

HOUSE VENTILATION AREA AND COVID-19'S HOUSEHOLD TRANSMISSION IN THE REGION OF PEMURUS DALAM HEALTH CENTRE BANJARMASIN

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Abstract:

The occurrence of COVID-19 is still increasing, especially in Banjarmasin. The increasing number of COVID-19 cases is caused by several factors, including the presence of household transmission from COVID-19 patients to other people in their homes. This household transmission can be affected by the ventilation area of the house. This study aims to analyze the relationship between the area of house ventilation and the occurrence of COVID-19 transmission at home in the region of Pemurus Dalam Health Centre Banjarmasin. The research method was analytic observational with a cross sectional approach. The research sample was confirmed COVID-19 patients based on PCR results and recorded at the Pemurus Dalam Health Center. Sampling using simple random sampling technique with a sample of 50 patients. Data analysis used chi square test at 95% confidence level. The results showed that there were 26 people (76.4%) of the research subjects who lived in a house with a house ventilation area that did not meet the requirements ($<10\%$ of the house area). Meanwhile, in the research subjects who lived in houses with adequate ventilation area ($\geq 10\%$ of the house area) only 4 people (25%) had household transmission. The analysis results showed that there was a significant relationship between the ventilation area of the house and the occurrence of COVID-19 household transmission in the Pemurus Dalam Health Center area of Banjarmasin ($p = 0.001$ and RR 3.24).

Keywords: Ventilation Area; Household Transmission; Covid-19

Introduction

Corona Virus Disease-19 or abbreviated as COVID-19 is a disease caused by a new type of corona virus. COVID-19 is very contagious and can cause mild to severe symptoms. Transmission of COVID-19 occurs through droplets containing the SARS-CoV-2 virus that enters the body through the nose, mouth, and eyes. The virus that causes it has mutated several times. It was found that the virus will mutate or adapt to the human body, resulting in a very strong and infectious transmission. This viral infection can cause mild to severe symptoms. The COVID-19 outbreak was first declared by WHO as an emergency on January 30, 2020 and became a pandemic on March 11, 2020.^{1,2,3} There were 57,368 cases in March 2020, in April 2020 there were 73,537 cases, in May 2020 there were 115,919 cases, and continues to increase until the latest data from WHO shows that on December 5, 2020 globally there have been 65,257,767 cases of COVID-19 including 1,513. 179 deaths.⁴ As of December 1, 2020, there were 217 countries infected with SARS-CoV-2 with a total of 63.2 million cases and 1.5 million deaths since China reported its first case.^{5,6}

The COVID-19 pandemic began in Indonesia with the announcement of 2 confirmed cases. On March 26, 2020, there were 3,925 people who had been tested for COVID-19 and from these examinations, 893 people were confirmed positive and 3,032 people were confirmed negative for COVID-19.⁷ The increase in cases then continued to occur. According to data from the SATGAS COVID19, case reports in Indonesia as of December 7, 2020, to date there have been 575,796 cases with details of 474,771 recovered, 17,740 died, and 83,285 active cases. From these data, it can also be seen that people with COVID-19 according to age group, mostly at the age of 60 years as much as 37.2%, followed by the 46–50-year age range as much as 36.6%, then the 31-45 year age group as many as 16, 3%, 6.9% for young adults 19-30 years old, 2.1% for adolescents and 0.9% for children.⁴

For the most cases per province, it was found in DKI Jakarta Province with a total of 144,774 patients.⁸ Meanwhile in South Kalimantan Province the data on COVID-19 cases as of 7 December 2020 were 13,605, with details of 12,338 recovered, 541 died, and 728 active cases.⁹ In addition, South Kalimantan was ranked 6th out of the top 10 most COVID-19 cases on September 7, 2020 with details of the number of positive confirmed cases of 8,760, 6,802 patients recovered, followed by 370 patients who died, and 1,588 patients being treated.¹⁰ In Banjarmasin City alone, data on COVID-19 cases as of December 6, 2020 found 3,678 positive confirmations, with details of 3,377 patients recovering, 174 patients dying, and 55 active cases. The most COVID-19 cases in Banjarmasin City are in the Pemurus Dalam Health Center area, with 196 confirmed cases and 42 people under monitoring.¹¹

Rapid transmission of COVID-19 can occur from the patient to the people around him, one of which is influenced by the condition of the room where the patient is located. Transmission of the virus that causes COVID-19 occurs through droplets that come out of the patient when he coughs, sneezes or talks which can be transmitted directly to people who are nearby or also infect objects around him. Unhealthy home conditions, especially the lack of ventilation, cause air circulation in the house to be not good so that if there are COVID-19 patients in the house, the virus that is in the droplets will remain in the house which is very at risk of spreading to the other residents. Transmission through a closed room occurs due to several factors, such as the lack of ventilation in a room, the number of individuals in the room which will bring the distance of interaction between individuals closer. The area of ventilation has an effect on droplet travel and an increase in the number of viruses that cause easy transmission to people living in the same house with COVID-19 patients, either directly or indirectly through contact with objects contaminated by the virus that causes COVID-19.^{12,13}

Ventilation is beneficial for circulating air changes in the room and reducing humidity, it also affects the air dilution process, so that it will also dilute the concentration of germs (the number of droplet nuclei) in the air of the room, with ventilation it will be able to free the room air from pathogens because the airflow occurs continuously. Airborne pathogens will continue to flow, thereby reducing the number of airborne pathogens in the house and reducing the possibility of transmitting infectious diseases to the occupants of the house.¹⁴

Research Method

This type of research is analytic observational with a cross sectional approach. The research subjects were patients who were confirmed to have COVID-19 based on the results of the PCR examination and were declared positive and registered at the Pemurus Dalam Health Center in Banjarmasin for the period January-June 2021, aged 20-50 years. The number of samples is 50 people. Sampling using simple random sampling technique.

The independent variable in this study was the percentage of the ventilation area of the house compared to the area of the house, the requirements of a healthy house if the ventilation area is 10% of the house area and does not meet the requirements of a healthy house if <10% of the house area. Home ventilation in this case is all open windows, doors or vents. The dependent variable in this study was household transmission, categorized as present if there were household members other than the study subject who was also confirmed to have COVID-19 within 1-4 days after the study subject was confirmed to have COVID-19, and categorized as absent if there were no household members other than the subject. study confirmed COVID-19 within 1-14 days after the study subject confirmed COVID-19.

Data analysis using univariate analysis to describe the distribution of variables and bivariate analysis to see the relationship between ventilation area and COVID-19

household transmission, the analysis used the chi square test at a 95% confidence level.

Results

A study was conducted on 50 people with COVID-19 in the Pemurus Dalam Health Center area of Banjarmasin which were confirmed based on the results of the PCR test in the January-June 2021. The characteristics of the research subjects were based on age and gender as shown in tables 1 and 2.

Table 1. The characteristics of research subjects based on ages.

No.	Age	n	%
1.	20 – 30 y.o	20	40
2.	>30 – 40 y.o	15	30
3.	>40 – 50 y.o	15	30
Total		50	100

In table 1 it can be seen that more research subjects are at the age of 20-30 years who are young adults. This shows that more COVID-19 patients are young adults, because at that age they have entered a productive age who tend to be often involved in social activities and have high mobility, thus facilitating the transmission of COVID-19 in that age group. According to research by Elviani et al (2021), all ages are at risk of being confirmed positive for Covid-19, and productive ages are most at risk of COVID-19 due to high mobility and social activities. This can be prevented by continuing to follow health protocols. However, based on statistical tests, it was found that there was no significant relationship between age and the incidence of COVID-19.¹⁵

Tabel 2. The characteristics of research subjects based on genders.

No.	Gender	n	%
1.	Men	23	46
2.	Women	27	54
Total		50	100

Based on table 2, most of the research subjects are women. This result is in accordance with the study of Nia Ayun Putri et al (2021) which stated that women were more

infected than men.¹⁵ This study is in line with research conducted by Australia through the COVID-19 National Incident Room Surveillance Team 2021.¹⁶ However, this is different from the national COVID-19 data where data on COVID-19 patients by gender in Indonesia shows that the number of male patients exposed to cases COVID-19 is higher

than women (Task Force for the Acceleration of Handling COVID-19, 2020). Data as of May 28, the year of 2020 illustrates that as many as 55 percent of men are positive for COVID-19. This pattern occurs not only nationally, but also in the provinces in Indonesia.¹⁷

Table 3. The correlation between house ventilation area and household transmission of Covid-19 in the region of Pemurus Dalam Health Centre Banjarmasin

Ventilation Area		Household Transmission		Total	<i>p</i>	RR
		Yes	No			
Not Eligible	<i>n</i>	26	8	34	0,001	3,24
	(%)	76,4	23,6	100		
Eligible	<i>n</i>	4	12	16		
	(%)	25	75	100		

Based on table 3, it can be seen that most of the research subjects who live in homes with ventilation areas that do not meet the requirements (<10% of the area of the house) occur at household transmission to members of their residents (76.4%). Meanwhile, research subjects who live in a house with a ventilation area that meets the requirements, only a small percentage of transmission occurs at home (25%). The results of the chi square test obtained a *p* value of 0.001 which indicates that there is a significant relationship between the area of house ventilation and the occurrence of transmission of COVID-19 patients in the house to other residents in the house. The RR value of 3.24 indicates that COVID-19 patients who live in a house with a ventilation area that does not meet the requirements have a 3.24 times risk of transmitting it to people who live in the same house with them.

Discussion

Natural and simple ventilation that has been in the room can be found in the form of doors and windows. If this natural ventilation is opened, there will be circulation and renewal of the healthy air we breathe. The area of permanent natural ventilation is at least 10% of the floor area. Ventilation is a very important aspect, a very important factor

to prevent the spread of viruses indoors. Ventilation is beneficial for circulating air exchange in the room and reducing humidity, it also affects the air dilution process, so that it will also dilute the concentration of germs/viruses (number of droplet nuclei) in the air in the room. The existence of ventilation will be able to free the room air from pathogens because there is always a continuous flow of air. Airborne pathogens will continue to flow thereby reducing the number of pathogens in the air in the house and reducing the possibility of transmitting COVID-19 to the occupants of the house.^{13,14,18}

Ventilation is one of the important factors to prevent the spread of the Corona virus, especially indoors. The better the ventilation in a room, the less chance of transmission of the SARS-Cov2 virus.¹³ Based on the field observations, some of the houses of the research subjects have windows made of glass that cannot be opened (known as dead glass), so they cannot function as air vents. There were also many windows with some damage, such as broken hinges that could not be opened. This reduces the amount of ventilation area in the house.

The results of the e study are in accordance with the research of Senatore V et al, and Bhagat et al which showed that the risk

of transmission increases more quickly in people who stay indoors than people who are outdoors. This is because the increase in transmission through a closed room occurs due to several things, namely, air ventilation in a room, the number of individuals in a room so that the interaction is quite close.^{12,13}

According to the theory of Rajesh K. Bhagat, et al (2020), a room is turbulent where the room is a spatiotemporal variation of flow that is greater than the average flow. The condition of this room is very complex because it is also influenced by other temporary things, such as the movement of occupants, the opening and closing of doors, and the natural ventilation of the building. In addition, there are droplets carried by CO₂ that spread through a series of sizes that will evaporate and decrease over time. In theory, it is also stated that ventilation is inadequate when the carbon dioxide concentration is above 750 p.p.m. apart from several very complex factors, air flow will occur when ventilation is present. Ventilation will circulate cool air through the bottom and remove polluted warm air through the upper vent.^{13,19}

These results are in line with the research of Sulistiyani and Lamsidi (2005) who found that there was a relationship between the area of ventilation and the incidence of acute respiratory infections in students living together at the Sabila Muhtadin Islamic boarding school, Mentaya Hilir Selatan.²⁰ The study of Sultan et al (2021) showed that there was a significant relationship between the extent of home ventilation and the length of exposure to acute respiratory infections during the COVID-19 pandemic.²¹

Ventilation is beneficial for circulating air in the room and reducing humidity. Room humidity in the house is the water content in the air in the house, is considered eligible if the humidity ranges from 40-70%. High humidity will be a good medium for the growth and proliferation of pathogens.^{18,22}

In addition, through the open ventilation also allows sunlight into the house. Sunlight, especially ultraviolet light, has the property of

killing pathogens, including the virus that causes COVID-19. The virus that causes COVID-19 can only be killed by direct sunlight.^{6,14,22}

Conclusions

In COVID-19 patients who live in homes with non eligible ventilation areas, there are 76.4% of household transmissions. There is a significant relationship between the area of house ventilation and the incidence of transmission of COVID-19 at home in the Puskesmas Pemurus Dalam area of Banjarmasin ($p = 0.001$ and RR 3.24).

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