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ANALYSIS OF ROOM VENTILATION, CLEAN AND HEALTHY LIVING BEHAVIOR WITH UPPER RESPIRATORY TRACT INFECTION INCIDENCE

Analisis Ventilasi Kamar, Perilaku Hidup Bersih dan Sehat dengan Kejadian Infeksi Saluran Pernapasan Atas

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ABSTRACT

Background: Upper Respiratory Tract Infection (URI) is often experienced by Islamic boarding school students, who experience 30% of total reported URIs. This high incidence of URI can be caused by ventilation in students' rooms not meeting health requirements and poor implementation of Clean and Healthy Living Behavior (CHLB). **Purpose:** This study aims to analyze the risk level of ventilation and CHLB as pertains to URI incidence among Amanatul Ummah Surabaya Islamic Boarding School students. **Methods:** This research used an analytic survey design with a cross-sectional approach. The study population was 853 students. The sampling method used was proportionate stratified random sampling, yielding a sample of 207 students. Samples were taken through drawing the number of absences. The data were obtained by interviews utilizing CHLB questionnaires, field observation of ventilation, and observation of respondent's medical records to obtain information on the history of the URI. The data was analyzed via chi-square test ($\alpha=0.05$). **Results:** Respondents with room ventilation that did not fulfil requirements tended to experience URI 11.13 times more frequently than respondents with room ventilation that fulfilled the requirements, while respondents with poor CHLB tended to experience URI 7.15 times more often than respondents with good CHLB. The more ventilation did not fulfil the requirements and the poorer the implementation of CHLB, the more respondents tended to experience URI. **Conclusion:** The leader of Amanatul Ummah

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Surabaya Islamic boarding school was expected to be able to evaluate the construction of boarding schools, particularly with regard to ventilation, to fulfil the applicable health requirements and provide adequate CHLB facilities.

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ABSTRAK

Latar Belakang: Penyakit Infeksi Saluran Pernapasan Atas (ISPA) merupakan salah satu penyakit yang sering dialami oleh santri di pondok pesantren hingga mencapai angka 30.00% dari total kejadian. Tingginya angka kejadian ISPA dapat disebabkan oleh ventilasi kamar santri yang tidak memenuhi syarat kesehatan dan pelaksanaan Perilaku Hidup Bersih dan Sehat (PHBS) yang kurang baik. **Tujuan:** Penelitian ini bertujuan menganalisis tingkat risiko ventilasi dan PHBS terhadap kejadian penyakit ISPA di Pondok Pesantren Amanatul Ummah Surabaya. **Metode:** Penelitian ini menggunakan jenis penelitian survei analitik dengan pendekatan cross sectional. Populasi penelitian sebanyak 853 santri. Sampling menggunakan Proportionate Stratified Random Sampling dan diperoleh sampel sebanyak 207 santri. Sampel diambil melalui pengundian nomor absen santri. Data penelitian ini diperoleh melalui wawancara kuesioner PHBS, observasi lapangan luas ventilasi dan observasi buku rekam medis responden untuk mendapatkan informasi riwayat kejadian penyakit ISPA responden. Analisis data menggunakan uji chi-square ($\alpha=0.05$). **Hasil:** Responden dengan keadaan ventilasi kamar yang tidak memenuhi syarat cenderung mengalami ISPA 11.13 kali lebih besar dibandingkan responden dengan keadaan ventilasi kamar yang memenuhi syarat, dan responden dengan PHBS yang kurang baik cenderung mengalami ISPA 7.15 kali lebih besar dibandingkan responden dengan PHBS yang baik. Semakin ventilasi tidak memenuhi syarat dan semakin pelaksanaan PHBS kurang baik, responden cenderung mengalami ISPA. **Kesimpulan:** Pimpinan Pondok Pesantren Amanatul Ummah Surabaya diharapkan dapat mengevaluasi pembangunan pondok pesantren khususnya terkait luas lubang ventilasi agar sesuai persyaratan kesehatan yang berlaku dan menyediakan fasilitas PHBS yang memadai.

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INTRODUCTION

Upper Respiratory Tract Infection (URI) is a disease that attacks the upper or lower respiratory tract. It is usually contagious and can cause a variety of diseases, ranging from mild to severe and even fatal infections. URI is one of the deadliest infectious diseases in Indonesia, with a period prevalence percentage of 25.50% in 2007 and 25.00% in 2013, although it experienced a significant decrease in 2018 to 9.30%. In the same year, 2018, East Java Province was included in the ten provinces with the highest URI period

prevalence of 9.50% (Ministry of Health RI, 2019).

A high incidence of URI can also be found in Islamic boarding schools. The results of preliminary studies conducted by researchers at the Amanatul Ummah Surabaya Islamic Boarding School showed that URI is the disease most frequently experienced by students, at up to 30.00% of total incidences. This result was obtained from Islamic boarding school health care post (Poskestren) visitor data. Poskestren was a manifestation of a Health Efforts-based Community in the Islamic boarding school

environment, which prioritizes promotive and preventive services without neglecting the curative and rehabilitative aspects and operates with the assistance of the local Public Health Center (PHC). According to the responses obtained from the visitors log at the Poskestren of Amanatul Ummah Surabaya Islamic Boarding School from July–September 2018, out of 3,314 visitors, 1,015 (30.00%) were suffering from URI. More people were found to be suffering from URI than from any other disease, including dyspepsia (7.00%), scabies (5.60%), cephalgia (4.10%), diarrhea (3.20%), etc (Istifaiyah, Adriansyah, & Handayani, 2019).

Many factors can influence URI in Islamic boarding schools, including ventilation in student rooms and students' clean and healthy living behavior (CHLB). Students living in rooms with ventilation that did not meet requirements and students who exhibited poor CHLB tended to experience URI (Istifaiyah, Adriansyah, & Handayani, 2019). A study conducted by Safrizal (2017) found that a person living in a poorly ventilated area has a URI risk 2590 times greater than a person living with good ventilation.

Based on observations of researchers at the Amanatul Ummah Islamic boarding school in Surabaya, some students had room ventilation areas that were less than 10% of the floor area of the room; moreover, some rooms did not use a cross-ventilation system. In addition, some students had a habit of not opening curtains or ventilation regions, and there are also students who close the window with clothes hangers. This can disrupt air circulation in the student's room, increasing the likelihood of URI events (Istifaiyah, Adriansyah, & Handayani, 2019).

CHLB also contributes significantly to URI incidence. The results of a CHLB household survey based on East Java Province Health Profile 2017 showed a CHLB prevalence of 59.20%. This figure has increased by 5.38% from 2016. Moreover, the CHLB survey conducted in the Surabaya City area based on Health Profile 2017 showed that households had an average CHLB score of 72.60%. This figure has decreased by 3.53% from the previous year. The maximum implementation of CHLB has not yet affected the incidence of URI (East Java Provincial Health Office, 2019). As research conducted by Sutrisna & Wahyuni (2016) stated, a relationship exists between health behavior and URI incidence: specifically, the study shows that worse health behavior is associated with an increased incidence of URI. Based on the description above,

researchers were interested in analyzing how ventilation risk and CHLB levels are linked with URI incidence in students at the Amanatul Ummah Surabaya Islamic Boarding School.

METHODS

This study was an analytical survey adopting a cross-sectional approach to analyze the risk level of students' room ventilation and CHLB and their impacts on URI incidence in students at the Amanatul Ummah Surabaya Islamic Boarding School. The population of this study was students in an Islamic boarding school who were willing to participate; these numbered 853 students in total, consisting of 376 male students and 477 female students.

The sampling technique used was Proportionate Stratified Random Sampling. The researcher in this study determined the study population, namely students who live in the Islamic boarding school in question. The Amanatul Ummah Surabaya Islamic Boarding School has two separate buildings, one for male students and another for female students. To obtain data that can represent the population at the Amanatul Ummah Surabaya Islamic boarding school, the researchers took the samples from two buildings, each with a different number of rooms and students, such that the sample is stratified into male and female students. It is hoped that the conclusions from the study results can represent these two strata. The researcher drew students through their absences until a random and proportional sample was obtained of 207 students (91 male students and 116 female students). This research was carried out from 22 June 2019 until 2 July 2019.

Primary research data were obtained through clean and healthy living behavior questionnaire interviews and field observations of respondents' room ventilation. Ventilation in this research was assessed by comparing the score of the ventilation in the students' rooms with the Regulation of the Health Minister of the Republic of Indonesia Number 1077/MENKES/PER/V/2011. The following ventilation categories and criteria were used: "not eligible" if ventilation was <10% of the ground floor rooms and no cross-ventilation system was present, and "eligible" if ventilation was $\geq 10\%$ of the room floor area and a cross-ventilation system was present (Ministry of Health RI, 2011).

CHLB is a set of clean and healthy behaviors among students in Islamic boarding schools. These

include using clean water, washing hands using soap and clean water, not smoking, engaging in physical activity and eating fruits and vegetables. CHLB assessment used minimum value criteria = 0 and the maximum value = 17; this was further divided into categories of “poor” (if the values obtained were between 0–9) and “good” (if the values obtained were between 10–17). Secondary data were obtained through observation of the respondents’ medical record books to determine the respondents’ history of URI over the past year since the study was conducted (i.e., from July 2018–July 2019).

This research was certified as ethically cleared by the Universitas Airlangga Faculty of Dental Medicine Health Research Ethical Clearance Commissions, Number: 441/HRECC.FODM/VII/ 2019.

RESULTS

The total number of respondents in this study was 207, consisting of 91 male students and 116 female students. Respondents in this study fell almost entirely (79.71%) into the category of early adolescents aged 12–16 (165 students). Based on the length of stay in Amanatul Ummah Surabaya Islamic Boarding School, almost all respondents, (78.72%; 163 students) had lived in Islamic boarding schools for one to two years. This data was used by the researcher to more easily search the respondents’ URI data.

Overview of State of Ventilation, Implementation of Clean and Healthy Living Behavior and History of Upper Respiratory Tract Infection Incidence

The frequency of respondents’ distribution based on ventilation conditions, implementation of clean and healthy living behavior, and URI incidence is presented in Table 1. From the table, it can be seen that 73.90% of respondents live under a state of ventilation that does not fulfil requirements; specifically, these students’ rooms did not have a cross-ventilation system in place, and the ventilation hole area was <10% of the room floor area.

The ventilation conditions in the male and female student buildings were almost identical. The buildings were all located in urban areas and quite crowded, as well as located too close to the buildings next door. This also led to the condition of the Amanatul Ummah Surabaya Islamic boarding school building being more closed off in terms of ventilation. As a result, many of the

students’ rooms did not meet requirements, having no cross-ventilation system and a ventilation hole area that was <10% of the room floor area.

Moreover, 70.00% of respondents in this study participated in good clean and healthy living behavior implementation overall. Based on the results of the CHLB questionnaire interviews, most respondents still did not use clean water in their daily lives, did not engage in physical activity and did not participate regularly in sports; most respondents only engaged in moderate levels of CHLB activities, such as walking, sweeping and jogging. Most respondents also washed their hands using soap and clean water.

Furthermore, many of the respondents in this study did not smoke, although there were still a small number of students who smoked. Most respondents in this study also did not consume fruits and vegetables every day; this is possibly because the boarding school cafeteria does not provide a variety of fruits and vegetables. Based on secondary data from the respondents’ medical record books, 54.10% of respondents in this study had experienced URI in the past year.

Table 1
Frequency Distribution of Respondents based on Ventilation Conditions, Clean and Healthy Living Behavior Implementation and URI Incidence

Category	n	%
Room Ventilation		
Not eligible	153	73.90
Eligible	54	26.10
Clean and Healthy Life Behavior Implementation		
Poor	62	30.00
Good	145	70.00
History of URI Disease		
Did experience	95	45.90
Did not experience	112	54.10
Total	207	100.00

Overview of Risk Factors of Ventilation and Upper Respiratory Tract Infection Incidence

As can be seen from Table 2 above, the more the ventilation conditions of the respondent’s room did not meet requirements, the more likely respondents were to experience URI; moreover, the more the ventilation conditions of the respondent’s room met requirements, the less likely a respondent was to experience URI. Based on the *chi-square test*, the ventilation had a *p-value* amount of 0.01, such that *p-value* (0.01) < α (0.05). This means that a relationship exists between ventilation and URI incidence. Moreover,

the value of the *Prevalence Ratio* (PR) was 11.13, which means that respondents living in rooms that did not meet the ventilation requirements had an 11.13 times higher chance of experiencing URI compared to respondents who lived in rooms that met ventilation requirements.

Overview of Risk Levels of Clean and Healthy Living Behavior Implementation and Upper Respiratory Tract Infection Incidence

Based on Table 2, it can be determined that if the CHLB of the respondent was poor, the respondent was more likely to experience URI, while if the CHLB of the respondent was good, the respondent tended not to experience URI. Based on the *chi-square test*, CHLB had a *p-value* amount of 0.01, such that $p\text{-value} (0.01) < \alpha (0.05)$. This indicates that a relationship exists between CHLB and URI incidence. Moreover, the value of the *Prevalence Ratio* (PR) was 7.15; this indicates that respondents who exhibited poor CHLB had a 7.15 times higher chance of experiencing URI compared to respondents who implemented good CHLB. The implementation of CHLB could thus affect the physical condition and health of the respondent. Poor implementation of CHLB would cause the respondents' immune system to decline, making them more vulnerable to disease, especially URI.

DISCUSSION

Analysis of State of Ventilation, Implementation of Clean and Healthy Living Behavior and History of Upper Respiratory Tract Infection Incidence

The results showed that the majority of respondents lived under ventilation conditions that did not meet requirements (i.e., ventilation hole <10% of the room floor area and no cross-ventilation system in place). The results of this study are supported by research conducted by Suryani, Edison, & Nazar (2015), who stated that the majority (55.60%) of respondents in their research lived under ventilation conditions that did not meet requirements. Ibadurrahmi, Veronica, & Nugrohowati (2017) further stated that the majority (60.00%) of rooms had ventilation that did not meet health requirements.

Fitriyah (2016) stated that almost all (93.50%) of their respondents' home ventilation did not satisfy health requirements. Mayasari (2017) noted that the majority (63.70%) of 102

respondents in their study lived in homes where ventilation did not measure up to health requirements. Astuti (2018) also mentioned that the majority of respondents in a particular Islamic boarding school lived in rooms with ventilation conditions that did not fulfill requirements (55.60%).

Furthermore, it was also found that many ventilation holes in students' rooms were covered with paper, while the windows were also left unopened, meaning that sunlight could not enter the room and air exchange was processed less smoothly (Astuti, 2018). Surahmawati & Rusmin (2015) noted that ventilation holes were covered by fabric, causing air flow to be obstructed. Moreover, the close proximity to other buildings nearby caused the ventilation to be less functional, as airflow was blocked by the building next to it; in addition, the lack of a cross-ventilation system in many student rooms also caused the air circulation to become obstructed.

In their study, Machfutra, Noor, Luxiarti, & Mutmainah (2018) noted that almost all (90.00%) of study respondents closed off ventilation channels with books. Poor ventilation can also be seen as resulting from the behavior of respondents who do not open windows, especially during the day; this is caused by the higher temperature during the day, resulting in the room having poor air circulation. Areas of ventilation that were too small to meet requirements and closing off ventilation systems could also increase the humidity in the room and promote the growth of microorganisms that cause URI; thus, the URI incidence in respondents who inhabited such rooms could increase.

The majority of respondents in this study implemented good levels of CHLB. The results of this study were similar to the research conducted by Nadrati, Wijayanto, & Musniati (2019), who stated that the majority of respondents in Islamic boarding schools implemented good CHLB. Sutrisna & Wahyuni (2016) stated that the majority (59.00%) of respondents in the PHC of Rajagaluh (Majalengka district worker area) were found to engage in good levels of CHLB, while less than half (41.00%) of respondents in this area implemented poor CHLB. In their research, Fatmawati & Saputra (2016) also mentioned that the majority (78.60%) of respondents were found to execute CHLB quite well, but CHLB among almost half of the respondents was still found to be poor.

Table 2

Chi-Square Analysis of Room Ventilation and Risk Levels of Clean and Healthy Living Behavior with URI Disease in Respondents at Amanatul Ummah Surabaya Islamic Boarding School 2019

Categories of Ventilation	URI Disease				Total		P	PR (95%CI)
	Yes		No		n	%		
	n	%	n	%				
Room Ventilation								
Not eligible	89	58.00	64	42.00	153	74.00	0.01	11.13 (4.49 – 27.57)
Eligible	6	11.00	48	89.00	54	26.00		
Risk Level of Clean and Healthy Living Behavior								
Poor	48	77.00	14	23.00	62	30.00	0.01	7.15 (3.59 – 14.25)
Good	47	32.00	98	68.00	145	70.00		
Total	95	46.00	112	54.00	207	100.00		

Poor CHLB could be influenced by various factors; these might include students' lack of knowledge about CHLB, facilities that cannot adequately support CHLB, and the absence of CHLB implementation policies in Islamic boarding schools. The implementation of CHLB in this study was assessed through a focus on five behaviors, namely using clean water, washing hands using soap and clean water, not smoking, engaging in physical activities, and consuming fruits and vegetables (Istifaiyah, Adriansyah, & Handayani, 2019).

Based on the interviews conducted, it was determined that there were still a large number of students who lived around smokers (such as trustees, employees, and neighbors around the boarding school), meaning that respondents could be exposed to cigarette smoke in the vicinity. Saleh, Gafur, & Aeni (2017) mentioned that the majority of respondents (73.00%) had smoking habits that could be a source of pollutants in the home. Smoking behavior causes air pollution, which could increase the incidence of respiratory diseases. Pujiani & Siwiendrayanti (2017) state that there is a relationship between smoking behavior and URI incidence. Manca, Ratag, & Rattu (2017) further note that a significant relationship exists between smoking behavior and the incidence of URI.

The majority of respondents in this study had experienced a URI in the past year. Research conducted by Adriansyah (2017) states that URI is included in the category of diseases occurring with fairly high frequency, up to 25.50%; this is the result of poor CHLB and poor environmental sanitation. Astuti (2018) also states that the majority of students (64.80%) experienced URI. Sati, Sunarsih, & Faisya (2015) further mentioned that the majority (58.30%) of female students

experienced URI events. Mahendrayasa & Farapti (2018) reported that almost half of respondents experienced URI, while in the research of Jayanti, Ashar, & Aulia (2018), the majority (80.00%) of respondents experienced a URI. URI thus needs to be given special attention and treatment by the health authorities of the relevant institutions.

Analysis of Risk Factors of Ventilation and Upper Respiratory Tract Infection Incidence

The results showed that a significant relationship exists between ventilation and URI incidence in students at the Amanatul Ummah Surabaya Islamic Boarding School. The results also showed that the greater the extent to which the ventilation conditions of the respondents' rooms did not meet requirements, the more the respondents tended to experience URI; by contrast, the more the ventilation conditions of the respondents' rooms met requirements, the less likely respondents were to experience URI.

The results of this study are supported by research conducted by Mahendrayasa & Farapti (2018), who found a significant relationship between ventilation and URI incidence. Husna, Mahfuz, & Hayati (2015) and Ranti, Gunawan, & Subagiyo (2019) also stated that there is a significant relationship between ventilation and URI events in children. Safrizal (2017) and Fitriyah (2016) additionally found a significant relationship between house ventilation and URI events.

This study also follows the research conducted by Astuti (2018), which identified a significant relationship between the area of ventilation holes and the incidence of URI in the female dormitory at the Assalafi Al Fithrah Islamic Boarding School Surabaya. This study was also in line with research conducted by Suryani,

Edison, & Nazar (2015) stating that there was a relationship between ventilation and URI. Research conducted by Manese, Rata⁹ & Rattu (2017) also found a significant relationship between ventilation and URI incidence.

Findings regarding the state of ventilation in this study are consistent with the work of Astuti (2018), where most of the ventilation conditions in Islamic boarding schools were determined not to meet health requirements. Ventilation conditions that do not meet these requirements could cause oxygen (O₂) levels in the air to decrease and carbon monoxide (CO₂) gas levels to increase. Moreover, using the cross-ventilation system serves as a means to ensure the quality and adequacy of air circulation from inside to outside and from outside to inside the house is properly maintained, enabling the balance of oxygen (O₂) required by its inhabitants to be established (Yusuf, Sudayasa, & Nurtamin, 2016).

The respondents' behaviors regarding ventilation also requires attention. The ventilation holes in the students' room must always be open so that the natural ventilation process can run smoothly. Therefore, keeping ventilation open must become customary for students and supported by the teachers and leaders at Islamic boarding schools. In this way, the environment of Islamic boarding schools can hopefully become a healthy and comfortable environment in which students can learn (Istifaiyah, Adriansyah, & Handayani, 2019).

Overview of Risk Levels of Clean and Healthy Living Behavior on URI incidence

The results showed a significant relationship between the CHLB and URI incidence in students at the Amanatul Ummah Surabaya Islamic Boarding School. The results also showed that respondents exhibiting poor CHLB tended to experience URI, while those implementing good CHLB⁴ tended not to experience URI.

The results of this study are supported by research conducted by Sutrisna & Wahyuni (2016) stating that a relationship exists between health behavior and URI incidence. The study shows that worse health behavior is associated with increased URI. Poor CHLB causes the condition of respondents to be less clean and less healthy. These poorer conditions put the respondent at risk of contracting diseases such as URI. Poor CHLB implementation (such as not consuming fruits and vegetables and not engaging in physical activity) also causes reduction in immune system functionality, making respondents more vulnerable

to various types of disease (Istifaiyah, Adriansyah, & Handayani, 2019).

CHLB in the boarding school structure comprises several kinds of behavior that must always be performed in the Islamic boarding school community, especially by students. The CHLB examined in this study consisted of five behaviors that could be related to the incidence of URI. The implementation of CHLB in Islamic boarding schools will not necessarily be immediately successful; rather, it requires a joint determination between the students, administrators and leaders of Islamic boarding schools, the Poskestren, and the local PHC, which is equally important (Istifaiyah, Adriansyah, & Handayani, 2019).

Moreover, the Poskestren, as the coordinating institution of CHLB implementation in Islamic boarding schools, should engage in promotion and prevention services that do not overlook the curative and rehabilitative aspects of such behavior, with leadership from the local PHC (Ministry of Health RI, 2013). Promotion of CHLB can be carried out by Poskestren via provision of counselling to the students, giving out pamphlets, posters on walls, magazines, and similar interventions.

Research Limitations

Limitations faced by researchers in this study include the fact that students tend to be quite busy with various activities; this meant that researchers needed to take samples at night after all activities were complete, which was less conducive to the sampling process. Moreover, conducting sampling at night interfered slightly with students' rest periods, meaning that students did not concentrate fully on answering the questionnaires.

CONCLUSION

² A significant relationship was found between ventilation conditions and the incidence ⁷ URI. There is also a significant relationship between clean and healthy living behavior and URI incidence in students at the Amanatul Ummah Islamic Boarding School in Surabaya. The Islamic boarding school is expected to be able to evaluate the construction of boarding schools, particularly with regard to ventilation, in order to meet the applicable health requirements and provide adequate facilities for clean and healthy living behavior.

12

CONFLICT OF INTEREST

The authors declare that there was no conflict of interest in this study.

AUTHOR CONTRIBUTIONS

AAA was in charge of monitoring and coordinating research activities in journal making and data analysis. AI was tasked with preparing research activities, team secretary, and collecting research data. DH was assigned to investigating references and analyzing data.

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