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# Risk Burden of Heat-Related Morbidity Due to Urban Heat Island Effect in Tamalanrea District, Makassar

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**ABSTRACT**

One of the problems in the urban environment is the rise in land surface temperature and heat buildup (Urban Heat Island) around built-up areas. People living in UHI areas will experience an increased risk of health burdens. Therefore, early identification for disaster mitigation is needed to achieve a sustainable city. This study aims to provide an overview of the risk of the spread of heat-related diseases based on the relative risk value in Tamalanrea District. This study considers the relationship between Land Surface Temperature (LST) values in 2019, 2020, and 2021 with the incidence of heat-related diseases obtained from the Integrated Health Center Recording and Reporting System (IHCRRS) in Tamalanrea District, Makassar City in 2019, 2020 and 2021. Data analysis used Pearson correlation test and Standardized Morbidity Ratio (SMR) epidemiological approach. The results showed a significant relationship between LST values and the incidence of hypertension, heart disease, and asthma in 2019 and the incidence of headache and hypertension in 2021. Bira and Kapasa sub-districts were at the highest risk for the spread of heat-related diseases than other sub-districts with a risk score > 4.00 (very high). These findings can be used to help guide public health interventions and preventive urban planning efforts.

## INTRODUCTION

One of the problems in urban environments is the increase in surface temperature around built-up areas. Urban materials such as building facades, roads, and other paved areas will absorb and store more heat and cause changes in thermal comfort conditions.[1] Changes in land cover will change the reflectance process of solar radiation on the earth's surface and cause global warming.[2] Global warming can accelerate and bring a series of disasters to urban communities.[3] The impact of global warming combined with the Urban Heat Island (UHI) effect adversely affects the health and well-being of urban residents.[4] UHI is a condition where the area has a warmer temperature than the surrounding area, due to the concentration of built-up land in certain locations.[5] People living in areas affected by UHI effects are at increased risk to health. UHI can contribute to thermal discomfort and various forms of morbidity and mortality.[1]

In 2019, high temperature was first listed as a risk factor by the Global Burden of Disease.[6] This happens because increasing temperatures can affect human physiological conditions and make the body more vulnerable to heat exposure.[5] The symptoms of heat-related diseases correlate with surface temperature patterns in urban environments.[7] Indicating that the value of LST or ground surface temperature can be an indicator of heat risk events.

Based on the results of Liong (2021), there was an increase in the average LST value in Makassar City by 0.39°C in the temperature range between 30-32°C.[8] In addition, the level of comfort in Makassar City has decreased due to high temperatures. This is evidenced by the recording data by the climatology station the temperature of Makassar City in 2019 was recorded at 38,2°C the highest temperature during the BMKG observation year.[9] When heat exposure becomes more frequent, it will adversely affect the comfort and health of urban residents of Makassar City and risk becoming a burden of morbidity. Compared to mortality, morbidity is considered to cover a wide range of health events and is more suitable for assessing the effects of temperature exposure on health.[10]

The relationship between temperature and mortality has been studied extensively in many studies, but its effect on morbidity has received less attention.[12]

Law No. 16/2016 on the Ratification of the Paris Agreement to the United Nations Framework Convention on Climate Change stipulates to hold the global average temperature rise below 2°C above pre-industrialization levels and to continue efforts to reduce the temperature rise to 1.5°C above pre-industrialization levels. This is a wake-up call about the risks that heat poses to urban communities.[11]

Indirectly, climate change and heat can exacerbate all causes and morbidity of certain diseases through reduced physical health. Heat will lead to heat stress and death in the most severe cases.[12]

One location that has the potential for Urban Heat Island effects is Tamalanrea Sub-district. This is due to the location of Tamalanrea Sub-district is an area of concentration and development of various educational activities equipped with other supporting activities. As an education center area, this sub-district experiences impacts due to changes in land cover and function. UHI is one of the urban planning issues that require monitoring as well as specific strategies to reduce its impact.[5]

Therefore, it is important to understand how the UHI phenomenon risks health impacts in Makassar City. This is done as a mitigation effort of the UHI phenomenon, identifying the morbidity risk burden of the UHI phenomenon can reduce the vulnerability of urban communities to rising urban temperatures.

This study aims to analyze the degree of surface temperature change in urban space and the relationship to heat-related diseases and map the areas at risk of morbidity burden due to UHI effects.

## MATERIAL AND METHOD

This research is a type of descriptive research through a quantitative approach. The research location was administratively carried out in Tamalanrea District, Makassar City, by taking surface temperature data and morbidity data at the Integrated Recording and Reporting System of Puskesmas (SP2TP) which were scattered based on research criteria. The data collected in this study are LANDSAT 8 OLI/TIRS image data

for 2019, 2020, and 2021. One important parameter in urban climate is Land Surface Temperature (LST), which directly controls the UHI effect.[12] Land surface temperature is a variable that describes thermal conditions that can be retrieved from satellite records.[13]

This study used LANDSAT 8 OLI/TIRS satellite data obtained from Google Earth Engine to obtain LST data in 2019, 2020, and 2021 and morbidity data obtained from the Integrated Health Center Recording and Reporting System (IHCRRS) distributed based on research criteria. Table 1, shows the time of land surface temperature data collection used and Table 2, shows the service area of the Tamalanrea sub-district health center.

Furthermore, a correlation analysis was using SPSS 27 conducted to test whether LST is closely associated with the incidence of morbidity in Tamalanrea Sub-district, Makassar City. The morbidity rate has a more important role than the mortality rate because if the morbidity rate is high, it will trigger death, which automatically causes a high mortality rate. Thus, morbidity can be used to describe the general condition of health.[14]

First, we collected morbidity rates in 2019, 2020, and 2021 at each health center in Tamalanrea sub-district. Then a relative risk epidemiological approach was conducted using the Standardized Morbidity/Mortality Ratio (SMR) method. This approach shows the risk burden of the area affected by the disease. Excess Risk is one of the SMR-based approach models available in the GeoDA tool. Through this tool, a spatial assessment of relative risk value was conducted to measure the morbidity burden caused by the impact of temperature change in Tamalanrea Sub-district, Makassar City. Excess risk/relative risk is a form of standardized morbidity or mortality (SMR) often used in public health approaches that are estimated as the ratio of the sum of all disease events across locations to the total population at risk.[15] The conceptual framework in this study is depicted in the structure in Figure 2.

**Table 1. Landsat Data Used**

| Location | Time | Season |
|---|---|---|
| **Tamalanrea District** | April – October, 2019 | Dry Season |
| | November – December, 2019 | Rainy Season |
| | April – June, 2020 | Dry Season |
| | July – December, 2020 | Rainy Season |
| | June – August, 2021 | Dry Season |
| | September – December, 2021 | Rainy Season |

Source: Secondary Data of BNPB, 2022

**Table 2. Description of Tamalanrea District Health Center Area**

| Location | Sub District | Health Center |
|---|---|---|
| **Tamalanrea District** | Tamalanrea Indah | Antara |
| | Tamalanrea Jaya | Tamalanrea Jaya |
| | Parangloe and Bira | Bira |
| | Tamalanrea Kapasa | Tamalanrea Kapasa |

Source: Secondary Data of Makassar Health Department, 2021
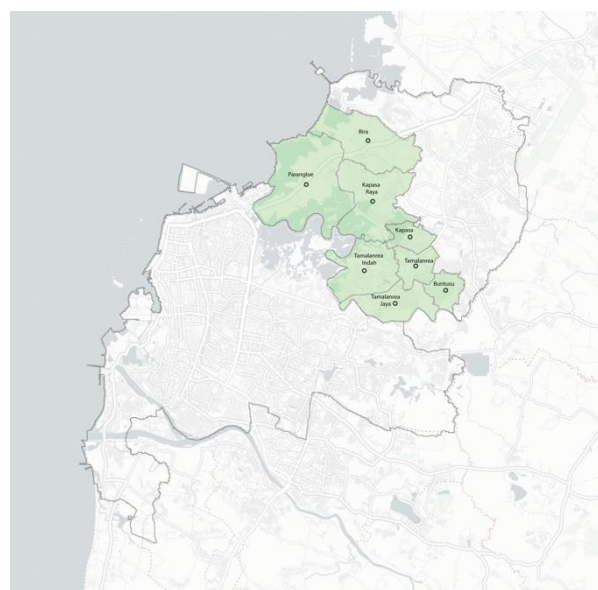


Source: Primary Data, 2022
**Figure 1. Research Sites**
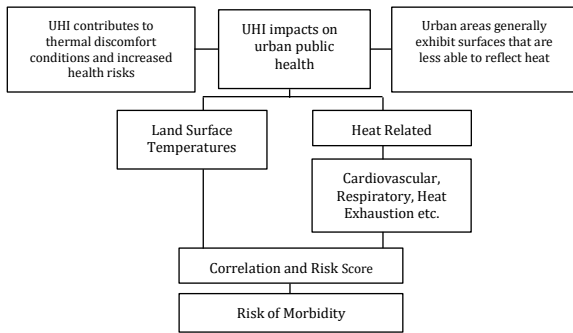
Source: Primary Data, 2022
**Figure 2. Conceptual Framework**

## RESULTS

Based on the results of the analysis of land surface temperature measurements in 2019, 2020, and 2021 in the dry season period in Tamalanrea District can be seen in Table 3. The data shows that 2019 is the year with the highest average temperature in the dry season period which is in the temperature range of 28 - 31°C. The highest average temperature is in Parangloe and Tamalanrea sub-districts, which is 31°C for 2019. In 2020, the highest average temperatures were in Buntusu and Tamalanrea sub-districts, which were 25°C. As for 2021, the highest average temperature is in Tamalanrea sub-district, which is 27°C.

The following mapping results of land surface temperature for the dry season period in Tamalanrea Sub-district are shown in figure 3. In general, it shows that Tamalanrea Sub-district has a variety of surface temperatures in each neighborhood. In 2019 there was an increase in

the average land surface temperature compared to 2020 and 2021. In 2020 there was a decrease in average temperature, then the temperature increased again in 2021, this can be seen from the color gradation shown on the map.

The results of land surface temperature measurements in 2019, 2020 and 2021 in the rainy season period in Tamalanrea District can be seen in Table 4. 2019 is the year with the highest average temperature in the rainy season period which is in the temperature range of 26 - 30°C and the highest average temperature is in Buntusu, Kapasa and Tamalanrea Sub-district, which is 30°C. In 2020 the land surface temperature decreased which was in the temperature range of 24-27°C and the highest average temperature was in Kapasa and Tamalanrea Sub-district.

Then in 2021 the land surface temperature again experienced a decrease which was in the temperature range of 23-25°C and was in Tamalanrea Indah, Tamalanrea Jaya and Kapasa Sub-district, namely 25°C. The following are the results of mapping the surface temperature of the Rainy season period in Tamalanrea District.

The following results of the mapping of the ground surface temperature of the rainy season period in Tamalanrea Sub-district are shown in figure 4. In general, there was an increase in the average land surface temperature in 2019 compared to 2020 and 2021 which experienced a decrease in temperature each year, this can be seen from the color gradation shown on the map.

**Table 3. Minimum, Maximum, and Average Values of LST in Tamalanrea District during the Dry Season**

| Sub-District | 2019 | | | 2020 | | | 2021 | | |
|---|---|---|---|---|---|---|---|---|---|
| | Min (°C) | Max (°C) | Mean (°C) | Min (°C) | Max (°C) | Mean (°C) | Min (°C) | Max (°C) | Mean (°C) |
| Bira | 26 | 32 | 29 | 22 | 27 | 23 | 22 | 29 | 26 |
| Parangloe | 25 | 33 | 31 | 21 | 26 | 22 | 21 | 32 | 24 |
| Buntusu | 28 | 32 | 30 | 22 | 27 | 25 | 23 | 29 | 26 |
| Kapasa | 27 | 32 | 29 | 23 | 28 | 24 | 24 | 28 | 26 |
| Kapasa Raya | 25 | 30 | 28 | 22 | 24 | 23 | 22 | 26 | 24 |
| Tamalanrea | 27 | 34 | 31 | 23 | 28 | 25 | 22 | 29 | 27 |
| Tamalanrea Indah | 25 | 33 | 30 | 21 | 28 | 24 | 22 | 29 | 26 |
| Tamalanrea Jaya | 26 | 34 | 30 | 21 | 28 | 24 | 22 | 29 | 25 |

Source: Primary Data, 2022

**Table 4. Minimum, Maximum and Average Values of LST in Tamalanrea District during the Rainy Season**

| Sub-District | 2019 | | | 2020 | | | 2021 | | |
|---|---|---|---|---|---|---|---|---|---|
| | Min (°C) | Max (°C) | Mean (°C) | Min (°C) | Max (°C) | Mean (°C) | Min (°C) | Max (°C) | Mean (°C) |
| Bira | 25 | 31 | 28 | 23 | 24 | 25 | 23 | 24 | 24 |
| Parangloe | 23 | 32 | 28 | 24 | 30 | 24 | 22 | 28 | 23 |
| Buntusu | 26 | 36 | 30 | 24 | 29 | 28 | 22 | 29 | 24 |
| Kapasa | 26 | 31 | 30 | 24 | 27 | 27 | 23 | 27 | 25 |
| Kapasa Raya | 24 | 28 | 26 | 23 | 26 | 24 | 22 | 25 | 23 |
| Tamalanrea | 26 | 33 | 30 | 23 | 27 | 27 | 21 | 28 | 23 |
| Tamalanrea Indah | 25 | 32 | 29 | 22 | 26 | 26 | 21 | 28 | 25 |
| Tamalanrea Jaya | 24 | 33 | 29 | 22 | 27 | 25 | 19 | 27 | 25 |

Source: Primary Data, 2022
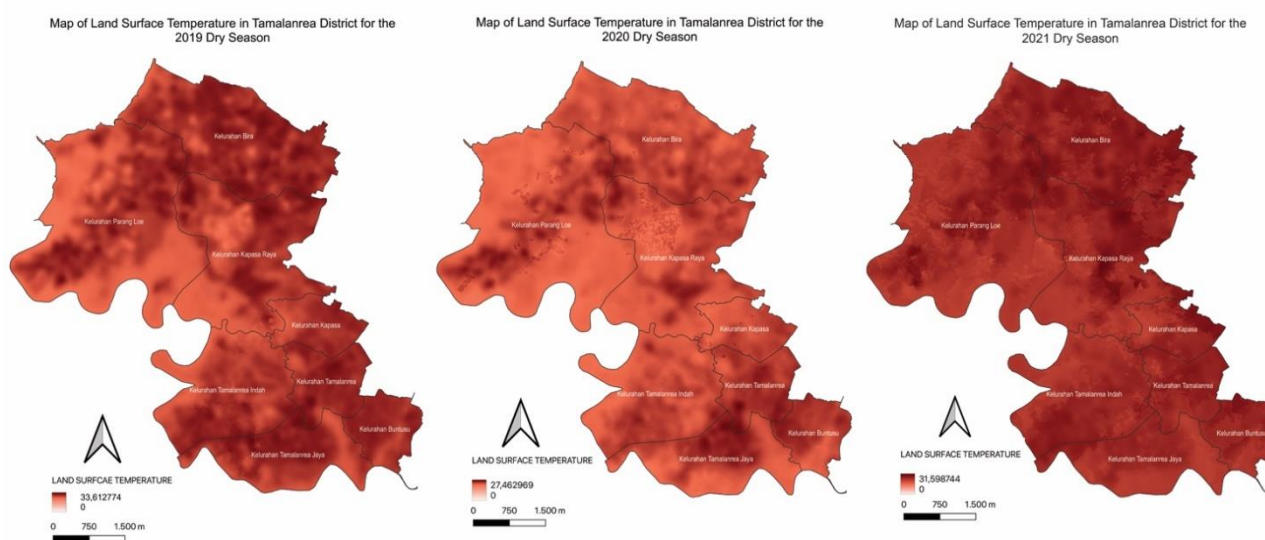


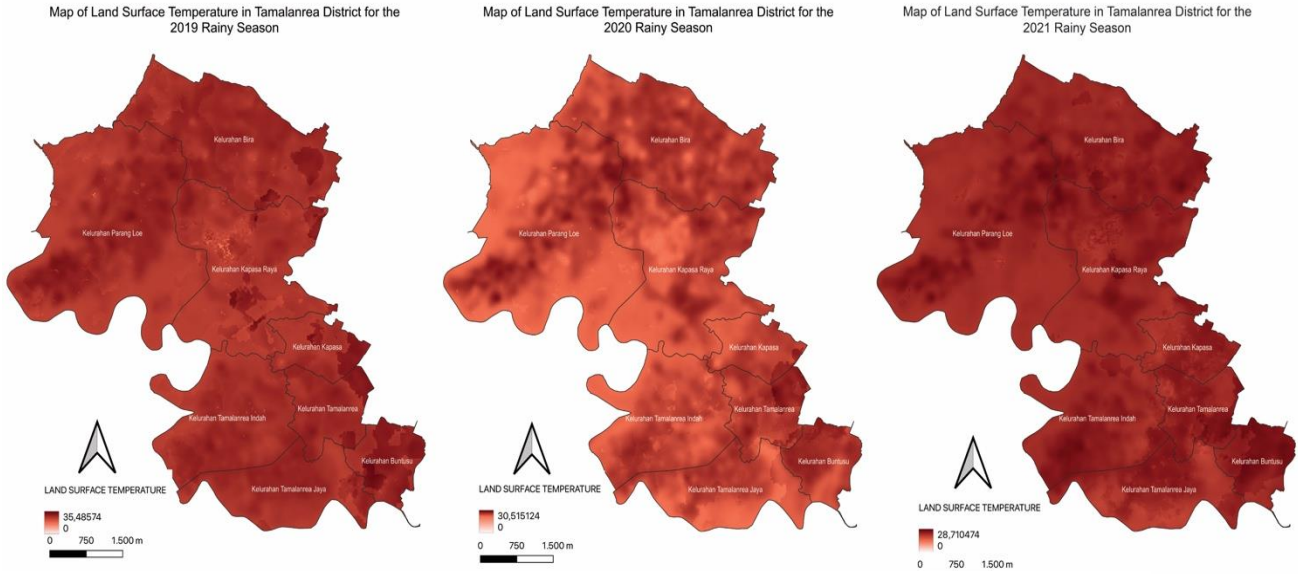Notes: Higher Land Surface Temperatures are Represented by Darker or Deeper Colours

Source: Primary Data, 2022

**Figure 3. Map of the Land Surface Temperature of the Tamalanrea District in 2019, 2020, and 2021 during the Dry Season**

Based on SP2TP data for 2019, 2020 and 2021, six heat-related symptoms were identified in Tamalanrea sub-district as signs or symptoms considered to be affected by urban heat islands. Urban heat island-related diseases identified in Tamalanrea sub-district in 2019 included hypertension, headache, myalgia, ARI, heart disease and asthma, but the distribution of these diseases did not occur evenly across health services.

Hypertension disease was identified to occur in all health centers in Tamalanrea Sub-district. Heart disease and asthma only occur in Kapasa Health Center. The figure 5, shows that many heat-related diseases that occurred in 2019 were hypertension and ARI. In 2020, the types of heat-related illnesses are different from the previous year. Where from six types of heat-related diseases identified in 2019, there were four types of diseases in 2020. This also happened in 2021 when ARI was the most common disease in 2020. Meanwhile, in 2021, hypertension was the disease with the highest incidence rate. Significant positive correlation results were only shown in three health centers out of five health centers spread across Tamalanrea Sub-district namely Antara, Tamalanrea Jaya, and Kapasa Health Centers Table 5. While the other two health centers did not show positive correlation results on disease incidence and land surface temperature.

Notes: Higher Land Surface Temperatures are Represented by Darker or Deeper Colours

Source: Primary Data, 2022

**Figure 4. Map of the Land Surface Temperature of the Tamalanrea District in 2019, 2020, and 2021 during the Rainy Season**
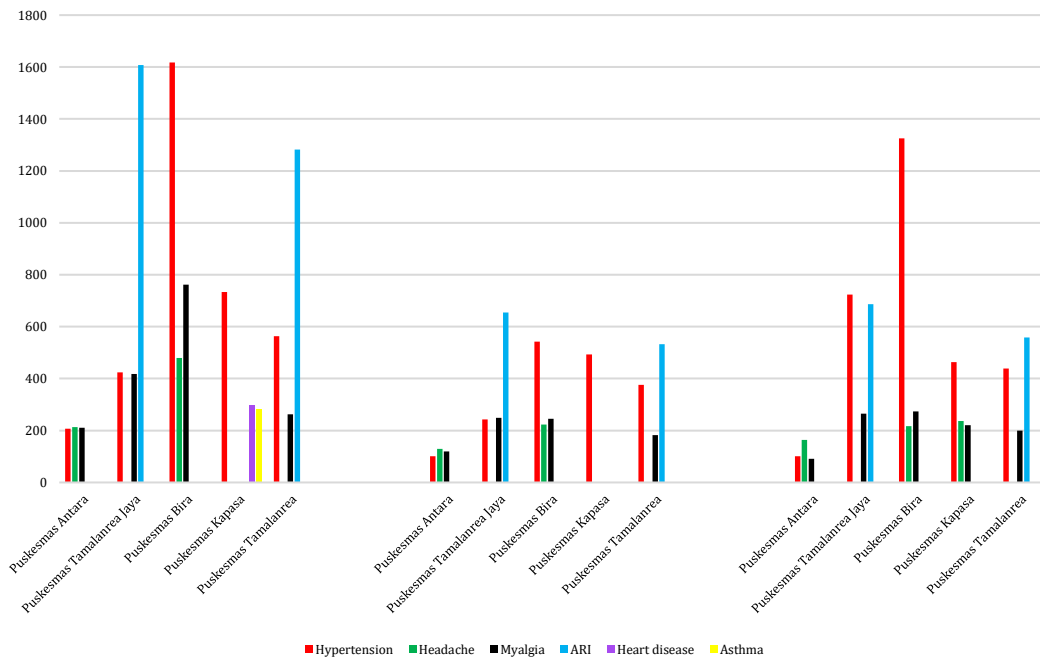


Source: Primary Data, 2022

**Figure 5. Frequency of Heat-Related Diseases in Tamalanrea District in 2019, 2020 and 2021**

Tamalanrea Jaya Health Center shows significant positive correlation results with a perfect level of relationship in hypertension in 2019, Puskesmas Antara in hypertension in 2021, and Puskesmas Kapasa has a positive and significant correlation in heart disease and asthma in 2019, and headache in 2021. This shows that rising land surface temperatures can affect ambient temperatures and disrupt the activities of urban communities. Land surface temperature is positively correlated with the incidence of hypertension, headache, heart disease and asthma from patients or people accessing health facilities in Tamalanrea sub-district. It can be assumed that patients who are exposed to heat and get indirect effects will require action or treatment to prevent disease.

An epidemiologic approach is used to estimate the risk of heat-related morbidity with excess temperature due to UHI effects. Excess risk mapping is a form of Standardized Morbidity or Mortality Rate (SMR) that is often used. The relative risk value of the spread of heat-related diseases in Tamalanrea sub-district is needed to see which sub-districts have a high risk of disease because of UHI and provide special behavior in these areas so that more rapid, planned, and sustainable treatment can be carried out immediately to prevent the effects of UHI attacking urban communities.

In disease mapping, the SMR approach is useful for identifying high-risk areas. The risk scores in Figure 6, show that Bira and Kapasa Sub-Districts are at the highest risk compared to other sub-districts with risk scores >4.00. This risk score can be seen in the incidence of hypertension in the sub-district of Bira, and asthma and heart disease in the sub-district of Kapasa in 2019.

In addition, in 2021, Bira and Kapasa Sub-Districts are also at the highest risk with a risk score of 2.00-4.00 for the incidence of hypertension and headache. These findings suggest that heat-related diseases that are positively correlated to surface temperature pose a health threat to urban populations in Tamalanrea District in 2019 and 2021.
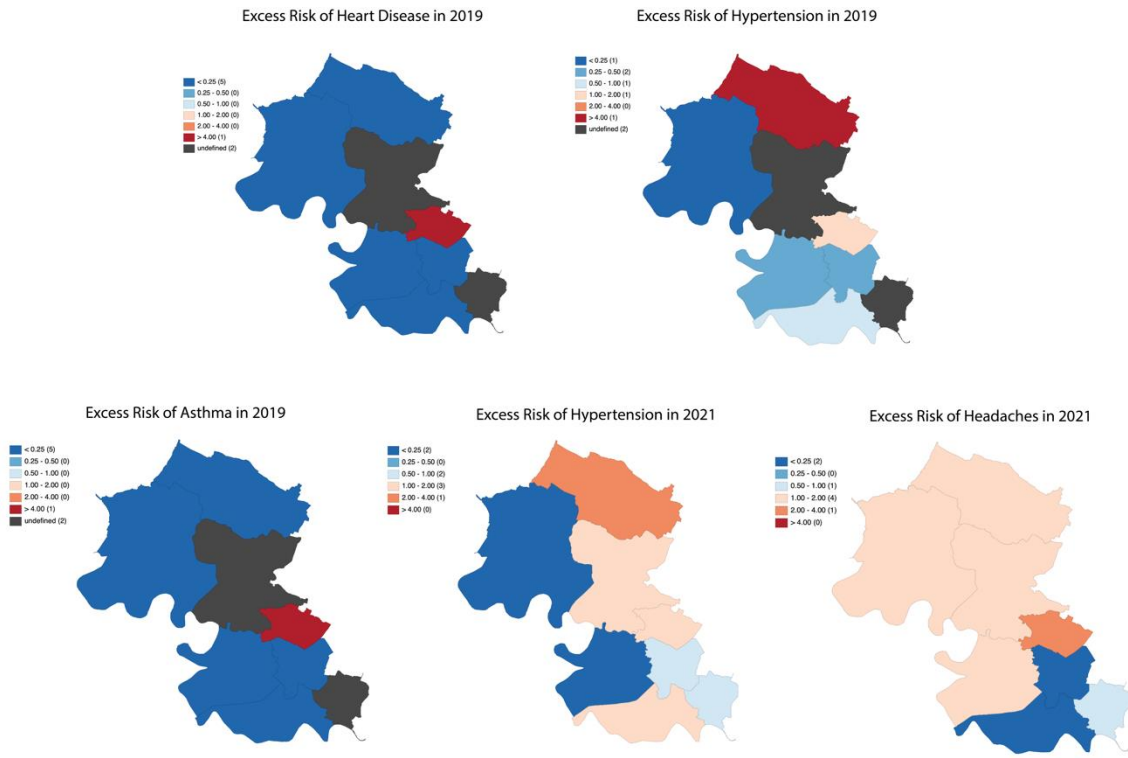
**Table 5. Correlation between Heat-Related Diseases and LST**

| Disease | LST 2019 | | LST 2020 | | LST 2021 | |
|---|---|---|---|---|---|---|
| | R | p-value | R | p-value | R | p-value |
| **Antara Health Center** | | | | | | |
| Headache | 0.416205 | 0.178374 | 0.056044 | 0.862655 | 0.223782 | 0.484441 |
| Hypertension | 0.566078 | 0.055029 | 0.427179 | 0.166034 | 0.759284** | 0.004179* |
| Myalgia | -0.098275 | 0.761239 | 0.112088 | 0.728726 | 0.394405 | 0.204545 |
| **Tamalanrea Jaya Health Center** | | | | | | |
| ARI | -0.098102 | 0.761648 | 0.306622 | 0.332361 | -0.223782 | 0.484441 |
| Hypertension | 0.835336** | 0.000718* | 0.391618 | 0.208051 | 0.083624 | 0.796113 |
| Myalgia | -0.443018 | 0.149197 | 0.195465 | 0.542650 | 0.449946 | 0.142190 |
| **Bira Health Center** | | | | | | |
| Headache | -0.369835 | 0.236705 | -0.083624 | 0.796113 | -0.393004 | 0.206303 |
| Hypertension | -0.563101 | 0.056606 | -0.250873 | 0.431579 | -0.055847 | 0.863133 |
| Myalgia | 0.171379 | 0.594334 | 0.224177 | 0.483649 | -0.056044 | 0.862655 |
| **Kapasa Health Center** | | | | | | |
| Headache | | | | | 0.706824** | 0.010163* |
| Hypertension | 0.220730 | 0.490573 | 0.195123 | 0.543370 | 0.419591 | 0.174507 |
| Myalgia | | | | | 0.224177 | 0.483649 |
| Heart Diseases | 0.589649** | 0.043605* | | | | |
| Asthma | 0.835336** | 0.000718* | | | | |
| **Tamalanrea Health Center** | | | | | | |
| ARI | 0.416205 | 0.178374 | 0.418121 | 0.176179 | 0.279236 | 0.379430 |
| Hypertension | 0.098102 | 0.761648 | 0.196502 | 0.540468 | 0.394405 | 0.204545 |
| Myalgia | 0.172897 | 0.591021 | 0.307700 | 0.330577 | 0.257248 | 0.419565 |

Source: Primary Data, 2022

* is mean the value is significant
** is mean the value has a level of correlation relationship

Excess Risk of Heart Disease in 2019    Excess Risk of Hypertension in 2019

Excess Risk of Asthma in 2019    Excess Risk of Hypertension in 2021    Excess Risk of Headaches in 2021

Source: Primary Data, 2022

**Figure 6. Excess Risk Map**

## DISCUSSION

The land surface temperature values obtained in this study may differ from those obtained in Liong, 2021 studies due to differences in the time and scale of the study area. In addition, LST values show differences between one environment and another. The land surface temperature in Tamalanrea Sub-district is in the range of 19-36°C and rises by 1°C when experiencing seasonal changes. This has a detrimental effect on the morbidity of the urban population.

The health impacts of increased LST are categorized as psychological impacts such as anxiety and aggressive behavior when exposed to excessive heat. In addition, excessive heat exposure may exacerbate the underlying disease and will be the main cause of the disease. The incidence of heat-related diseases will increase as the ambient temperature also increases due to current climate change.[16]

To understand the relationship between LST and heat-related illnesses, a correlation model was used. The frequency of identified heat-related illness symptoms correlated with LST results. This is in line with the findings that heat-related illness symptoms correlate with surface temperature patterns in urban environments.[7] Although, the correlation between LST and heat-related illness does not imply a direct cause of heat-related illness, it can be one of the risk indicators of the morbidity burden. UHI directly affects human health by generating heat waves, heat stress, and the spread of vector-borne diseases and can also lead to increased and chronic exposure to air pollutants and decreased physical health.[16] Increased temperature will disrupt daily activities. Although not as severe as other countries, Makassar City has moderate to tropical climate conditions. Therefore, early anticipation of the impact of urban heat is necessary.

Urban heat poses a risk to the health of urban residents, but it is also important to remember that there are many other risk factors that influence and harm. Air pollution, traffic noise, poor water quality, poor housing, and over-crowding can also be risk factors.[17] Air pollution is also the cause of various respiratory diseases such as COPD and asthma.[19]

The findings of this study, the risk score of Tamalanrea sub-district is in the range of 0.25 -

4.00. The resulting risk score estimation is based on the SMR model approach. The high-risk score indicates that the neighborhood has a higher risk level of incidence compared to other areas. Furthermore, a low-risk score indicates that the area is less likely to be affected by the disease. The low-risk rate is due to the low number of sufferers. Assessing the health risks of high temperature changes was thought to be feasible, to reduce the risk of heat exposure and to safeguard the health of urban residents to maintain healthy and sustainable urban spaces.

This study has limitations regarding data on individuals/patients accessing health facilities. In addition, SP2TP data collected from visits to health center limit the findings of this study. Therefore, further research on a more micro scale is needed to obtain more optimal results, and it is hoped that this study can serve as an illustration for the government to increase preventive and promotive efforts in controlling and preventing the impacts of climate change on health.

## CONCLUSION AND RECOMMENDATION

The land surface temperature of Tamalanrea Sub-district is in the range of 19-36°C and rises by 1°C when experiencing seasonal changes. The increase in temperature, during the dry season will turn the centers of Tamalanrea Sub-district into undesirable hot areas in certain areas. It was found that hypertension, heart disease, asthma and headaches showed a correlation with significant values (p<0.05) with the land surface temperature trend. Bira and Kapasa sub-districts were at the highest risk for the spread of heat-related diseases than other sub-districts with a risk score >4.00 (very high). These findings can serve as an overview for the government to increase preventive and promotive efforts to control and prevent the effects of climate change on public health.

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## AUTHOR CONTRIBUTIONS

AK writing-original draft; I and AK conceptualization; AK writing-review and editing; I, AK, and MP methodology; AK software and visualization; I and MP validation. AK = Angelia Khairunnisa; I = Ihsan; MP = Marly Patandianan.

## CONFLICTS OF INTEREST

The authors declare no conflict of interest.

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# Media Effect to Risk Perception and Protective Behavior During COVID-19 in Indonesia Partial Least Squares Modeling Analysis

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## ABSTRACT

Indonesia has implemented a Large-Scale Social Distancing policy, limiting major public activities to control the COVID-19 pandemic. This study investigates the media content information, the perception of its role, and its contribution to forming the general public's risk perception and protective behavior during this situation. This study was an observational study using a cross-sectional design. Data was collected through an online semi-structured questionnaire using Google Forms. A total of 522 participants were obtained through snowball sampling for two weeks. The data analyzed used the Partial Least Squares (PLS) technique. The results showed the structural model of media content information and the perception of media's role in influencing risk perception and protective behavior. Media content information and perception of media's role directly influence protective behavior significantly. The only perception of the media's role is that it significantly influences risk perception. Then, risk perception directly influences protective behavior. The structural model of media content information and perception of media's role in influencing risk perception and protective behavior during COVID-19 when the transition period to the new normal era in Indonesia has been conducted.

## INTRODUCTION

Coronavirus disease 2019 (COVID-19) has been announced as a global pandemic, with the primary reproductive number (R0) around 3.28.[1]. This pandemic affected more than 200 countries, including Indonesia. By the end of June 2020, there have been 56,385 confirmed cases, including 2,876 deaths, reported within the country.[2] To control the transmission, Indonesia implemented a large-scale social distancing policy, *Pembatasan Sosial Berskala Besar (PSBB),* limiting major public activities, except in vital sectors. In early June 2020, Indonesia entered a transitional period as the government started to prepare to enter a '*new normal.*' The transition period allows for the opening of public places, but only with several restrictions, such as limiting the space down to only 50% of its average capacity and implementing a restrictive health protocol called 3M (*Menggunakan Masker, Mencuci tangan, Menjaga jarak)* (Wearing masks, Washing hand, and Social distancing).

Despite many new cases per day (±1000 cases per day by the end of June 2020), the government has started to open several public places during the transition period. This high rate of social mobility is likely to increase the risk of the virus being transmitted between people. On the other hand, some public members need to go out to fulfill their duties and, in some cases, even need to use public transportation. Eventually, the transition period to a new normal has pushed people to be ready to take personal measures to protect themselves from virus transmission. In this case, the media provides information during this transitional period.

The role of media during the transitional period and into a new normal, in the case of the COVID-19 pandemic in Indonesia, is essential. Media exposure to COVID-19 related information will continue to increase since every type of media platform provides updates about the pandemic daily. Sources of media consumption, media content, and the frequency and ability to access that information will impact the change in knowledge, risk perception, and the acute psychological outcome of the pandemic.[3,4]

The media is responsible for ensuring that the information it provides is accurate. Therefore, people will be more likely to follow this information, ensuring that it continues to adhere to its role in preventing the spread of diseases.[3,5] Media content also defines what information people have access to. Previous studies demonstrated that the increase in media exposure is in line with the change in perception of risk and protective behavior, as shown in the case of the Zika virus.[6] Therefore, media content related to the protective behavior specific to COVID-19, which has been promoted by WHO, such as washing hands, wearing a mask, social distancing, and adequate food for immune improvement, is important in preventing the transmission of the virus.

Transitional periods before the new normal have caused high social mobility during the middle of the pandemic. It has led to a change in behavior amongst the general public as an extra measure to prevent infection during public activity. Throughout this crucial period, it is important to understand the role of media, as it significantly impacts how the general public reacts to the virus and what information, if any, the general public has access to. Therefore, this study aims to investigate the media content information and perception of the media's role in contributing to the formation of perception risk and protective behavior during the transitional period before the new normal in Indonesia.

## MATERIAL AND METHOD

This study was an observational study using a cross-sectional design. Data collection was conducted in June 2020. The population of this study was Indonesian citizens. Then, the sample was Indonesian citizens over 18 years old with Internet access. The exclusion criteria are somebody with high awareness due to information exposure and better knowledge, like health workers, COVID-19 cases/ suspected/recovered cases, or somebody living with them.

The sample collection technique needed to be more robust with the snowball sampling method. Data was collected by an online semi-structured questionnaire using Google-form for two weeks. WhatsApp and social media rolled out the Google-form link to as many people as possible.[4,7,8] Finally, the total number of participants after selection using exclusion criteria was 522 participants.

Then, the data analyzed used the Partial Least Squares (PLS) technique using the SmartPLS 3.2.6 software (www.smartpls.com). The first test in the PLS technique was the validity and reliability of the measures. After the study model had been fit, the analysis examined the hypothesized relationship.[9] The ethical approval was obtained from the Health Research Ethics Commission at Muhammadiyah University of Prof. Dr. Hamka (UHAMKA) with approval number 03/20.06/0473.

## RESULTS

The number of participants in this study is 522, which consists of 413 (79.1%) female and 109 (20.9%) male participants each, with an average age of 28 years old (SD = 8.3). Based on educational characteristics, 264 participants (50.6%) did not graduate from high school and 258 participants (49.4%) did. Based on occupational characteristics, 219 participants (42%) were formal workers, 209 participants (40%) were students, 54 participants (10.3%) were housewives, and 40 participants (7.7%) were informal workers.

### Protection Behavior

The result in Table 1, showed protective behavior participants had good. The majority of participants always used maskers when using public transportation (91.4%), always hand-washed after going outside (84.6%) and social distanced when queuing up (59%).

### Media Use

Media use assessment in this study has consisted of content information. That was because all media content information could be found on all media sources both of the conventional media (TV, radio, printed newspaper) and the new media (electronic-newspaper, information, and videos on social media e.g. Instagram, Facebook, Youtube, WhatsUp, Line, Telegram). The media content information assessment a frequency participants view of this content on media. The questionnaire involved 5 questions like case update, viral news, the pandemic policy of the government, updated national situation, and protective behavior (never = 1, until always = 4).

Based on the type of information, 258 participants (49.4%) were actively looking for information about COVID-19 prevention during the transitional period. For COVID-19 outbreak response information, viral information, and policy information, usage was 9.2%, 7.9%, and 7.7% respectively. Out of 522 participants, 196 participants (37.5%) usually use social media to access videos as a media source of information, and 155 participants (29.7%) usually used social media news outlets instead. On the other hand, tv, radio, printed newspapers, and online newspapers were rarely used by participants.

### Perception of Media's Role

The participants have a good perception of the role of the media. This is clear from the proportion of participants' answers, which stated that the role of the media to increase the obligation of approval was 316 (60.5%) participants. 297 (56,9%) participants have stated that the perception of the media's role is to educate the community on what they need to do during the transitional period. 310 (59,4%) participants stated that the media's role is to spread awareness to the wider community of COVID-19 during the transitional period.

### Risk Perception

Risk perception for all item questioners showed the participants did not fells risk for transmission of COVID-19. Only 22% of participants always feel worried about possible infection at the workplace and 24% of participants always feel dangerous to go outside.

### Measurement Model Analysis

To assess the measurement model two types of validity were being examined - first the convergent validity and then the discriminant validity.[10]

### Convergent Validity

The convergent validity of the measurement was usually ascertained by examining the loading factor, average variance extracted (AVE), and composite reliability. The loadings were all higher than 0.708, the composite reliabilities were all higher than 0.7 and the AVE of all constructs were also higher than 0.5 as suggested in the literature.[11] The results in table 2, show the data is convergent valid.

### Discriminant Validity

Discriminant validity analysis was done to measure the cross-loading value. Cross loading

value showed the magnitude of the correlation between the construct and their indicator and indicator with another construct (Table 3). Discriminant validity was valid if the correlation between the construct and their indicator was higher than the correlation indicator with other constructs as Table 3.

**Structural Model Analysis Testing**
**Model Fit**

Several parameters were used to declare the study model had been fit and ready to continue analysis. This study used the value of the Standardized Root Mean Square Residual (SRMR) dan the Normed Fit Index (NFI). The analysis results showed The SRMR (0.063) was considered a good fit because less than 0.08. [13] The second NFI (0.822) was above 0.9 which is an incremental fit.[12]

**Table 1. Frequency Distribution of Media Use**

| Constructs | Item | Always | |
|---|---|---|---|
| | | **n** | **%** |
| Media Sources | TV | 31 | 5.9 |
| | Radio | 5 | 1 |
| | Printed newspaper | 0 | 0 |
| | Online newspaper | 37 | 7.1 |
| | Video on social media | 196 | 37.5 |
| | News on social media | 155 | 29.7 |
| Conten Information | Case update | 67 | 12.5 |
| | Viral news | 41 | 7.9 |
| | The pandemic policy of the government | 40 | 7.7 |
| | Update national situation | 48 | 9.2 |
| | Protective behavior | 258 | 49.4 |
| Perceptions of Media's role | Educate people to prevent covid-19 | 221 | 41.4 |
| | Increase protective behavior | 203 | 38 |
| | Increase awareness | 208 | 39 |
| | Educate illness behavior | 223 | 41.8 |
| Risk Perception | Fell dangerous to go outside | 128 | 24 |
| | Fell covid-19 is more dangerous than cough and cold | 227 | 42,5 |
| | Worried about possible infection at the workplace | 118 | 22.1 |
| | Worried about possible infection at the public area | 234 | 43.8 |
| | Worried about possible infection at public transportation | 243 | 45.5 |
| Prevention Behavior | Mask use when making conversation with people | 334 | 62.5 |
| | Mask use when used public transportation | 488 | 91.4 |
| | Handwashing after going outside | 452 | 84.6 |
| | Handwashing after shaken hand, area | 370 | 69.3 |
| | Handwashing after touching an object in the public areas | 361 | 67.6 |
| | Social distanced with other people | 276 | 51.7 |
| | Social distanced when queuing up | 315 | 59.0 |

Source: Primary Data, 2020

**Table 2. The Results of Convergent Validity**

| Constructs | Item | Loadings | Cronbach's Alpha | rho_A | Composite Reliability | Average Variance Extracted (AVE) |
|---|---|---|---|---|---|---|
| Content Information (CI) | CI.1 | 0.791 | 0.824 | 0.826 | 0.878 | 0.592 |
| | CI.2 | 0.786 | | | | |
| | CI.3 | 0.842 | | | | |
| | CI.4 | 0.801 | | | | |
| | CI.5 | 0.605 | | | | |
| Perception of Media's role/ (PM) | PM.1 | 0.846 | 0.904 | 0.910 | 0.933 | 0.776 |
| | PM.2 | 0.910 | | | | |
| | PM.3 | 0.889 | | | | |
| | PM.4 | 0.877 | | | | |
| Risk Perception (RP) | RP.1 | 0.724 | 0.834 | 0.844 | 0.876 | 0.504 |
| | RP.2 | 0.597 | | | | |
| | RP.3 | 0.771 | | | | |
| | RP.4 | 0.874 | | | | |
| | RP.5 | 0.863 | | | | |
| Prevention Behavior (PB) | PB.1 | 0.619 | 0.825 | 0.837 | 0.879 | 0.597 |
| | PB.2 | 0.590 | | | | |
| | PB.3 | 0.743 | | | | |
| | PB.4 | 0.792 | | | | |
| | PB.5 | 0.789 | | | | |
| | PB.6 | 0.706 | | | | |
| | PB.7 | 0.707 | | | | |

Source: Primary Data, 2020

## Hypothesis Testing Results

Path coefficient assessment is included in the structural model indicating the power of the relations among the R2 value, independent variable, and dependent variable. To define the consequence level of the paths definite within the structural model which looks at the R2, beta (β), and the corresponding t-values via a bootstrapping procedure with a resample of 5.000. Hair et al. (2017). This study used a 5% significance level ($p<0.05$) as a statistical conclusion measure. The level of significance using the extent of the identical factor estimates between the constructs is indicated in the resultant t-value when the t-statistic more than 1.96.

From Table 4 showed content information, perception of media's role and risk perception are influence directly the protective behavior significantly. And indirectly, the perception of media's role through the risk perception is influence significantly the protective behavior.

The relationship between content information and protective behavior was supported and significant with the original sample (β) = 0.285, statistics (t) = 7.213 and significant p-value = <0.001 indicates that protective behavior is influenced directly and positively by conten information.

The relationship between perception of media's role and protective behavior was supported and significant with the original sample (β) = 0.094, statistics (t) = 2.004 and significant p-value = 0.044 indicates that protective behavior is influenced directly and positively by perception of media's role.

The relationship between risk perception and protective behavior was supported and significant with the original sample (β) = 0.176, statistics (t) = 3.590 and significant *p-value* = <0.000 indicates that protective behavior is influenced directly and positively by risk perception.

The relationship between between perception of media's role and protective behavior through risk perception was supported and significant with the original sample (β) = 0.053, statistics (t) = 2.776 and significant *p-value* = <0.000 indicates that protective behavior is influenced directly and positively by risk perception.

From Figure 1, the results R2 value is 0,149. That means the protective behavior is influenced by that variable 14,9% and the remaining can be obtained by other factors which were not examined in this study. Then the only perception of media's role influenced directly the risk perception significantly, with R2 value is 0,100. That means the risk perception is influenced by the perception of media's role 10% and the remaining can be obtained by other factors which were not examined in this study.

**Table 3. The Results of Discriminant Validity**

|  | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| 1. Media conten information | 0.769 |  |  |  |
| 2. Perseption of media's role | 0.243 | 0.881 |  |  |
| 3. Protective behavior | 0.319 | 0.215 | 0.710 |  |
| 4. Risk behavior | 0.103 | 0.315 | 0.232 | 0.773 |

Source: Primary Data, 2020

**Table 4. The Result of Hypothesis Testing**

|  | Relationship | Original Sample (β) | Sample Mean | SD | Statistics (t) | p-values | Influence |
|---|---|---|---|---|---|---|---|
| H1 | CI -> PB | 0.285 | 0.288 | 0.039 | 7.213 | 0.000 | Significant |
| H2 | CI -> RP | 0.007 | 0.010 | 0.048 | 0.148 | 0.544 | - |
| H3 | PM -> PB | 0.094 | 0.093 | 0.047 | 2.004 | 0.044 | Significant |
| H4 | PM -> RP | 0.303 | 0.303 | 0.053 | 5.729 | 0.000 | Significant |
| H5 | RP-> PB | 0.176 | 0.177 | 0.049 | 3.590 | 0.000 | Significant |
| H6 | CI -> RP -> PB | 0.001 | 0.002 | 0.009 | 0.141 | 0.565 | - |
| H7 | PM -> RP -> PB | 0.053 | 0.054 | 0.019 | 2.776 | 0.006 | Significant |

Source: Primary Data, 2020
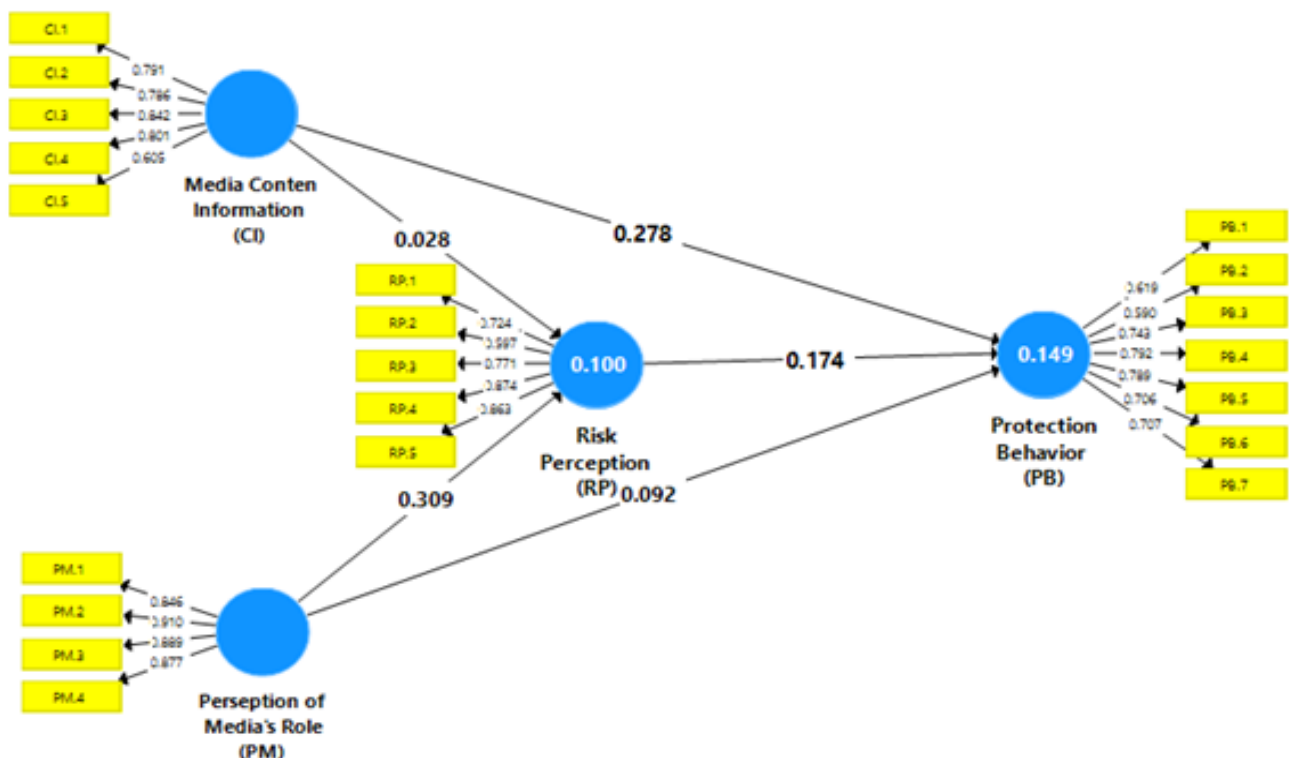


Source: Primary Data, 2020

**Figure 1.  Presenting The Final Path Model and Showing the Bootstrapping Diagram**

## DISCUSSION

The main results of this study showed the structural model of media content information, perception of media's role, and risk perception to influence risk protective behavior during COVID-19 during the transition period to the new normal era in Indonesia. The amount of research on the topic of media effect on protective behavior supported this model.[4,6,13,14] and risk perception.[4,6,15,16]

The study showed that new media sources (electronic newspapers and social media) were used more than old ones (paper newspapers, TV, and radio). That was because the use of new media was indeed high among respondents. The development of technology causes the development of information media to be more robust, making the use of old media sources decline.

The other reason is that new media sources present the information by visual imagery. The utilization of visual imagery will affect message effectiveness through social.[17] For the case when the video showed off feeling afraid, that would increase perceptions of severity and risk.[18]

Low access to old media also occurs in other related studies about infectious disease.[19] This is due to reduced public interest in old media and lack of actuality in providing information. In contrast, the information provided through new media sources continues to grow and is updated regularly. The use of social media has changed the way people obtain and use information.[16] Looking at the development aspect of new media sources, it can be used as a guide in dealing with pandemic situations.[20]

The first funding is that media content information influences directly protective behavior directly. The media content information was associated with media use. That is because it is also part of the media exposure, which also affects preventive behavior.[14]

The content information shows a significant relationship between protective behavior and negative emotion variables. The results of the Social Network Site (SNS) study show that people use social media as a useful tool to obtain relevant information during outbreak periods.[19] Someone will seek information according to their needs. Based on this, the most sought-after information content by respondents in this study was the content of protective behavior.

This shows that the contents are the most needed information in the community.

According to Green & Murphy,[21] The media plays an essential role in behavior change in the theory of Health Belief Models (HBM). In the HBM theory, the information content presented in the media is included in variable cues for action. Furthermore, in the context of the HBM theory, the search for protective behavior and policy contents affect a person's perception of benefits, thereby increasing the occurrence of protective behavior. One of the information content related to policies influenced increasing protective behavior.

This align with Green's study, which stated that policy is a reinforcing factor for behavior.[15,21,22] Stated that information protective behavior contents are used to develop perception controllability that influences the risk perception and increases self-efficacy.[15] This tends to influence the protective and preventive behaviors associated with health.[23]

Meanwhile, the information content rarely sought is related to developments in the COVID-19 case. This can indicate that the information is the type of information that the respondent does not like or avoids. This is possible because the content mentions an increase in the number of COVID-19 cases, which is increasing daily. So, it can cause negative emotions such as fear, worry, anxiety, and so on. Because information from the mass media can also have a negative emotional effect.[3,16,24] This was proven in this study, and correlation analysis results showed that the information content about the case update was associated significantly with negative emotionality, although in the results of the multivariate analysis, the information content was not the most influential factor in increasing negative emotions.

The second funding was the perception of the media's role in significantly influencing the perception of protective behavior directly. Moreover, the media's role indirectly influenced protective behavior through risk perception. It means the perception of the media's role supports increasing risk perception, which influences protective behavior. The perception of the media role could also be seen as trust in the media, which aligns with the perception of the media role as an influential variable.

This perception of media roles describes trust in society and from the questions asked. Participants show a high confidence level in the role of education carried out by the media because they provide the proper education and information regarding the pandemic. High levels of belief and trust related to information obtained through the media were usually related to the formation of public risk perceptions.[25] That could amplify the effect of media use on health behavior compliance levels.[13]

The study's findings indicate a link between media exposure and protective behavior during the epidemic. This research also faces limits in interactions in this pandemic era. During a pandemic, this is a factor for the health and safety of researchers and respondents. So, data collecting methods using the non-purposive sampling technique through the Internet can reach many respondents safely. However, that sampling technique has limitations, as the study's findings cannot be generalized. The findings of this study can only indicate the population that has access to the Internet.

## CONCLUSION AND RECOMMENDATION

The structural model of media content information and perception of media's role in influencing risk perception and protective behavior during COVID-19 when the transition period to the new normal era in Indonesia has been conducted. Media content information, perception of media's role, and risk perception directly influence protective behavior.

According to the results, the government can use the media to spread health information. The government must maintain the veracity of the content of valid and accurate media. That is by creating a government's mass media account. This account will allow the public to obtain and verify health information easily.

The next study explores the kind of media with the highest effect on risk perception and protective behavior in Indonesia.

## AUTHOR CONTRIBUTIONS

All authors conceptualized and designed the study. ENA and IA drafted the manuscript, ENA conducted the data analysis, IS and MPS provided additional analysis. All authors have read and approved the manuscript. All authors equally contributed to this study.

## CONFLICTS OF INTEREST

The authors declare no conflict of interest.

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# Multifactorial Analysis of Work Accidents among Transportation Sector Workers in Parepare City

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## ARTICLE INFO

## ABSTRACT

Reports have shown that there has been a continuous annual increase in the number of traffic accidents in Indonesia. Parepare City, in particular, faces significant congestion in its public transportation system, leading to 167 cases and 144 cases of accidents in 2019 and 2020, respectively. Therefore, this study aims to analyze the influence of knowledge, attitude, personality, and safety riding practice on traffic accidents among transportation workers in Parepare City. This cross-sectional study comprised 100 respondents selected using the simple random sampling method. The study instrument was a questionnaire, which had previously been tested for its validity and reliability. The data obtained were analyzed using univariate analysis to describe the characteristics of each variable. In contrast, bivariate analysis was conducted using the chi-square test with a confidence level of 95%. Data were collected through interviews with a questionnaire and analyzed using multiple logistic regression with the forward LR method. The results showed that attitude and safety riding practice had a significant influence. Multivariate analysis showed that factors influencing accidents included attitude (AOR = 0.031; 95%CI = 0.45-0.26), practice (AOR = 0.108; 95%CI = 0.03-0.38), and knowledge (AOR = 0.337; 95%CI = 0.13-0.88), while personality had no effect. Based on the results, future studies were advised to conduct long-term investigations (longitudinal studies) to monitor changes in the variables observed and the relationship with the rate of traffic accidents.

# INTRODUCTION

Implementing Occupational Safety and Health (OSH) is a crucial strategy to prevent work-related accidents and diseases.[1] One of the proactive steps in this aspect is the identification of hazards and risks. Furthermore, establishing a safe, comfortable, and healthy workplace can reduce the risk of accidents and mitigate the danger experienced by workers.[1]

According to Law Number 1 of 1970, work accidents are unexpected and undesirable events that disrupt the regulated workflow of an activity, potentially leading to both human casualties and property loss. Meanwhile, occupational diseases are physical and spiritual, health issues caused by work or the workplace.[2] Safety management and work safety protocols must be applied across all sectors, including transportation. Despite Indonesian extensive regulations governing security in the transportation sector, accidents persist. To address this challenge, the National Transportation Safety Committee (NTSC) plays an essential role in ensuring safety and enhancing services to the public. In 2021, NTSC reported 19 accidents in the shipping sector, leading to a tragic toll of 342 casualties, including fatalities and missing individuals. The aviation sector also experienced a similar challenge, with 18 reported cases, and 9 of them were classified as severe accidents. For example, the Boeing 737-500 plane crash on January 9, 2021, claimed the lives of 56 people. The NTSC also reported an equivalent figure for road traffic and transportation modes. The NTSC maintains a list of accident-prone areas where these incidents frequently occur.[3]

On January 21, 2022, a tragic accident occurred in Balikpapan, East Kalimantan, in the transportation sector. A Tronton truck collided with several motorists at the intersection of Simpang Rapak, Jalan Soekarno Hatta, leading to a devastating loss of five lives and causing slight injuries to 30 individuals. This indicates a need to monitor and evaluate accidents by carrying out assistance programs to create occupational safety and health management systems for drivers, toll road education, and OSH education for drivers.[3] Traffic accidents in Indonesia during the 2015-2019 period experienced a surge, with an average annual percentage increase of 4.87%. This increment was simultaneously followed by an increase in the number of deaths and minor injuries by 1.41% and 6.26%, respectively.[4] Parepare is the second largest city in South Sulawesi and is also known as the Commercial City due to its port, which serves as a hub for transporting agricultural and livestock production to other regions.

Reports through page one data managed by Parepare City Regional Government show the large flow of foreign and domestic goods based on shipping type at the port. This level of importation also increases the use of land transportation, such as goods trucks between regions, leading to congestion of public vehicles in the regions. This indicates that transportation drivers must consider safety and security while riding. Secondary data obtained indicates that Parepare City witnessed 167 traffic accidents in 2019, followed by 144 cases in 2020. These accidents led to substantial material losses, totaling Rp. 125,400,000 in 2020, with 13 fatalities, three severely injured individuals, and 150 sustaining minor injuries. Safety riding, characterized by adherence to riding regulations and safety riding behavior, is essential in reducing the risk of traffic accidents. This concept is designed to enhance driver awareness of potential hazards during their journeys, promoting safe riding practice.[6] Therefore, this study aims to analyze the influence of knowledge, attitude, personality, and safety riding practice on traffic accidents among transportation workers in Parepare City.

# MATERIAL AND METHOD

This was an analytical observational study with a cross-sectional approach. Furthermore, the samples were taken using a simple random sampling method, totaling 100 transportation sector workers, particularly public transport drivers in Parepare City. The study instrument was a questionnaire, which had previously been tested for its validity and reliability.

The data obtained were analyzed using univariate analysis to describe the characteristics of each variable. In contrast, bivariate analysis was conducted using the chi-square test with a confidence level of 95%. Multivariate analysis with the logistic regression method was then used to identify the variables with the highest significant influence on the dependent variable. In this study, all the data analyses were carried out using SPSS 24.

## RESULTS

The characteristics of respondents observed included age, educational background, gender, type of work, years of service, duration of work, and shift work, as shown in Table 1. Based on the results, the majority of respondents were males (99%) aged ≤ 40 years (80%), senior high school graduates (67%), online drivers (75%), ≤ 5-year experience (80%), > 8 hours (77%), and work shift on Afternoon – Night. Table 2 showed that 51% of drivers experienced work accidents in the last 6 months, specifically during the night (23%). The dominant types of accidents included falling (28.0%), crashing (14%), and being hit (4%), while the remaining respondents did not experience accidents (54%). The severity of injuries experienced by respondents was mild (39%), moderate (6%), and severe (1%).

**Table 1. Characteristics of Respondents**

| Characteristics | n = 100 | % |
| --- | --- | --- |
| **Age (Years)** | | |
| ≤ 40 | 80 | 80 |
| > 40 | 20 | 20 |
| **Educational Background** | | |
| Elementary School | 1 | 1 |
| Junior High School | 15 | 15 |
| Senior High School | 67 | 67 |
| University | 17 | 17 |
| **Gender** | | |
| Male | 99 | 99 |
| Female | 1 | 1 |
| **Type of Work** | | |
| Taxi Bike | 7 | 7 |
| Online Driver | 75 | 75 |
| Courier | 17 | 17 |
| Public Transport Driver | 1 | 1 |
| **Years of Service** | | |
| ≤ 5 years | 80 | 80 |
| > 5 years | 20 | 20 |
| **Duration of Work (Hours)** | | |
| ≤ 8 | 23 | 23 |
| > 8 | 77 | 77 |
| **Shift Work** | | |
| Morning – Afternoon | 25 | 25 |
| Afternoon – Night | 37 | 37 |
| Night – Morning | 3 | 3 |
| Fullday | 35 | 35 |

Source: Primary Data, 2023

**Table 2. Work Accidents History**

| Work Accidents History | n = 100 | % |
| --- | --- | --- |
| **Accidents History in the Last 6 Months** | | |
| Yes | 51 | 51 |
| No | 49 | 49 |
| **Occurrence Time** | | |
| Morning | 7 | 7 |
| Afternoon | 16 | 16 |
| Night | 23 | 23 |
| Did not have an accident | 54 | 54 |
| **Severity of Injury** | | |
| Mild | 39 | 40 |
| Medium | 6 | 6 |
| Severe | 1 | 1 |
| Did not have an accident | 54 | 54 |
| **Type of Accident** | | |
| Fall | 28 | 28 |
| Crashing | 14 | 14 |
| Hit | 4 | 4 |
| Did not have an accident | 54 | 54 |

Source: Primary Data, 2023

Bivariate analysis between the variables of knowledge, attitude, personality, and safety riding practice on work accidents was presented in Table 3. Based on the analysis results, the variables of knowledge, attitude, and practice had a statistically significant relationship with work accidents ($p<0.05$), while the personality variable did not have a significant relationship with the dependent variable ($p>0.05$). Furthermore, an analysis of the pure influence of work accidents risk factors was carried out using multivariate analysis.

Table 4 showed the results of the analysis carried out to determine the most influential variables. The multiple logistic regression test using the forward LR method was carried out by entering all independent variables with a p-value of ≤ 0.25 into the model, including knowledge, attitude, and practice. The independent variables with a *p-value* ≤ 0.25 and those with *p-value* < 0.05 were gradually entered from the smallest to the largest value. The results of the multivariable analysis of this study are presented in Table 5.

The multivariate analysis results showed that the variables related to work accidents in transportation sector workers included attitudes (AOR = 0.031; 95%CI = 0.45-0.26), practice (AOR = 0.108; 95%CI = 0.03-0.38), and knowledge (AOR = 0.337; 95%CI = 0.13-0.88). This indicated that practice and attitude had the highest level of influence on work accidents.

**Table 3. Bivariate Analysis**

| Variable | Accidents | | | | Total | *p-value* | (95%CI) |
|---|---|---|---|---|---|---|---|
| | Once | | Never | | | | |
| | n | % | n | % | | | |
| **Knowledge** | | | | | | | |
| Good | 21 | 40.4 | 31 | 59.6 | 52 | 0.044 | 0.182-0.909 |
| Bad | 30 | 62.5 | 18 | 37.5 | 48 | | |
| **Attitude** | | | | | | | |
| Positive | 37 | 43.5 | 48 | 56.5 | 85 | 0.001 | 0.007-0.438 |
| Negative | 14 | 93.3 | 1 | 6.7 | 15 | | |
| **Personality** | | | | | | | |
| Positive | 44 | 55.5 | 36 | 45.0 | 80 | 0.177 | 0.819-6.288 |
| Negative | 7 | 35.0 | 13 | 65.0 | 20 | | |
| **Practice** | | | | | | | |
| Safe | 35 | 43.8 | 45 | 56.3 | 80 | 0.008 | 0.060-0.634 |
| Not safe | 16 | 80.0 | 4 | 20.0 | 20 | | |

Source: Primary Data, 2023

**Table 4. Multivariate Analysis**

| | Variable | Wald | *p-value* | AOR | 95% CI | |
|---|---|---|---|---|---|---|
| | | | | | Lower | Upper |
| Step 1[a] | Attitude Category | 7.510 | 0.006 | 0.055 | 0.007 | 0.438 |
| | Constant | 7.905 | 0.005 | 23.562 | | |
| Step 2[b] | Practice Category | 11.806 | 0.001 | 0.119 | 0.035 | 0.401 |
| | Attitude Category | 9.998 | 0.002 | 0.034 | 0.004 | 0.277 |
| | Constant | 19.331 | 0.000 | 515.096 | | |
| Step 3[c] | Knowledge Category | 4.937 | 0.026 | 0.337 | 0.129 | 0.880 |
| | Practice Category | 11.980 | 0.001 | 0.108 | 0.031 | 0.381 |
| | Attitude Category | 10.256 | 0.001 | 0.031 | 0.004 | 0.259 |
| | Constant | 21.256 | 0.000 | 3240.410 | | |

a. Variable (s) entered on step 1: Attitude Category
b. Variable (s) entered in step 2: Practice Category
c. Variable (s) entered in step 3: Knowledge Category
Source: Primary Data, 2023

## DISCUSSION

The analysis showed that the knowledge variable significantly influenced ($p = 0.026 < 0.05$) the incidence of work accidents among drivers in the Parepare transportation sector. Based on the findings, most respondents lacked knowledge about basic traffic rules, such as "at roundabout intersections, drivers must give priority to other vehicles coming from the right." Furthermore, a lack of knowledge about the basic traffic rules could be a risk factor contributing to the occurrence of work accidents. The results supported the theory that actions or behavior based on knowledge were more likely to be remembered and applied compared to those without a solid knowledge base.[7] Several studies showed that there was a significant relationship between knowledge about safety riding and accidents associated with online two-wheeled transportation drivers in Pekanbaru with a correlation coefficient of 0.000 ($p < 0.05$).[8] Another study used a sample population of 60 respondents who had experienced work accidents in a certain period. In the last one year, 53 respondents were affected, and 48 (90.6%) had less knowledge.[9]

The results of the analysis of respondents' attitudes showed that there was a significant

influence ($p = 0.001 < 0.05$) on the incidence of work accidents. This was in line with previous studies that individuals' attitudes could influence behavior. Based on the results, if someone had a positive attitude towards an object or idea, they tended to take actions supporting the object, and vice versa.10 In line with other studies, most of the respondents had a negative attitude towards safety riding ($p = 0.011$).11 This study showed that some drivers only followed traffic rules when the police were around, and some who had not experienced accidents felt there was no reason to change their riding style. However, maintaining this attitude could increase the risk of getting into an accident.

Based on the results, there was a significant relationship between safety riding practice and the incidence of work accidents in the Parepare transportation sector ($p = 0.008 < 0.05$). In line with other studies, there was a significant relationship between safety riding behavior and work accidents among online drivers in the X Tembalang Community with a significance value ($p = 0.017 < 0.05$). Furthermore, the results showed that the odd ratio value was 13.00, where drivers with unsafe riding behavior had a 13 times higher risk than others.

Unsafe riding practices, such as non-compliance with traffic rules, use of inadequate personal protective equipment, or non-compliance with company safety policies, could increase the risk of work accidents. For example, drivers or workers who did not wear helmets or appropriate personal protective equipment could increase the risk of serious injury. Furthermore, violations of traffic rules, such as excessive speed or ignoring traffic signals, often led to collisions and accidents that threatened the safety of workers. According to the Theory of Planned Behavior (TPB), individual behavior could be explained through 4 components: attitude, subjective norm, perception of self-control over behavior (Perceived behavior control), and intention to carry out the attitude.12

This study confirmed that implementing safety riding behavior was essential in reducing the risk of traffic accidents.13 Based on previous studies, there was a relationship between unsafe workplace actions and accidents among online drivers and base drivers in Manado, with a significance level of (0.002).14 Furthermore, a study in 2019 also showed a relationship between driver behavior and accidents among drivers in Bitung, with a significance level of (0.04).15

Multivariate analysis in this study showed that the most influential variables affecting the occurrence of work accidents among drivers in the Parepare transportation sector included safety riding practice ($p = 0.001 < 0.05$), attitude ($p = 0.001 < 0.05$) and knowledge ($p = 0.026 < 0.05$). At the same time, personality had no association ($p = 0.177 > 0.05$). To reduce the incidence of work accidents in this sector, it was important to promote safety riding practice through training, awareness, and enforcement of policies. Apart from protecting workers' lives and well-being, this could also produce long-term benefits for companies, such as reducing medical care costs, workers' absenteeism, and negative impacts on the company's reputation. Therefore, managing good safety riding practices was key to achieving a safer and more productive work environment in the Parepare transportation sector.

## CONCLUSION AND RECOMMENDATION

In conclusion, this study showed that the most influential variables influencing the occurrence of work accidents among drivers in the Parepare transportation sector were safety riding practice, attitude, and knowledge. Based on the results, future studies were recommended to conduct long-term investigations (longitudinal studies) to monitor changes in knowledge, attitude, and safety riding practice in relation to the rate of work accidents. Several interventions were also advised, such as implementing specific safety training programs for drivers. Furthermore, there was a need for collaboration among related parties, such as local governments, transportation companies, or road safety organizations, to collect data and obtain support in implementing intervention programs.

## ACKNOWLEDGMENTS

## AUTHOR CONTRIBUTIONS

Organize and design research; SSR and LMS, conducting research; SSR, LMS NMS, and NHI, analyzed the data; AN and AFMN, wrote the manuscript; All authors. The author read and approved the final manuscript. SSR = Syamsiar S. Russeng; LMS = Lalu Muhammad Saleh; NMS = Nurul Mawaddah Syafitri; NHI = Naufal Hilmy Imran; AN = Auliyah Nurazizah; AFMN = Andi Fatimah Mustovia Nurhidayah.

## CONFLICTS OF INTEREST

The authors declare no conflict of interest.

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# Related Factors of Work Stress Among Breastfeeding Working Women in Indonesia

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## ARTICLE INFO

## ABSTRACT

Work stress is a common response experienced by workers, including breastfeeding working women, due to stressors arising in the workplace. In the short term, work stress has a negative impact on the productivity and lactation activity of working women. Therefore, this study aimed to investigate the factors associated with work stress among breastfeeding working women. A cross-sectional design was used by distributing the workplace stress scale questionnaire and additional questions to breastfeeding working women. The data used were obtained from 162 respondents spread across Indonesia who were willing to fill out online questionnaires. Subsequently, the collected data were analyzed using the Logistic Regression test. The results indicated that 85 people (52.47%) felt high stress, particularly regarding the lack of opportunity to show ability and talent during work. A statistically significant relationship ($p$=0.034, aOR= 2.139) was also discovered between the type of family and work-related stress in breastfeeding working women. Although this problem was directly sourced from stressors at work, demographic factors such as the type of family contributed to the stress experienced by breastfeeding working women.

# INTRODUCTION

The mental health situation in Indonesia is demanding urgent attention, as indicated by the data from the Ministry of Health of Indonesia (2019). Mental health disorders rank first as the leading cause of disability or illness, with a 13.4% higher likelihood of resulting in a disability or disease compared to other factors such as cardiovascular or respiratory issues.[1]

According to Indonesian Basic Health Research data 2018, mental-emotional disorders occur primarily in the productive working age, predominantly in women (12.1%) than men (7.6%).[2] This phenomenon is attributed to stress, where the higher number of mental-emotional disorders in women is workplace-related. The rapid economic growth has led many women to actively participate in various workplaces in the Indonesian labor force over the past five years. In 2018, data from the Central Statistics Agency showed that the participation of women increased to 54% compared to 51% in the previous year.[3]

Women in most societies carry out multiple roles including domestic household affairs, leading to different characteristics in female and male workers.[4] The combination of responsibilities within life groups and the workload also creates psychosocial stressors for working women.[5]

Conflicting work schedules also add to the causes of work-related stress in breastfeeding working women. A previous study in China found that the work scheduling of a female healthcare worker, namely a nurse, affected work stress for breastfeeding working women, particularly when returning to work after giving birth.[6] Another issue was caused by the distance between the mother and the baby due to the demands of the workplace, requiring mothers to spend extended hours away from home, leaving their babies unattended.[7]

Study by Sattari et al. also suggested that work-related stress among breastfeeding female doctors was associated with the availability of lactation breaks at work.[8] A significant proportion of working mothers, approximately 25% feel very stressed due to concerns about the difficulties and discomfort of lactation at work.[9]

Apart from insufficient knowledge, the type of family, workplace, and lactation breaks could be factors related to women's work stress. Therefore, further study is essential to determine the right strategy for dealing with stress levels among breastfeeding working women.[10–12]

Several studies have investigated the effect of workplace stressors on work stress. However, only a few investigations examined the relationship between lactation support factors at the workplace and the effect of social support, such as the type of family, on work stress among breastfeeding working women. This study aimed to explore various factors related to work stress among breastfeeding working women in Indonesia.

# MATERIAL AND METHOD

This study was conducted between July and September 2022 using a quantitative approach with a cross-sectional design and a population of all working women in Indonesia. The inclusion criteria were women workers in industry or offices, breastfeeding status, and willingness to be respondents. The number of samples was determined using the hypothesis test formula for two different proportions with the Sample Size 2.0 software to obtain a total of 162 respondents. An accidental sampling technique was used to initially obtain 173 people who willingly responded to surveys through the Internet. However, after cleaning the data, it was discovered that some responses lacked completeness, resulting in a total of 162 responses used for analysis.

Data collection was facilitated through an online questionnaire by distributing survey invitations using social media platforms such as WhatsApp and Instagram. The purpose and scope of the study and guidance were explained to the respondents before completing the questionnaire. Respondents who agreed to complete the questionnaire signed the consent form by clicking the "yes" button, while anonymity and confidentiality were maintained throughout this study. Subsequently, the workplace stress scale instrument was used to measure the work stress variable. Previous studies identified the workplace stress scale instrument as an instrument applicable across all settings and types of work.[13,14] This instrument consisted of eight questions items to obtain a description of work stress by calculating a

score using a five-point Likert scale. For unfavorable questions, "never", "very rarely", "sometimes", "often", and "very often" received a score of 1, 2, 3, 4, and 5, respectively. Meanwhile, for favorable statements, the answer score was the opposite. The measurement results on the work stress variable were seen in 2 forms, based on each question item score. When the total score was above 3, the respondent agreed with the related question. When the total score was between 1-3, it was concluded that the respondent did not agree with the corresponding question. Before entering the advanced stage of bivariate analysis, the work stress variable was divided into two categories using the median value. This was carried out because, from the normality test results, the data was not normally distributed. For the category of high and low levels of work stress, the total scores were ≥18.69 and <18.69, respectively. Meanwhile, the independent variables in this study were level of education, type of workplace, and lactation breaks at work. Questions for the independent variables in the dichotomous form were the level of education ("≤High School" or ">High School"), the type of family ("nuclear family" or "extended family"), the type of workplace ("Industry" or "office") and lactation breaks ("yes" or "no").

The independent and dependent variables were statistically analyzed using the statistical software Chi-square test. The univariate analysis described data based on quantitative amounts and percentages. The bivariate analysis was used to determine the relationship between education level, type of workplace, time of lactation, and type of family. When the analysis results showed that the variable with a p-value <0.25 was included in further tests using Logistic Regression with the forward method. The stages are carried out by entering variables gradually based on the most significant partial correlation. The process is stopped when the new variables cannot increase the effective contribution significantly (sig below 0.05).

The logistic regression was used as a type of determinant to determine the dominant factors influencing the occurrence of work stress. In the results section, additional information was provided to explain individual characteristics such as the age of the respondent, the age of their children, and locations. Data collection was carried out after obtaining approval from the Ethics Committee of the Faculty of Health Sciences, Syarif Hidayatullah State Islamic University Jakarta, with letter number: (Un.01/F.10/KP.01.1/KE.SP/06.08.017/2022.

## RESULTS

This study aimed to explore the related factors of work stress among breastfeeding working women, including education level, type of family, workplace, and lactation breaks. A total of 162 breastfeeding working mothers voluntarily participated in this study. Table 1 showed the results of the univariate descriptive analysis.

**Table 1. Characteristics of Respondent**

| Characteristics | n = 162 | % |
|---|---|---|
| **Mother's Age** | | |
| Young (< 32.67 years old) | 82 | 50.62 |
| Old (≥ 32.67 years old) | 80 | 49.38 |
| **Child Age** | | |
| 0 – 6 mos | 26 | 16.00 |
| 7 – 12 mos | 38 | 23.45 |
| > 12 mos | 98 | 60.55 |
| **Education** | | |
| Low (≤ High School) | 44 | 27.16 |
| High (≥ Diploma) | 118 | 72.84 |
| **Location** | | |
| DKI Jakarta | 12 | 7.40 |
| West Java | 5 | 3.08 |
| Banten | 102 | 62.96 |
| Lampung | 34 | 20.98 |
| North Sumatera | 6 | 3.70 |
| Aceh | 1 | 0.62 |
| West Nusa Tenggara | 1 | 0.62 |
| South Sulawesi | 1 | 0.62 |
| **Family Type** | | |
| Extended Family | 85 | 52,46 |
| Nuclear Family | 77 | 47.54 |
| **Workplace Type** | | |
| Industry | 69 | 42.59 |
| Office | 93 | 57.41 |
| **Lactation Breaks** | | |
| No | 22 | 13.58 |
| Yes | 140 | 86.42 |
| **Work Stress** | | |
| Low (< 18,69) | 77 | 47.53 |
| High (≥ 18,69) | 85 | 52.47 |

Source: Primary Data, 2022

The result showed that out of 162 respondents, 82 (50.62%) were young women, with an average age of under 32.67 years. A total of 98 respondents (60.55 %) had children over 12 months old, while 118 (72.84%) had a high level of education. The average number of respondents who lived in Banten Province was 102 (62.96%). Furthermore, the majority of respondents (52.46%) had extended family, and 93 (57.41%) reported working in offices as their primary place of employment.

The majority of respondents (86.42%) had lactation break facilities, which included special rest periods for lactation activities at various facilities at work. According to the survey, 85 respondents (52.47 %) reported high levels of work stress.

Table 2 showed a perception analysis based on the workplace stress scale instrument to determine trends in each statement item. Based on the results, for the statement item "Conditions at work were unpleasant or sometimes unsafe". The total mean score was 1.74, indicating that most respondents perceived their workplace as comfortable and safe.

Regarding the statement item "Work negatively affecting my physical or emotional well-being", the average score was 1.54. This indicated that most respondents perceived their workplace as having a positive influence on their physical and mental health.

According to the statement item "much work to do in a short time", the total average score of answers was 2.41. This showed that the majority of respondents perceived their workload as manageable within safe limits.

The total average score was 1.96 on the statement that "it is difficult to express my opinion or feelings about my work conditions to my superiors". This indicated that the majority of respondents exhibited an easy perception of expressing opinions and feelings about working conditions to their superiors.

The average total score was 1.64 for the statement that "work pressure affects personal and family life". This showed that the majority of respondents perceived no conflict between work and personal life.

Regarding the statement item "able to control and provide input on tasks to be performed", the mean total score was 3.5. This showed that the majority of respondents possessed the ability to control and provide their input during work.

The average total score was 3.07 for the statement item "there is an appropriate recognition and rewards if they give a good performance". This showed that the majority of respondents received rewards and recognition after performing well at work.

In the statement item "able to make the most of their abilities and talents at work", the average total answer score was 2.83. This indicated that the majority of respondents did not get the opportunity to make the most of their abilities and talents at work.

**Table 2. Perception of Respondents About Work Stress**

| Statement | Responds (%) | | | | | Mean | SD |
|---|---|---|---|---|---|---|---|
| | Never | Rarely | Someti mes | Often | Very Often | | |
| Conditions at work are unpleasant or sometimes even unsafe. | 50.6 | 25.3 | 23.5 | 0.6 | 0 | 1.74 | 0.84 |
| I feel that my job is negatively affecting my physical and/or emotional well-being. | 64.2 | 19.8 | 14.2 | 1.2 | 0.6 | 1.54 | 0.83 |
| I have too much work to do and/or too many unreasonable deadlines | 29.0 | 16.0 | 42.6 | 9.9 | 2.5 | 2.41 | 1.08 |
| I find it difficult to express my opinions or feelings about my job conditions to my superiors | 43.8 | 21.0 | 31.5 | 2.5 | 1.2 | 1.96 | 0.98 |
| I feel that job pressures interfere with my family or personal life. | 58.6 | 22.2 | 16.0 | 2.5 | 0.6 | 1.64 | 0.88 |
| I have adequate control or input over my work duties | 5.6 | 12.3 | 37.7 | 15.4 | 29.0 | 3.5 | 1.19 |
| I receive appropriate recognition or rewards for good performance. | 7.4 | 27.2 | 32.1 | 17.9 | 15.4 | 3.07 | 1.17 |
| I can utilize my skills and talents to the fullest extent at work. | 8.6 | 32.7 | 33.3 | 17.9 | 7.4 | 2.83 | 1.06 |

Source: Primary Data, 2022

Based on Table 3, the results of bivariate analysis using the Chi-square technique showed that the level of education had a significant relationship with Work Stress with *p-value* = 0.002 and Odds Ratio (OR) 3.27. This indicated that respondents with low education levels were three times more likely to experience work stress compared to those with a higher education level.

The type of family had a significant relationship with work stress at *p-value* = 0.002 and OR 2.872. This indicated that respondents living with their extended family in the same house were three times more likely to experience work stress compared to those with nuclear family.

The analysis of the type of workplace showed that the variable had a significant relationship with work stress with *p-value* = 0.039 and OR 2.008. This indicated that respondents working in the industry were two times more likely to experience work stress compared to those in offices.

The analysis of the lactation breaks showed a significant relationship with the work stress with *p-value* = 0.005 and OR 4.903. This indicated that respondents working in the industry were more prone to work-related stress compared to those in offices by four times.

The multivariate analysis presented in Table 4 showed that the variable most significantly related to the incidence of work stress in breastfeeding working women was the type of family. In contrast, lactation breaks, type of workplace, and education of women were controlling variables. The results also showed that the Adjusted Odds Ratio (aOR) for this type of family was 2.14 (95% CI: 1.058 – 4.325). This indicated that breastfeeding working women living with extended family had a risk of experiencing work stress two times higher compared to with nuclear family after controlling by variables of lactation breaks at work, type of workplace, and education level.

## DISCUSSION

This study showed that the prevalence of work stress among breastfeeding working women in Indonesia was relatively high. This number was higher compared to another investigation in Florida, where an elevated level of work stress was observed among female doctors with breastfeeding status.[8]

The result also showed that the return of a new mother to work triggered stress due to several events, such as psychosocial stressors from the work environment and social life. The stigma of breastfeeding in public spaces, particularly at work, often resulted in embarrassment. This phenomenon contributed to a decrease in the productivity of breastfeeding, which became a burden for other co-workers to take over the job.[15] However, when lactation support was available at work, there was a decrease in stress levels. The productivity of these women also increased, as there was no hindrance in returning to work after maternity leave.[16]

This study also found that perception about using their skill and talents at work was psychosocial stress among breastfeeding working women. In this case, granting workers greater control over their working time and facilities provided by the company to support lactation activities helped to mitigate work stress.[17]

**Table 3. Results of Bivariate Analysis with Chi-Square**

| Variable | Work Stress | | | | *p-value* | OR |
| | High | | Low | | | |
| | n = 85 | % | n = 77 | % | | |
|---|---|---|---|---|---|---|
| **Education** | | | | | | |
| Low (≤High School) | 32 | 72.72 | 12 | 27.28 | 0.002* | 3.270 |
| High (≥ Diploma) | 53 | 44.91 | 65 | 55.09 | | |
| **Family Type** | | | | | | |
| Extended Family | 55 | 64.70 | 30 | 35.30 | 0.002* | 2.872 |
| Nuclear Family | 30 | 39.00 | 47 | 61.00 | | |
| **Workplace Type** | | | | | | |
| Industry | 43 | 62.31 | 26 | 37.68 | 0.039* | 2.008 |
| Office | 42 | 45.16 | 51 | 54.84 | | |
| **Lactation Break** | | | | | | |
| No | 18 | 81.81 | 4 | 18.19 | 0.005* | 4.903 |
| Yes | 67 | 47.85 | 73 | 52.15 | | |

Source: Primary Data, 2022

**Table 4. Multivariate Analysis of Factors of Work Stress among Breastfeeding Working Women**

| | B | S.E | Sig | Adjusted OR | 95% CI for Exp (B) | |
| --- | --- | --- | --- | --- | --- | --- |
| | | | | | Lower | Upper |
| Lactation Breaks | 0.911 | 0.653 | 0.163 | 2.488 | 0.691 | 8.954 |
| Workplace Type | -0.210 | .0456 | 0.645 | 0.811 | 0.332 | 1.981 |
| Education | 0.721 | .0551 | 0.190 | 2.057 | 0.699 | 6.057 |
| Family Type | 0.760 | 0.359 | 0.034 | 2.139 | 1.058 | 4.325 |
| Constanta | -0.495 | 0.249 | 0.046 | 0.610 | | |

Source: Primary Data, 2022

Each worker exhibited a different capacity for the level of stress. However, one common issue with women was the conflict relating to the time at work and family due to the various roles and increasing responsibilities.[15,18,19]

The results indicated that the family type variable predominantly influenced the occurrence of work stress among breastfeeding working women. Subsequently, this led to the statement item "How is the influence of level of education, type of family, workplace, and lactation breaks on work stress among breastfeeding working women?". To answer this question, some underlying reasons were made.

**Level of Education**

This study found that the education level of the mother did not have a significant effect. However, it significantly controlled the variables affecting work stress. According to Ornek, education level was significantly related to breastfeeding and work stress management.[20] This phenomenon occurred because mothers with higher education sought information from various sources, including ease of access and accuracy of the information to increase the duration of breastfeeding compared to those with middle or lower levels of education.[21]

According to a previous investigation, mothers with a low education level believed that when a baby was given formula milk, it showed the established economic level of the family. These mothers were easily influenced by various advertisements for formula milk to replace the role of breast milk. Based on an assumption, breastfeeding while working was also found tricky, increasing stress and discouraging working women.[22]

Interventions to increase the knowledge of working mothers increased the ability of female workers to cope with their stressors.[23]

**Family Type**

This study found a significant relationship between the type of family and work stress among breastfeeding working women. The results showed that characteristics of the family type affected work stress.

A new mother faces several situations that cause stress during events or life changes. The type of family can also be a factor contributing to vulnerability and disruption between interactions. This is because a household with a baby needs the utmost support from its family.[24,25]

The results showed that living only with their husbands significantly related to the motivation and readiness of mothers for exclusive breastfeeding. According to a previous study, support from other family members was essential in breastfeeding and raising a baby, particularly from the mother-in-law.[26] When mothers or in-laws live together, it can create an environment that helps in coping with stress due to shared breastfeeding experiences. However, there is a tendency for negative impacts when the mother/in-law does not understand the concept of exclusive breastfeeding and lactation management.[22]

Other studies present a different perspective, emphasizing that support from extended families is rarely found in this modern era. The role of the nuclear family, including the husband as a new father, is the primary support for the success of exclusive breastfeeding. In correlation to the previous variable, other investigations also added that the higher education level of a woman and the husband will result in separate living from their families, leading to limited reliance on family support.[27]

**Type of Workplace**

According to this study, the type of workplace did not have a significant relationship with the prevalence of work stress among breastfeeding working mothers. Accord-

ing to the responses to the job stress question in the workplace condition perspective item, workers feel comfortable working and believe that work pressure does not affect their physical or mental health. In addition, working conditions did not adversely affect individual needs, mainly regarding breastfeeding while working.

However, several previous studies also stated that types of workplaces, both in offices and industry, have low breastfeeding coverage rates. Women working in offices were often tasked with doing administrative work. According to Lauer, 70.6% of working mothers in various industries planned to provide breastfeeding until the baby was two years old or older, but only a 10.7% success rate was recorded.[28] This number included mothers working in an office and those who know the breastfeeding-friendly policies of their companies.[29,30]

Women working in industries exhibited low lactation time flexibility, education level, shift-based work, and additional bonuses, depending on the group productivity. This phenomenon was related to the previous investigation, where women working in offices tended to have higher education levels (73%) compared to those in a factory (51.48%).[21]

The different characteristics between industrial and office workplaces in providing space for breastfeeding working mothers will be rooted in the organizational culture in any workplace category. Organizational culture can have an impact on increasing breastfeeding in the workplace, which ultimately has an impact on the prevalence of work stress among breastfeeding working mothers.

Another study stated that working mothers, particularly those who breastfeed, can reduce their stress levels by properly organizing work and family matters well, as well as avoiding blaming others. This can also be contradictory when the role of working women requires more flexibility and a higher workload due to the inability to perform multiple roles.[5]

**Lactation Breaks**

This study found no significant relationship between the availability of lactation breaks and work stress. The availability of working time became a controller of the influential variable.

However, the absence of facilitated lactation breaks at work increased the emergence of work stress due to the perceived psychosocial stressors of respondents at work. This phenomenon occurred because the high workload that had to be completed prevented workers from pumping breast milk during working hours.[31]

According to Gergel, work stress experienced by respondents was related to support for breastfeeding working women, whether there was sufficient time to carry out lactation activities at work.[32]

The ideal lactation time at work should consider the length of breastfeeding interval allowed in a certain period, frequency, and duration. Furthermore, the conditions should consider whether lactation time is among working hours, or there will be a loss of income. There is a need to support and make it easier for breastfeeding working women to carry out their roles while balancing work and breastfeeding.[15]

**CONCLUSION AND RECOMMENDATION**

This study discovered that the problem of job stress is a direct result of workplace stresses owing to demographic characteristics, particularly among breastfeeding mothers. According to the study, family type is critical in preventing job stress among breastfeeding women. The mother's decision to reside with the nuclear family and apart from the extended family is critical in preventing job stress, particularly the effect on the mother/in-law. However, further study is needed to determine the impact of living with a large family on preventing work stress, particularly in working moms who are breastfeeding.

The workplace can also play a crucial role in supporting working women by providing breastfeeding facilities to avoid stress. This included providing of a lactation room and time to express breast milk during work.

**AUTHOR CONTRIBUTIONS**

## CONFLICTS OF INTEREST

The authors have no conflicts of interest associated with the material presented in this paper.

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# Spatial Analysis of Diarrhea Incidences, Environmental Influences, and Behavioral Factors in An Ecological Study

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**ABSTRACT**

Diarrhea is a global health problem that causes morbidity and death in all age groups. Among the cities in Indonesia, Depok has the second-highest incidence of diarrhea outbreaks. Although previous studies have shown the correlation between diarrhea and environmental and behavioral factors, the spatial analysis of these factors is still very limited. Therefore, in this study, we investigated the spatial analysis of the association between diarrhea incidence and environmental and behavioral factors using an ecological study. The secondary data from the Depok City Health Office were used in the analysis. Our results showed a significant relationship between proper drinking water coverage ($p$ = 0.00; r = -0.289) and healthy latrine coverage ($p$ = 0.02; r = -0.233) with the incidence of diarrhea. Meanwhile, household coverage of Clean and Healthy Behavior (*Perilaku Hidup Bersih dan Sehat (PHBS)*) and population density showed no significant association. Spatial analysis maps also revealed the distribution pattern of diarrhea in Depok City from 2013 to 2021, tending to be more common in areas with low coverage of adequate drinking water. The findings from this study will contribute to optimizing diarrhea control and prevention programs.

## INTRODUCTION

Diarrhea is a disease characterized by more frequent bowel movements compared to the normal frequency and produces stools with a more liquid consistency.[1] Diarrhea is still one of the global public health problems that never end. In the world, 1.7 billion cases of childhood diarrhea are found each year.[1] Diarrhea is also an increasing burden of disease in elderly.[2] Referring to the 2018 Primary Health Research data, the prevalence of diarrhea in Indonesia was 6.8% for all ages and 11% for toddlers.[3] The province in Indonesia with a high incidence of diarrhea is West Java. The prevalence of diarrhea in West Java is 7.4% for all age groups and 12.8% for children under five, both of which are still above the national prevalence.[4] Depok City is one of the West Java areas facing diarrhea problems. Depok City has experienced diarrhea outbreaks in 2018 and 2021.[5,6] Diarrhea is also included in the top 15 most common diseases at public health centers and hospitals in Depok City.[7,8]

Diarrhea is often associated with environmental factors such as drinking water quality and basic sanitation conditions.[9] Poor access to drinking water is associated increased disease cases, especially waterborne diseases such as diarrhea, cholera, and typhoid.[10] Open defecation also leads to fecal contamination of water and food, potentially resulting in diarrhea.[11] The combination of a contaminated environment and unhealthy behavior also causes diarrhea. Hygiene and health behaviors such as washing hands with soap and clean water, using healthy latrines, implementing waste management, using clean water, and handling food correctly are also correlated with diarrhea prevention.[12] In addition, high population density results in poor environmental conditions that increase the potential for diarrhea transmission.[13]

While previous studies have established a correlation between diarrhea and environmental and behavioral factors, the spatial analysis of these variables remains limited. Notably, Depok City ranks second in terms of diarrhea incidence, with certain areas still facing challenges such as improper access to drinking water and insufficient availability of healthy latrines.[6] Therefore, this study focuses on investigating the spatial analysis of the association between diarrhea incidence and environmental and behavioral factors in Depok City.

## MATERIAL AND METHOD

This research is a quantitative study using ecological study design. The independent variables consisted of exposure behavioral factors (households with *PHBS* coverage and population density) and environmental factors (proper drinking water coverage and healthy latrines coverage), while the dependent variable was the incidence of diarrhea. The research was conducted in Depok City with the research population of all diarrhea patients recorded by the Depok City Health Office during 2013-2021. The data used were secondary data from the Depok City Health Office.

The analysis conducted in this study was bivariate analysis and spatial analysis. Bivariate analysis is correlation test used Spearman test because the diarrhea incidence data were not normally distributed. Spatial analysis used overlay method which integrates data from different layers to produce a new map containing the results of the analysis. The data on the independent variable and the dependent variable were grouped into three categories-namely low, medium, and high-using the Natural Breaks (Jenks) method for the spatial analysis. This research has undergone ethical screening by The Research and Community Engagement Ethical Committee of FKM UI and has obtained Ethical Approval with number: Ket-180/UN2.F10.D11/PPM.00.02/2023.

## RESULTS

The results of spatial analysis between households with *PHBS* coverage and incidence of diarrhea showed a varied distribution pattern. Sawangan District has a relatively high incidence of diarrhea with low coverage of households with *PHBS*. Sukmajaya and Pancoran Mas Districts experienced a fluctuating incidence of diarrhea even though both districts had a high coverage of households with *PHBS*. Therefore, there is no consistent pattern of relationship between the two variables (Figure 1).

The spatial analysis result between population density and diarrhea incidence showed a varied distribution pattern. Sukmajaya and Cipayung Districts experienced fluctuating diarrhea incidence despite having high

population density. Meanwhile, Sawangan District with a low population density experienced a higher incidence of diarrhea. Therefore, there is no consistent pattern of relationship between the two variables (Figure 2).

The spatial analysis result between the proper drinking water coverage and incidence of diarrhea had a varied distribution pattern in each year, but showed a tendency of a negative relationship. Cinere District, which almost every year is always included as a district with high proper drinking water coverage, has the lowest incidence of diarrhea. Sawangan and Cimanggis Districts, which are in the low and medium proper drinking water coverage, have a relatively higher incidence of diarrhea (Figure 3).

The spatial analysis result between healthy latrines coverage and incidence of diarrhea showed a varied distribution pattern. Pancoran Mas District has a high incidence of diarrhea with low coverage of healthy latrines. However, Tapos, Sukmajaya and Cimanggis Districts still have a high incidence of diarrhea despite having high healthy latrines coverage. Therefore, there is no consistent pattern of association between the two variables (Figure 4).

The correlation between diarrhea incidence with environmental and behavioral factors is shown in Table 1. Our results showed a significant negative correlation between proper drinking water coverage and healthy latrines and the incidence of diarrhea, indicating that an increase will follow a decrease in these variables. On the other hand, households with PHBS coverage and population density did not have a significant relationship with diarrhea incidence (Table 1).
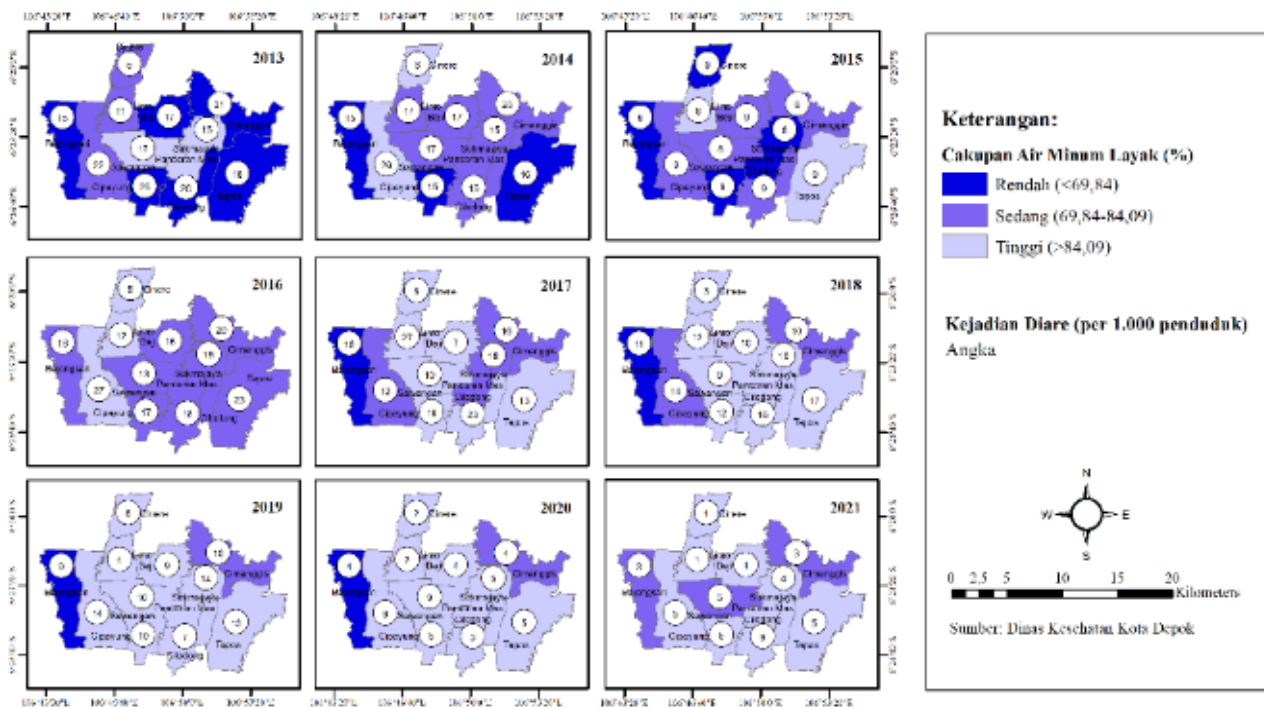


Source: Secondary Data of the Depok City Health Office, 2013-2021

**Figure 1. Spatial Analysis Map of Households with *PHBS* Coverage and Diarrhea Incidence in Depok City 2013-2021**
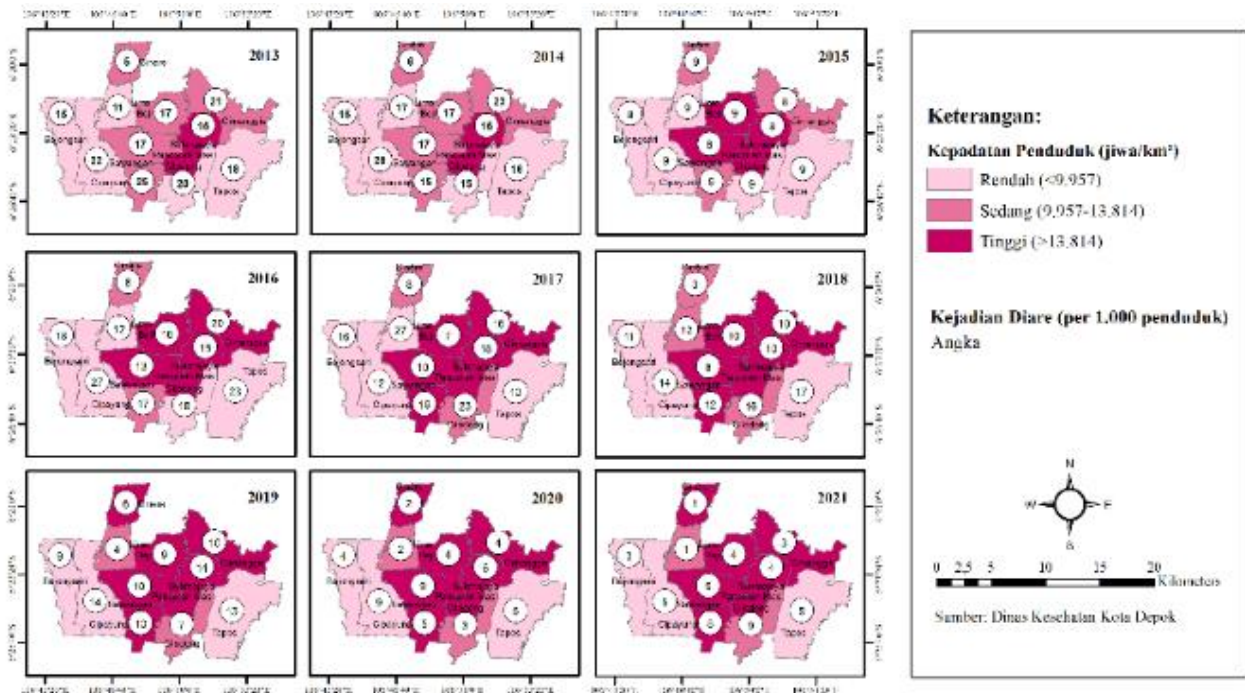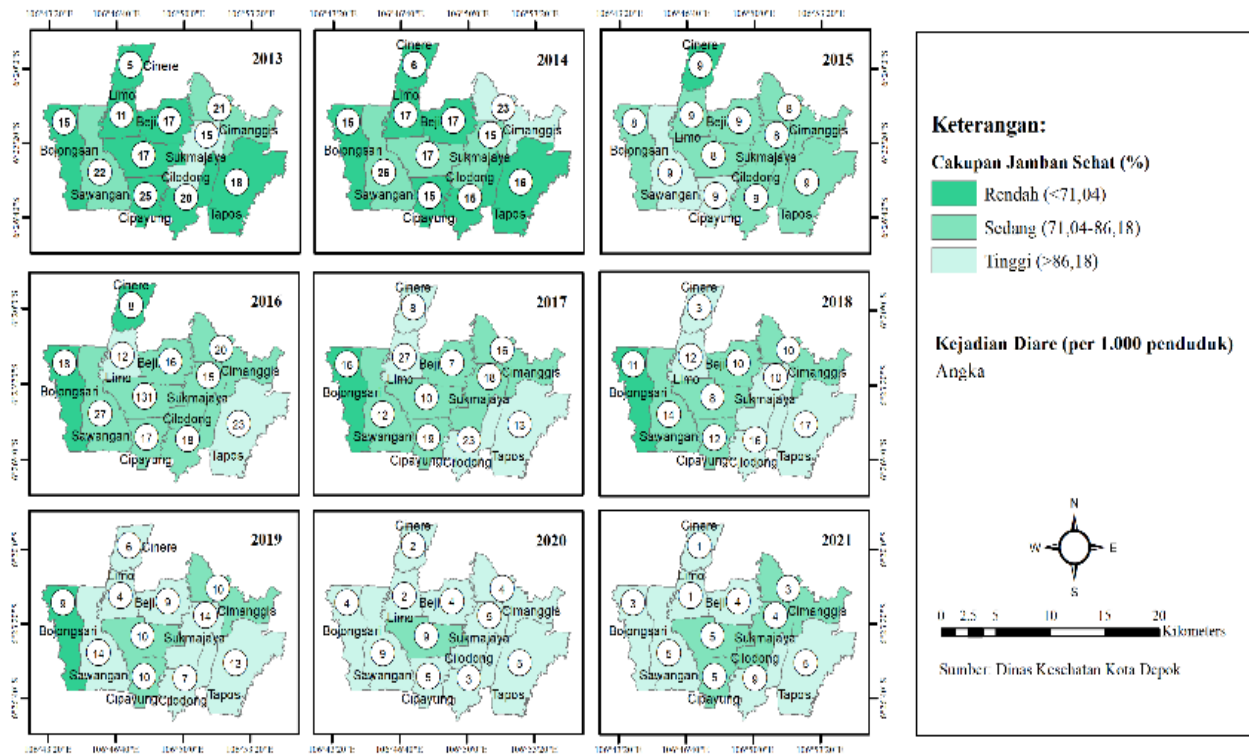
Source: Secondary Data of the Depok City Health Office, 2013-2021

**Figure 2. Spatial Analysis Map of Population Density and Diarrhea Incidence in Depok City 2013-2021**



Source: Secondary Data of the Depok City Health Office, 2013-2021

**Figure 3. Spatial Analysis Map of Proper Drinking Water Coverage and Diarrhea Incidence in Depok City 2013-2021**

Source: Secondary Data of the Depok City Health Office, 2013-2021

**Figure 4. Spatial Analysis Map of Health Latrines Coverage and Diarrhea Incidence in Depok City 2013-2021**

## DISCUSSION

This study aimed to investigate the association between diarrhea incidence and environmental and behavioral factors. Our results revealed a significant correlation between proper drinking water and the incidence of diarrhea in Depok City. Diarrhea is a disease known to be transmitted through the fecal-oral route, with water playing a crucial role as a transmission medium.[10] Groundwater, commonly used as a drinking water source in Depok City, may naturally contain germs and harmful chemicals. Human activities further exacerbate contamination.[25] Therefore, effective drinking water management, including water treatment and storage, is crucial to ensure water safety for human consumption. Simple treatment methods such as boiling water, filtration, coagulation to collect particles causing turbidity, chlorination, and disinfection to destroy unfiltered microorganisms are essential.[19] Proper drinking water storage involves storing water in a safe, enclosed place and placing water storage containers in a clean environment.[21]

**Table 1. The Correlation Between Diarrhea with Environmental and Behavioral Factors in Depok city**

| Variables | r-value | p-value |
|---|---|---|
| Household with *PHBS* | 0,083 | 0,41 |
| Population density | 0,047 | 0,64 |
| Proper drinking ater | -0,289 | 0,00* |
| Healthy latrines | -0,233 | 0,02* |

*Statistically significant
Source: Secondary Data of the Depok City Health Office, 2013-2021

In addition to proper drinking water coverage, our results demonstrated a significant correlation between healthy latrine coverage and the incidence of diarrhea. Open defecation poses a high risk of water source pollution, while healthy latrines offer a solution to prevent contamination.[26,27] Conversely, latrines that do not meet health requirements can increase the potential for diarrhea transmission.[26] Healthy latrines represent a manifestation of sanitary sanitation facilities-facilities that prevent direct transmission through proper feces disposal and inhibit disease vectors from spreading to users and the surrounding environment. Therefore,

the use and maintenance of healthy latrines are crucial to prevent the transmission of diarrhea and other diseases within the community.[21]

In this study, other variables, including households with *PHBS* and population density, do not show a significant correlation with diarrhea incidence. *PHBS* itself consists of 10 indicators, namely, labor assisted by health workers, exclusive breastfeeding, regular weighing of babies and toddlers, handwashing with soap and clean water, use of clean water, use of healthy latrines, consumption of fruits and vegetables, eradication of mosquito larvae, daily physical activity, and not smoking at home.[14] However, previous studies indicate that among these indicators, only handwashing, using healthy latrines, and using clean water have shown a correlation with diarrhea.[15-19] The Indonesian Ministry of Health has implemented the Community-Based Sanitation (*Sanitasi Total Berbasis Masyarakat/STBM*) program as an approach to reduce diarrhea and other environment-based diseases related to behavior and sanitation.[20] *STBM* is designed to strengthen clean and healthy behavior, prevent the spread of environment-based diseases, improve community capabilities, and increase access to drinking water and basic sanitation.[21] Some of the pillars promoted in the STBM program align with the household setting indicators of *PHBS*, such as stopping open defecation, washing hands with soap, and handling drinking water and food properly.[22] Therefore, the promotion of clean and healthy behaviors should consistently be enforced as a supportive measure to strengthen the sustainability of diarrhea prevention programs.

Densely populated areas have the potential to give rise to slums, contributing to environmental degradation. A poor environment can impact the transmission of diseases, making areas with high population density more susceptible to disease transmission, including diarrhea.[23] The construction of septic tanks is often constrained in densely populated area leading to them being situated close to drinking water sources. Septic tanks that do not adhere to construction requirements can contaminate groundwater, which is then consumed by the population.[13] Another prevalent issue in densely populated areas is waste management. With the increase in population, the volume and diversity of garbage rise. Improper disposal practices, such as piling up garbage or throwing it into waterways, lead to stagnant water bodies and rotting garbage. The decomposition of garbage attracts vectors like flies, which act as intermediaries for diarrhea transmission.[24] In light of these circumstances, it becomes evident that population density indirectly influences the incidence of diarrhea. The lack of a significant relationship between population density and diarrhea incidence may be attributed to other factors that hold a more dominant association with the occurrence of diarrhea.

## CONCLUSION AND RECOMMENDATION

In this study, the risk factors that exhibit a significant relationship with the incidence of diarrhea are proper drinking water coverage and healthy latrine coverage. However, the risk factors related to household *PHBS* coverage and population density did not show a significant relationship with the incidence of diarrhea. Spatial analysis results indicate a tendency for a negative relationship between proper drinking water coverage and the incidence of diarrhea. Using the results from this study, we recommend the optimizations of diarrhea control and prevention in each district through community empowerment and collaboration across sectors.

## AUTHOR CONTRIBUTIONS

Conceived and designed the study by BPA, RAW; BPA performed the study; BPA analyzed the data; BPA and RAW wrote the initial manuscript. FK review and editing the manuscript. The authors read and approved the final manuscript.

## CONFLICTS OF INTEREST

The authors declare no conflict of interest.

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