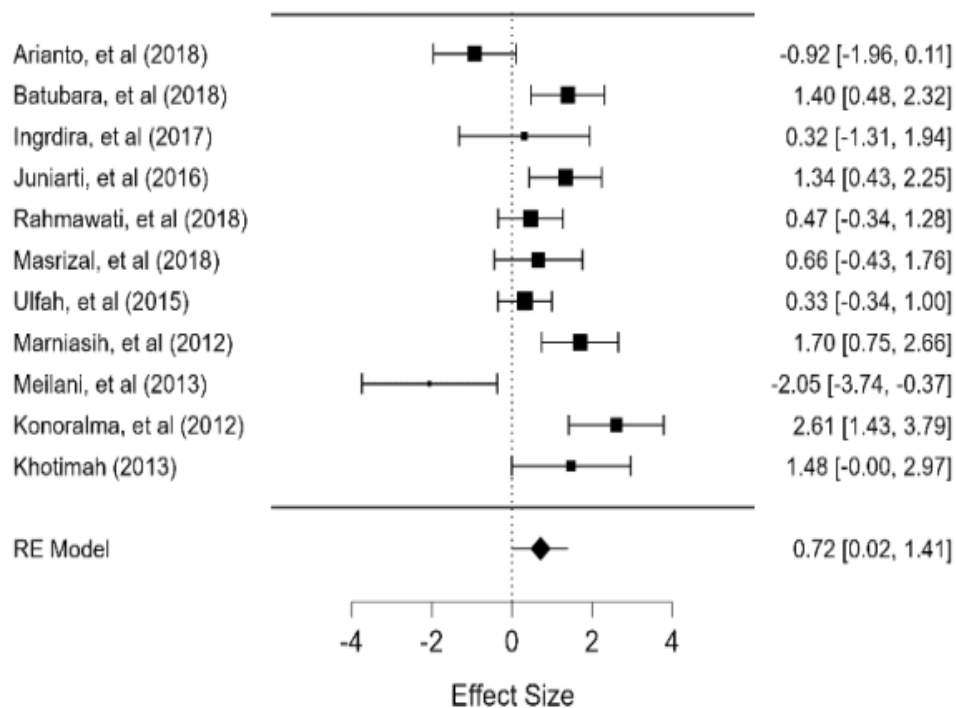

Figure 3. Forest plot Risk Factors for Nutritional Status for the Incidence of Measles in Indonesia

The forest plot image shown in Figure 3 shows that the RE (OR) number in this analysis is 0.72 with a 95% CI range of 0.02 – 1.41. Based on these results, the pooled OR score of this analysis is $e^{0.72}= 2.05$. Based on these results, nutritional status has a risk influence of 2.05 times on the incidence of measles in Indonesia. The results of the analysis of this study prove that nutritional status is one of the risk factors for the incidence of measles, with a risk value of 2.05 times. Research by Rahmawati, et. Al (2018) mentioned that nutritional status has a risk of 2.11 for measles. This result is linear with the analysis results obtained in this analysis. Several other research articles show results that align with this study, which shows that nutritional

status influences the incidence of measles in Indonesia (Rahmawati et al., 2018). The study in the Republic Democratic of Chongo also shows that chlid with malnutrition has a significant association with measles. It may be a sign of past low nutritional status, linked to a decline in cell-mediated immunity, and is known to affect children's vulnerability to infectious infections (Ashbaugh et al., 2020). Nutritional status is an indirect factor in the occurrence of measles. Immunity after immunization is influenced by nutritional status. In addition to affecting post-immunization immunity, nutritional status also plays a vital role in forming immunity. Aside crucial for preserving healthy and regular bodily functions, nutrients are also needed to boost

143

immunity and protect against viral infections (Thirumdas et al., 2021). Almost all immune systems are impacted by protein-energy deficiency. An effective immune response depends on micronutrients, and immune function is reduced by deficits in one or more micronutrients (Calder & Yaqoob, 2020). The study on Sub-sahara Africa showed that the vast majority of those impacted are pastoralists, whose food instability results in widespread

malnutrition. To combat measles, it is essential to enhance nutritional conditions (Nchasi et al., 2022). There are still few international articles that discuss the risk factors for nutritional status with the incidence of measles, and there is not even a meta-analysis that discusses this. Based on the analysis in this study, nutritional status has a considerable risk factor for the incidence of measles in Indonesia.

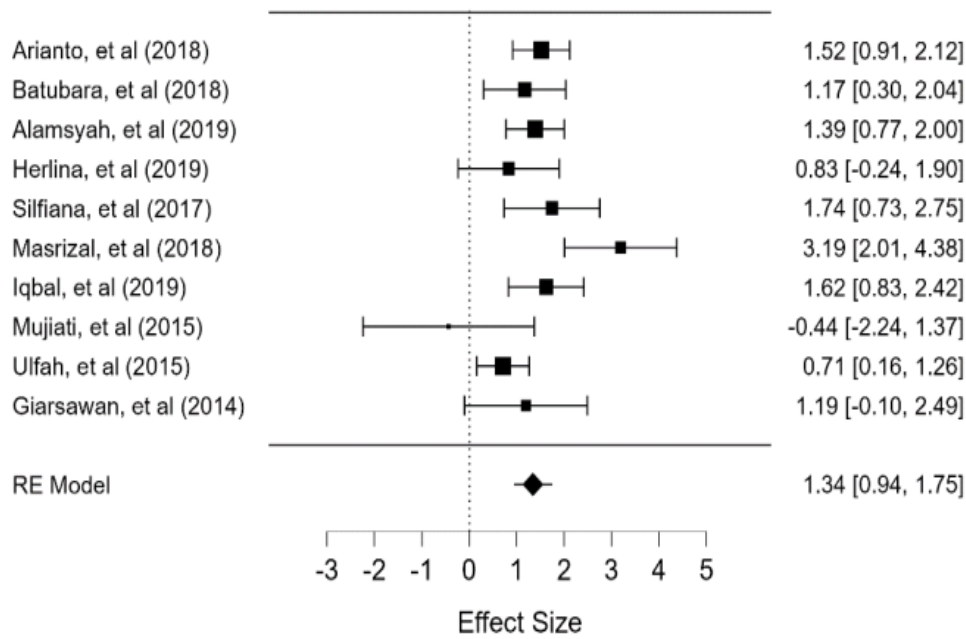|		
Arianto, et al (2018)		1.52 [0.91, 2.12]
Batubara, et al (2018)		1.17 [0.30, 2.04]
Alamsyah, et al (2019)		1.39 [0.77, 2.00]
Herlina, et al (2019)		0.83 [-0.24, 1.90]
Silfiana, et al (2017)		1.74 [0.73, 2.75]
Masrizal, et al (2018)		3.19 [2.01, 4.38]
Iqbal, et al (2019)		1.62 [0.83, 2.42]
Mujiati, et al (2015)		-0.44 [-2.24, 1.37]
Ulfah, et al (2015)		0.71 [0.16, 1.26]
Giarsawan, et al (2014)		1.19 [-0.10, 2.49]
RE Model		1.34 [0.94, 1.75]

Figure 4. Forest Plot Risk Factors for Mother Knowledge on the Incidence of Measles in Indonesia

The RE value in Figure 4 showed that the OR estimation from the Mother knowledge risk factor analysis of measles incidence was 1.34 with a 95% CI range of 0.94 – 1.75. Based on these results, the pooled OR value obtained is e1.34 = 3.82. These results mean that the Mother knowledge variable has a risk influence of 3.82 on the incidence of measles in Indonesia.

The results of this study show that Mother knowledge affects the incidence of measles and has a risk of 3.82 times the incidence of measles in Indonesia. Knowledge is a condition in which a person knows and has a sensitivity to an event. Knowledge or cognitive's factors is the dominant factor in the determination of attitudes and behaviors. Knowledge affects things. The higher the mother's knowledge of a disease, will be accompanied by the increase in the mother's behavior and attitude in efforts to

prevent and control the disease. The study from the Philippines found that mothers with a high degree of knowledge had a favorable attitude and appropriate behaviors toward children's vaccination (Arceo et al., 2021). The results of this study are in line with research conducted by Muluneh (2022), which states that there is a relationship between mothers' knowledge of measles incidence. Four risk factors make infants suffer from measles, and one of them is a mother with no maternal education (Bettampadi et al., 2021).

Mother knowledge is closely related to the level of education of mothers and their age (Yufika et al., 2020) Mothers without educational background or just primary education had fewer children with a second dose vaccine than a mother who has higher education level (Goshu Muluneh et al., 2022). Mothers with a

higher level of education, such as a diploma, tend to be more courageous and not afraid of immunization compared to mothers with low education. Meanwhile, mothers with higher education have better analytical skills. On the contrary, mothers with low education tend to be easily influenced by others (Mohd Azizi et al., 2017). It can be understood that mothers with higher education are more likely to be exposed to knowledge about immunization than mothers with low education. In addition, Mothers who have received more education are more likely to actively seek medical attention, adhere to nutritional guidelines, and use health services. They are also better able to identify serious conditions affecting children's health, follow immunization requirements, actively seek prenatal care, and receive postnatal care services that increase the likelihood of their child's health (Amoah & Asamoah, 2022).
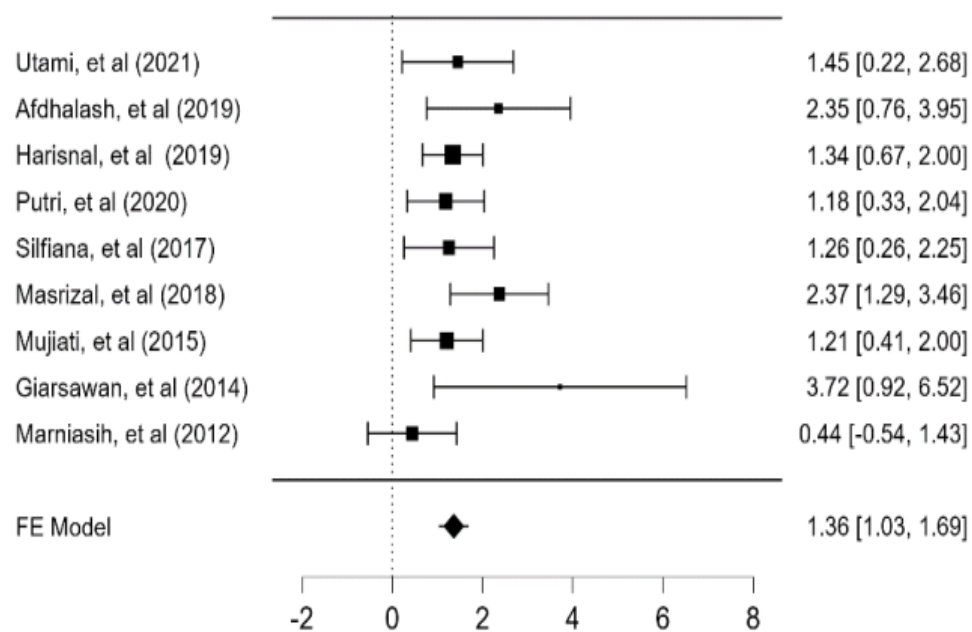

Figure 5. Forest Plot Risk Factors for Occupancy Density for Measles Disease Incidence in Indonesia

The analysis results with the forest plot in Figure 5 showed that the Fixed Effect Model value was 1.36 with a 95% Confident Interval (CI) value of 1.03-1.69. The pooled OR value from the forest plot analysis results is e1.36= 3.89. Based on the pooled OR analysis, occupancy density has a 3.89 times risk of measles incidence. This analysis can also mean that people who have houses with poor occupancy density or do not comply with regulations set by the government have a 3.89 times risk of being infected with measles.

Measles is one of the infectious diseases through air transmission (Nardell & Nathavitharana, 2023). Occupancy density is one of the factors that affect the air quality in the home space. The ideal condition of a house is when the size of the house meets the Indonesian standard of 8 m2 / person. So that when the house does not meet the standard standards, it is said to have poor occupancy density. In the analysis, the results were obtained that there was a significant relationship between the variable occupancy density and the incidence of measles in Indonesia, with a pooled OR risk value of 3.40. Otherwise, the analysis in this study had shortcomings, namely that there was a research bias described in the funnel plot and Egger's test. This bias is likely because the articles used are homogeneous and less varied.

Indonesia is one of the most populous countries in the world. Although it has a large area, the population distribution is still uneven and is still centered in the Java region. Urban areas in Java have a very dense population, so the land houses are limited. People with lower-middle-class socioeconomic conditions are forced to live in narrow locations. This condition

145

causes occupancy density, so it is not suitable for habitation. The presence of good ventilation can minimize this condition. Good ventilation is proven to reduce the risk of airborne disease infection. These two factors, occupancy density and ventilation, when combined well, can be one of the solutions to control the spread of airborne disease (Zhang et al., 2021).

A healthy building is a building built to promote and serve the well-being of occupants. A good strategy in building management is the key to provide good indoor air quality (Vergerio & Becchio, 2022). One of the ways is to pay attention to manage the occupancy density. A building must ensure that the building area is following the number of occupants of the house in one room. A study from a hospital in China showed that occupancy density highly affects indoor PM25 concentrations, and it shows how crucial the number of people inside is to the interior atmosphere (Zhou & Yang, 2022). We need to increase our knowledge of how buildings affect occupant health as well as the elements that support occupant health in buildings. We need to understand the health effects of building design, construction, usage, operation, and maintenance is crucial given that we spend the majority of our time inside our homes, schools, workplaces, and other indoor spaces (Nardell & Nathavitharana, 2023).

Conclusions

Measles is still a challenge for Indonesia, especially in the post-pandemic period. This research analyses some of the risk factors faced by Indonesians to be free from measles. The result shows that the variable with the highest risk factor for measles incidence in Indonesia is the variable occupancy density, followed by Mother knowledge; immunization status; and nutritional status. The disadvantage of this study is that there is one variable that has a research bias, namely the occupancy density variable. In contrast, the other variable does not have a research bias. More research needs to be done on the influence of risk factors for residential density on the incidence of measles in Indonesia. In addition, it is necessary to increase the coverage of measles immunization and nutrition in the community. Parents, especially mothers, need to increase their knowledge of measles and support government programs called measles-rubella immunization to avoid infection with measles. One of the way is enhancing primary health care facilities to improve the proportion of moms who are well-versed in immunization and address other concerns surrounding childhood vaccination

References

Amoah, A., & Asamoah, M.K., 2022. Child Survival: the Role of a Mother's Education. *Heliyon,* 8(11), pp.e11403.

Arceo, E., Dizon, J.C., Chavez, M., Cordero, P.K., de Leon, M.R., de Luna, J., de Vera, T.F., Jose, J., Manalo, L.-D., & Tiongco, R.E., 2021. Knowledge, Attitude, and Practices of Mothers from a Rural Community in Pampanga, Philippines Toward Childhood Immunization: A Cross Sectional Survey. *Vacunas (English Edition),* 22(3), pp.183–188. https://doi.org/10.1016/j.vacune.2021.10.010

Ashbaugh, H.R., Cherry, J.D., Hoff, N.A., Doshi, R.H., Alfonso, V.H., Gadoth, A., Mukadi, P., Higgins, S.G., Budd, R., Randall, C., Mwamba, G.N., Okitolonda-Wemakoy, E., Muyembe-Tamfum, J.J., Gerber, S.K., & Rimoin, A.W., 2020. Measles Antibody Levels Among Vaccinated and Unvaccinated Children 6–59 Months of Age in the Democratic Republic of the Congo, 2013–2014. *Vaccine,* 38(9), pp.2258–2265.

Bettampadi, D., Carlson, B.F., & Mathew, J.L., 2021. Impact of Multiple Risk Factors on Vaccination Inequities: Analysis in Indian Infants Over 2 Decades. *American Journal of Preventive Medicine*, 60(1), pp.S34–S43.

Bose, A.S., Rai, P., Gupta, B.P., Pradhan, R., Lacoul, M., Shakya, S., Shrestha, D., Gautam, A., Bhandari, B., Shrestha, B., Tinkari, B.S., Jha, R., Khanal, B., Shrestha, P., Bhusal, S., & Gautam, J.S., 2022. Nepal Measles Outbreak Response Immunization during COVID-19: A Risk-Based Intervention Strategy. *Vaccine,* 40(20), pp.2884–2893.

Calder, P.C., & Yaqoob, P., 2020. *Immune Response. Present Knowledge in Nutrition.* Elsevier Inc.

Conis, E., 2019. Measles and the Modern History of Vaccination. *Public Health Reports,* 134(2), pp.118–125.

Donadel, M., Stanescu, A., Pistol, A., Stewart, B., Butu, C., Jankovic, D., Paunescu, B., & Zimmerman, L., 2021. Risk Factors for Measles Deaths Among Children During a Nationwide Measles Outbreak – Romania, 2016–2018. *BMC Infectious Diseases*, 21(1).

Goshu Muluneh, A., Woldemariam, M.M., Tigabu, B., Getie, F.M., Molla, K.G., & Animut, Y., 2022. Less than One-Fifth of Ethiopian Children were Vaccinated for Measles Second Dose; Evidence from the Ethiopian Mini Demographic and Health Survey 2019. *Vaccine,*: X(12), pp.100217.

Harapan, H., Shields, N., Kachoria, A.G., Shotwell, A., & Wagner, A.L., 2021. Religion and Measles Vaccination in Indonesia, 1991–2017. *American Journal of Preventive Medicine*, 60(1), pp.S44–S52.

Ichimura, Y., Yamauchi, M., Yoshida, N., Miyano, S., Komada, K., Thandar, M.M., Tiwara, S., Mita, T., Hombhanje, F.W., Mori, Y., Takeda, M., & Hachiya, M., 2022. Effectiveness of Immunization Activities on Measles and Rubella Immunity Among Individuals in East Sepik, Papua New Guinea: A Cross-Sectional Study. *IJID Regions*, 3, pp.84–88.

Methley, A.M., Campbell, S., Chew-Graham, C., McNally, R., & Cheraghi-Sohi, S., 2014. PICO, PICOS and SPIDER: A Comparison Study of Specificity and Sensitivity in Three Search Tools for Qualitative Systematic Reviews. *BMC Health Services Research,* 14(1).

Mohd Azizi, F.S., Kew, Y., & Moy, F.M., 2017. Vaccine Hesitancy Among Parents in a Multi-Ethnic Country, Malaysia. *Vaccine*, 35(22), pp.2955–2961.

Morgan, E., Halliday, S.R., Campbell, G.R., Cardwell, C.R., & Patterson, C.C., 2016. Vaccinations and Childhood Type 1 Diabetes Mellitus: A Meta-Analysis of Observational Studies. *Diabetologia*, 59(2), pp.237–243.

Nardell, E., & Nathavitharana, R., 2023. Air Disinfection in Measles Transmission Hotspots Seeing Your Older Inpatient in Better Times. *The Lancet,* 394(10203), pp.1009–1010.

Nchasi, G., Paul, I.K., Sospeter, S.B., Mallya, M.R., Ruaichi, J., & Malunga, J., 2022. Measles Outbreak in Sub-Saharan Africa Amidst COVID-19: A Rising Concern, Efforts, Challenges, and Future Recommendations. *Annals of Medicine and Surgery,* 81, pp.104264.

Nguyen, T.H.T., Nguyen, T.V., Luong, Q.C., Ho, T.V., Faes, C., & Hens, N., 2022. Understanding the Transmission Dynamics of a Large-Scale Measles Outbreak in Southern Vietnam. *International Journal of Infectious Diseases*, 122, pp.1009–1017.

Peart Akindele, N., 2022. Updates in the Epidemiology, Approaches to Vaccine Coverage and Current Outbreaks of Measles. *Infectious Disease Clinics of North America,* 36(1), pp.39–48.

Pollock, A., & Berge, E., 2018. How to do a Systematic Review. *International Journal of Stroke*, 13(2), pp.138–156.

Qin, S., Ding, Y., Yan, R., & He, H., 2019. Measles in Zhejiang, China, 2004-2017: Population Density and Proportion of Floating Populations Effects on Measles Epidemic. *Health Security,* 17(3), pp.193–199.

Rahmawati, L., Ma'rufi, I., & Wahyuningtyias, F., 2018. Nutrition Status as Determinant of Incidence of Measles in Jember Regency. *Health Notions,* 2(1).

Rasool, M.H., Rafiq, A., Nawaz, M.Z., Shafique, M., & Saqalein, M., 2018. Sero-Epidemiology and Risk Factor Analysis of Measles among Children in Pakistan. *Polish Journal of Microbiology,* 67(2), pp.227–231.

Salman, Y., Shaeen, S.K., Khan, H.A., Islam, Z., & Essar, M.Y., 2022. The Effect of Child Malnourishment on Measles Spread Amidst the COVID-19 Pandemic in Afghanistan. *Annals of Medicine and Surgery*, 78, pp.0–2.

Schneider, E.B., 2022. The Effect of Nutritional Status on Historical Infectious Disease Morbidity: Evidence from the London Foundling Hospital, 1892-1919. *History of the Family*, 2022.

Thirumdas, R., Kothakota, A., Pandiselvam, R., Bahrami, A., & Barba, F.J., 2021. Role of Food Nutrients and Supplementation in Fighting Against Viral Infections and Boosting Immunity: A Review. *Trends in Food Science and Technology,* 110, pp.66–77.

Torner, N., Ferràs, J., Curto, L., Rebull, J., Sol, J., Costa, J., Mosquera, M.M., Izquierdo, C., Martínez, A., & Jané, M., 2021. Measles Outbreak Related to Healthcare Transmission. *Vacunas*, 22(1), pp.20–27.

Vergerio, G., & Becchio, C., 2022. Pursuing Occupants' Health and Well-Being in Building Management: Definition of New Metrics Based on Indoor Air Parameters. *Building and Environment,* 223, pp.109447.

Yufika, A., Wagner, A.L., Nawawi, Y., Wahyuniati, N., Anwar, S., Yusri, F., Haryanti, N., Wijayanti, N.P., Rizal, R., Fitriani, D., Maulida, N.F., Syahriza, M., Ikram, I., Fandoko, T.P., Syahadah, M., Asrizal, F.W., Aletta, A., Haryanto, S., Jamil, K.F., Mudatsir, M., & Harapan, H., 2020. Parents' Hesitancy Towards Vaccination in Indonesia: A Cross-Sectional Study in Indonesia. *Vaccine,* 38(11), pp.2592–2599.

Zhang, S., Ai, Z., & Lin, Z., 2021. Occupancy-Aided Ventilation for Both Airborne Infection Risk Control and Work Productivity. *Building and Environment*, 188.

Zhou, Y., & Yang, G., 2022. Science of the Total Environment A Predictive Model of Indoor PM 2.5 Considering Occupancy Level in a Hospital Outpatient Hall. *Science of the Total Environment,* 844, pp.157233.

Home Environment and Larva Indices: A Cross-Sectional Study in the Indonesian Transition to Endemic COVID-19

Tri Wahyuni Sukesi[1], Sulistyawati Sulistyawati[1✉], Herman Yuliansyah[2], Arfiani Nur Khusna[2], Surahma Asti Mulasari[1], Fatwa Tentama[3], Bambang Sudarsono[4], Fanani Arif Ghozali[5]

[1]Faculty of Public Health, Universitas Ahmad Dahlan, Yogyakarta, Indonesia
[2]Department of Informatics, Faculty of Industrial Technology, Universitas Ahmad Dahlan, Yogyakarta, Indonesia.
[3]Faculty of Psychology, Universitas Ahmad Dahlan, Yogyakarta, Indonesia
[4]Department of Automotive Technology Vocational Education, Faculty of Teacher Training and Education, Universitas Ahmad Dahlan, Yogyakarta, Indonesia
[5]Department of Electronics Engineering Vocational Education, Faculty of Teacher Training and Education, Universitas Ahmad Dahlan, Yogyakarta, Indonesia.

Article Info

Abstract

This study aimed to assess the association between home environment and larval indices during the COVID-19 pandemic transition. A cross-sectional design was carried out in this study. The population was the houses in two villages of Gamping Sub-District, Sleman, Yogyakarta Province. The sample was calculated by considering the confidence interval value of 95%, the margin error of 5%, and the distribution response of 50%. Accordingly, the minimum sample size was 207 households. The chi-square test was used to analyze the data. The home environment was associated with the value of the container index (CI), indicated by a significant difference p-value of 0.008 with a prevalence ratio of 3.630, which means an unhealthy house will increase the value of the container index by 3.630 times greater. Sanitation of the home environment showed a significant relationship with the value of the container index (CI) with a p-value of 0.019 and a prevalence ratio of 2.625, which means that poor sanitation conditions will increase the value of the container index by 2.625 times. The health of the home environment is associated with the mosquito larvae index.

Introduction

Indonesia has had a relatively high number of COVID-19 cases during the pandemic attack. Data released by the Ministry of Health of the Republic of Indonesia in September 2022 shows Indonesia is in the second rank after Vietnam for the country with the most COVID-19 cases in Asia (Indonesia Ministry of Health, 2022). COVID-19 Pandemic affects all aspects of life, with the emergence of policies handling COVID-19 (Setyawan and Lestari, 2020; Susilawati, Falefi and Purwoko, 2020). Dengue prevention is one program impacted due to the COVID-19 Pandemic (Wilder-Smith et al., 2020)

Before the Pandemic, Dengue control was carried out with activities such as fogging, larvacidation, and larvae inspection by Jumantik cadres and 3M (closing and draining water containers and managing waste properly) (Sayono et al., 2019; Sulistyawati et al., 2019). Those involved in controlling Dengue are health workers, jumantik cadres, and households. Health workers are responsible for promoting health, community awareness of Dengue prevention policies, mentoring, and fogging (Nuryunarsih, 2015). The Jumantik's role is to assist the community in observing mosquito larvae in every house in their working area to monitor the population of Aedes aegypti or Aedes Albopictus mosquitoes surrounding the society (Indarwati & Prayitno, 2016).

Household is expected to conduct 3M, namely closing and draining water containers, cleaning water reservoirs, and managing waste properly. The 3M campaign aims to reduce the potential breeding places for mosquitoes in the home environment (Nuryunarsih, 2015; Sayono et al., 2019). The collaboration between health workers, jumantik cadres, and households in the Dengue program can maintain the mosquito population under control, and Dengue cases can be reduced.

The government's COVID-19 policy, which entails social restrictions to stop the spread of the COVID-19 disease, is challenging for performing routine Dengue control during the Pandemic. Figure 1 shows the progress of Indonesia's COVID-19 control policy (Agustino, 2021; Roziqin, Mas'udi and Sihidi, 2021; Ikmal and Noor, 2022; Taher, 2022). On that figure, we know that from the beginning of COVID-19, announced in Indonesia for the first time, till the middle of 2022, Indonesia

faced three waves of COVID-19 with different virus variants. Each wave was followed with a policy emphasizing social restriction and distancing. Even in the first wave, the policy can be seen as semi lockdown that directly affected the stop of dengue control operation (Ernawati et al., 2021). On the other hand, for health workers, during that time, activity related to COVID-19 was a priority over Dengue control. So, the combination between COVID-19 policy restrictions and health worker priorities impacted the Dengue control cannot be carried out normally. In society, Jumantik cadres cannot carry out larval observation in homes due to limited social interaction. As a result, the mosquito population needs to be adequately monitored. It could be the cause of why Dengue cases during the COVID-19 Pandemic remain high or reduced due to society's reluctance to have medical examinations (Mashudi, Ahmad and Said, 2022; Peri Arista, Sawitri and Suganda Yatra, 2022).
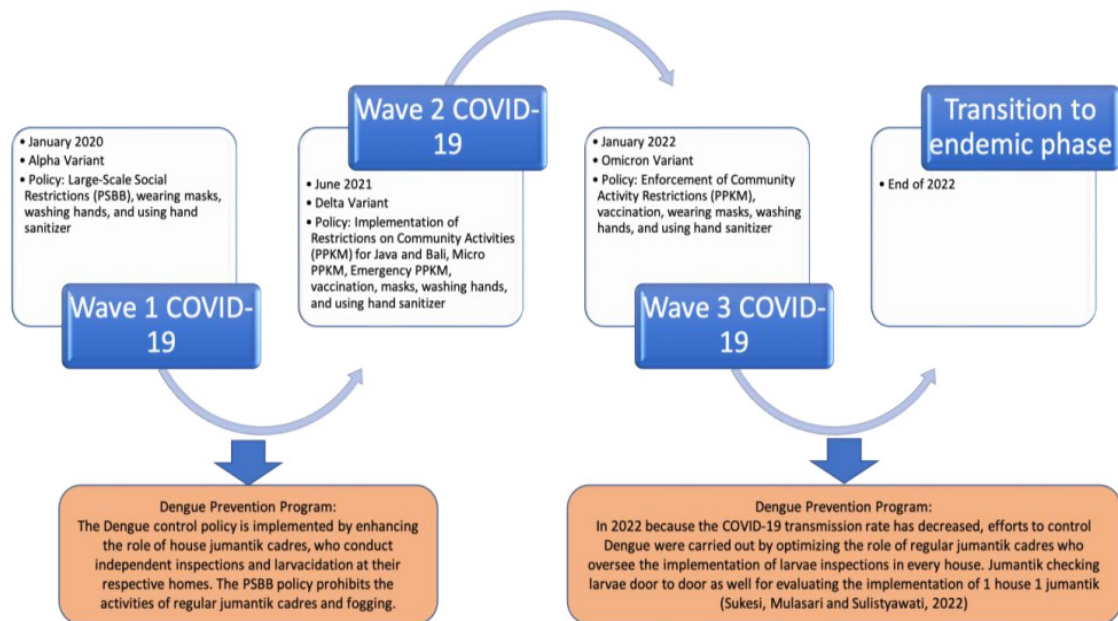

Figure 1. COVID-19 Journey and the Policy in Indonesia

Because from previous research, people say they do not have time to do 3M in their home environment for various reasons, such as work (Sulistyawati et al., 2019b). On the other hand, with social restrictions and the movement to work from home, people should have had time to observe and clean up their surroundings. Recently, Indonesia has entered

a transition to endemic COVID-19, which implies that the policies have begun to be relaxed, and life activities in Indonesia are back to normal (Sinto, 2022). So, in this study, we want to monitor how the condition of the home environment relates to indices larvae in this transition to endemic. This research contributes to developing an understanding and potential

action on the Dengue vector control during the Pandemic and social restriction for future mitigation.

Method

The research took place in the Gamping District, Yogyakarta Province, Indonesia. The location was chosen as the research location because, based on data from the Gamping 1 Health Center, this area found some Dengue cases during the Pandemic. The population in this study was all houses (287) distributed in two villages (Nyamplung lor and Mejing Lor). The number of samples is calculated using the 95% confidence interval value, a 5% error margin, and a 50% response distribution. Accordingly, the minimum sample size was 207. During the research, we collected data from 217 houses.

In this study, the independent variables were the home environment, the habit of keeping clean water on hand, the parts of the house, and the sanitation facilities. The condition of a healthy home is measured using a standard checklist from the Ministry of Health of the Republic of Indonesia. Habits of holding water were measured using an observation sheet. The components of the house are calculated using a checklist to see the floor, walls, ventilation, roof, smoke holes, and lighting. Sanitation facilities

are measured using a checklist to see clean water facilities and sources, toilets, waste, and garbage disposal. While the dependent variable was the container index. The container index is the value obtained from the number of positive larval containers divided by the number of containers inspected multiplied by 100% (Jesha M et al., 2015). According to WHO more than 5% of containers are at high risk of transmitting Dengue (Nofita, Renita Rusdji and Irawati, 2017). The presence of larvae is indicated in the house examined. Cross tabulation was used to calculate the univariate analysis, which was then carried out by a chi-square test to see the relationship among the variables. The value size for the prevalence ratio shows how much risk is caused by poor conditions. When the p-value is less than 0.05, the relationship is considered significant. Ethical approval was received from Universitas Ahmad Dahlan Ethical Board (#012205052)

Result and Discussion

In total, 217 houses were surveyed in this study. We assessed the percentage of healthy houses, habits of storing clean water, house components, sanitation facilities, and container index values.

Table 1. Home Environment Condition

Variables	Frequency	Percentage (%)
Healthy house		
Unhealthy	123	56.7
Healthy	94	43.3
The habit of holding water		
Yes	63	29.0
No	154	71.0
Home Components		
Poor	80	36.9
Good	137	63.1
Sanitation facilities		
Poor	31	14.3
Good	186	85.7

Source: Primary Data, 2022

Table 2. Indicators of Mosquito Larvae

Variables	Frequency	Percentage (%)
Index Container (CI)		
Poor	23	10.6
Good	194	89.4

Source: Primary Data, 2022

Table 3. The Relationship between Home Environmental Conditions and Larval Indicators

Variables	Container Index (CI)		P value	Prevalence Ratio	95% CI	
	High	Low			Lower	Upper
Healthy house						
Unhealthy	19	104	0.008*	3.630	1.278	10.314
Healthy	4	90				
The habit of holding water						
Yes	7	56	0.875	1.069	0.462	2.473
Not	16	138				
Home Components						
Poor	9	71	0.812	1.101	0.499	2.473
Good	14	123				
Sanitation facilities						
Poor	7	24	0.019*	2.625	1.176	5.858
Good	16	170				

*= significant at p-value 0.05
Source: Primary Data, 2022

Table 1 shows that more than half of the houses were unhealthy (56.7%). The majority (63.1%) of dwellings have proper home components, and more than 85.7% have good sanitation facilities. More than 71% of respondents reported not holding water in their containers.

The container index was found by dividing the number of containers with larvae by the number of containers checked and then multiplying that by 100% (Jesha M et al., 2015). From the larval inspection in the 217 houses, we found that almost 90% have a suitable container index (Table 2). Among four measured variables, we found two significantly associated with the container index: healthy house and sanitation facilities. People who reside in unhealthy houses have a 3.63 prevalence ratio of 3.63, higher than people who live in healthy ones. Sanitation facilities were significantly associated with the container index with a prevalence ratio of 2.625 (Table 3).

This research aimed to know how well Dengue vector control was going in Indonesia when COVID-19 went from a pandemic to an endemic. The condition of the home environment is one of the factors that can affect the transmission of Dengue fever (Sukesi et al., 2021). How the people who live in a house take care of the health of their home environment significantly affects how well it is kept. The house occupants' busy carrying out other activities outside the home will further reduce the time available to maintain the health of the home environment (Ibarra et al., 2014). The family's economic condition is another factor affecting the house's condition. Financial incapacity causes the minimum facilities met as a condition for a healthy home to be carried out (Ibarra et al., 2014).

COVID-19's impact on people living in poverty is increasing (Supriatna, 2020). Even though more time at home means they should have more time to clean the house. However, economic inadequacy causes an inability to manage home health related to fulfilling the housing requirement, such as providing clean water. Good CI value houses are under 5% are under 5% (Martini et al., 2019); this value can be seen in every house inspected by observing each container that possibly stores clean water for Aedes to lay their egg.

During the Pandemic, several policies were implemented that limit people's activities outside the home. More time is spent inside than outside. With more time in the house, someone can do more housekeeping than before. Good home environmental conditions can influence the presence of Aedes larvae (Sukesi et al., 2021). The health condition of the house associated with the value of the container index (CI) shows that there is a significant difference in a p-value of 0.008 with a prevalence ratio of 3.630, which means that an unhealthy house will increase the value of the container index by 3.630 times (Table 3). Biologically, the Aedes mosquito is anthropophilic; it likes humans, so its habitat will not be far from humans

(Mubarok et al., 2018). The house can be a place for humans to live and a habitat for Aedes mosquitoes, primarily if the house's condition can support the breeding of Aedes mosquitoes. The house's lack of home lighting and high humidity have good carrying capacities for Aedes mosquitoes (Kusumawati et al., 2016). Sanitation of the home environment shows a significant relationship with the value of the container index (CI) p-value of 0.019 (Table 3) with a prevalence ratio of 2.625, which means that poor sanitation conditions will increase the value of the container index by 2.625 times. Good sanitation facilities include clean water, suitable waste disposal, and closed sewers. If all these aspects are adequately met, the chances of the house becoming a habitat for Aedes mosquitoes will decrease. Adequate clean water can reduce water containers that can become breeding grounds for Aedes mosquitoes. Good waste and disposal facilities can reduce containers that accidentally hold clean water. Water stored in the garbage can be a breeding ground for Aedes mosquitoes (Nurmaini and Lubis, 2017)

In this study, the habit of storing clean water and house components did not have a significant relationship with the container index (CI). The data is dominated by people who do not habitually store water with a low container index value. People no longer have the habit of collecting water because water providers always supply clean water using water pipes. When the supply of clean water is fulfilled correctly, the community no longer has the habit of storing water. It is usually found where clean water is not available properly. Hence, people collect water using many containers to meet their family's clean water needs (Satoto et al., 2017). The average house component is good with a permanent house that has met the requirements of a good roof, wall, floor, ventilation, and lighting. It can reduce the carrying capacity of the house to become a preferred habitat for Aedes mosquitoes (Sukesi et al., 2021). Based on the results, a Dengue control flow can be made during the transition to endemic.

New policy policies during the Pandemic limit the community's space for movement, including jumantik cadres, who cannot monitor larvae at society's house (Sasmono and Santoso, 2022). Dengue control during the Pandemic until the transition to endemic is optimized by the role of families in maintaining a healthy environment in their respective homes. The family's role in controlling Dengue remains essential, especially in maintaining the home environment's health, which can influence mosquito larvae indicators. A healthy home environment can break the chain of Dengue transmission (Nurmaini and Lubis, 2017). During the transition period to endemic, efforts to control Dengue are returning to normal conditions, and jumantik cadres can carry out their duties again but with several protocols that must be met.

Conclusion

This research underlines that during this transitional period, vector control needs to be encouraged more because it turns out that even though many people were at home during the pandemic, this did not change all people's environmental health behavior in cleaning their houses. Housing, health, and sanitation are still the enabling factors for the container index value to be high. We recommend that the health authority must take action to implement and expand the one house one jumantik movement. So that community empowerment in controlling the dengue vector can be optimal. To support the optimization of the program, To support the program optimization, we need to strengthen the role of jumantik cadres who will supervise by sampling the implementation of the "1 house 1 jumantik" movement.

References

Agustino, L., 2021. Policy Learning and Handling of Covid-19 in Indonesia. *Transformasi: Jurnal Manajemen Pemerintahan*, 2021, pp.62–78.

Ernawati, K., Farras, R.M., Zakiyyah, A., Hayu, M.,

Salsabila, A.P., Aulia, M.L., Kurnianingsih, I., & Rifqatussa'adah., 2021. Community Behavior in Controlling Aedes aegypti Mosquito Breeding Places before and during the Covid-19 Pandemic. *IOP Conference Series: Earth and Environmental Science*, 940(1).

Ibarra, S., Anna, M., Luzadis., Valerie, A., Cordova, N., Mercy, J., Silva, Mercy, O., Tania, A., Efraín, B., & Ryan, S.J., 2014. *A Social-Ecological Analysis of Community Perceptions of Dengue Fever and Aedes aegypti in Machala, Ecuador.*

Ikmal, N.M., & Noor, M., 2022. Kebijakan Pemerintah Indonesia Dalam Penanganan COVID-19. *Jurnal Litbang Provinsi Jawa Tengah,* 19(2), pp.155–167.

Indarwati & Prayitno, H., 2016. Analysis Of Performance Factors Cadres Jumantik on Dengue Fever Eradication In Kadipiro Surakarta. *IJMS-Indonesian Journal on Medical Science*, 3(2).

Indonesia Ministry of Health., 2022. *Coronavirus Disease Coronavirus Disease (COVID-19) Spreads.* Kementerian Kesehatan Republik Indonesia. Jakarta.

Jesha M,M., Sebastian, N.M., Sheela, P.H., Shabeer, M., & Manu, A., 2015.. Mosquito Density in Urban Kerala: a Study to Calculate Larval Indices in Municipal Area of Perinthalmanna. *Indian Journal of Forensic and Community Medicine*, 2(1), pp.7-12

Kusumawati, L.S., Mudigdo, L., Ambar., & Sumanto., 2016. Association Between Socio-Economic Factor, Home Sanitation, Sense of Belonging, and Health Behavior, in Patients with Dengue Hemorrhagic Fever in Kediri, East Java. *Journal of Health Promotion and Behavior*, 1(4), pp.238–243.

Martini, M., Annisa, J., Saraswati, L.D., Hestiningsih, R., Kusariana, N., & Yuliawati, S., 2019. Larvae Density and Environmental Condition as Risk Factors to Dengue Incidence in Semarang City, Indonesia. *IOP Conference Series: Earth and Environmental Science,* 380(1).

Mashudi, D.N., Ahmad, N., & Said, S.M., 2022. Level of Dengue Preventive Practices and Associated Factors in a Malaysian Residential Area During the COVID-19 Pandemic: A Cross-Sectional Study. *PLoS ONE*, 17(4).

Mubarok, M.A., Wahyuningsih, N.E., Riani, D.A., Putri, R., & Budiharjo, A., 2018. The Relationship between Healthy Hygiene Behavior and Dengue Hemorrhagic Fever (Dengue) Incidence in Semarang. *Journal of Physics: Conference Series*, 1025(1).

Nofita, E., Renita Rusdji, S., & Irawati, N., 2017. Analysis of Indicators Entomology Aedes aegypti in Endemic Areas of Dengue Fever in Padang, West sumatra, Indonesia. 57 *International Journal of Mosquito Research*, 4(2), pp.57–59.

Nurmaini., & Lubis, N., 2017. *Family Empowerment to Prevent Dengue Hemorrhagic Fever (DHF) in Dataran Tinggi, Binjai, Sumatera Utara.*

Nuryunarsih, D., 2015. Sociodemographic Factors to Dengue Hemorrhagic Fever Case in Indonesia. *Jurnal Kesehatan Masyarakat Nasional,* 10(1), pp.10–16.

Peri Arista, I.G., Sawitri, A.A.S., & Suganda Yatra, I.M., 2022. Comparison of Risk Factors Dengue Hemorrhagic Fever Outbreaks in Urban and Rural Areas During the COVID-19 Pandemic. *Journal of Public Health Research and Community Health Development*, 5(2), pp.99.

Roziqin, A., Mas'udi, S.Y.F., & Sihidi, I.T., 2021. An Analysis of Indonesian Government Policies Against COVID-19. *Public Administration and Policy,* 24(1), pp.92–107.

Sasmono, R., & Santoso, M., 2022. Movement Dynamics: Reduced Dengue Cases During the COVID-19 Pandemic. *The Lancet Infectious Diseases*, 22(5), pp.649–656.

Satoto, T.B.T., Alvira, N., Wibawa, T., & Diptyanusa, A., 2017. Controlling Factors that Potentially Against Transmission of Dengue Hemorrhagic Fever at State Elementary Schools in Yogyakarta. *Kesmas,* 11(4), pp.178–184.

Sayono, S., Widoyono, W., Sumanto, D., & Rokhani, R., 2019. Impact of Dengue Surveillance Workers on Community Participation and Satisfaction of Dengue Virus Control Measures in Semarang Municipality, Indonesia: A Policy Breakthrough in Public Health Action. *Osong Public Health and Research Perspectives,* 10(6), pp.376–384.

Setyawan, F.E.B., & Lestari, R., 2020. Challenges of Stay-At-Home Policy Implementation During the Coronavirus (COVID-19) Pandemic in Indonesia. *Jurnal Administrasi Kesehatan Indonesia*, 8(2), pp.15.

Sinto, R., 2022. COVID-19 Pandemic-to-Endemic Transition in Indonesia: What Does the Future Hold? Acta Med Indones-Indones *J Intern Med*, 54(2), pp.159-160.

Sukesi, T.W., Satoto, T.B.T., Murhandarwati, E.H., & Padmawati, R.S., 2021. Effects of Health Education-Based Intervention on Community's Perception, Healthy House,

and Social Capital of Dengue in Endemic Area of Sleman Regency Indonesia. *Open Access Macedonian Journal of Medical Sciences*, 9, pp.428–436.

Sulistyawati, S., Astuti, F.D., Umniyati, S.R., Satoto, T.B.T., Lazuardi, L., Nilsson, M., Rocklov, J., Andersson, C., & Holmner, Å., 2019. Dengue Vector Control Through Community Empowerment: Lessons Learned from a Community-Based Study in Yogyakarta, Indonesia. I*nternational Journal of Environmental Research and Public Health*, 16(6).

Supriatna, E., 2020. Socio-Economic Impacts of the COVID-19 Pandemic: The Case of Bandung City. *Journal of Governance*, 5(1).

Susilawati, S., Falefi, R., & Purwoko, A., 2020. Impact of COVID-19's Pandemic on the Economy of Indonesia. *Budapest International Research and Critics Institute (BIRCI-Journal): Humanities and Social Sciences,* 3(2), pp.1147–1156.

Taher, A., 2022. The Journey of Policies During the COVID-19 Pandemic in Indonesia: A Need of Evidence-Informed Policy. *Medical Journal of Indonesia*, 31(1), pp.3–6.

Wilder-Smith, A., Tissera, H., Ooi, E.E., Coloma, J., Scott, T.W., & Gubler, D.J., 2020. Preventing Dengue epidemics during the COVID-19 Pandemic. *American Journal of Tropical Medicine and Hygiene,* 103(2), pp.570–571.

Assessment of Self-Care Activities Using Diabetes Self-Management Questionnaire in Diabetes Patients

Balgis[1✉], Selfi Handayani[2], Sumardiyono[3], Nur Kholifah Putri Taufan[4]

[1]Public Health Department, Faculty of medicine, Sebelas Maret University, Indonesia
[2]Anatomy and Embryology Department, Faculty of medicine, Sebelas Maret University, Indonesia
[3]Occupational Safety and Health Department, Vocational School, Sebelas Maret University, Indonesia
[4]Vocational School, Sebelas Maret University, Surakarta, Indonesia

Article Info

Abstract

One of the non-communicable diseases found in all regions of the world, including rural areas, is Diabetes Mellitus, caused by a chronic metabolic disorder characterized by increased glucose levels in the blood due to impaired insulin secretion. Diabetic neuropathy is damage to peripheral nerves or peripheral nerves commonly experienced by people with type 2 diabetes mellitus, characterized by excessive pain and decreased sensitivity to touch. The purpose of this study was to determine the self-management carried out by diabetic patients in the city of Surakarta. This study is cross-sectional with a sample of 99 respondents using a purposive sampling technique with inclusion criteria of 40-60 years of age and type 2 DM patients. The tests carried out were the inter-class intercorrelation coefficient test and the Kruskal–Wallis test using SPSS. The results of this study mean the highest interclass correlation coefficient was the diabetic foot care subclass with a value of 0.773 representing the homogeneity of the DMSQ questions and a confidence interval of 0.687-0.839 at 95% with a significance of $p < 0.05$ in each subclass.

Introduction

One of the non-communicable diseases found in all regions of the world, including rural areas, is Diabetes Mellitus (Bhagyalaxmi, Atul and Shikha, 2013), caused by a chronic metabolic disorder characterized by increased blood glucose levels due to impaired insulin secretion (Galicia-Garcia et al., 2020). Data based on The International Diabetes Federation (IDF), almost 537 million people worldwide suffer from diabetes (Saeedi et al., 2019). The IDF shows an estimation that in 2030 DM prevalence will be 643 million and keep on to increase up to 784 million in 2045 due to population growth, aging, obesity, and lack of physical activity as the primary causes of diabetes mellitus (Saeedi et al., 2019).

According to data from the Ministry of Health of the Republic of Indonesia in 2019, Indonesia was ranked 6th out of 10 countries with the highest number of people with diabetes worldwide, namely 10.7 million people (Amir and Munir, 2021). The percentage of death rate for people with diabetes mellitus in Indonesia is the 2nd highest after Sri Lanka (Ligita et al., 2019). These non-communicable diseases have increased from year to year and are mostly caused by unfavorable lifestyle factors such as smoking, unhealthy eating patterns, lack of physical activity, obesity, high blood pressure, and high cholesterol (Musaiger and Al-Hazzaa, 2012).

Two out of three people with diabetes mellitus in Indonesia do not know they have diabetes mellitus until they experience complications, which is why this disease is often referred to as a silent killer (Todkar, 2016). Chronic complications can be macrovascular, such as coronary heart disease and cerebrovascular. And microvascular

complications such as retinopathy, nephropathy, and neuropathy (Carmienke et al., 2020). Diabetic neuropathy is damage to peripheral nerves commonly experienced by people with type 2 diabetes mellitus, characterized by excessive pain and decreased sensitivity to touch (Kuate-Tegueu et al., 2015). About one-third to one-half of people with diabetes have peripheral neuropathy (Pop-Busui et al., 2017). The high level of diabetes complications in diabetes people in Indonesia highlights the lack of attention to the control of the condition and self-management as a cornerstone to optimal control of the disease. This disease costs a lot for the patients and affects both life quality and life expectancy and imposes health and economic burdens on the national budget for the loss of productivity (Jahangir et al., 2020).

According to the Regulation of the Minister of Health of the Republic of Indonesia Number 4 of 2019 that health services that are by standards for all people with diabetes mellitus are the obligation of the Regency/City Government. On the other hand, the amount of health workers cannot accommodate the growth of diabetes cases (Todkar, 2016). The number of available health workers is not proportional to the increased number of diabetic patients (Jin et al., 2017). In this regard, an alternative way is needed, so that diabetic patients are also able to carry out diabetes care independently. In line with Korzs' statement in 2020, diabetes patients need to engage in sustainable self-management in self-care activities (Kamillah et al., 2022). Approximately 95% of diabetes therapy depends on self-care measures regardless of the type of diabetes and also the patient and his family taking self-care (Takele et al., 2021). Therefore diabetic patients must change their habits, such as adhering to prescribed medication, diet control, and doing some physical activity, especially for older patients, to prevent diabetes complications, which are potentially lethal (Gemeda and Woldemariam, 2022).

In addition to health care from the local government, Diabetic neuropathy can be treated with good self-management of diabetes (Adu et al., 2019). Several instruments can be used to measure the self-management of diabetes. One of them is the Diabetes Self-Management Questionnaire (DSMQ) (Schmitt et al., 2016; Vincze, Losonczi and Stauder, 2020). This instrument was developed at the Research Institute of the Diabetes Academy Mergentheim, covering the management of blood sugar levels, diet, physical activity, and diabetes foot self-care (Schmitt et al., 2013). Studies have reported that high-level fulfillment with self-management by diabetic patients is associated with improving glycemic control and reducing diabetes complications, even morbidity and mortality rate (Nakhaeizadeh and Khalooei, 2021). Another study states that DSMQ plays a vital role in preventing the progression of neurovascular complications in diabetes patients type 2, thereby helping to reduce the risk of diabetic foot (Uly, Fadli and Iskandar, 2022). The purpose of this study was to determine the self-management carried out by diabetic patients in the city of Surakarta. The choice of the location of Surakarta City is because data from the Central Java Provincial Health Office shows the highest cases of type 2 diabetes mellitus in Surakarta City, a total of 22,543. According to the Surakarta City Health Office, diabetes mellitus (DM) is still a problem that must be controlled, considering that this type of disease is one of the highest comorbidities in the mortality rate due to COVID-19. This study uses DSMQ as a research instrument. It is hoped that this research can increase awareness and compliance in the self-management of diabetes.

Method

This study is an analytical observational study using a cross-sectional design. The study population was people with type 2 DM in the Puskesmas work area in Surakarta city. Research data collection will be carried out from March 28, 2022, to May 25, 2022. The study population was dm type 2 sufferers in 5 health centers in 5 sub-districts in Surakarta City (Districts: Pasar Kliwon, Jebres, Banjarsari, Lawiyan, and Serengan). The study sample was determined using purposive sampling with inclusion criteria: age 40-60 years, patients with type 2 DM, and signed informed consent. Based on the sampling technique, the number of samples obtained totaled 99 people. The exclusion criterion is to have a psychiatric disorder and not be willing to be a respondent.

The research instruments used in this study were The DSMQ (Diabetes Self Management Questionnaire) questionnaire and medical record data. The number of DSMQ questions of 19 items includes Management of blood sugar levels (items 11, 12, 13, 14, 15), Diet control (items 1, 2, 3, 4, 5, 6, 7), Physical activity (items 8,9,10), and Diabetic foot care (items 16,17,18, 19). The free variable is Diabetes Self-Management using a categorical scale (Diet Control, Physical Activity, Management of blood sugar levels, and Diabetic foot care). The bound variable is the Answer Score of each question item on the DSMQ using an Ordinal Scale. The validity and reliability test refers to the research conducted by Schmitt et al. (Schmitt et al., 2013). The DSMQ is equipped with sample data i.e., gender and age. Age variable data are categorized into ≤ 40 years, 41-50 years, 51-60 years, and ≥ 61 years. The data obtained will be analyzed using the interclass correlation coefficient and Kruskal–Wallis test. Statistically, the difference is significant if the p-value <0.05.

All analyzes were performed using SPSS for Windows version 23.

Result and Discussion

In diabetes mellitus patients, the factors that influence self-care behavior are age and gender. Age affects the ability to learn in receiving skills, new information, and physical abilities. But with increasing age, especially in old age, there will be a decrease, especially after the age of 55. Then at the age of under 55 years, self-care management is still good. On the influence of sex on type 2 diabetes mellitus, the tendency occurs in women. It is because women tend to have higher cholesterol. Women are at 3-7 times the risk of developing type 2 diabetes mellitus because women's fat is higher than that of men. Female fat is 20-25% of body weight, while male fat is 15-20% of body weight. In this study, data on the characteristics of age and sex variables from 99 study respondents were seen in Table 1.

Table 1. Characteristics of Respondents

Age Group	Gender		Total
	Male	Female	
≤ 40	0	1	1
41-50	3	9	12
51-60	20	42	62
≥ 61	3	21	24
Total	26	73	99

Source: Primary Data, 2022

Based on Table 1 above, the respondents in this study were dominated by respondents with an age range of 51-60 years, as many as 62 of 99 respondents. In general, 20% of the elderly have diabetes mellitus, and a similar proportion have undiagnosed diabetes mellitus (Chentli, Azzoug, and Mahgoun, 2015). According to research (González et al., 2012), a person over 50 years of age has a greater risk of developing diabetic neuropathy (Ratih et al., 2022). It is due to a person's physiological changes with age, which can decrease the body's metabolism. In a study (Rooney et al., 2021), patients over 45 years old have a higher risk of suffering from type II diabetes mellitus compared to younger patients (less than 45 years old). This study also shows not only age but co-morbid factors also

affect diabetes. Co-morbidities such as heart disease, hypertension, kidney disease, and decreased vision.

The female sex dominated the gender of the respondents in this study as many as 73 of 99 respondents. Research states that a person with a female gender has a greater risk of developing diabetic neuropathy. Women tend to be more at risk for complications of diabetes mellitus because of a large body mass index, menstrual cycle syndrome, and menopause which can facilitate fat accumulation, which causes inhibited glucose transport (Kautzky-Willer, Harreiter, and Pacini, 2016). Gender can affect the incidence of diabetic neuropathy where the sex of women is 2 times greater risk of complications than men. Hormonally,

estrogen causes women to get neuropathy more often because the absorption of iodine in the intestine is disrupted so that the process of forming nerve myelin does not occur. The hormone testosterone causes men to have less type 2 diabetes mellitus than women.

Self-care management is one of the factors that determine the health status and quality of life of dm type 2 patients. Self-care management, which includes the dimensions of maintenance, monitoring, and self-care, is the

process of intervention when complications of the disease are detected. In DM patients, good self-care management can improve metabolic control, quality of life and reduce cardiovascular risk, length of hospitalization, and disease-related complications. However, there are still many DM patients who have poor self-care management. In this study, the Adherence to Self-Care Activities among Diabetes Patients Question About Self-Care is seen in Table 2.

Table 2. Adherence of Self-Care Activities among Diabetes Patients Question about Self- Care

Self-care questions	Almost Always	Often	Seldom	Never
I follow the meal plan (diet)as recommended	2 (2.02)	44(44.4)	28(28.3)	25(25.3)
I limit the number of servings of food so that my blood sugar levels arecontrolled	7 (7.1)	60 (67.7)	26 (26.3)	6 (6.1)
I am picky about food, so my blood sugar level isnormal cakes, biscuits, soy sauce,sweet tea, etc.)	5 (5.1)	66 (66.7)	18 (18.2)	10 (10.1)
I eat foods that are high infat (like meat, foods that contain oil or butter, etc.)	20 (20.2)	27 (27.3)	45 (45.5)	7 (7.1)
Every day I eat three servings of vegetables	22 (22.2)	54 (54.5)	23 (23.2)	0 (0)
Sometimes I eat a lot / of excessive food, especially when there is a party	1 (1)	22 (22.2)	38 (38.4)	38 (38.4)
I do physical activity regularly 20-30 minutes/day so that my blood sugar level is normal	4 (4)	41 (41.4)	36 (36.4)	18 (18.2)
I do light exercises such as walking around the house.	15 (15.2)	50 (50.5)	32 (32.3)	2 (2)
I tend not to do planned physical activities	3 (3)	35 (35.4)	48 (48.5)	13 (13.1)
I check my blood sugar levelat the health service or independently at home.	58 (58.6)	31 (31.3)	9 (9.1)	1 (1)
I regularly come to see the doctor	49 (49.5)	41 (41.4)	9 (9.1)	0 (0)
I take medication or injectinsulin according to the doctor's instructions	53 (53.5)	36 (36.4)	9 (9.1)	1 (1)
I tend to forget to take diabetes medicine/insulin	4 (4)	19 (19.2)	24 (24.2)	52 (52.5)
I see health workers moreoften for my diabetes treatment.	14 (14.1)	64 (64.6)	21 (21.2)	0 (0)
I checked the feet (for sores and calluses)	1 (1)	44 (44.4)	45(45.5)	9 (9.1)
I clean my feet with soap	11 (11.1)	47 (47.5)	37 (37.4)	4 (4)
I dry between my toes after washing	6 (6.1)	36 (36.4)	37 (37.4)	20 (20.2)
I checked the inside of the sandal/shoe to be used	7 (7.1)	31 (31.3)	50 (50.5)	11 (11.1)

Source: Primary Data, 2022

Self-management in diabetes mellitus is a set of behaviors carried out by individuals with diabetes to manage their condition, including taking medication, managing diet, doing physical exercise, self-monitoring of blood glucose, and maintaining foot care (Schmitt et al., 2013). Based on table 2 above shows that 100% of respondents eat three servings of vegetables every day, respondents regularly see doctors, and respondents often

see health workers for diabetes care. It shows that respondents still have concerns about their diabetes condition (Isroin, 2019). The results of the study relevant to this study showed a relationship between family support (Trisnadewi et al., 2020), low self-acceptance and moderate self-acceptance (Pranata, Mudatsir and Jannah, 2021), spirituality level (Zareipour et al., 2016), and physical activity (Chowdhury and Chakraborty, 2017) with

anxiety levels in people with type 2 diabetes mellitus.

Findings from a qualitative study found barriers to diabetes self-management practices. The barriers were a lack of knowledge on diabetes self-management, unfortunate perception of susceptibility and severity of diabetes mellitus complications, lack of motivation, and support from family on diabetes self-management practice. Related to the regulation of diet control, most respondents stated that they had difficulty managing a healthy diet. They eat like ordinary people and never follow dietary recommendations. Especially the culture of Indonesian people, who choose rice as their main food. Many of them eat sweet and fatty foods in large portions (Pamungkas et al., 2021).

Table 2 shows that 52.2% of respondents forget to take their diabetes/insulin medication. Researchers also mentioned that controlling blood sugar levels must be adjusted between patients and healthcare providers to make

appropriate treatment adjustments. Healthcare providers function as patient-centered training and support providers to carry out good self-management so the patient's blood glucose is controlled (Jutterström et al., 2016). Several serious complications can be suffered by patients with diabetes, such as complications related to the foot. Of the average mortality rate within five years after suffering from diabetic foot, 43-74% get foot amputation as this condition is related to bad habits, poor management of diabetes, and lack of preventive actions (Mahdalena and Ningsih, 2016). Based on the data above, it shows that most respondents have low knowledge about preventing diabetic foot. Clinicians and other healthcare professionals should take up positive roles in giving education and training on both medication and lifestyle matters to patients with diabetes, to have a positive effect on the health outcomes of diabetic patients by improving their self-care practices (Al-Qahtani, 2020).

Table 3. Subscale Characteristics and Average Intraclass Correlation among Diabetics

Self- management Questionnaires	Question Number	Mean	The average correlation coefficient between classes	Lower bond	Upper bond
Control Diet	1,2,3,4,5,6,7	2.511	.160	-.068	.365
Physical Activity	8,9,10	2.539	-.020	-.363	.259
Management of Blood Sugar Levels	11,12,13,14,15	2.004	.168	-.008	.341
Diabetic FootCare	16,17,18, 19	2.586	.773	.687	.839

Source: Primary Data, 2022

Based on the results in Table 3, the highest average interclass correlation coefficient is the diabetic foot care subclass, with a value of 0.773 representing the appropriate homogeneity of the DSMQ questions and a confidence interval of 0.687-0.839 at 95%. The physical activity subscale shows the average value of the

negative interclass correlation coefficient and the maximum average value compared to other subscales. The study (Khan et al., 2021) showed that a high average correlation coefficient value represented a matched similarity of DSMQ items.

Table 4. Significant Differences between Questions Using Kruskal–Wallis Test

Diabetes Self-Management Questionnaires	Questions	Mean Rank	Chi-Square	Degree of Freedom	P-value
Diet Control	I follow the meal plan (diet) as recommended	397.15	106.46	6	.000
	I limit the number of servings of food so that my blood sugar levels are controlled	300.67			
	I am picky about food, so my blood sugar level is normal	300.29			
	I eat snacks or drink sweet drinks, which contain lots of carbohydrates (such as cakes, biscuits, sweet tea, etc.)	378.78			
	I eat foods that are high in fat (like meat, foods that contain oil or butter, etc.)	331.48			
	Every day I eat three servings of vegetables	238,94			
	Sometimes I eat a lot / of excessive food, especially when there is a party	481,68			
Physical Activity	I do physical activity regularly 20-30 minutes/day so that my blood sugar level is normal	162,06	23,631	2	.000
	I do light exercises such as walking around the house.	117,35			
	I tend not to do planned physical activities	167,60			
Management of blood sugar levels	I check my blood sugar level at the health service or independently at home.	179,83	190,005	4	.000
	I regularly come to see the doctor	194,64			
	I take medication or inject insulin according to thedoctor's instructions	189,15			
	I tend to forget to take diabetes medicine/insulin	400,59			
	I see health workers more often for my diabetes treatment.	275,80			
Diabetic foot care	I checked the feet (for sores and calluses)	202,44	12,829	3	.005
	I clean my feet with soap	166,35			
	I dry between my toes after washing	214,61			
	I checked the inside of the sandal/shoe to be used	210,61			

Source: Primary data, 2022

172

Based on the results of the Kruskal-Wallis test in Table 4, the average ranking of the DSMQ question items that respondents most often do is 1, 7, and 14. Question item number 1 is about following a diet plan according to the recommendation that the majority of respondents do so the average rating on that item is 397.15; Diet is related to the increase in cases of diabetes mellitus because a poor diet and lack of exercise can lead to obesity as a trigger for diabetes mellitus (Oktora and Butar, 2022). Question item 7 regarding overeating habits, especially when most respondents do this. So that the average rating on the item is 481.68; question item number 14 is about the tendency to forget to take diabetes/insulin medication, which the majority of respondents do, so the average rating on that item is 400.59. Each subclass had p<0.05, meaning there were differences between the subclasses of diet, physical activity, blood sugar management, and diabetic foot care. The factor of forgetting to take medication is a vital factor to consider regarding self-care management in patients with diabetes mellitus because taking medication every day is a real inconvenience for some patients (Wang, Bian and Mo, 2013).

Conclusion

This research provides evidence that the DSMQ is an efficient assessment instrument for self-management in diabetic patients. Adherence and consistency to diabetes medication should always be done. Along with the help from clinicians and every healthcare providing education about the importance of self-management in diabetes control. This study was only conducted in one city, which cannot represent the entire population. In addition, the assessment of self-care behavior is only based on self-report by the respondents. As such, data may be affected by bias arising from overreporting or underreporting.

References

Adu, M.D., Malabu, U.H., Malau-Aduli, A.E.O., & Malau-Aduli, B.S., 2019. Enablers and Barriers to Effective Diabetes Self-Management: A Multi-National Investigation. *PLoS ONE*, 14(6), pp.1–22.

Al-Qahtani, A.M., 2020. Frequency and Factors Associated with Inadequate Self-Care Behaviors in Patients with Type 2 Diabetes Mellitus in Najran, Saudi Arabia. *Saudi Medical Journal*, 41(9), pp.955–964.

Amir, H., & Munir, N.W., 2021. Effect of Health Education on Improving the Knowledge among Diabetes Mellitus Patients in the Prevention of Diabetic Ulcer in Regional Hospital of Tidore Island. *International Journal of Nursing and Health Services (IJNHS)*, 4(4), pp.379–384.

Bhagyalaxmi, A., Atul, T., & Shikha, J., 2013. Prevalence of Risk Factors of Non-Communicable Diseases in a District of Gujarat, India. *Journal of Health, Population and Nutrition*, 31(1), pp.78–85.

Carmienke, S., Baumert, J., Gabrys, L., Heise, M., Frese, T., Heidemann, C., & Fink, A., 2020. Participation in Structured Diabetes Mellitus Self-Management Education Program and Association with Lifestyle Behavior: Results from a Population-Based Study. *BMJ Open Diabetes Research and Care*, 8(1), pp.1–10.

Chentli, F., Azzoug, S., & Mahgoun, S., 2015. Diabetes Mellitus in Elderly. *Indian Journal of Endocrinology and Metabolism*, 19(6), pp.744–752.

Chowdhury, S., & Chakraborty, P., 2017. Universal Health Coverage - There is More to It Than Meets the Eye. *Journal of Family Medicine and Primary Care*, 6(2), pp.169–170.

Galicia-Garcia, U., Benito-Vicente, A., Jebari, S., Larrea-Sebal, A., Siddiqi, H., Uribe, K.B., Ostolaza, H., & Martín, C., 2020. Pathophysiology of Type 2 Diabetes Mellitus. *International Journal of Molecular Sciences*, 21(17), pp.1–34.

Gemeda, S.T., & Woldemariam, Z.B., 2022. Assessment of Self-Care Practice Amongst Patients with Type II Diabetes Attending Adama Hospital Medical College, Ethiopia. *BMC Endocrine Disorders*, 22(1), pp.1–10.

González, R., Pedro, T., Martinez-Hervas, S., Civera, M., Priego, M.A., Catalá, M., Chaves, F.J., Ascaso, J.F., Carmena, R., & Real, J.T., 2012. Plasma Homocysteine Levels are Independently Associated with the Severity of Peripheral Polyneuropathy in Type 2 Diabetic Subjects. *Journal of the Peripheral Nervous System*, 17(2), pp.191–196.

Isroin, L., 2019. The Acceptance and the Development of Renal Function of People with Diabetes Mellitus. *Jurnal Kesehatan Masyarakat,* 14(3), pp.419–425.

Jahangir, F., Kavi, E., Masmouei, B., Bazrafshan, M., Delam, H., Shokrpour, N., Namjoonasab,

M., Foruozandeh, H., & Zarei, E., 2020. Self-Management Status in Patients with Diabetes and Disease Control Indicators in Lamerd City, Iran. *Jundishapur Journal of Chronic Disease Care*, 9(2).

Jin, Y., Zhu, W., Yuan, B., & Meng, Q., 2017. Impact of Health Workforce Availability on Health Care Seeking Behavior of Patients with Diabetes Mellitus in China. *International Journal for Equity in Health*, 16(1), pp.1–10.

Jutterström, L., Hörnsten, Å., Sandström, H., Stenlund, H., & Isaksson, U., 2016. Nurse-led Patient-Centered Self-Management Support Improves HbA1c in Patients with Type 2 Diabetes-A Randomized Study. *Patient Education and Counseling*, 99(11), pp.1821–1829.

Kamillah, S., Panduragan, L.S., Poddar, S., & Abdullah, B.F., 2022. Patients Experiences in Using Diabetes Self-Management Application: a Scoping Review. *Kesmas: Jurnal Kesehatan Masyarakat Nasional (National Public Health Journal)*, 17(1), pp.67–73.

Kautzky-Willer, A., Harreiter, J., & Pacini, G., 2016. Sex and Gender Differences in Risk, Pathophysiology and Complications of Type 2 Diabetes Mellitus. *Endocrine Reviews*, 37(3), pp.278–316.

Khan, M.S., Mahmood, S.E., Ahmad, A., Khan, A.A., & Arfin, I., 2021. Assessment of Self-Care Activities Using Diabetes SelfManagement Questionnaire (DSMQ) amongst Diabetes Patients Attending a Rural Health Training Centre in Lucknow. *Journal of Evolution of Medical and Dental Sciences,* 10(18), pp.1324–1328.

Kuate-Tegueu, C., Temfack, E., Ngankou, S., Doumbe, J., Djientcheu, V.P., & Kengne, A.P., 2015. Prevalence and Determinants of Diabetic Polyneuropathy in a Sub-Saharan African Referral Hospital. *Journal of the Neurological Sciences*, 355(1–2).

Ligita, T., Wicking, K., Francis, K., Harvey, N., & Nurjannah, I., 2019. How People Living with Diabetes in Indonesia Learn About Their Disease: A Grounded Theory Study. *PLoS ONE*, 14(2), pp.1–19.

Mahdalena., & Ningsih, E.S.P., 2016. Effectivity of Foot Care Education Program in Improving Knowledge, Self-Efficacy and Foot Care Behavior Among Diabetes Mellitus Patients in Banjarbaru, Indonesia. *Kesmas*, 11(2), pp.56–60.

Musaiger, A.O., & Al-Hazzaa, H.M., 2012. Prevalence and Risk Factors Associated with Nutrition-Related Noncommunicable Diseases in the Eastern Mediterranean Region. *International Journal of General Medicine*, 5, pp.199–217.

Nakhaeizadeh, M., & Khalooei, A., 2021. Psychometric Properties of the Persian Version of the Diabetes Self-Management Questionnaire for Patients with Type 2 Diabetes in Iran. *International Journal of Preventive Medicine*, 12(120), pp.1–7.

Oktora, S.I., & Butar, D.B., 2022. Determinants of Diabetes Mellitus Prevalence in Indonesia. *Jurnal Kesehatan Masyarakat*, 18(2).

Pamungkas, R.A., Chamroonsawasdi, K., Charupoonphol, P., & Vatanasomboon, P., 2021. A Health-Based Coaching Program for Diabetes Self-Management (DSM) Practice: A Sequential Exploratory Mixed-Method Approach. *Endocrinologia, Diabetes y Nutricion,* 68(7), pp.489–500.

Pop-Busui, R., Boulton, A.J.M., Feldman, E.L., Bril, V., Freeman, R., Malik, R.A., Sosenko, J.M., & Ziegler, D., 2017. Diabetic Neuropathy: A Position Statement by the American Diabetes Association. *Diabetes Care*, 40(1), pp.136–154.

Pranata, A., Mudatsir., & Jannah, S.R., 2021. Diabetes Distress in Patients with Type 2 Diabetes Mellitus of the Aceh Tamiang Regional Hospital. *EAS Journal of Nursing and Midwifery*, 3(6), pp.294–297.

Ratih, P.F., Solikah, T.A., Nasirochmi, D., & Dilma'aarij., 2022. The Affecting Factors of Compliance Diabetes Mellitus Treatment of Type 2 in Pandemic Era. *Jurnal Kesehatan Masyarakat*, 4, pp.574–582.

Rooney, M.R., Rawlings, A.M., Pankow, J.S., Tcheugui, J.B.E., Coresh, J., Sharrett, A.R., & Selvin, E., 2021. Risk of Progression to Diabetes among Older Adults with Prediabetes. *JAMA Internal Medicine*, 181(4), pp.511–519.

Saeedi, P., Petersohn, I., Salpea, P., Malanda, B., Karuranga, S., Unwin, N., Colagiuri, S., Guariguata, L., Motala, A.A., Ogurtsova, K., Shaw, J.E., Bright, D., & Williams, R., 2019. Global and Regional Diabetes Prevalence Estimates for 2019 and Projections for 2030 and 2045: Results from the International Diabetes Federation Diabetes Atlas, 9th Edition. *Diabetes Research and Clinical Practice,* 157, pp.107843.

Schmitt, A., Gahr, A., Hermanns, N., Kulzer, B., Huber, J., & Haak, T., 2013. The Diabetes Self-Management Questionnaire (DSMQ): Development and Evaluation of an Instrument to Assess Diabetes Self-Care

Activities Associated with Glycaemic Control. *Health and Quality of Life Outcomes*, 11(1).

Schmitt, A., Reimer, A., Hermanns, N., Huber, J., Ehrmann, D., Schall, S., & Kulzer, B., 2016. Assessing Diabetes Self-Management with the Diabetes Self-Management Questionnaire (DSMQ) Can Help Analyse Behavioural Problems Related to Reducedglycaemic Control. *PLoS ONE,* 11(3), pp.1–12.

Takele, G.M., Weharei, M.A., Kidanu, H.T.M., Gebrekidan,K.G., & Gebregiorgis, B.G., 2021. Diabetes Self-Care Practice and Associated Factors Among Type 2 Diabetic Patients in Public Hospitals of Tigray Regional State, Ethiopia: A Multicenter Study. *PLoS ONE*, 16, pp.1–11.

Todkar, S., 2016. Diabetes Mellitus the ‘Silent Killer' of Mankind: An Overview on the Eve of World Health Day!. *Journal of Medical and Allied Sciences,* 6(1), pp.39.

Trisnadewi, N.W., Adiputra, I.M.S., Oktaviani, N.P.W., Suapriyanti, P.A., & Saraswati, N.L.G.I., 2020. Correlation between Stress Level and Family Support Towards Fasting and Postprandial Glucose Level in Type 2 Diabetes Mellitus. *Bali Medical Journal,* 9(3), pp.811–815.

Uly, N., Fadli, F., & Iskandar, R., 2022. Relationship between Self-Care Behavior and Diabetes Self-Management Education in Patients with Diabetes Mellitus Type 2. *Macedonian Journal of Medical Sciences*, 10(E), pp.1648–1651.

Vincze, A., Losonczi, A., & Stauder, A., 2020. The Validity of the Diabetes Self-Management Questionnaire (DSMQ) in Hungarian Patients with Type 2 Diabetes. *Health and Quality of Life Outcomes,* 18(1), pp.1–9.

Wang, J., Bian, R.W., & Mo, Y.Z., 2013. Validation of the Chinese Version of the Eight-Item Morisky Medication Adherence Scale in Patients with Type 2 Diabetes Mellitus. *Journal of Clinical Gerontology and Geriatrics*, 4(4), pp.119–122.

Zareipour, M., Abdolkarimi, M., Valizadeh, R., Mahmoodi, H., Khazir, Z., & Ghojogh, M.G., 2016. Perceived Stress and Its Relationship with Spiritual Health in Patients with Diabetes in the City of Urmia, Iran. *Bioscience Biotechnology Research Communications*, 9(4), pp.750–755.