Original Research

EPIDEMIOLOGICAL CONTACT (EPICONTACT) INVESTIGATION OF COVID-19 AT ISLAMIC BOARDING SCHOOLS IN KUNINGAN REGENCY, INDONESIA

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ABSTRACT

Introduction: COVID-19 has spread throughout the world with more than 61, 27 million patients infected, including in education clusters that implement boarding schools. Contact investigations on the cluster are necessary to control the spread of the virus. **Aims:** To describe the epidemiological contact pattern of investigation results in the Islamic Boarding School cluster in Kuningan Regency. **Methods:** The design of this study is descriptive with epidemiological approach. The population is all students of Pondok Pesantren X, as many as 164 students, a sample of 157 students who are positive for COVID-19, and research instrument for the COVID-19 outbreak is investigation form, the variables studied included age, gender, symptoms, duration of contact, number of contacts, number of contact groups and place of contact. **Result:** Univariate data analysis with epi-contact analysis show: sex: 33.3% male, 60.03% female, average age 15.05 years, the average number of contacts 3.25 people, the average number of male contacts 2.62 and female 3.39, number of male contact groups 41, number of female contact groups 91. Age of value p=0.037. **Conclusions:** Contact pattern conclusions are mostly in female with the number of contacts between 3-4 people and age is related to the number of contacts. Limiting contact when there is suspicion is necessary to prevent transmission.

Keyword: Epidemiology Close Contact, Contact Investigation, COVID-19

INTRODUCTION

The coronavirus illness 2019 (COVID-19), caused by the SARS-CoV-2 virus, is a pneumonia condition that became global in 2020. In December 2019, Wuhan, Hubei Province, China, became the site of the disease's initial discovery. The virus causes widespread human lung infection and has a detrimental effect on many aspects of life, particularly on physical and mental health. Between December 2019, the month of the initial COVID-19 patient discovery, and November 27, 2020, SARS-CoV-2 infected 61,277,488 people, with daily additions reaching +10,000 people and causing 1,436,796 deaths worldwide (OMS, 2022). Not only affecting the health aspect, COVID-19 also impacts the socioeconomic aspect of the population. Many people lost their job, which can have direct impact on household income. Decreasing of household income can impact on increasing the amount of poverty. Globally, poverty worldwide increased from 7.8% (before pandemic) to 9.1% (during pandemic). From the social challenge aspect, there occurred social inequalities between the stratum in society, such as low-skilled and high-skilled people, part-time and full-time worker, temporary and self-employed workers. Thus, COVID-19 leads the global burden around the world. The global burden can impact on the population in the future, such as economically, socially, etc.

In Indonesia, in the same period, there were 522,581 confirmed cases with daily additions reaching +5000 people and causing 16,521 deaths (COVID-19 Handling Task Force, 2022). The highest number is in DKI Jakarta Province contributing 20.8% of daily cases, followed by West Java province with 15.3% of cases (PIKOBAR, 2022). Cases in Kuningan Regency are among the highest cases, with this being the most with a prevalence rate of 14/1000 of the population. This is due to the existence of public places that have the potential to hold large crowds, such as Islamic boarding schools, schools, offices and so on. Rapid transmission in clusters is due to asymptomatic cases with an asymptomatic prevalence in various adult clusters of 29.48% and in children at 24.09% (Ravindra, Malik, Padhi, Goel, & Gupta, 2022).

There are social restrictions in place to stop the spread of the disease, one of which is in schools and Islamic boarding schools. However, there are still a number of Islamic boarding schools that do not stop their operations, and as a result, there are crowds in the Islamic boarding school environment, which leads to an increase in cases in the surrounding area. One of them was at the Husnul Khotimah Islamic boarding school which occurred in October 2020 with the number of confirmed people reaching 467 people from 1083 people in the PCR test (KompasTV Bandung, 2020). At the Al-Mutawally Islamic boarding school in Bojong Village, Cilimus District, the Islamic boarding school cluster later reappeared, and up to 102 students tested positive for COVID-19 (Baskara, 2020).

Therefore, to study, prepare, and implement interventions against the outbreak, epidemiologists need extensive contact data analysis tools. Cluster transmission investigations are also needed to determine contact patterns and analysis of disease outbreaks involving various tasks, from data collection to exploratory analysis (Randhawa, Campbell, Crellen, Sudre, & Jombart, 2019). COVID-19

cluster investigation method and guidance was determined by the WHO. The WHO reveals that cluster investigation aims to rapidly identify, test of suspected people, and isolate properly people who probable and confirmed cases. Thus, cluster investigation is needed by epidemiologist to finding cases (World Health Organization (WHO), 2020).

Furthermore, epidemiological modelling is used for event prediction (Funk, Camacho, Kucharski, Eggo, & Edmunds, 2018) or the impact of certain interventions. Currently, The timing of symptoms, the definition of the distribution of major delays (such as the incubation time, serial intervals, and data on patient contact) are all important aspects of epidemic study (Nouvellet et al., 2018). The latter type of information is crucial for outbreak analysis since it can help identify epidemic triggers and limit ongoing transmission by identifying new cases earlier (Nouvellet et al., 2015). Because students living in boarding schools are very vulnerable, not only to the transmission of the virus among students but also, in the end, transmission to their families after travelling (Cesilia, Sudarmaji, Setiabudi, & Nataprawira, 2021). Students living in boarding schools are a closed population because they will stay there with same group there. Thus, infecting each other is the common phenomenon in boarding schools.

The research gap is related with the many previous studies which reveal the risk factor of COVID-19. However, few studies explained the COVID-19 situation through figures on a map. This study reveals both the risk factor and mapping the COVID-19 situation. Using this study, the policy makers can know what are the significant factors related with the COVID-19 and can also imagine the COVID-19 situation through a map provided in this research.

COVID-19 infection is a possibility for students who interact with cases in Islamic boarding schools, especially close acquaintances who are not shielded. After a

COVID-19 patient receives a diagnosis, his close contacts are identified. These individuals may be local or non-local to the boarding school (Luo et al., 2020).

To our knowledge, Indonesians still only have a basic concept of epi-contact. To better understand epi-contact in Indonesia, it is crucial to identify this problem. Epi-contact is a summary of each person's relationship from the results of case tracing and close contacts or people who are physically close while they have the potential to spread from person to person with the aim of stopping the spread of COVID-19. (Wu, Wang, Nicholas, Maitland, & Fan, 2020). The purpose of this study is to determine how epi-contact is used, row lists, and contact data, as well as the basic functions for handling, visualizing, and analyzing epidemiological contact data on ongoing events.

METHODS
Study design

A descriptive research design with epidemiological approach was conducted on November 27, 2020.

Participants

The population is all students and teachers at Islamic boarding schools as many as 156 people. Sampling technique was with total sampling. A sample of 156 students who are positive for COVID-19 makes up the population of all students and teachers at Al-Mutawally, which is 156 students and teachers. The inclusion criterion was: Students and caretakers of Islamic boarding schools who have COVID-19 symptoms while at Islamic boarding schools. The exclusion criterion was: Invited guests visiting Islamic Boarding Schools.

Data collection

Data collection was carried out by interviewing through epidemiological investigations and contact tracing. The research instrument used is the COVID-19 outbreak investigation form from Ministry of Health (Ministry of Health RI, 2020). COVID-19 surveillance uses a more detailed case investigation form that includes information about specific risk factors, vaccinations or other methods of disease prevention, more detailed clinical information, and names or contact information for other potentially exposed people. Case investigation forms are completed by healthcare providers, by public health surveillance staff interviewing healthcare providers, or through abstraction of charts from information collected in patient history (Teutsch & Churchill, 2000).

Variables

The variables studied included age, sex, symptoms, duration of contact, number of contacts, number of contact groups and place of contact. Age is how long a person has lived according to the research. Male and female are the two primary categories (sex) into which humans and the majority of other living creatures are separated based on their reproductive capabilities. People with COVID-19 have reported experiencing a wide range of symptoms, from minor discomfort to serious sickness. Symptoms may start to show two to 14 days after virus contact. Anyone can experience minor to major symptoms. Fever or chills, coughing, shortness of breath or difficulty breathing, fatigue, muscle or body aches, headache, and a new loss of taste or smell are some possible symptoms as are runny or congested nose, sore throat, vomiting or nausea, and diarrhea (CDC, 2020). People who are thought to be at risk due to their exposure to an infected person are referred to as contacts (Braithwaite, Callender, Bullock, & Aldridge, 2020). Contact duration or time of contact are measures how long a person has interacted with a COVID-19 positive person. The number of contacts is the total number of individuals who came in contact during the outbreak. The number of contact groups is the number of contact clusters from all contacts in one place. Place of contact is a location where

there us personal contact interaction with someone who is supportive of COVID-19.

Data Analysis

The data analysis carried out is univariate analysis with the online application Data Tab and visualization of the case network (Epi-contact) with the Flourish Studio online application. Bivariate analysis was used in this investigation to assess the relationship between age, the number or proportion of detected contacts, and the number or proportion of detected contacts who later turned out to be infected (Braithwaite et al., 2020). An analysis of bivariate data with Pearson correlation test was using SPSS. The statistical analyses were two-sided. Statistical significance was defined as a p-value <0.05.

Ethical Consideration

The ethical commission of the Institute of Health Science Kuningan No. 73/EP/STIKKU/2020 accepted the research's conduct in terms of ethics.

RESULT

Table 1. Respondents' characteristics (n=156)

Group	Frequency	%
Sex		
Male	52	33.33
Female	104	66.66
Age		
6-19 Years	152	97.43
20-29 Years	1	0.06
30-39 Years	2	0.12
40-49 Years	1	0.06
COVID-19 Status		
Positive	156	100
Negative	-	-

Based on Table 1, the univariate analysis for the characteristics of the respondents showed that the majority were female (66.66%) and the age of the respondents was mostly 6-19 years (97.43%) and all (100%) were positive for COVID-19. Figures 1 and 2 below indicate the epi-contact of cases in the group of male and female students as a result of the univariate analysis. Figure 1 shows the COVID-19 cluster pattern of male students. Interaction between respondents occurs in groups. The respondents contact at least two people, the most contact is about 42 people, and the average contact is 10 people; then, the spread occurs massively.

Figure 2 shows the COVID-19 cluster pattern of female students. Respondent contact occurs in a circular pattern with interactions between circles of more than one. This means that the respondent could spread the virus from one group to another more quickly.

Figure 3 displays the boxplot distribution of the number of contacts by age for both male and female students. The average contact is 15 years old, with the lowest being 13 years and the highest being 43 years. The most interactions (contacts) occurred 18 times at the age of 40 years, with an average of three contacts per day at the age of 15-20 years. The age of over 25 years shows that this is not a student but a teacher.

Figure 4 shows the epi-contact COVID-19 cluster model. The contact model that occurs in Islamic boarding schools with more than eight hours of

contact will be transmitted from case A to case B. The first case or case index (A) shows that five people (B, C, D, E, and F) are in contact as secondary cases before an active case occurs. After contact with the first case (A), two of them are in contact with each other, increasing the risk of spreading to the other, so that there is case seven (G) as a tertiary case.
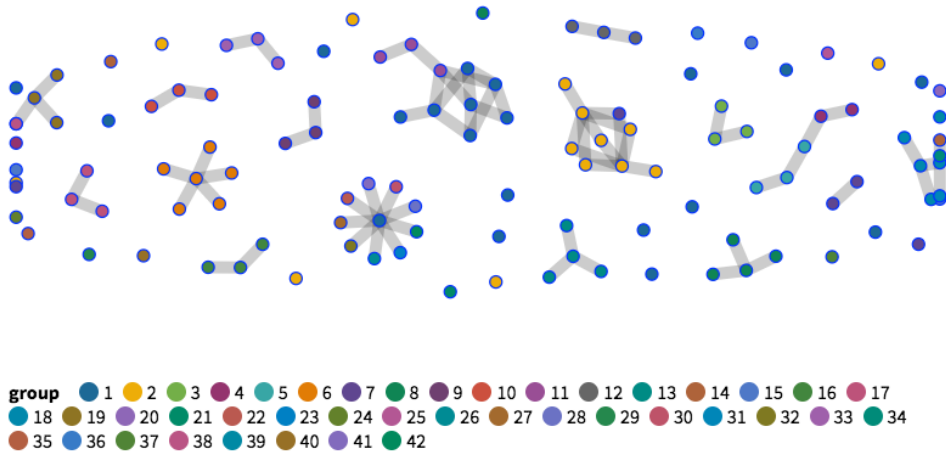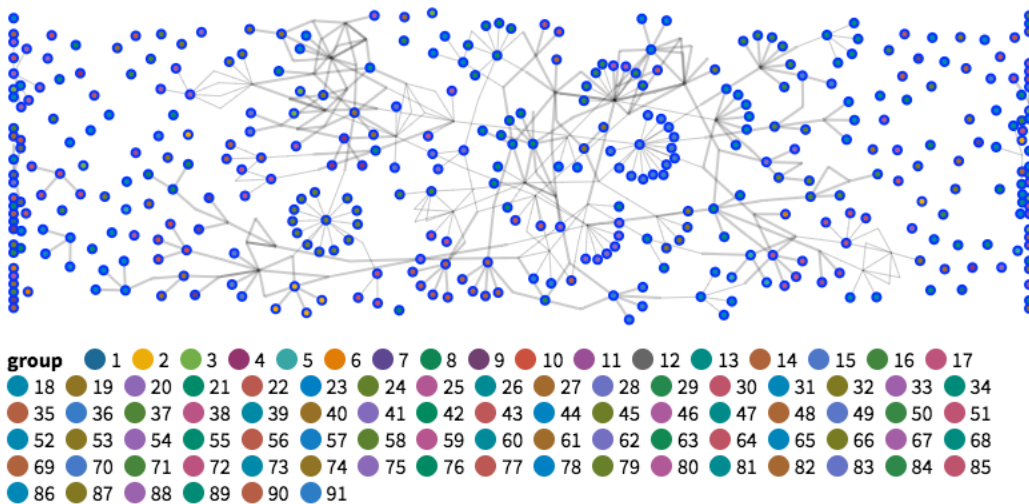

Figure 1. COVID-19 cluster contact pattern of male students

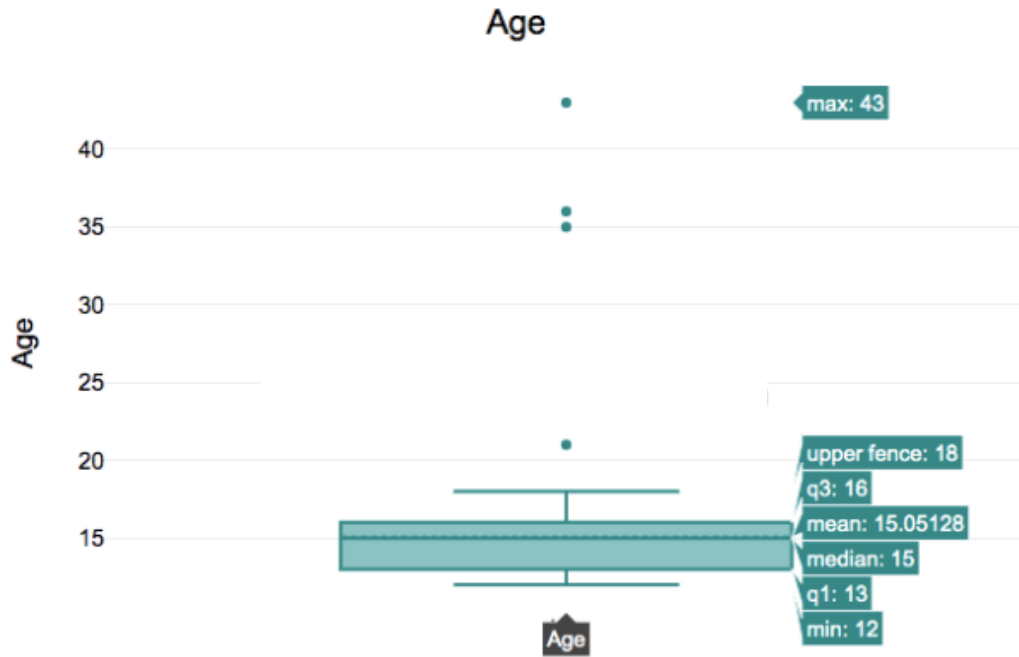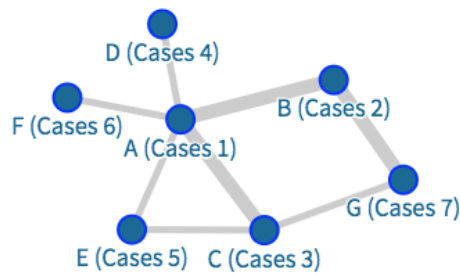**Figure 2**. COVID-19 cluster contact pattern of female students

Figure 3. Boxplot showing the distribution of contacts by age among male and female students.

Figure 4. Epi-contact COVID-19 cluster model

Table 2. Correlation analysis of age and the number of contact in Islamic Boarding School Kuningan Regency

Group	Mean	SD	Median	p-value	95% CI	
					Lower	Upper
Correlation						
Age	15,5	3.658	15	0.037	14.926	16.074
The number of contact	3.5	3.3	3			

(SD: standard deviation; CI: confident interval

The Pearson correlation test findings revealed that the association between age and contacts had a value of p = 0.037. In the COVID-19 cluster at the Al-Mutawally Islamic boarding school, Kuningan Regency there is a correlation between age and the number of interactions. Based on the confidence interval level (CI 95%), it reveals that the range is above 1 (14.926 – 16.074) which means the correlation between age is a risk factor to the number of contact among respondents,

DISCUSSION

In this descriptive research design, we identify the use of epi-contact, row lists, and contact data, as well as the basic functions for handling, visualizing, and analyzing epidemiological contact data on ongoing events. Our study found that the average age of the respondents is 15 years old. Furthermore, 33.3% of respondents were male. Among male students, the average contact is 10 people, whereas among female students, the contact occurs in a circular pattern with interactions between circles of more than one. The contact model that occurs was more than eight hours of contact and will be transmitted from case A to case B. Furthermore, our research indicated a relationship between age and the quantity of contacts in the COVID-19 cluster at the Al-Mutawally Islamic boarding school, Kuningan Regency. To the best of our knowledge, this research is the first to demonstrate an epidemiological contact investigation (Epi-contact) of COVID-19 in an Indonesian Islamic boarding school.

Beginning with the prevention and application of social distance so that behavior does not adhere to health protocols that have an impact on the widespread transmission of COVID-19 and an increase in the number of positive patients and patients who die, there is still a low level of public understanding of COVID-19 (Tian et al., 2020). When viewed from gender, this study shows that women are twice as many as men with 33.3% men and 60.03% women.

This is in line with previous study (Ruapertiwi, 2021) that the sex of COVID-19 sufferers is mostly female The previous studies also found that close contact investigations in Shinzen China showed that women were 72% more than men 28% from the results of Contact Based Surveillance (Bi et al., 2020). This is because women have more social interactions. The population in the Islamic boarding school cluster is school-age children, so the average patient age is 15.05 years old. An increased risk of infection following contact with COVID-19 cases is linearly correlated with the age of close contact, with a 1.8% incidence rate in the adolescent age group of 0–17 years (Luo et al., 2020). Then the characteristics of COVID-19 sufferers are on average aged in the productive age range (10-40 years). In the productive age range (10-40 years) they have a high lifestyle, mobility and social interaction, so they are very vulnerable to being infected with COVID-19 (Supandi, Kandou, & Langi, 2021).

Previous studies have shown that children are more likely to have milder SARS-CoV-2 infections compared to adults. About 20% of the 171 confirmed cases of PCR, showed asymptomatic in children and adolescents (Cesilia et al., 2021). Plus the risk of transmission in Islamic boarding schools with activities in

classrooms, buildings or certain locations that are closed will cause influence on air quality which triggers the spread of the coronavirus so quickly (Ghiffari, 2020).

From the description above, it can be concluded that this study shows that women are more infected with COVID-19 due to environmental factors and are more at risk of spreading the virus. According to the study's findings, there are 56 more female instances than male cases (44 cases) (Cheng et al., 2020).

Our finding showed that students had average contact with three other students before the PCR test was carried out. According to a previous study, children and teenagers interact with others more than adults do. Children may also not completely understand the health risks associated with not donning a mask; yet, even if they are aware of their risk of infection, they may feel more pressured to engage in social activities regardless of the risks (Doerre & Doblhammer, 2022). Thus, in the present study, one possible reason for this finding may be that adolescent students tend to have close friends who carry out their daily activities simultaneously because they help each other. So that the number of contacts is very risky for the transmission of COVID-19 because it is at risk of transmission between students. In addition, it risks transmitting to their families after traveling (Cesilia et al., 2021). Transmission is very fast in covid-19 in a short time, because of the transmission through droplets when interacting between students. The infection can happen if a person is within a relatively short distance of less than 1 meter because COVID-19 is spread by droplets (Susilo et al., 2020). With a person exhibiting respiratory illness signs (e.g. coughing and sneezing), droplet splashes are particularly at risk of transmitting to others if exposed to the oral and nasal mucosa or the potentially infective conjunctival mucosa of the eye (Nugroho, Alanish, Istiqomah, & Cahyasari, 2020). In addition, it spreads very quickly from other viruses, also not

accompanied by knowledge about the virus (Rifaldi & Laiding, 2021).

This is consistent with the study by Nugroho et al. (2020) which contends that airborne transmission within the same setting increases the chance of the COVID-19 outbreak spreading. Therefore, as a mechanism in emerging infectious diseases, the risk of fomitus transmission exerts a greater influence than transmission through droplets (Yen, 2020). The duration of student interaction during concurrent activities increases the risk of transmission in addition to the quantity of contacts. The findings of a prior study revealed that the reported COVID-19 contact time within six feet of a subject, together with information from a personal tracking device, revealed 14 contacts in patient subjects who were students (Volpp, Kraut, Ghosh, & Neatherlin, 2021).

Breaking the chain of transmission can be accomplished by immunization, isolation, early detection, and basic protection measures like handwashing with soap, maintaining social distance, donning masks, sprinkling disinfectant in public areas, and screening for in-person visits. Then carrying out contact tracing and tracking (case investigations and outbreak investigations), as well as providing isolation and quarantine facilities to prevent case transmission (Cheng et al., 2020; Han et al., 2020). So, from the description above, it is concluded that the risk of spread occurs in a dense environment, especially in rooms where the air does not circulate properly and is coupled with the risk of the number of students interacting in the room.

The spread of COVID-19 cases can be minimized by breaking the chain of transmission, which can be done by vaccination, isolation, early detection, and basic protection by washing hands with soap, maintaining social distance, wearing masks, spraying disinfection in places public places and screening for in-person visits. Then carry out contact tracing and tracking (case investigations and outbreak investigations), as well as providing

isolation and quarantine facilities to prevent case transmission (Cheng et al., 2020; Han et al., 2020)

Risk of Contact Clusters in COVID-19 Transmission

Students at the Islamic Boarding School carry out daily activities by staying in one room containing 5-10 people according to the area of the room; this is a risk factor for contact and a high risk of transmission of COVID-19 because there is a transmission from person to person and frequent contact (Luo et al., 2020). Additionally, when there are exposures in confined spaces, information on the room's dimensions, ventilation, and whether windows were open could be linked to these, and then further linked to follow-up on cluster size (Tupper & Colijn, 2021).

The beginning of the spread of cases focused on one environment and gradually spread to another. The focus of one such environment is called a cluster, which makes it a risk of spreading the disease (Vermonte, 2020). A cluster is an accumulation of cases that are linked together in space and time and are believed to be more numerous than anticipated, even though the anticipated number may be known (CDC, 2012). A cluster is defined as an accumulation of actively rare events or illnesses in space or time in quantities that are thought or perceived to be higher than would be predicted by chance (Porta, 2008). The word is usually used to describe a cluster of cases of a rare (usually non-infectious) disease, and putative clusters of disease are often suspected to have an environmental cause based on anecdotal evidence. As a result, much effort is often expended in response to public outcry in attempts to determine whether a true cluster exists (Webb, Bain, & Page, 2017).

A COVID-19 cluster is characterized as having a minimum of five confirmed diagnostic cases, first positive test findings, or illness onsets within 14 days, and a credible epidemiologic relationship between cases (NCDHSS, 2021), or defining a cluster as two or more incidents connected to the same place, people, or event that happened at the same time (Madison & Dane County, 2020). Two or more COVID-19 test-confirmed cases among people connected to a particular non-residential context with disease onset dates within 14 days meet the criteria for a cluster (without specific information regarding the nature of contact between the cases). No cases with sickness onset dates in the previous 14 days and test-confirmed cases mark the end of the cluster (Gov.UK, 2020).

This cluster is possible because of the interests of the teacher or group leader who has to interact with other groups for the benefit of coordination and teaching. According to research conducted by Mahrania et al. (2020), the appearance of early patients and contact history are risk factors for the development of new clusters, clinical manifestations, supporting examinations of the lungs and treatment management. Then, transmission, in this case, is characterized by gastrointestinal symptoms (diarrhea and nausea), feverish patterns, namely higher temperatures at night to early morning (Wang, Tang, & Wei, 2020). The results of a contact investigation study in Shinzen China, showed that the attack rate of contact in the room (room / house) showed 11.2% with AN OR of 15, which means that household members who are in the same room or house are at risk of 15 times to contact it compared to those who are not in the same room or household. Additionally, students will eat meals together, which could result in face-to-face interactions between individuals who are at risk of spreading COVID-19 if someone in the group has the infection. The results of a study in Shinzen China, showed an attack rate when eating of 8.2% and AN OR of 23, meaning that those who contacted while eating together were at risk of contracting it 23 times compared to those who did not eat together. Eating together risks interaction and contact with the case for more than 15 minutes. A person

who interacts with this case is called a contact case. Tracing and monitoring of close contact cases of COVID-19 in Indonesia is carried out in full through the SILACAK Application. The use of contact tracing technology is in line with a directive from the WHO in February 2021 on COVID-19 Contact Tracing, which states that the use of digital technology is important in supporting the surveillance process of contact tracing of COVID-19 cases, given that tracing is a crucial part of emergency response efforts to prevent the spread of infectious diseases (WHO Indonesia, 2020).

The relationship of age to the number of contacts

The findings revealed a correlation between age and contacts ($p = 0.037$). This is because students are mostly teenagers. After all, the behavioral characteristic of adolescents is to have a peer playgroup. Teenagers will engage in a variety of daily activities at the playgroup, enhancing the possibility of increased contact. Given that there are still simultaneous activities of attending class and living in a room with, on average, 10 people, the number of contacts will rise. This is also due to the productive age, especially school age, having activities with high socialization and supported by a closed environment. So that if there is a case in that place, it will spread quickly and massively (Sirajuddin, 2020).

This research calls this secondary attack rate. Secondary attack rate is a measure of the frequency of new cases of a disease among contacts of cases. A secondary attack rate is calculated by dividing the total number of contacts during the research period by the number of cases among contacts of initial cases. Typically, we deduct the number of primary cases from the total number of people living in those households to arrive at the overall number of household contacts (Gregg, 2009).

According to a study's findings (Cheng et al., 2020) contact tracing revealed 23 secondary cases. It was estimated that the mean incubation period was 4.1 days (95% credible interval [CrI], 0, 4-15.8), and the median serial interval was 4.1 days (95% CrI, 0.1-27.8) (95% CI, 0.1-27.8) (Cheng et al., 2020)

This is in line with research (Seftiya & Kosala, 2020) which suggests that the results of the study show a meaningful relationship between the number of contacts and age, with a p-value = 0.015 ($p < 0.05$). Additionally it is consistent with Satria et al.'s (2020), observational analytical research and bivariate tests, which, with a p-value of 0.041, found a correlation between the number of connections and age. Additionally, male sex, active smokers, and comorbid diseases like hypertension and diabetes mellitus are risk factors for SARS-CoV-2 infection (Susilo et al., 2022).

The COVID-19 Laboratory-Based Surveillance System in Islamabad, Pakistan, was evaluated by Mustaq et al. (2020) and the results show that the system was deemed to be straightforward because the laboratory was using a uniform and consistent WHO standard case definition. The system gathers vital data from all laboratories on demographics, clinical signs and symptoms, travel history, contact information, and co-morbidities (Mushtaq et al., 2020)

It is clear from the explanation above that there is a correlation between age and the number of contacts because it is influenced by a variety of factors. Social and environmental variables predominate. Because of its high fatality rate, relatively rapid transmission, and lack of an effective treatment, COVID-19 is still a disease to be on the lookout for. There are still many shortcomings in this study so further studies are needed.

This research has a weakness related with the research design which used descriptive and bivariate analysis. The descriptive analysis cannot reveal the association significantly and cannot reveal the causality between variables studied. However, the bivariate analysis can explain

the association between research variables. The data were obtained from respondents through cross-sectional design by which the design is related with the temporal ambiguity. The temporal ambiguity is the research error that has effect on the causality error. Thus, the association between variables is potentially on a bidirectional association. In addition, this study also did not include other variables as a confounding or mediating variables. If both variables were included in the study, the researcher can estimate the adjusted odds ration which is the goodness of fit model in a statistical method. However, this research has a strength related to explaining clearly through figures or pictures. Readers can imagine what this research result explains. On determining the COVID-19 variable, the researcher used the COVID-19 test kit to know the status among respondents whether positive or negative of COVID-19. Related with the instruments, this research used the COVID-19 outbreak investigation form. COVID-19 surveillance uses a more detailed case investigation form that includes information about specific risk factors, vaccinations or other methods of disease prevention, more detailed clinical information, and names or contact information for other potentially exposed people. Thus, this instrument cannot be doubted because it includes complete information

CONCLUSION

The conclusion of contact patterns is mostly in women with the number of contacts between 3-4 people and age is related to the number of contacts. The advice is to limit contact when there is a need to prevent transmission

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