pISSN 0216-2482
eISSN 2356-4067

MKMI

MEDIA KESEHATAN MASYARAKAT INDONESIA

The Indonesian Journal of Public Health

Terakreditasi Nomor : 12/M/Kp/II/2015
Bekerjasama dengan IAKMI

Volume 19 No 3, September 2023

Media Kesehatan Masyarakat Indonesia
Volume 19 Issue 3 2023
DOI : 10.30597/mkmi.v19i3.24954
Website : http://journal.unhas.ac.id/index.php/mkmi

Unlocking the Hidden Impact: How Mental Workload Shapes Safety-Insights from NOSACQ-50 and NASA-TLX Method

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ARTICLE INFO

Article History:
Received May, 23rd, 2023
Accepted Sept, 8th, 2023
Published online Sept, 29th, 2023

Keywords:
Safety;
stress;
workload;
NASA-TLX;
NOSACQ-50;

ABSTRACT
The decrease in capability is caused by work fatigue and the level of error in work will increase. The increase in errors in work will cause the opportunity for work accidents in the industry which is the cause and effect of a work accident. This study aimed to determine solutions to eliminate mental workload from a safety climate based on NOSACQ-50 using the NASA-TLX method at PT. X part of The Batam City field in 2021. This quantitative study uses an analytical design with a cross-sectional approach between NOSACQ-50 to determine safety climate and NASA-TLX Method to determine mental workload based on the safety climate. The objects of this research are all workers of PT. X in 2021, with a sample size of 30 respondents. Statistical analysis used chi-square test. The results of this study show that Mental Workload in PT.X mostly was in moderate Level (73,3%) with the highest workload score was in the physical needs. NASA-TLX shows that Empowerment of Work Safety from Management was the significant factor causing mental stress. It was concluded that mental stress is caused by poor work arrangements. Suggestions for companies is to rotate work in each group of workers, especially riggers so that the workload is evenly distributed, and top management participates and is committed to carrying out OHS programs by directly demonstrating the programs that have been set.

INTRODUCTION

The safety climate is critical to establish a safe working environment. The safety climate is defined as a concept perceived or determined by workers' perceptions of the importance of safety and how occupational safety, management, and occupational health are prevalent in the workplace at a given period.[1,2] A positive security climate indicates that a group of workers understands the importance of workplace safety and prioritizes it when considering the security climate.[3–5]

NOSACQ-50 (The Nordic Safety Climate Questionnaire) is a method for determining the occupational safety climate developed by Team Nordic (Sweden, Finland, Denmark, Norway, and Iceland). NOSACQ-50 has seven dimensions, namely management's work safety priorities, management that develops work safety, proper management of work safety, employees who are committed to working safely, employees who prioritize work safety, and attitudes that do not want to take risks to work safety, communication, and job safety training, including trusting in the work safety competence of colleagues, worker confidence in the safety system.[6,7]

PT. X (PT; refers to a company or corporation in Indonesia, X; was used because the company doesn't want their name to be exposed or publicized) is engaged in loading and unloading service providers, which carry out stevedoring, cargo during, forwarding, lifting and handling, supply chain, and service, with stages of transportation work to the dock. Then goods are loaded onto PT. X ships.[8] The PT. X has never measured the safety climate and mental workload, it is not an obligation to measure the safety climate using NOSACQ-50 and measure mental workload using the NASA-TLX method, but it can be helpful to be input and evaluation for companies regarding workers' commitment and perception of safety.[9]

Based on the results of initial observations that researchers made at PT.X, workload, especially physical demand, is very high for the physical needs in question, such as pulling when installing webbing slings to pipes, pushing, and twisting. One of the factors in the occurrence of unsafe behavior is due to fatigue.[10,11] The decline in capability caused by work fatigue and the level of errors in work will increase.[12] Increased employment errors will allow for work accidents in the industry.[13] This is the cause of a work accident. These physical needs are included in the NASA-TLX (Task Load Index) mental workload consisting of 6 dimensions: cognitive demand, physical demand, temporal demand, effort, and frustration.[14–16]

NASA-TLX is one of the modes for mental workload measurement, developed by Sandra G. Hart of NASA-Ames Research Center and Lowell E. Staveland of San Jose State University in 1981. This method has a compact measuring scale and does not require much cost or time.[14]

Unveiling the concealed impact of mental workload on safety is paramount to create a secure work environment. This study aims to investigate the intricate relationship between mental workload and safety by utilizing the NOSACQ-50 and NASA-TLX methodologies. By delving into the findings, the study seeks to shed light on the factors contributing to mental workload and propose effective strategies for enhancing safety and performance. The research will focus on uncovering these insights at PT. X Batam city field section in 2021, facilitating actionable recommendations for improved safety measures.

MATERIAL AND METHOD

This research was quantitative research which designed as observational research with a cross-sectional approach to determine the relationship between mental workload as a dependent variable and the occupational safety climate measured by the NOSACQ-50. This study's population is the entire PT.X field section in 2021, with a sample size of 30 respondents determined by total sampling. The occupational safety climate data collection instrument used a questionnaire (NOSACQ-50) with a Likert scale using positive questions on a scale of 1-4 and vice versa for negative questions; at the same time, collecting mental workload measurement data using the NASA-TLX method using a score of 0-100. The data was analyzed using statistical tests using the chi-square method with the confidence interval used at 95% or $\alpha = 0.05$ to determine the correlation of the variables.

The ethical clearance process was conducted before conducting this research. The ethical clearance was obtained from the Research Ethics Committee of Faculty of Health Science Lamongan Islamic University on October 28,

2022. The ethical clearance number for this research was 120/13.251/KEPK/2022. The participants of this study were informed about the purpose and benefits of the study, and their consent was obtained before data collection. The participants were also informed about their right to withdraw from the study at any time without any negative consequences. Confidentiality of the participants was ensured by not disclosing their identity and keeping their data secured. The researchers also followed the ethical guidelines of the Helsinki Declaration (2013) and Good Clinical Practice guidelines (GCP) to ensure the ethical standards of the research were met.

RESULTS

The safety climate is measured using the NOSACQ-50 method in PT. X field division in 2021, as many as 30 respondents in seven dimensions. Where the score uses the average score range of <2.70 (Very Low); 2.70-2.99 (Low Enough); 3.00-3.30 (Good Enough); and >3.30 (Good). At the same time, the measurement of mental workload in the same respondents was carried out with the NASA-TLX method using an average score range of >80 (Heavy Workload); 50-79 (Medium Workload); and <50 (Light Workload). The result describes the workload score compared to the NASA-TLX Standardized indicators comprising 6 indicators ranging from 0-100%.

Based on Table 1, the classification of medium mental workload got the highest score, with 22 (73.3%); for the type of heavy mental workload it was the second-highest score at 5 (16.7%). Then, in the comparison between NASA-TLX elements in Table 2, it can be seen that the six aspects of NASA-TLX, namely mental needs (Mental Demand), physical needs (Physical Demand), time needs (Temporal Demand), performance (Performance), effort level (Effort), and frustration level (Frustration Level). The highest number of scores is physical needs (Physical Demand) with 9.110.

The relationship of the safety climate with mental workload and statistical tests (Table 3) can be presented that ρ-value (ρ-value <0.05) dimension one safety climate with the mental workload, i.e., 0.021; dimension two safety climate with the mental workload is 0.000; measurement three safety climate with the mental workload, i.e., 0.005; dimension four safety climate with the mental workload, i.e., 0.010; dimension five climate safety with a mental workload of 0.027; dimension six safety climate with the mental workload of 0.019; The 7th dimension of the safety climate with a mental workload is 0.002, which means that there is a relationship in each of the seven dimensions of the safety climate with the mental workload.

Table 1. Workload Frequency Distribution

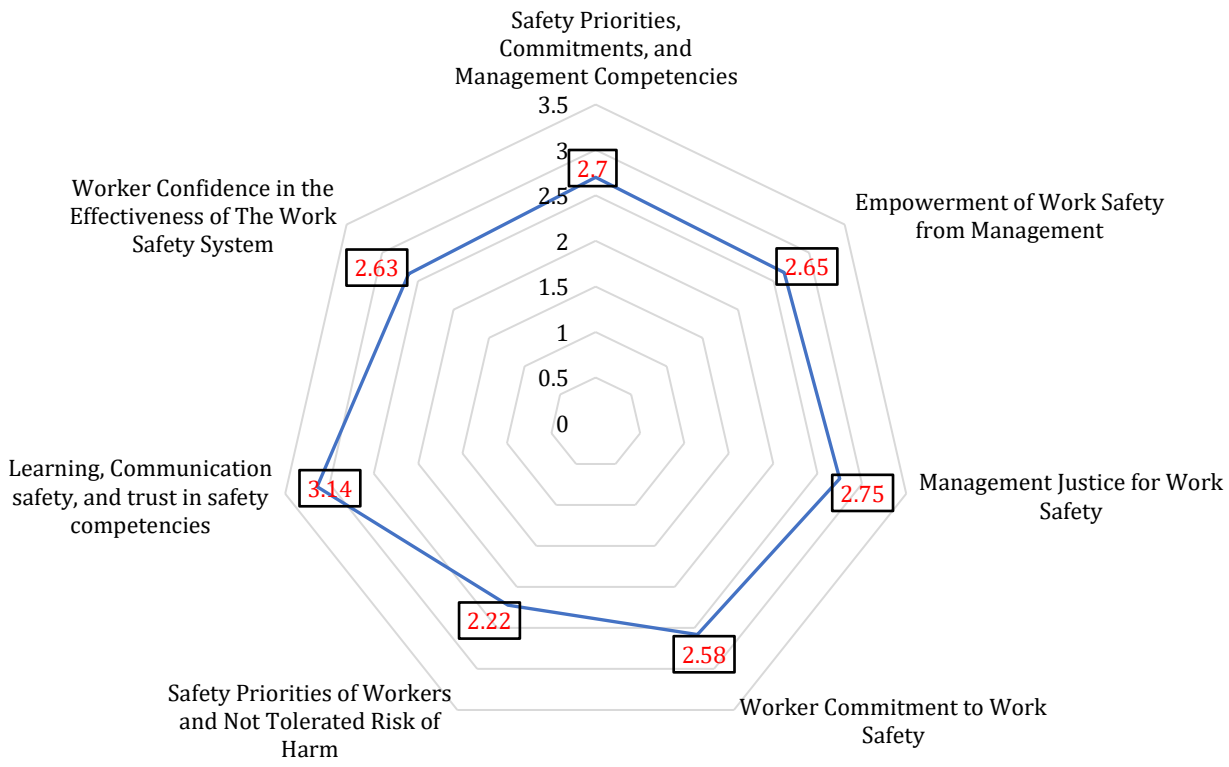
Workload Classification	n = 30	%
Heavy Workload (>80)	5	16.7
Medium Workload (50-79)	22	73.3
Light Workload (<50)	3	10

Source: Primary Data, 2021

Table 2. Workload Score Calculation Results with NASA-TLX Indicator

Indicators	Scores 28.150	Average 938.33	%
Mental Needs	4.370	145.67	15.52
Physical Needs	9.110	303.67	32.36
Time Requirements	2.790	93	9.91
Performance	3.540	118	12.58
Effort	770	256.67	27.35
Frustration Level	640	21.33	2.27

Source: Primary Data, 2021



Source: Primary Data, 2021

Table 3. Safety Climate Correlation Analysis Based on NOSACQ-50 with Mental Workload Using NASA-TLX Method

NOSACQ-50 Dimensions	*p*-value (Vs. Workload)	Significance
Safety Priorities, Commitments, and Management Competencies	0.021	Significant
Empowerment of Work Safety from Management	0.000	Significant
Management Justice for Work Safety	0.005	Significant
Worker Commitment to Work Safety	0.010	Significant
Safety Priorities of Workers and Not Tolerated Risk of Harm	0.027	Significant
Learning, Communication safety, and trust in safety competencies	0.019	Significant
Worker Confidence in the Effectiveness of The Work Safety System	0.002	Significant

Source: Primary Data, 2021

DISCUSSION

Figure 1 shows us that the highest score is in the sixth dimension, with an average of 3.14, an aspect of learning, safety communication, and trust in safety competencies. The sixth talks about the perception of workers about safety in the workplace in terms of discussing safety issues, learning from work experience, helping each other to work safely, receiving input regarding protection well, and believing in each other's ability to ensure safety while working.[17] A high score on dimensions includes learning, safety communication, and trust in the safety competencies in PT. X shows that all field personnel support implementing OHS (Occupational Safety and Health) to participate in the company's OH&S management system (Occupational Safety and Health) in terms of safety communication. As for the state of safety, communication is carried out by PT. X includes toolbox meetings, HIRADC (Hazzard Risk Assessment and Determining Control), JSA (Job Safety Analysis), program socialization and OHS policy, OHS training, and following up on OHS findings. A study revealed that safety

communication significantly influences work safety. [18]

The lowest value is in dimension 5, with an average of 2.22; dimension 5 is an aspect of the safety priority of workers and the non-tolerance of the risk of harm. Dimension 5 explains workers' perception of work safety regarding whether they generally prioritize safety over job targets, do not accept risky conditions, or do not take and do not show courage contrary to safety aspects.[17,19]

Based on Table 1, the classification of moderate mental workload got the highest score, with 22 (73.3%); for the type of heavy mental workload, the second-highest score is 5 (16.7%). The number of physical needs is very high, making workers exhausted. According to Nurmianto, work fatigue can lead to decreased capacity and increased errors in work, thus allowing work accidents in the industry.[20] If physical needs are high and cause fatigue, this can reduce productivity. Budiono said a relationship exists between fatigue and a company's productivity.[21]

As the results shown on data on Table 3, it can be assumed that the workers did not put safety first or a priority, and the company is still less committed. Adu, M. A. informs that safe behavior at work (safety behavior) can be predicted by the climate of work safety (safety climate).[22] Nopiyanti et al's Research, also shows that the safety climate figure is quite good with a value of 2.02-3.07 and an excellent OHS culture with a value of 671.[23] In the same research indicates that commitment is one of the main factors of the work safety culture; without support from the management, it is tough to achieve success in carrying out work safety programs. Kurnia stated that commitment to the company is an essential behavioral dimension and can be used to assess workers' attachment to the company.[24] This matter was supported which revealed that the level of an employee's willingness to prove himself to the company and his willingness to contribute to the company activity is a commitment to the company.

The results of the study show that workers at PT. X prioritize learning, safety communication, and trust in safety competencies in the workplace, but they do not prioritize safety as much as they should. This finding is consistent with previous research that suggests that safety communication significantly influences work safety.[25] It is essential for companies to have a good safety climate to ensure safe behavior at work.[22] However, the study indicates that the company is still less committed to work safety programs.[26]

Furthermore, the study found that the workers' mental workload was mostly classified as moderate, and the physical needs of workers were high, leading to fatigue that can decrease their capacity and increase errors in work, which can result in work accidents.[27] This finding is consistent with the previous research that suggests that there is a relationship between fatigue and a company's productivity.[28]

Commitment to the company is also an important behavioral dimension that can be used to assess workers' attachment to the company.[29] The level of an employee's willingness to contribute to the company's activity is a commitment to the company.[30] Therefore, it is essential for companies to support work safety programs and have a good safety climate to achieve success in carrying out work safety programs.

In conclusion, the study emphasizes the importance of prioritizing safety in the workplace, improving safety communication, and promoting a good safety climate. Companies should also consider reducing workers' mental workload and physical needs to prevent fatigue and increase productivity. Finally, companies should strive to increase workers' commitment to the company and work safety programs.

The findings presented in the chart and tables highlight several crucial aspects of safety culture in PT. X. The high score in the sixth dimension of safety culture suggests that workers perceive safety as an essential aspect of their job and are committed to learning and improving safety practices. This is a positive sign as it indicates that the workers are willing to engage in safety-related activities, such as training and reporting safety concerns, which can help reduce the risk of accidents and injuries.

However, the low score in the fifth dimension suggests that workers may not always prioritize safety over job targets and may be willing to take risks. This could lead to unsafe behavior and potentially increase the risk of accidents and

injuries. It is essential to address this issue and promote a safety-first culture where workers prioritize safety over job targets.

The high mental workload and physical needs of workers also raise concerns about safety. Fatigue and decreased capacity can increase the risk of errors and accidents. It is crucial to manage workload and provide adequate rest to ensure that workers are on alert and focused while on the job.

The safety climate in PT. X appears to be good, but the commitment of the company to safety still needs improvement. Management support and commitment are crucial factors in promoting safety culture, and without it, safety programs may not be successful. Companies must invest in safety culture and provide the necessary resources to ensure that workers are equipped to prioritize safety and engage in safety-related activities.

In conclusion, safety culture is a critical aspect of any organization, and PT. X must take steps to address the areas of concern identified in the result chart and tables. By prioritizing safety, managing workload, and providing adequate support and resources, PT. X can create a safe and healthy work environment for its workers.

Therefore, it can be concluded that although workers in PT. X support the implementation of OHS in the company and show good safety communication, there is still a need to improve their perception of safety priority and risk tolerance. The study suggests that the company should prioritize safety and provide adequate training and support to workers to enhance their safety awareness and risk management skills.

Another research gap identified in this study is the issue of mental workload and physical needs. The study shows that workers in PT. X experience high levels of physical needs, leading to fatigue and reduced productivity, which can increase the risk of work accidents. However, the study also indicates that workers experience moderate mental workload more frequently than heavy mental workload, which suggests that there may be room for improvement in managing mental workload to reduce fatigue and improve productivity. Future research can explore ways to optimize mental workload management in the construction industry to enhance workers' safety and well-being.

In terms of practical implications, this study highlights the importance of safety communication, trust, and learning in promoting work safety. The study suggests that companies should prioritize safety communication and create a culture of trust and learning to improve workers' safety awareness and risk management skills. Moreover, the study emphasizes the need for companies to prioritize workers' physical needs and mental workload management to enhance their well-being and productivity, which can ultimately contribute to improving work safety.

Overall, this study provides valuable insights into the perception of work safety in the construction industry in Batam and highlights some important research gaps and practical implications that can inform future research and practice in enhancing work safety and well-being in this industry.

CONCLUSION AND RECOMMENDATION

The majority of field workers at PT. X has a medium workload. The work climate based on worker perceptions measured by NOSACQ-50 shows the working environment in PT. X is likelier to learn, communication safety, and trust in competence is indicated by the highest perception average of 3.14. Mental workloads with the NASA-TLX method significantly correlate with all dimensions of occupational safety climate measurements. Recommendation for workers to make the most of rest time to be reinvigorated when returning to work. Wear PPE (Personal Protective Equipment) completely while working, such as helmet, gloves (for rigger work), and safety shoes. The company can rotate each group of field workers, especially the loading and unloading rigger workforce, so that the workload can be divided equally.

ACKNOWLEDGMENTS

We would like to thank the Faculty of Health Science, Universitas Ibnu Sina, for their technical support and all the contributors who helped in this study.

AUTHOR CONTRIBUTIONS

RS is the main researcher who has research ideas and concepts, formulates research methodologies, conducts data analysis and

drafts articles, MG as the second author helps conduct data analysis and make research reports and translate articles into English. Meanwhile, N and NU as the third and fourth authors contributed as data collectors in the field and made field observations. Finally, RH as the fifth author facilitate the administration process to conduct the research on PT. X.

CONFLICTS OF INTEREST

The authors declare no conflict of interest.

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Media Kesehatan Masyarakat Indonesia
Volume 19 Issue 3 2023
DOI : 10.30597/mkmi.v19i3.27507
Website : http://journal.unhas.ac.id/index.php/mkmi

The Role of Healthy Social Life, Food Security, and Nutrition in Shaping a Healthy Island: An Analysis Using Structural Equation Modeling

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ARTICLE INFO

Article History:
Received Jul, 4th, 2023
Accepted Sept, 7th, 2023
Published online Sept, 29th, 2023

Keywords:
Food security;
healthy island;
structural equation model;
social life;

ABSTRACT
Several important factors are associated with establishing a healthy island including a healthy social life, food security, and nutrition but in-depth information related to these dimensions is limited. The relationship dimensions include addressing poverty, managing natural and social disasters, handling disabilities, food availability, and food security. Therefore, this study aimed to identify the best model for establishing a healthy island in South Sulawesi. The experiment was carried out on five islands located in three municipalities/regencies in South Sulawesi, namely Tanakeke Island in Takalar Regency, Barrang Caddi Island and Lummu-Lumu Island in Makassar Municipality, as well as Saugi Island and Sapuli Island in Pangkep Regency. The sample consisted of 196 households, while data were analyzed using multivariate analysis through structural equation model tests. The results showed that addressing poverty (t value = 13.77; R2 = 0.75), managing natural and social disasters (t value = 12.15; R2 = 0.61), as well as handling disabilities (t value = 12,53; R2 = 0.64) significantly affected healthy social life. Additionally, food availability (t value = 6.25; R2 = 0.66), and security (t value = 2.72; R2 = 0.85) played key roles in the relationship between food security and nutrition affecting a healthy island. The best indicator of a healthy social life variable was addressing poverty (t value = 13.77; R2 = 0.75). Meanwhile, the best indicator of food security and nutrition variables was food availability (t value = 6.25; R2 = 0.66).

INTRODUCTION

A healthy island is one that is clean, safe, comfortable, and healthy for its inhabitants to live on because of environmental integrity, which includes community participation and cross-sector collaboration in relation to and in accordance with existing legislation. A healthy island is defined by community participation/ involvement in decision-making processes and cross-sector collaboration for social good.[1] The healthy island concept is a solution to the health problems faced by Pacific Island Countries.[2]

World Health Organization noted that Healthy Islands, as a brand, is subject to a wide range of interpretations and dynamics; countries use it however it best fits, and the concept evolves over time. It is not surprising then, that the vision is expressed in a plethora of ways, from mobilising people in a single village to clean up waste and remove pools of water to improve sanitation and control malaria, to using media to encourage awareness of a netball program to promote physical activity and reduce the burden of Non-Communicable Diseases (NCDs).[3] The group of countries that are developing healthy islands are Fiji, Samoa, Papua New Guinea, Kiribati, Vanuatu, Solomon Island and Tuvalu. Generally, these countries are included in the group of countries that have small populations. Apart from the Western Pacific Region, healthy islands are also being developed in many countries in South East Asia.[4,5]

The Healthy Island Initiative in several Pacific Island nations and the Maldives focuses on a variety of issues, such as focusing on eradicating specific illnesses or health issues, such as malaria control in the Solomon Islands, environmental health and health promotion initiatives in Fiji, or community development-based water supply and sanitation initiatives in Tonga, as well as community-based health promotion projects in the Cook Islands, Kiribati, Niue, Tuvalu, and Samoa.[6] The ongoing dietary transition in the Solomon Islands has resulted in an over-reliance on commercial food sources, leading to food insecurity, and subsequently an increase in various forms of malnutrition.[7] Food insecurity occurs when the food system experiences stress so that food is not accessible, available and/or of adequate quality. Food security in Pacific Island Countries (PICs) varies based on island geography and culture, ranging from inland and coastal communities on large islands with considerable natural assets to communities occupying small, low-lying islands with little or no limited land and clean water resources.[8] Climate change is one of the causes of food vulnerability in island countries. Kiribati, the country with the lowest GDP per capita in the Pacific, has inherent climate vulnerability with limited land area, low island population density and water shortages exacerbating public health problems. To ensure food security, the Kiribati government purchased land in Fiji and also used it as a migration site when sea levels rise.[9] The focus of this study is to look at the relationship between a healthy social life, food security, and nutrition towards a healthy island.

MATERIAL AND METHOD

This investigation was carried out using a quantitative approach. Permission to carry out the research was obtained from the local authorities and the Hasanuddin University Health Research Ethics Committee with protocol number 207220930010 on July 26 2022. The research was conducted from September 2022 to December 2022. Five islands in South Sulawesi were the subjects of this research: Tanakeke Island is in Takalar Regency; Barrang Caddi Island, Lummu-Lumu Island is in Makassar Municipality; Saugi Island, Sapuli Island are in Pangkep Regency. The total population on these 5 islands is 2,600 families. The sample calculation in this study uses the recommended sample size in SEM (Structural Equation Modeling) research, namely between 100 - 200. The guideline for determining the SEM sample size according to is.[10-13] Lastly, the final sample in this study was 196 families.

Univariate analysis was used in this study to get a general picture of the distribution of participants or variations of the variables under investigation, and complicated multivariate analysis was used to test a model based on the Structural Equation Modeling (SEM) strategy of the Lisrell program.

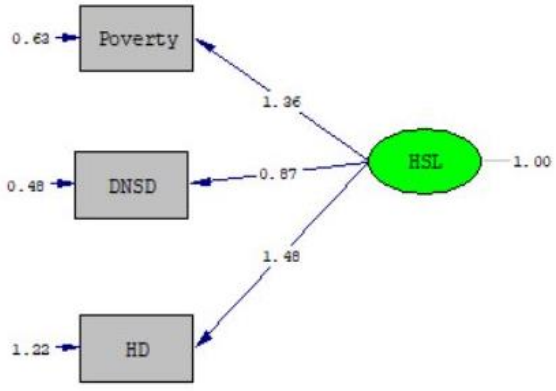
RESULTS

Healthy Social Life

Figure 1 is the result of confirmatory factor analysis testing for healthy social life variables with estimated values. The estimated value shows the size of the loading factor. Figure 2 is the result of confirmatory factor analysis testing for healthy social life variables with t values. The t value shows the indicator values that are considered significant for the main variable.

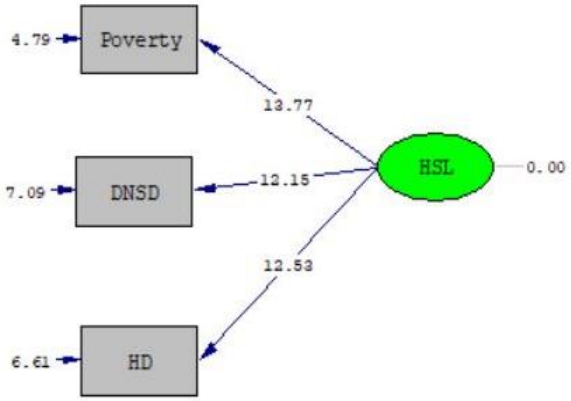
The results of the construct test for the healthy social life variable were evaluated based on the goodness of fit criteria in the following Table 1 with the results of the model and its criticality (cut-off value) presented.

From the evaluation of the proposed model, it shows that the evaluation of the construct as a whole produces a value above critical indicating that the model is in accordance with the data, so further model suitability tests can be carried out. Table 1 shows that the measurement model for a healthy social life has shown a fit model or suitability between the data and the model. This is evidenced from the existing fit criteria, there are already two that have met the criteria. Thus, referring to the principle of parsimony theory, the model above shows a good level of acceptance, so it can be concluded that the model is acceptable.



Source: Primary Data, 2022

Figure 1. Testing Confirmatory Factor Analysis of the Healthy Social Life Variable with Estimated Values



Source: Primary Data, 2022

Figure 2. Testing Confirmatory Factor Analysis of the Healthy Social Life Variable with t Values

Furthermore, to find out the indicators that contribute significantly to the healthy social life variable can be observed from the factor loading or lambda coefficient (λ) and its level of significance reflecting the contribution of each indicator to the healthy social life variable as shown in the following Table 2.

Table 2 shows that the indicators of handling poverty, dealing with natural and social disasters (BA), and handling disabilities have a t value of > 1.96, meaning that all of these indicators are statistically significant. Of the three indicators of the healthy social life variable, handling poverty is the best (most significant) indicator because it has the greatest R^2 value of 0.75, meaning that the contribution of handling poverty is 75.0% (compared to dealing with natural and social disasters (BA) = 0.61 and handling disabilities = 0.64).

Table 1. Evaluation of the Goodness of Fit Index Criteria for a Healthy Social Life

The Goodness of Fit Index	Cut of Value	Results	Model Evaluation
Chi-Square		0.000	
Probability	≥ 0.05	1.00	Good
RMSEA	≤ 0.08	0.000	Good
The Model is Saturated, and the Fit is Perfect!			

Source: Primary Data, 2022

Table 2. Factor Loading, t and R^2 Values of the Healthy Social Life Variable Measurements

Variable Indicator	Factor Loading	t value	R^2	Information
Handling poverty	1.36	13.77	0.75	Significant
Dealing with natural and social disasters	0.67	12.15	0.61	Significant
Handling disabilities	1.48	12.53	0.64	Significant

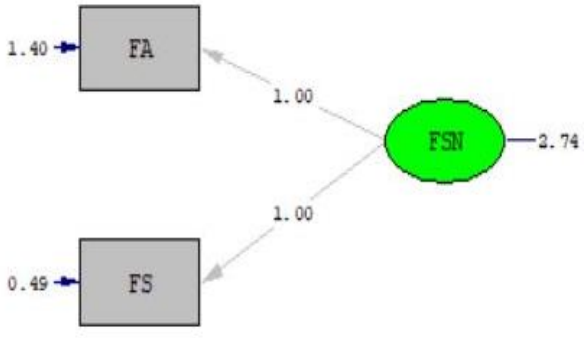
Source: Primary Data, 2022

Meanwhile, the factor loading value shows the correlation between the indicators and their latent constructs. Indicators with greater factor loading values have a higher correlation to explain their latent constructs. The results show that of the three indicators of the healthy social life variable, handling disabilities is the indicator with the greatest factor loading value, namely 1.48 (compared to handling poverty = 1.36 and dealing with natural and social disasters = 0.67).

Food Security and Nutrition

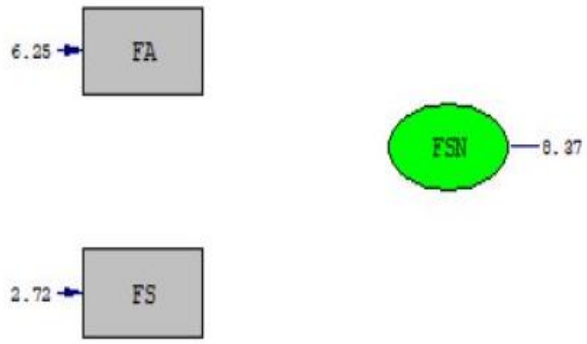
Figure 3 is the result of confirmatory factor analysis testing for food security and nutrition with estimated values. The estimated value shows the size of the loading factor. Figure 4 is the result of confirmatory factor analysis testing for food security and nutrition with t values. The t value shows the indicator values that are considered significant with the main variable.

The results of the construct test for the food security and nutrition variables were evaluated based on the goodness of fit criteria in the following Table 3 with the results of the model and its criticality (cut-off value) presented.



Source: Primary Data, 2022

Figure 3. Testing Confirmatory Factor Analysis of the Food Security and Nutrition Variables with Estimated Values



Source: Primary Data, 2022

Figure 4. Testing Confirmatory Factor Analysis of the Food Security and Nutrition Variables with t Values

Table 3. Evaluation of the Goodness of Fit Index Criteria for Food Security and Nutrition

The Goodness of Fit Index	Cut of Value	Results	Model Evaluation
Chi-Square		0.000	
Probability	≥ 0.05	1.00	Good
RMSEA	≤ 0.08	0.000	Good
The Model is Saturated, and the Fit is Perfect!			

Source: Primary Data, 2022

From the evaluation of the proposed model, it shows that the evaluation of the construct as a whole produces a value above critical indicating that the model is in accordance with the data, so further model suitability tests can be carried out. Table 3 shows that the food security and nutrition measurement model has shown a fit model or suitability between the data and the model. This is evidenced by the existing fixed criteria, two of which have met the criteria. Thus referring to the principle of parsimony theory, the model above shows a good level of acceptance, so it can be concluded that the model is acceptable.

Furthermore, to find out the indicators that contribute significantly to the food security and nutrition variables can be observed from the factor loading or lambda coefficient (λ) and its level of significance reflecting the contribution of each indicator to the food security and nutrition variables as shown in the following Table 4.

Table 4 shows that the indicators of food availability and food security have a t value of > 1.96 meaning that all of these indicators are statistically significant. Of the two indicators of the food security and nutrition variables, food security is the best (most significant) indicator because it has the greatest R^2 value of 0.85,

meaning that the contribution of food security is 85.0% (compared to food availability = 0.66).

Meanwhile, the factor loading value shows the correlation between the indicators and their latent constructs. Indicators with greater factor loading values have a higher correlation to explain their latent constructs. The results of the study show that the two indicators of the food security and nutrition variables are similar (food availability and food security have the same factor loading value of 1.00).

Table 4. Factor loading, t and R2 Values of the Food Security and Nutrition Variables Measurements

Variable Indicator	Factor loading	t value	R^2	Information
Food availability	1.00	6.25	0.66	Significant
Food security	1.00	2.72	0.85	Significant

Source: Primary Data, 2022

DISCUSSION

An island is a setting whose quality needs to be maintained based on several aspects, one of which is the social environment.[14] The findings of this study demonstrate that addressing poverty is the greatest metric for gathering data on the variable of a healthy social life on an island. This is so that those who are experiencing poverty can receive social help when appropriate measures are taken to combat it. This social support might take the form of cash aid, basic service access, and empowerment initiatives. With this support, those who are struggling with poverty might feel more safe and protected, which improves their quality of life and interactions with other people.[15] Addressing poverty must also include reducing stigma and discrimination against individuals who experience poverty. Social stigma related to poverty can limit their access to jobs, education, and health services and affect their social relationships. By reducing stigma and discrimination, individuals who experience poverty can feel more accepted in society and have better opportunities to participate in a healthy social life.[16]

The research conducted included two social health policy approaches: prevention and treatment.[17] Prevention is sometimes referred to as a social welfare policy that aims to improve public health conditions. Another definition of prevention is social work, which has a broader meaning that social life does not only refer to health. While healing is generally understood as a "social health care system," as noted by Johnson and Schwartz it is defined as a system that is generally responsible for disease and disability.

Food selection is a complex process as it is also influenced by taste, smell and texture. Non-food factors such as geography, seasonality, economics, food technology, shopping locations, and food availability.[18] The findings of this study also demonstrate that the greatest indicator for assembling indicators of food security and nutrition variables for a healthy island is food availability. This is due to the fact that ensuring food security and adequate nutrition depends in large part on the availability of food. When food availability is guaranteed, various aspects of food security and nutrition can be achieved,[19,20] including: Accessibility: availability of adequate food allows individuals and families to obtain food physically and financially. This includes factors such as market availability, equitable distribution of food, and access to adequate resources and income to buy food; Availability: availability of adequate food is an important aspect of food security. Stable and sustainable food production is very important to be able to meet food needs in a sustainable manner.

Factors such as climate change, natural disasters, and conflict can affect food availability; Adequacy of nutrition: availability of adequate food means that the food available must provide adequate and balanced nutrition for the individual. This includes aspects of micronutrients (vitamins and minerals) as well as macronutrients (carbohydrates, protein, and fat). Malnutrition can cause health problems such as undernourishment, vitamin deficiency, or malnutrition; Sustainability: sustainability of food means the management of natural resources, agriculture, and food systems that are economically, socially, and environmentally sustainable. This sustainability is important to ensure that future generations can also enjoy adequate food availability.

Small islands generally depend on subsystems and plants for survival and econom-

ic development. Local food production is very important for small islands, even with very limited land. Island communities are highly dependent on the sea and biological resources for their survival. Because land-based development is limited, the sea and fisheries sectors play an important role in the lives and economies of island communities. The ecological dependence of small island economies and their communities is also an issue.[21,22] Small island communities at the research location are very dependent on fishing activities and inter-island trade transportation. most of their basic needs, especially for food, are supplied from large islands, especially small islands, far from large islands and limited land for agriculture. Bad weather conditions, such as strong winds and high waves, disrupt fishing and trade activities on small islands. Fishermen stopped fishing and supplies from other islands also stopped.

Food insecurity has a detrimental impact on human health, meaning food and nutritional security are critical to improving public health outcomes.[23] In public health, food and nutrition have a very important impact both at the community and individual levels on the quality of life related to health and also socio-economic aspects.[24] Research carried out the physical formation of fishermen due to the risk of hard work activities carried out so that they consider fulfilling primary food needs such as rice and tubers not as a main priority but rather fulfilling the secondary needs of fishermen's households.[25] Apart from that, the existence of actors providing socio-economic guarantees in the fishing environment on Barrang Caddi Island adds to the worry factor of fishermen regarding the issue of fulfilling food for the households of capture fisheries fishermen, especially anglers.

Sensitive and specific interventions are needed as well as cross-sector collaboration that is focused and has a common target to improve food and nutrition security.[26]

CONCLUSION AND RECOMMENDATION

Handling poverty is the best indicator of a healthy social life. This is because poverty can affect various aspects of social life, such as access to education, adequate housing, decent work, access to health services, and social support. Effective efforts of handling poverty can help create a more just, inclusive, and supportive social environment, thereby promoting a healthy social life and improving the quality of life of people affected by poverty. Food security and availability have a close relationship with food security and nutrition. Food security and availability is the best indicator of food security and nutrition because it relates to availability, accessibility, and adequate food quality to meet the nutritional and health needs of the community. Besides, food security also reflects the ability of a region or population to face, cope with, and adapt to environmental changes, natural disasters, and food crises. Good nutrition is also closely related to food security because safe and quality food is a prerequisite for adequate nutritional intake.

Special policies are needed relating to handling poverty, food security, and food availability in the archipelago. So, island communities can have the same access as urban communities, especially in the fields of education, adequate housing, decent work, access to health services, security in food consumption, and food availability, especially when the rainy season arrives.

ACKNOWLEDGMENTS

The researchers would like to deliver their gratitude to the Provincial Government of South Sulawesi, the Government of Makassar, the Government of Takalar, the Government of Pangkep, and Universitas Hasanuddin.

AUTHOR CONTRIBUTIONS

SP and NSS contributed to the conceptualization of the writing of the section "Healthy islands based on the vision of healthy islands, conducting investigations or tracing results related to healthy social life in archipelagic areas, food security and nutrition in archipelagic areas." ABB and HH contributed to the “data analysis methods” section. TJ and SSR contributed to preparing tables and figures. SR, WH, and JAM contributed to editing and language. All authors read the manuscript and approved the final manuscript.

CONFLICTS OF INTEREST

There was no conflict of interest in this study.

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Media Kesehatan Masyarakat Indonesia
Volume 19 Issue 3 2023
DOI : 10.30597/mkmi.v19i3.26340
Website : http://journal.unhas.ac.id/index.php/mkmi

Predictors of Indonesian National Health Insurance Knowledge: A Cross-Sectional Study Among Public Health Students in Palembang

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ARTICLE INFO

Article History:
Received Apr, 3rd, 2023
Accepted Jun, 19th, 2023
Published online Sept, 29th, 2023

Keywords:
Health insurance;
JKN;
knowledge;
students;

ABSTRACT
Students, as agents of change, are expected to assist in reaching the success of the Indonesian National Health Insurance/*Jaminan Kesehatan Nasional (JKN)* program. Therefore, this study aimed to analyze the JKN knowledge among public health students and the associated factors in Palembang City, Indonesia. A cross-sectional online survey was conducted to collect data from 279 students at Universitas Sriwijaya in Palembang City, Indonesia. The analyzed variables included gender, age, marital status, residence, family size, income, study level and period, as well as source of JKN information. Additionally, statistical analysis using binary logistic regression, presenting odds ratio and 95% CI, was conducted to identify the determinants of JKN knowledge with significance set at a *p-value* <0.05. The results showed that 92.47% of respondents had low JKN knowledge with the following characteristics; female (93.83%), aged >20 years (92.93%), not married (93.75%), living in urban areas (90.24%), having family members >4 people (91.39%), income ≤UMR (93.38%), undergraduate level (93.70%), study period ≤2 years (93.89%), and receiving information from the Social Security Administration Agency for Health/*Badan Penyelenggara Jaminan Sosial Kesehatan (BPJSK)* (94.32%). The most associated variable with JKN knowledge was reside nce after being controlled by gender, study period, and information source variables. Specifically, respondents residing in urban areas (aOR = 10.73; 95% CI: 1.32–86.89) showed a higher likelihood of having good JKN knowledge than those in rural areas.

INTRODUCTION

Several countries around the world are implementing social health insurance schemes for financing health services. In Indonesia, this scheme was organized by the National Government through the implementation of the National Health Insurance/*Jaminan Kesehatan Nasional (JKN)* program in 2014. This program, administrated by the Social Security Administration Agency for Health or *Badan Penyelenggara Jaminan Sosial Kesehatan (BPJSK)* is crucial as part of the government efforts to achieve Universal Health Coverage (UHC).

Given that health services are crucial needs of every citizen, the government continually strives to build programs capable of improving these services. However, in Indonesia, the understanding of social health insurance is still very low due to the lack of exposure to vital information. A previous study reported that nearly half of the respondents had low perceptions of health insurance benefits.[1] This lack of understanding may result in low utilization of health insurance at primary care.[2]

Insurance participation is basically driven by government policy.[3] In Indonesia, National Health Insurance is implemented on the principle of cooperation and its participation is mandatory. In this context, contributions are based on a percentage of wages and are carried out on a non-profit basis, ensuring that individuals do not incur exorbitant costs for health services. To achieve the goals of UHC, people who have not become JKN participants are encouraged to register as Non-Receiving Wage Workers/*Pekerja Bukan Penerima Upah (PBPU).* Without an adequate understanding of insurance policies, UHC cannot be achieved, even where appropriate and acceptable services are accessible.[4] Individuals with a grasp of the general principles and functions of health insurance have a high chance of registering. This underscores the importance of awareness, which is defined as a condition between acquiring clear knowledge and individual behavior.[5]

Universities, as intellectual centers, can greatly contribute to the implementation of health policies. However, among students, awareness and knowledge about health insurance are still very low. A previous study conducted at a public university in the southeastern United States reported that students had limited knowledge of health insurance.[6] A similar study carried out in Nepal reported that more than half of the undergraduate students had poor health literacy.[7] Increased knowledge of health insurance among students is encouraged when illness occurs and requires health services.[8] Increasing health insurance literacy in populations such as students is essential to improve access to health care, with knowledge being one of the factors that shape literacy.[9] Knowledge of health insurance among university students is important in making decisions to enroll in health insurance and use health services.[10]

The Social Security Administration Agency for Health has developed collaborations with universities in Indonesia to help students realize UHC through the BPJSK *"goes to campus program"*. Students are intellectuals who can act as agents of change and are expected to understand the importance of JKN ownership for financial risk protection when sick and raise public awareness to voluntarily register. Therefore, it is very important to improve their understanding of the JKN program.

Measuring individual knowledge of health insurance is important for efficient health services, but less attention has been paid to this aspect. Therefore, this study aimed to analyze knowledge about JKN and its associated factors among public health students.

MATERIAL AND METHOD

This study used a descriptive-analytic method based on quantitative data with a cross-sectional design. The population comprised all students of the public health faculty at Universitas Sriwijaya in Indonesia. Although a minimum of 100 respondents was set for the survey, all students who were interested in participating were welcomed. All undergraduates in the first–fourth year and graduate students of the faculty participated in this study, totaling 279.

A self-administered questionnaire concerning JKN knowledge was first tested for its validity and reliability by distributing to 30 other public health students who were not part of the respondents. The correct answer to each question was given a score of 1, and the wrong answer was accorded a score of 0. Among the 12 questions, 11 were considered valid, resulting in

a questionnaire with a Cronbach Alpha of 0.70. Furthermore, data collection was carried out through an online survey using Google Forms.

The questions, which comprised socio-demographic characteristics of respondents and education-related aspects were considered to be important variables influencing health insurance knowledge. Informed consent was also gathered from the students, while the questionnaire about JKN knowledge comprised 11 questions, with each item containing two options, namely, "true" and "false". In this context, 1 point was given for a correct response, and 0 point was awarded for an incorrect answer, with the total knowledge score ranging from 0 to 11. Knowledge of respondents was grouped using Bloom's cut-off point, comprising good when the score was between 80 and 100% (9–11 true answers), and poor when less than 80% (<9 true answers).[11] To identify the characteristics of the respondents, descriptive statistics with frequency distributions were presented. Bi-variable analysis was conducted to assess the association of the independent variables with the dependent ones.

The binary logistic regression model was performed to determine the dominant factor associated with JKN knowledge. To estimate the strength of association between the independent variables and the JKN knowledge, an odds ratio, a 95% CI, and a *p-value* were presented. This study obtained ethical approval from the Ethics Committee of the Public Health Faculty at Universitas Sriwijaya number: 367/UN9.FKM/TU.KKE/2022. To maintain confidentiality, the personal identities of respondents were not included. Moreover, well-explained informed consent was gathered. Respondents were also given a right to participate or not, and answer all questions or quit the interview before completing all questions.

RESULTS

Table 1 shows the characteristics of the respondents, with the frequency and percentage for each variable. Based on the results, the majority of public health students in Palembang had poor knowledge regarding JKN (92.47%) dominated by women (87.10%), aged above 20 years (65.95%), unmarried (86.02%), residing in urban areas (73.48%), had four family members or more (54.12%). Moreover, the family income was mostly below the minimum regional wage (54.12%), the majority were undergraduate (91.04%), and only participated in study periods of less than two years (93.91%), For JKN, information sources were mostly obtained from BPJSK (82.08%).

Table 2 shows the distribution of knowledge regarding JKN. Respondents with low health insurance (JKN) knowledge were dominated by female (93.83%), aged >20 years (92.93%), not married (93.75%), living in urban areas (90.24%), had a large family size > 4 members (91.39%), had an income below the UMR (93.38%), undergraduate education (93.70%), study period ≤ 2 years (93.89%), and obtained JKN information from BPJSK (94.32%). As shown in Table 2, five variables were found to be associated with knowledge of students including gender, residence, study level, study period, and JKN information sources.

Table 1. Characteristics of Respondents

Variable	n=279	%
Knowledge of JKN		
Poor	258	92.47
Good	21	7.53
Gender		
Male	36	12.90
Female	243	87.10
Age		
18-20 Years	95	34.05
>20 Years	184	65.95
Marital status		
Not married	240	86.02
Married	39	13.98
Residence		
Rural	74	26.52
Urban	205	73.48
Family size		
Small (≤4 People)	128	45.88
Big (>4 People)	151	54.12
Family income		
≤UMR (Regional Minimum Wage)	151	54.12
>UMR (Regional Minimum Wage)	128	45.88
Study level		
Undergraduate	254	91.04
Graduate	25	8.96
Study period		
≤2 Years	262	93.91
>2 Years	17	6.09
JKN information sources		
Not from BPJSK	50	17.92
From BPJSK	229	82.08

Source: Primary Data, 2022

Table 3 shows that among the 11 JKN knowledge questions, a total of six were mostly answered incorrectly. The majority of the respondents did not know that type D hospitals were not the Referral Health Facilities/*Fasilitas Kesehatan Rujukan Tingkat Lanjutan (FKRTL)* for JKN participants (72.76%), JKN membership was mandatory for all Indonesians (54.12%), membership was permanent (76.70%), and referral programs could be obtained at FKRTL (66.67%). Moreover, a significant proportion of the respondents were not aware that JKN participants could select the First-Level Health Facilities/*Fasilitas Kesehatan Tingkat Pertama (FKTP)* preferred when registering (61.65%), and emergency services at FKRTL may be obtained without showing a referral letter from the FKTP (73.48%).

The outcome variable (JKN knowledge) was treated as a binary outcome, including "1" for good knowledge and "0" for poor knowledge. In this context, a total of six explanatory variables were considered in the multivariate model. The binary logistic analysis showed that gender, residence, study period, and source of information were significantly associated with JKN knowledge.

Table 2. The Difference in JKN Knowledge among Public Health Students in Palembang

Variable	Knowledge		*p-value*
	Poor	Good	
	%	%	
Gender			
Male	83.33	16.67	0.038*
Female	93.83	6.17	
Age			
18-20 Years	91.58	8.42	0.684
>20 Years	92.93	7.07	
Marital Status			
Not Married	93.75	6.25	0.092
Married	84.62	15.38	
Residence			
Rural	98.65	1.35	0.019*
Urban	90.24	9.76	
Family Size			
Small (≤4 peoples)	93.75	6.25	0.457
Big (>4 peoples)	91.39	8.61	
Family Income			
≤UMR (Regional Minimum Wage)	93.38	6.62	0.534
>UMR (Regional Minimum Wage)	91.41	8.59	
Study Level			
Undergraduate	93.70	6.30	0.029*
Graduate	80.00	20.00	
Study Period			
≤2 Years	93.89	6.11	0.005*
>2 Years	70.59	29.41	
JKN information sources			
Not from BPJSK	84.00	16.00	0.032*
From BPJSK	94.32	5.68	

Source: Primary Data, 2022
*Significant at the 0.05 level (2-tailed)

Table 3. The Distribution of Answers on JKN Knowledge among Public Health Students

Statement	Answer	
	True	False
	%	%
One of the first-level health facilities (FKTP) for JKN participants is the public health center	85.30	14.70
One of the referral health facilities (FKRTL) for JKN participants is a type D hospital	27.24	72.76
The JKN program is organized by the Social Security Administration Agency for Health (BPJSK)	99.64	0.36
Participation in the National Health Insurance (JKN) is mandatory for all Indonesians	45.88	54.12
JKN membership is valid for life unless changing nationality	23.30	76.70
The referral program for JKN participants can be obtained at FKRTL	33.33	66.67
JKN participants in the contribution assistance segment/*Penerima Bantuan Iuran (PBI)* are the poor and the poor whose contributions are paid by the government	73.48	26.52
Non-wage workers are independent respondents who do not receive assistance in paying JKN contributions	79.21	20.79
Payment of JKN dues no later than the 1st of every month	51.61	48.39
JKN participants cannot choose the desired FKTP when registering	38.35	61.65
JKN participants can obtain emergency services at FKRTL by showing a referral letter from the FKTP	26.52	73.48

Source: Primary Data, 2022

Table 4 shows the results of the multivariate analysis. The variables risk factors for JKN knowledge included female students (OR = 0.17; 95% CI: 0.05 – 0.59), living in the urban area (OR = 10.73; 95 % CI: 1.32 – 86.89), study period >2 years (OR= 10.02; 95% CI: 2.62 – 38.37), and JKN information sources from BPJSK (OR=0.15; 95% CI: 0.05 – 0.47).

DISCUSSION

In this study, the majority of the respondents were female, reflecting the prominence of female public health students in Palembang. Based on the statistical analysis results, there was a significant relationship between gender and knowledge about JKN (*p-value* = 0.038). Poor health insurance knowledge was found in the female students (93.83%). This result was consistent with a previous study stating that gender had a significant effect on low knowledge of health insurance among artisans in Ekiti State, Nigeria.[12] Another study also stated that health literacy among students was influenced by demographic characteristics, namely gender.[13] However, the results differed from Kaklottar (2019) which found no relationship between gender and knowledge among nursing staff in hospitals.[14] The difference may be due to the use of varying respondent groups and living areas.

The statistical analysis results further showed that there was no significant relationship between age and knowledge about JKN (*p-value* = 0.684), probably due to the limited variation in age grouping. This was consistent with a previous study conducted in Ahmedabad District, India, where socio-demographic variables, such as age, had no significant relationship with knowledge.[14] In contrast, a study carried out in Katsina State, Nigeria found that age had a significant correlation with health insurance knowledge among the community.[15] JKN knowledge can influence participation, with age playing a significant role. A similar investigation also stated that age could predict health insurance literacy.[16]

Based on the results, there was no significant relationship between marital status and knowledge about health insurance among public health students (*p-value* = 0.092). In a previous study conducted at Pargarutan village, the results showed that marital status was not significantly related to BPJS service utilization.[17] Conversely, in another study, marital status was found to have a significant effect on the probability of getting health insurance.[18]

This study underscored the role of government in achieving UHC through effective socialization.[19] Based on the statistical test results, the residence had a significant correlation with the level of JKN knowledge among public health students (*p-value*=0.026 and an adjusted OR of 10.73). This implies a 10.73 times higher risk of exposure to JKN knowledge in urban areas. The result was consistent with a previous study showing that

low health literacy increased a disparity in healthcare utilization among urban society in China.[20] Health insurance providers can use social media to increase opportunities for rural communities to obtain information.[21] A study conducted in rural South India stated that the majority of the respondents were not aware of government health insurance schemes due to a lack of campaigns.[22]

The statistical test results showed that there was no significant relationship between the number of family members and the JKN knowledge of public health students (*p-value* = 0.457). Similar results were found among the community in Nigeria where the number of household members did not significantly affect knowledge of health insurance.[15] However, a study carried out in Bhaktapur District of Nepal showed that family number was significantly associated with health utilization.[23] Knowledge gap in health insurance literacy is a challenge for families to access health services and treatment.[24] The greater the number of family dependents, the higher the JKN contribution required, and this will affect membership. The study performed in Nepal reported that households with more than four family members were more likely to register for health insurance.[25] Among farmers in Banyuasin Regency, the number of family members also affected JKN membership.[26]

Based on the statistical test results, there was no significant relationship between family income and JKN knowledge among public health students (*p-value* = 0.534). A previous study reported that more than four-fifths of the respondents had poor knowledge of health insurance. One of the factors associated with low health insurance knowledge was family income.[12]

Table 4. Multivariate Analysis of Predictors of JKN Knowledge among Public Health Students

Variable	Initial Model				Final Model			
	p-value	Crude OR	95% CI		*p-value*	Adjusted OR	95% CI	
			Lower	Upper			Lower	Upper
Gender	0.005*				0.005*			
Male (ref)		1				1		
Female		0.18	0.55	0.59		0.17	0.05	0.59
Marital Status	0.911				-	-		
Not Married (ref)		1						
Married		0.89	0.12	6.72				
Residence	0.026*				0.026*			
Rural (ref)		1				1		
Urban		10.71	1.33	86.50		10.73	1.32	86.89
Study Level	0.779				-	-		
Undergraduate (ref)		1						
Graduate		0.67	0.04	10.69				
Study Period	0.064				0.001*			
≤2 years (ref)		1				1		
>2 years		14.21	0.86	234.55		10.02	2.62	38.37
JKN Information Sources	0.046*				0.001*			
Not from BPJSK (ref)		1				1		
From BPJSK		0.14	0.02	0.97		0.15	0.05	0.47

Source: Primary Data, 2022

*Significant at the 0.05 level (2-tailed)

Adults with higher educational status have better health due to accessible healthcare.[27] The statistical test results showed a significant relationship between education level (*p-value* = 0.029) and study period (*p-value* = 0.005) with JKN knowledge of public health students. A well-educated person tends to have better thinking skills when processing information. This heightened cognitive function is particularly beneficial in recognizing disease symptoms, fostering a desire to learn more about JKN, use the services, and play an active role in overcoming health problems. In other words, people with higher education tend to value health more as an investment and use related services. Education has a positive effect on health insurance participation. As stated in a previous study, communities with a high level of education showed an increased understanding and awareness of good health insurance.[19]

Improving health literacy requires several effective communication methods, such as the teach-back method, visualizing, summarizing, and repeating information.[28] A previous study illustrated the importance of using various media to disseminate information on health insurance schemes to support increased knowledge.[29] Based on the statistical test result, there was a significant relationship between the source of information from the JKN organizing agency and knowledge of public health students (*p-value* = 0.032). The adjusted OR of 0.15 means that exposure to information from BPJSK has a 0.15 chance of increasing knowledge. This underscores the importance of BPJSK improving its information dissemination to the public. The more information provided clearly and reliably, the more the likelihood of people using the available health facilities. Furthermore, high social health insurance literacy correlates with community participation when coupled with socialization through effective media. A low intensity of socialization can lead to failure to understand the benefits of JKN.[30] In this context, social media is an interesting strategy for information dissemination and can promote knowledge exchange.[31] A previous study showed how the dissemination of inaccurate health information might impact perceptual barriers.[32] Awareness and knowledge are important to increase the coverage of the social security scheme.[33]

CONCLUSION AND RECOMMENDATION

In conclusion, the variable most associated with JKN knowledge among public health students in Palembang City was residence after being controlled by gender, study period, and JKN information sources. Respondents residing in urban areas had a 10.73 higher likelihood of having good JKN knowledge compared to those in rural areas. At the 95% confidence level, residence was identified as the dominant factor for students to have good knowledge about JKN, with an interval range of 1.32 to 86.89. Furthermore, the results underscored the need for BPJSK to provide more resources to improve knowledge among the students. Effective socialization and communication activities should be implemented using various media to improve students understanding of health insurance.

AUTHOR CONTRIBUTIONS

AA contributed to the design and implementation of the study, analysis of the results, and writing of the paper. P contributed to the analysis and writing of the manuscript. All authors have read and approved the final manuscript.

CONFLICTS OF INTEREST

The authors declare that there is no conflict of interest.

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Media Kesehatan Masyarakat Indonesia
Volume 19 Issue 3 2023
DOI : 10.30597/mkmi.v19i3.24478
Website : http://journal.unhas.ac.id/index.php/mkmi

Analysis of Resilience to Stress in Adolescents Student during the COVID-19 Pandemic

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ARTICLE INFO

Article History:
Received Jun, 5th, 2023
Accepted Sept, 4th, 2023
Published online Sept, 29th, 2023

Keywords:
Adolescents stress;
stress tolerance;
COVID-19;

ABSTRACT

Stress is a condition of worry or mental tension caused by a difficult situation, often referred to as pressure. Meanwhile, resilience comprises active and distinct biological processes that protect organisms from the effects of stress. The COVID-19 pandemic has significantly impacted mental health, specifically among adolescents navigating a transitional period. Therefore, this study aimed to determine the relationship between stress and resilience among adolescents student during the COVID-19 pandemic. An analytic cross-sectional design was used and the study was conducted between February to July 2021. The subjects comprised 238 people from 22 MAN in the Jabodetabek area, selected through Cluster Random Sampling. Primary data were obtained by filling out the 42-item Depression Anxiety Stress Scale (DASS-42) and Miller Smith Rating Scale for Stress Tolerance (MSRS-ST) online questionnaires through the Google form application. Furthermore, data were analyzed using Chi-square and Multiple logistics regression tests. The results showed that the majority of respondents totaling 185 (77.7%) had high stress levels with 202 (84.9%) having low resilience. There was a significant relationship between stress levels and resilience as demonstrated by *p-value* = 0.0002. The variable "difficulty in relaxing" had a 0.13 times potential impact as a factor associated with stress levels. On the other hand, the variable "not drinking alcohol" was found to have a 16.77 times higher potential to be a factor associated with resilience.

INTRODUCTION

Stress is a condition of worry or mental tension caused by a difficult situation, often referred to as pressure.[1] According to Weinberg and Gould, stress is characterized by an imbalance between physical and psychological demands.[2] There are three types, namely neustress, distress, and eustress. Neustress is a neutral type that does not cause any consequences for the recipient. Meanwhile, distress and eustress have negative and positive effects on the recipient respectively.[3] Various factors contribute to resilience including individual skills such as cognitive abilities, self-concept, self-confidence, and social skills. Family support comprising parental treatment and time-sharing as well as participation in community activities also play vital roles.[4]

Previous studies showed that resilience is influenced by both internal and external factors. Internal factors include spirituality, self-efficacy, optimism, and self-confidence, while external factors consist of social support.[5] Stress tolerance, on the other hand, refers to the ability of an individual to endure stressful situations while remaining rational and logical. It must be acknowledged that not everyone perceives the same events as stressful stimuli.[6]

Self-concept contributes positively to resilience, hence, the higher the self-concept, the greater the level of resilience. Individuals with high self-esteem are more optimistic, full of confidence, and always have a positive attitude even in the face of failure.[4] Furthermore, adolescence is a transitional phase of development characterized by several mental and physical changes. The occurrence of psychological changes causes confusion, resulting in a deviation from social rules and norms established in society. The main cause of physical and psychological change among young people is stress.[7]

According to various studies, the current COVID-19 pandemic has further impacted mental health. Stress level in the general population during pandemic was estimated at 29.6%.[8] Factors contributing to stress include learning assignments (70.29%), boredom at home (57.8%), boring online learning processes (55.8%), inability to meet loved ones (40.2%), signal limitations to participate in online learning (37.4%), inability to carry out usual hobbies (35.8%), as well as challenges in applying for practicum due to the lack of tools and lecture load.[9,10] Stress defense strategies used during the pandemic are to accept the present situation, carry out activities during quarantine, maintain a semblance of normalcy, recognize the benefits of being at home, and not appearing worried.[11] Based on these preceding discussions, this study aimed to investigate the relationship between stress and resilience among adolescents student during the COVID-19 pandemic.

MATERIAL AND METHOD

This was an analytic study conducted with a cross-sectional design. The population consisted of high school students in the Jabodetabek area (Jakarta, Bogor, Depok, Tangerang, Bekasi). The samples, selected using random cluster sampling comprised adolescents from 22 MAN (Madrasah Aliyah Negeri) who met the exclusion and inclusion criteria, totaling 238 based on the Lemeshow formula. This study was conducted from October to December 2021 and collaboration was carried out with OSIS through social media to collect random data for each MAN. Data were collected from the respondents using a validated questionnaire through the Google form application, distributed online. To control the quality of data, the questionnaires were not distributed at random, but through the head of each student council. Moreover, the respondents included their email address/cell phone number, ensuring that the filling was personal. The Google forms were also configured such that respondents could only submit one. The collected data were then coded and analyzed univariately using statistical applications, focusing on variable frequency distribution.

Statistical analysis was conducted using SPSS 26, with univariate analysis describing the data for each variable presented in the frequency distribution table. Subsequently, the data were analyzed with bivariate analysis to determine the relationship between all variables with the chi-square test. The multivariate analysis aimed to analyze the relationship between the independent and the dependent variables. The statistical test used was multiple logistic regression. This study assessed stress level with the DASS-42 questionnaire, while resilience was measured using MSRS-ST with a Likert scale

consisting of 20 question items. The variables examined were the characteristics of the respondents, including gender, place of residence, level of education at school, number of relatives, a family of medical personnel, families infected with COVID-19, and online learning. The dependent variable was stress level divided into normal, mild, moderate, severe, and very heavy categories. On the other hand, the independent variable was resilience to stress which consisted of high and low. This study has been reviewed by the Health Research Ethics Commission, Faculty of Medicine and Health, University of Muhammadiyah Jakarta, and obtained ethical approval No: 037/PE/KE/FKK-UMJ/II/2021.

RESULTS

The characteristics of respondents were used to determine diversity based on gender, regional domicile, number of siblings, having a health worker in the family, having a COVID-19-infected family member, and duration of online learning. Based on the results, the majority of the respondents were women (172 or 72.27%), and residing in Tangerang, (74 or 31.09). The largest number of siblings owned was two (92 or 38.67%), and a significant proportion did not have medical personnel as a family member (214 or 89.92%). Additionally, most of the respondents had no family infected with COVID-19, (209 or 87.82%), and 130 people (54.62%) engaged in online learning for 3-6 hours (Table 1).

The majority of respondents experienced high-stress levels (185 or 77.73%), with only 53 (22.37%) experiencing low levels. A significant proportion had a low level of resilience, (202 or 84.87%), while 36 (15.13%) showed a high level. Based on the result, there was a significant relationship between stress level and resilience in respondents, with a p-value of 0.002 (Table 2).

As shown in Table 2, several indicators of low resilience to stress include eating a balanced healthy diet, getting enough and regular sleep, giving and receiving love, having reliable relatives, engaging in exercise, not smoking, not drinking alcohol, adequate income, regular social participation, functional network of friends and acquaintances, good physical health, regular communication with housemates, ability to manage time, and consuming less caffeine. Meanwhile, several factors were identified as not indicative of a low level of resilience. These included balance of height and weight, religious beliefs, presence of trusted friends, frankness in expressing anxiety and anger, having personal time, and allocating time to stay at home (Table 2).

Based on Table 3, analysis results showed that several symptoms indicated a high level of stress among the respondents including being angry over trivial things, overreacting to situations, difficulty relaxing, and easily irritated. Other symptoms included feeling anxious, impatience when experiencing delays, easily irritated and angered, difficulty calming down when upset, difficulty being patient with disturbances, restlessness, inability to tolerate work interruptions, and an easily agitated attitude with a p-value of 0.0001 (Table 3).

Table 1. Characteristics of Respondents

Characteristics	n = 238	%
Sex		
Female	172	72.27
Male	66	27.73
Regional Domicile		
Jakarta	71	29.83
Bogor	37	15.55
Depok	21	8.82
Tangerang	74	31.09
Bekasi	31	13.03
Other	4	1.68
Number of Siblings		
0	13	5.46
1	78	32.77
2	92	38.67
3	25	10.50
≥ 4	30	12.60
Have a Health Worker in the Family		
Yes	24	10.08
No	214	89.92
Have the COVID-19 Infected Family Member		
Yes	29	12.18
No	209	87.82
Duration of Online Learning (Hours)		
1-3	79	33.20
3-6	130	54.62
6-8	20	8.40
> 8	9	3.78

Source: Primary Data, 2021

Table 2. The Relationship between Stress Levels and Resilience

Variable	Stress Level				Total	%	*p-value*
	Low		High				
	n = 202	%	n = 36	%			
Resilience							
Low	38	71.70	15	28.30	53	22.37	0.002
High	164	88.65	21	11.35	185	77.73	

Source : Primary Data, 2021

Table 3. Factors Affecting Stress Level

Variable	Stress Level				*p-value*
	Low		High		
	n = 53	%	n = 185	%	
Angry Over Trivial Things					
Yes	8	15.09	115	62.16	0.0001
No	45	84.91	70	37.84	
Overreacting to Situations					
Yes	2	3.78	99	53.51	0.0001
No	51	96.22	86	46.49	
It's Hard to Relax					
Yes	6	11.32	109	58.92	0.0001
No	47	88.68	76	41.18	
Easily Annoyed					
Yes	11	20.75	137	74.05	0.0001
No	42	72.25	48	25.95	
Wasting Energy on Feeling Anxious					
Yes	5	9.43	110	59.46	0.0001
No	48	90.57	75	40.54	
Can't Wait to Experience Delays					
Yes	9	16.98	96	51.89	0.0001
No	44	83.09	89	48.11	
Easily Offended					
Yes	3	5.66	107	57.84	0.0001
No	50	94.34	78	42.16	
It's Hard to Rest					
Yes	10	18.87	100	54.05	0.0001
No	43	81.13	85	45.95	
Easy to Get Angry					
Yes	2	3.77	116	62.7	0.0001
No	51	96.23	69	37.3	
It's Hard to Calm Down When You're Upset					
Yes	4	7.47	116	62.70	0.0001
No	49	92.53	69	37.30	
It's Hard to be Patient with Distractions					
Yes	2	3.77	98	52.97	0.0001
No	51	96.23	87	47.03	
Feeling Restless					
Yes	6	11.32	89	48.11	0.0001
No	47	88.68	96	51.89	
The attitude of Not Being Able to Understand Anything That Prevents Me from Completing What I'm Doing					
Yes	2	3.77	63	34.05	0.0001
No	51	96.23	122	65.95	
Anxiety Easily					
Yes	3	5.66	90	48.65	0.0001
No	50	94.34	95	51.45	

Source : Primary Data, 2021

Based on Table 4, the multivariate analysis conducted using multiple logistic regression in the initial step showed that certain variables had a significant effect ($p < 0.05$) on high stress levels. These variables included being angry about trivial matters, overreacting to situations, difficulty relaxing, having a hard time resting, spending energy on anxiety, irritability, difficulty calming down when upset, struggling with distractions, and an inability to tolerate work interruptions. Meanwhile, variables such as easily irritated, impatient during delays,

irritability, difficulty resting, restlessness, and being easily agitated had no significant effect (p>0.05). The multivariate analysis using multiple logistic regression at the end of the step showed that some variables remained significantly associated with stress levels, including anger over trivial matters, overreaction to situations, difficulty relaxing, spending energy on anxiety, irritability, difficulty calming down when upset, difficulty in tolerating distractions, and inability to tolerate work interruptions. The variable difficult to relax had the highest OR value of 0.134 (Table 4).

Based on Table 5, the multivariate analysis using multiple logistic regression in the initial step showed that several variables had a significant effect (p<0.05) on high resilience. These included warm and balanced food, sleeping 7-8 hours, having reliable relatives, exercise, not drinking alcohol, regular social participation, presence of trusted friends, good health, regular communication with house-mates, ability to manage time, and consuming little caffeine (<3 cups/day). Meanwhile, the variables of friends, networks, acquaintances, and the allocation of time staying at home, were insignificant (p>0.05). The multivariate analysis with multiple logistic regression in the final step showed that some variables remained significantly related to resilience. These included warm and balanced food, sleeping 7-8 hours, having reliable relatives, exercising, not drinking alcohol, regular social participation, presence of trusted friends, good health, regular communication with house-mates, ability to manage time, and consuming less caffeine (< 3 cups/day). The variable not drinking alcohol had the highest OR value of 16.770.

Table 4. Multivariate Analysis Model Stress Level X Factors

Variable	B	Exp (B)	95% CI for Exp (B)		*p-value*
			Lower	Upper	
Initial					
Angry over trivial things	-1.866	0.155	0.036	0.671	0.013
Overreacting to situations	-3.415	0.033	0.003	0.384	0.006
Hard to relax	-1.523	0.218	0.050	0.959	0.044
Easy to get irritated	0.439	1.551	0.317	7.578	0.588
Wasting energy to feel anxious	-2.153	0.116	0.022	0.614	0.011
Impatient with delayed experiences	-0.535	0.586	0.142	2.414	0.459
Easily offended	-1.543	0.214	0.026	1.794	0.155
Hard to rest	-1.319	0.267	0.026	1.794	0.071
Angry easily	-2.789	0.061	0.064	1.122	0.018
Hard to calm down when upset	-2.366	0.094	0.006	0.624	0.013
Hard to be patient with distractions	-2.282	0.102	0.015	0.606	0.040
Feeling restless	-1.507	0.222	0.012	0.900	0.137
The attitude of not being able to tolerate anything that prevents me from completing what is being done	-2.127	0.119	0.030	0.612	0.038
Anxiety easily	-0.591	0.554	0.016	0.886	0.622
Hard to be patient with distractions	-2.234	0.107	0.014	0.830	0.033
Intolerant to work distractions	-2.128	0.119	0.017	0.823	0.031
Final					
Angry over trivial things	-2.040	0.130	0.035	0.483	0.002
Overreacting to situations	-2.639	0.071	0.009	0.567	0.013
Hard to relax	-2.014	0.134	0.037	0.477	0.002
Wasting energy to feel anxious	-2.321	0.098	0.024	0.396	0.001
Angry Easily	-2.252	0.105	0.017	0.638	0.014
Hard to calm down when upset	-2.435	0.088	0.018	0.417	0.002
Hard to be patient with distractions	-2.234	0.107	0.014	0.830	0.033
Intolerant to work distractions	-2.128	0.119	0.017	0.823	0.031
N Observed = 238					

Source : Primary Data, 2021

Table 5. Multivariate Analysis Model of Resilience X Factors

Variable	B	Exp (B)	95% CI for Exp (B)		*p-value*
			Lower	Upper	
Initial					
Eat warm and balanced meals	2.549	12.795	2.296	71.293	0.004
Sleep duration (7-8 hours/day) at least 4 days/week	2.122	8.348	1.564	44.551	0.013
Having reliable relatives	2.922	18.580	2.859	120.738	0.002
Exercise	2.555	12.876	2.362	70.178	0.003
Don't drink alcohol	3.847	46.838	5.261	416.969	0.001
Regular social participation	1.923	6.844	1.506	31.096	0.013
Network of friends and acquaintances	21.506	2187877938	0.000	,	0.995
The existence of a trusted friend	2.896	18.102	1.214	269.872	0.036
Good health	2.002	7.4060	1.045	52.476	0.045
Regular communication with house-mate	3.645	38.301	6.119	239.736	0.000
Ability to manage time	2.098	38.301	6.119	239.736	0.000
Consume less caffeine (<3 cups/day)	2.890	18.002	2.353	137.704	0.005
Allocation of time to stay at home	1.449	4.258	0.860	21.092	0.076
Final					
Eat warm and balanced meals	1.714	5.554	1.431	21.549	0.013
Sleep duration (7-8 hours/day) at least 4 days/week	1.466	4.332	1.142	16.434	0.031
Having reliable relatives	2.492	12.080	2.730	53.443	0.001
Exercise	1.461	4.312	1,258	14.780	0.001
Don't drink alcohol	2.820	16.770	3.243	86.712	0.001
Regular social participation	1.804	6.072	1.829	20.156	0.003
The existence of a trusted friend	2.275	9.727	1.247	75.870	0.030
Good health	1.626	5.082	1.090	23.701	0.030
Regular communication with house-mate	2.494	12.105	2.931	49.992	0.001
Ability to manage time	1.995	7.350	1.921	28.115	0.004
Consume less caffeine (<3 cups/day)	2.602	13.497	2.767	65.844	0.001
N Observed = 238					

Source : Primary Data, 2021

DISCUSSION

Based on the results, the majority of respondents were female, residing in Tangerang, had two relatives, did not have medical personnel as family members, had no family members infected with COVID-19, and engaged in online learning for 3-6 hours. The differences in the characteristics compared to other studies may be attributed to the pattern of distributing questionnaires. In this study, the questionnaires were distributed online through social media, both randomly and systematically, thereby increasing the likelihood of respondents with the above-mentioned characteristics.

The results showed that stress levels among most MAN adolescent respondents fell into the high-stress level category with a percentage of 77.73% (Table 2). This value differed compared to those of previous studies. The different stress levels could be attributed to both internal factors related to how students deal with problems and external factors such as environmental, school, and family-related issues. [12] Individuals having a positive mindset towards situations, an optimistic personality, and high self-confidence are more likely to possess lower stress levels.[13]

In Palembang City, adolescents aged 18 years showed varying stress levels, with 28.65% no stress, 31.77% mild stress, 34.38% moderate stress, and 5.21% severe stress.[14] Another study on adolescents in Patrang District during online learning showed different stress levels, with the majority (52.10%) in the normal category.[15] Similarly, a study conducted at SMKN3 Bengkulu City showed that the majority (56.80%) had normal stress levels.[16]

Adolescence is a critical period associated with various life changes. During this time, adolescents must adapt to new lives and surroundings, as well as become familiar with

new people, and situations.[39] This condition causes vulnerability to high levels of stress, as observed in this study. Factors that cause high stress in adolescents include academic tasks, interpersonal relationships with others, life changes, and career exploration.[39]

In a previous study, elementary school students engaged in online learning processes during the COVID-19 pandemic showed a trend where the higher the grade level, the greater the stress level.[17] The high stress level was attributed to academic pressure, such as mounting assignments, boredom at home, and a lack of family support in completing tasks.[18] This study found similar results, where 9 out of 12 students experienced different degrees of stress.[12] However, the results differed slightly from a study conducted in India, where only 139 students out of the 336 surveyed, experienced mild stress.[19]

Other studies conducted worldwide on the general population include an investigation in Tabanan, Bali, where 29.25% of respondents aged 15-64 experienced stress at mild to severe levels.[20] In India, 97% of health workers reported stress,[19] compared to 42% of 442 in Turkey.[21] Furthermore, in China, out of 5062 health worker participants, only 1509 reported cases of stress.[22] Approximately 11.60% of the 354 general public participants in India experienced stress,[23] compared to 32% of the 1210 in China.[25]

A previous study conducted in Spain showed that 37% of the 1314 general public participants experienced stress.[24] This was in line with an Italian study where 27.15% of 2766 participants reported stress.[25] In Iraq, 17.52% of 548 participants experienced this condition.[26] Furthermore, Salari et al. showed that 29.6% of the general population reported stress during the COVID-19 pandemic.[8] Wang et al., who examined 1210 respondents from 194 cities in China reported that 8.10% had moderate to severe levels.[27] Agustin et al. also showed that 95.83% of the 71 volunteers for the COVID-19 disaster management in Indonesia experienced mild stress.[28]

In this study, most of the respondents had a low level of resilience (84.87%). This result differed compared to previous studies that measured the level of resilience in adolescents. For example, Galaresa[32] found that out of 149 high school adolescents in class XI, only 46.3%, or 69 had high resilience, while 53.7%, or the remaining 80 showed low resilience.[29] The results showed a significant relationship between stress levels and resilience (p-value 0.002), with higher stress levels, leading to lower resilience. These results were consistent with previous studies, stating that low resilience was associated with high sensitivity to anxiety and depression.[30]

Several indicators of high resilience to stress include eating a balanced healthy diet, getting enough and regular sleep, giving and receiving love, having reliable relatives, regular exercise, not smoking, not drinking alcohol, adequate income, regular social participation, having a network of friends and acquaintances, good physical health, regular communication with housemates, ability to manage time and consume less caffeine. On the other hand, factors that were not indicative of high resilience include the balance of height and weight, religious beliefs, presence of trusted friends, frankness in expressing anxiety and anger, having personal time, and allocating time to stay at home. These results were consistent with Tamarit et al. stating that the protective factors of adolescents in dealing with stress symptoms include younger age, a more elaborate house, doing voluntary work, and having romantic relationships.[31]

The bivariate analysis results indicated that symptoms showing a high level of stress in respondents included anger over trivial things, overreaction to situations, difficulty relaxing, easily irritated, spending energy to feel anxious, impatient when experiencing delays, irritability, difficulty in resting, difficulty in calming down when upset, difficulty in being patient with disturbances, feeling restless, inability to tolerate work interruptions and an easily agitated attitude, with a *p-value* of 0.0001.

Stress in adolescents often manifests in physical, emotional, cognitive, and behavioral symptoms. According to a previous study, symptoms of stress in adolescents are typically shown through changes in eating habits, signs of depression, and headaches[39]. As stated by Gaol, adolescents student with mild stress showed signs of overreacting to situations, were

sensitive, irritable, anxious, impatient, and usually felt uncomfortable when faced with delays.[32] Furthermore, Roy et al. stated that symptoms of stress showed by respondents during the COVID-19 pandemic included continuously thinking about pandemic (80%), paranoia about being infected (40%), anxiety about being alone (72%), difficulty sleeping (12%), reduced social contact (82%), avoidance of gatherings or parties (90%), avoidance of online food delivery (75%), repetitive discussion about the COVID-19 with friends (80%), and panic due to media-related news (50%).[33]

According to Muslim, symptoms of stress during the COVID-19 pandemic include excessive worrying, leading to irrational thinking and negative thoughts about infected individuals. Excessively searching for news resulted in the inability to sort out accurate information, causing anxiety, difficulties sleeping, headaches, as well as other physical pain.[34] Taylor also mentioned that psychological symptoms arising due to the pandemic include changes in thinking about health information, emotional shifts (fear, worries, anxiety), and alterations in social behavior.[35] As stated by WHO, stress during the COVID-19 pandemic was marked by fear and anxiety about health, alterations in sleep or eating patterns, difficulty concentrating, and using drugs.[36]

Following the multivariate analysis with the backward method, it was found that three factors significantly influenced stress levels in the adolescents population, namely difficulty relaxing (OR = 0.134), anger over trivial things (OR = 0.130), and being unable to tolerate work disturbances (OR = 0.119). Other significant factors include overreacting to situations, difficulty relaxing, spending energy on anxiety, irritability, difficulty calming down when upset, and difficulty being patient with distractions. As stated in various studies, stress adversely affects sleep and relaxation.[1,37] Based on the results, difficulty in resting was identified as the most influential variable, with a 0.13 times higher potential to be a factor associated with stress levels.

The multivariate analysis results with the backward method showed that the three most influential factors on resilience included not drinking alcohol (OR = 16,770), consuming little caffeine (<3 cups/day) (OR = 13,497), and regular communication with housemates (OR = 12.105). Other factors with a significant influence consisted of a warm and balanced diet, 7-8 hours of sleep, having reliable relatives, exercise, regular social participation, trusted friends, and good health.

A previous study showed that there was a relationship between alcohol abuse and high stress levels in adolescents.[38] Similar results were found in this study where high stress levels were influenced by low resilience, with alcohol consumption being one of the associated factors. The variable not drinking alcohol had a 16.77 times higher potential to be a factor associated with resilience. Another study showed the critical role of family connection in helping to prevent undesirable consequences. Spending time with family and friends was associated with reduced loneliness. According to a previous study, low resilience is more common in adolescents who have introverted personalities.[29]

The strength of this study lies in its analysis of factors influencing resilience to stress in MAN students during the COVID-19 pandemic. On the other hand, the weakness was that the subjects were not directly monitored or controlled when completing the Google forms. This study can be a reference to support further investigations in analyzing the post-pandemic impact of COVID-19 on student stress using different instruments.

CONCLUSION AND RECOMMENDATION

In conclusion, this study showed that there was a relationship between resilience and stress levels in adolescents students during the COVID-19 pandemic. Based on the result, the higher the stress level, the lower the resilience. The variable difficulty in relaxing had the highest impact on stress levels, while the variable not drinking alcohol yielded the most significant impact on resilience. Further studies are needed to examine the correlation between each aspect related to stress and resilience levels. There is also a need to measure the levels of stress and resilience in the same subjects to examine the relation or the impact of the COVID-19 pandemic.

ACKNOWLEDGMENTS

The authors are grateful to the Faculty of Medicine and Health, University of Muhammadiyah Jakarta, and all respondents from MAN schools in Jabodetabek.

AUTHOR CONTRIBUTIONS

All authors played key roles in this study from the conceptualization to the writing of the manuscript. Correspondent writers played a role in compiling, designing, and analyzing the study, as well as writing manuscripts. The second author acted as a conceptualizer, while the third author functioned as a designer, analyst, and writer of the manuscript. The 4th & 5th author played the role of collecting, validating data, and writing the manuscript. All authors have read and agree to the published version of the manuscript.

CONFLICTS OF INTEREST

The authors declare that there is no conflict of interest.

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Media Kesehatan Masyarakat Indonesia
Volume 19 Issue 3 2023
DOI : 10.30597/mkmi.v19i3.27807
Website : http://journal.unhas.ac.id/index.php/mkmi

Identification of Psychological Conditions and Feelings of Fatigue Among Employees at Makassar Air Traffic Service Center

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ARTICLE INFO

Article History:
Received Jul, 23rd, 2023
Accepted Sept, 11th, 2023
Published online Sept, 29th, 2023

Keywords:
Anxiety;
ATC;
Covid-19;
fatigue;
quality of life;

ABSTRACT
Air Traffic Control (ATC) remains an active field of work during the pandemic due to the demand from domestic and international travelers. It is crucial for controllers to prioritize both their mental health while on duty and their body's immunity against conditions that make them vulnerable to Covid-19. Therefore, this study aims to review psychological conditions, feelings of fatigue, and quality of life among ATC during the pandemic. A cross-sectional descriptive design was used and the participants were 89 ATC in Makassar Air Traffic Service Center. The data collected included the general characteristics of ATC, DASS-21, KAUPK2, and (WHOQOL)-BREF. Data were collected from February to March 2022, then analysis was carried out using SPSS and Excel software. The results indicated the presence of negative emotional conditions among ATC even outside of their normal traffic control duties. Approximately 24% of ATC reported feelings of fatigue, while the quality of life exhibited a wide distribution of data, ranging from moderate to low. Therefore, it was concluded that the health status of ATC, even with regulations limiting the amount of traffic related to the pandemic period, still needs special attention to maintain performance.

INTRODUCTION

The Covid-19 pandemic has proven to be a terrifying force for the global society, not only due to its ability to damage lives and immunity but also to disrupt social life and the world economy.[1–5] The global aviation industry has also suffered significant losses.[6–9] Indonesia at the beginning of 2022 faced a third wave of Covid-19 due to the Omicron variant.[10] However, there is now a gradual improvement in aviation policies, driven by increased public awareness and Implementation of vaccination.

Airnav Indonesia as the organizer of flight navigation also experienced adaptation during the COVID-19 pandemic when aircraft movements remained relatively low or fail to fully recover.[11] However, there has been a slow increase in flight services in 2022, both domestically and internationally. Domestic flights increased by 14% compared to 2021, while international and cross-country flights experienced a significant rise of 70% compared to 2021 and 47% in 2020.[12]

Despite these developments, Air Traffic Control (ATC) continued to be frontline workers who interact with people in an environment highly susceptible to the transmission of the Covid-19 virus. Therefore, the risk of infection among workers, specifically those working in enclosed spaces, remains considerable. A study conducted by Russeng et al., (2021) before the pandemic found that 43.1% of ATC in air traffic controllers at Sultan Hasanuddin Airport experienced fatigue, and and there is a significant relationship between workload and shift work with the onset of fatigue.[13] Several studies also reported that ATC workload can have psychological effects, leading to decreased productivity and potential disruptions or hazards in flight operations.[14–18]

Optimal performance is crucial for ensuring flight safety, ultimately saving millions of passengers' lives every day. Therefore, this study aims to review concerns about psychological conditions, feelings of work fatigue, and quality of life for air traffic controllers (ATC), precisely during the third wave of Covid-19 attacks.

MATERIAL AND METHOD

This cross-sectional study was conducted by collecting data from Makassar Air Traffic Service Center (MATSC), between February and March 2022. Sampling was carried out by using the probability method, culminating in the selection of 89 people at random. The data collected included characteristics of respondents, consisting of name, gender, education, age, years of service, and marital status of employees. This was achieved using a questionnaire through direct interviews with ATC. Data related to Depression, Anxiety, and Stress was obtained in line with (Lovibond, 1995).

Data related to feelings of work fatigue were obtained using the Questionnaire for the Measure of Work Fatigue (KAUPK2) consisting of 17 items. This instrument was prepared by Lientje Setyawati in 1994 and has been tested for its validity and reliability. It was used to measure the feeling of work fatigue as a subjective symptom experienced by ATC employees. Previously, this questionnaire had also been tested for validity and reliability among ATC employees of 30 people. The results showed that all question items were valid and reliable. Data related to the quality of life were obtained from the World Health Organization Quality of Life (WHOQOL)-BREF questionnaire compiled in 2004. Subsequently, analysis was performed using SPSS, and Excel software. This study obtained ethical approval from the Ethics Commission, Faculty of Public Health, Hasanuddin University, with protocol number 14222105002.

RESULTS

The majority or 70.79% of the respondents were male, while 93.26% were in the Diploma/Bachelor category, 75.28% were aged <34 years, the most years of service was >5 years at 67.4%, and 71.9% were married as shown in Table 1.

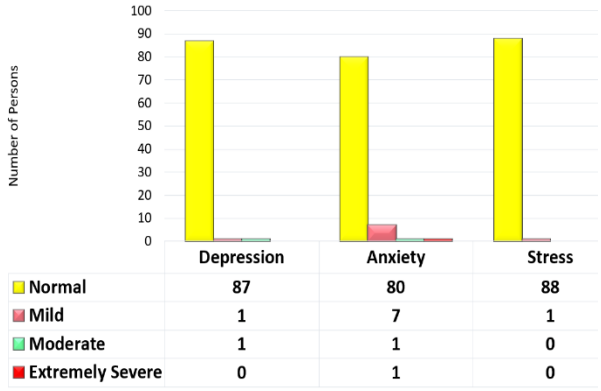
Based on Figure 1, the negative emotional conditions of the Makassar Branch AirNav controllers when measurements were taken during the pandemic varied significantly. A total of two controllers experienced depression at different levels, while for anxiety cases, there were nine controllers with 7, 1, and 1 in the mild, moderate, and extremely severe categories. Meanwhile, stress conditions were only experienced by one controller in the mild category.

As shown in Figure 2, the feeling of fatigue experienced by the controllers after discharging their duties were as follows; 18%, 4%, and 2% in the mild, moderate, and severe categories. Figure 3 shows that thirst, shoulders feeling stiff, pain in the back after work, and memory loss ranked highest among the feelings of fatigue.

Table 1. Characteristics of Respondents

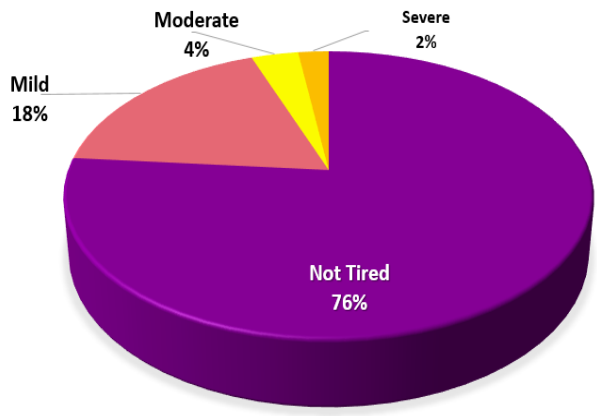
Characteristics	n=89	%
Gender		
Female	26	29.21
Male	63	70.79
Education		
Magister Degree	6	6.74
Diploma/Bachelor's Degree	83	93.26
Age (Years)		
< 34	67	75.28
≥ 34	22	24.72
Years of Service		
≤ 5 Years	29	32.58
> 5 Years	60	67.42
Marital Status		
Single	21	23.60
Widower/Widow	4	4.49
Married	64	71.91

Source: Primary Data, 2020



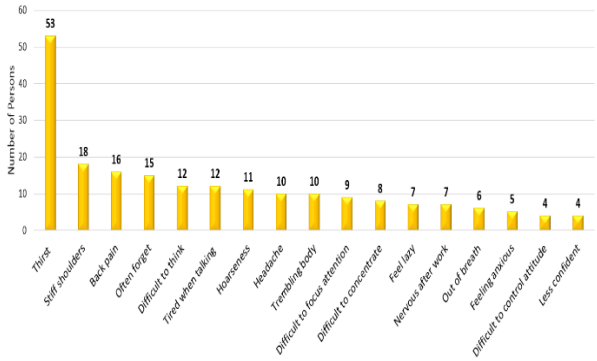
Source: Primary Data, 2020

Figure 1. Distribution of Emotional Status among Air Traffic Controllers during the Covid-19 Pandemic



Source: Primary Data, 2020

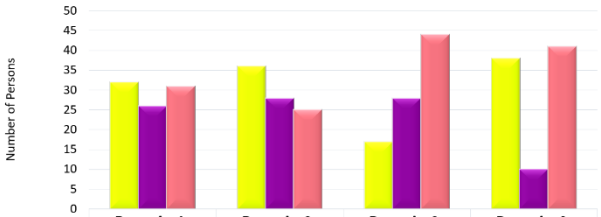
Figure 2. Distribution of Feelings of Fatigue Among Air Traffic Controllers During the Covid-19 Pandemic



Source: Primary Data, 2020

Figure 3. Details of Feelings of Fatigue Experienced Among Air Traffic Controllers During the Covid-19 Pandemic

Figure 4 shows the quality of life among ATC for different domains. In domain 1 (physical health), the good and low quality of life categories had almost the same value. In domain 2 (psychological health), the good quality of life category was less than 50% of the total controller sample. Meanwhile, in domains 3 (Social Relations) and 4 (Relations with Environment), the good quality of life category was more predominant.



	Domain 1-Physical	Domain 2-Psychological	Domain 3-Social	Domain 4-Environmental
High	32	36	17	38
Medium	26	28	28	10
Low	31	25	44	41

Source: Primary Data, 2020

Figure 4. Distribution of Quality of Life Among Air Traffic Controllers During the Pandemic Covid-19 Pandemic

DISCUSSION

The results showed the presence of negative emotional conditions among ATC during the pandemic, despite the reduced traffic levels. Among the identified conditions, anxiety emerged as the most identified group among controllers compared to depression and stress. Fatigue was also reported, with some respondents falling in the severe category. Additionally, the results indicated the predominance of medium and low quality of life.

However, since the Covid 19 health emergency occurred, economic-social conditions have been in turmoil, including in the aviation industry, which has experienced a decline in services in an effort to reduce the number of cases of positive confirmed cases.[19,20] The prediction that negative emotional conditions (stress, anxiety, and depression) at ATC will be nil due to the decreased traffic factor, has proven not to have occurred completely and 24% even experienced fatigue from the moderate to severe category. Work activities during the pandemic were relatively limited with the implementation of Work From Home (WFH), there were only several types of work that were directly active in the field, looking at research on workers who remained on duty during the Covid 19 period such as medical experts also proved there was an increase in anxiety while on duty especially if low resilience,[21–24] even with different professions, both professions are prone to experiencing anxiety its relation to mental load,[25,26] so it requires adequate coping.

Even in a study Mrklas et al (2020) which wanted to assess the impact of COVID-19 on the mental health mitigation needs of health workers and other working professions, it was found that during the initial phase of the COVID-19 outbreak, mental health disorders increased, especially the prevalence of stress, but statistically significantly higher in other working professions than in the medical profession.[27] In addition to the workload factor, increased anxiety for workers during a pandemic is associated with living in the red-orange zone and a lack of resilience.[24]

Edmund Jacobson asserted that tension arises due to a natural reaction to the shortening of muscle fibers resulting in anxiety.[28] This common condition of mental disorders affects nearly 30% of adults.[29] Although individual responses differ, stress is the main trigger for anxiety. The brain, influenced by stress hormones such as cortisol, may struggle to regulate negative emotions, leading to excessive negative thinking, difficulty concentrating, and memory bias.[30,31] Simultaneously, the amygdala, which controls the emotions of the brain, becomes overactive and hinders mental tranquility.[32]

Fatigue, a psychological disorder, and one of the biggest health problems in the world, is no exception in the industrial sector.[33] The anxiety response experienced by ATC arises from work stressors associated with air traffic control including fatigue. The working concept of ATC is to prevent collisions between aircraft and surrounding obstacles, with the expectation of error-free control decision-making.[18,34–37] Moreover, the current pandemic adds further complexity to the mental health of ATC, as they face the threat of infection.[38–41] The findings regarding the low quality of life were consistent with previous studies highlighting that the stressful conditions experienced by ATC had a significant effect on feelings of fatigue and quality of life.[42]

Through the results of research studies related to occupational safety and health principles, particularly observations of the potential for psychological disorders in air traffic controllers, even though the frequency of

air traffic control is low, it is hoped that this will make a positive scientific contribution. The aspiration is for aviation industry authorities, especially organizations handling the scope of air traffic control, to enhance preventive or coping efforts for risk factors that can disrupt performance. This includes the implementation of simple relaxation techniques after completing control activities.

The significant challenge in this research lies in the difficulty of establishing direct contact with respondents, especially when seeking deeper insights into perceived health problems. Some respondents had to be interviewed by telephone due to their health conditions. The anticipation is that future researchers will be better equipped to identify risk factors related to ATC psychological disorders and achieve accuracy in assessing psychological disorders levels and their relationships with risk factors by using standardized medical tools, along with ATC officer biomarker tests.

CONCLUSION AND RECOMMENDATION

In conclusion, ATC officers experienced negative emotional states including feelings of fatigue and moderate to low quality of life, even outside their normal air traffic control duties. This complexity was further amplified when pressure at work was combined with personal problems. The interplay between these factors poses a threat to the ability of workers to fulfill performance, manifesting in various ways including physical, mental, and emotional. Therefore, it is important to provide principles of disease control/prevention, such as practicing relaxation for each ATC as an early coping strategy in the emergence of psychological disorders' symptoms.

ACKNOWLEDGMENTS

The authors are grateful to the Education Fund Management Institute (LPDP) for funding, as well as Hasanuddin University, the Institute for Research and Community Service (LPPM), and the Faculty of Public Health, Department of Occupational Safety and Health, who contributed to the success of this study. They are also grateful to the Controllers, the International Air Traffic Controller Association (IATCA), and AirNav for their support.

AUTHOR CONTRIBUTIONS

LMS made substantial contributions to the study design up to the drafting of the article, SSR, performed a critical review with important intellectual contributions, specifically in the study of medicine, IT contributed substantially to a crucial review with essential scholarly contributions specifically in the study of psychology, IHY, and YR, made significant contributions to conception and design of work, analysis, and interpretation of data. In addition, NMS and MY contributed substantially to all aspects of the study and ensured that questions related to the accuracy or integrity of any part of the study are appropriately investigated and resolved.

CONFLICTS OF INTEREST

The authors declare that there are no significant competing financial, professional, or personal interests.

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