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Healthcare Students' Knowledge and Distrust of COVID-19 Conspiracy Theories

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Abstract
Introduction: The spread of various conspiracy theories (CT) is one of the causes of the difficulty in handling the COVID-19 pandemic. The purpose of this study was to analyze the level of knowledge and distrust of healthcare students towards CT about COVID-19 and analyze what factors influence it.
Methods : This survey research involved 230 health students from higher education institution in Malang. The respondents were selected through purposive sampling techniques. Data collection were conducted through online distributed questionnaires. Data analysis were done by one-way ANOVA test, LSD test, Pearson correlation tests, and calculation of the determination coefficients.
Results: A total of 47.83% of the subjects were in good category for their knowledge scores on Covid 19, while only 7.39% of students were in good category for distrust on CT. The students' knowledge scores were significantly different by length of study, degree program, and institution type, but CT scores were only different by institution type. Student knowledge was not significantly correlated to their distrust of CT about COVID-19.
Conclusion: The majority of health students still believe on CT about COVID-19. Considering the findings, it is necessary to reformulate the curriculum for healthcare education to prepare for the next pandemic.

Keywords: conspiracy theory, COVID-19 pandemic, knowledge, misinformation, healthcare students

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Introduction

Coronavirus Disease 2019 (COVID-19) is an infectious disease caused by SARS-CoV-2 virus infection.[1] The disease, which was first identified in Wuhan, China in December 2019[2], infected the patient's respiratory system.[3] Under certain conditions, because SARS-CoV-2 can infect cells outside the respiratory system[4], COVID-19 disease also causes damage to other organ systems.[5] Although generally have milder symptoms than SARS and MERS[2], COVID-19 can also cause death and has a higher transmission rate.[6] Hence, a few months after the first infection was reported, this disease has caused a global pandemic that has claimed millions of lives.[7]

Despite being a serious threat in the health sector, until now, drugs that are truly effective in treating COVID-19 have not been found. Prevention through social distancing is the main policy adopted by many countries.[8] In addition, the use of

masks in public places was also instructed to suppress the transmission of COVID-19.[9] Various researchers and the pharmaceutical industry are also trying to develop a vaccine to increase the human body's immunity against SARS-CoV-2.[10] In line with that, the government is promoting a free vaccination program for the people in their country.[11] However, even though various steps have been taken, the spread of COVID-19 has continued to increase in recent times since the emergence of the latest variants.[12]

In line with the high rate of COVID-19 transmission, the spread of misinformation related to this disease is also increasing.[13] Misinformation related to COVID-19 can be found on various social media platforms, such as Facebook[14], Twitter[15], to WhatsApp[16]. Misinformation is also found on other platforms, from YouTube[17] to Instagram[18]. Misinformation circulating is very diverse, from simple misinformation to misinformation that has a dangerous impact.[19] Not infrequently, such information becomes a stumbling block for the government to tackle the pandemic.[20] Of the many misinformation, some information in the form of conspiracy theories (CT) also emerged.

CTs are often easily trusted by people from various circles. Conspiracies in the health sector are not only easily believed by ordinary people who do not have a scientific background, but also public figures to academics. Regarding COVID-19, several CTs have led the public to believe that the COVID-19 pandemic is a planned pandemic.[21] Some CTs claim that the COVID-19 pandemic is the work of the global elite[21,22], some other CTs accuse the pharmaceutical industry of being the mastermind of the ongoing pandemic.[23] In addition, there is also a CT that incites the public to refuse the use of masks to vaccinations.[24] The existence of these CTs will prolong the pandemic because CT adherents will refuse recommendations or instructions from the government, researchers, and health workers during the pandemic.[20]

In connection with the emergence of CTs, healthcare students are expected could to become enlighteners who can help the government straighten public understanding regarding COVID-19.[25] Healthcare students should to have the knowledge regarding COVID-19 even though COVID-19 is a new disease that has never been taught in their class. They are considered to have learned various concepts related to biology, viral evolution, infectious diseases, the principle of the immune system, to the working principle of vaccines.

In line with the role of healthcare students in the pandemic era, several studies evaluating the knowledge of health students about the COVID-19 pandemic have been studied by several previous researchers. Research that evaluates knowledge as well as attitudes and practices (KAP) about COVID-19 has been carried out in several countries, such as China [26], Egypt [27], Pakistan [28], the United States [29], to Malaysia.[30] KAP research has also been conducted on health students in Indonesia.[25,31] However, studies that access CT of health students are still rarely done. Some studies try to analyze what predictors play a role in trusting CT [32] and the impact of trusting CT [33], some other studies analyzed the spread of CT in social media [15,17,21] and developed instrument about CT.[34] Therefore, the purpose of this study was to analyze the knowledge of healthcare students' distrust of CT about COVID-19. This research is need to be carried out to ensure the level of student understanding of COVID-19. Considering that many academics do not understand COVID-19 and fall into CT, healthcare students also have the potential to easily accept, trust, and even spread CTs related to COVID-19. Therefore, the findings of this study could become the basis for universities to reformulate the healthcare education curriculum, especially to prepare the healthcare students for the next pandemic.

Methods

Research Design and Participants

This survey research was intended to analyze the prior knowledge and level of distrust of healthcare students in Malang and the educational factors that influence it. Therefore, a short survey involving health students at several higher education institutions in Malang, Indonesia was

conducted for the first two weeks in June 2020. The institutions involved come from polytechnics and colleges. These institutions not only provide diploma programs but also bachelor's in the health sector. Since this study adopted a quick survey, the target population for this survey was 500 respondents. Based on the Krejcie and Morgan table, the minimum sample size with a 95% confidence level and 5% margin of error is 217 students.

During the data collection process, higher education institution implemented online-based distance learning policies. Therefore, the survey was also conducted online. Purposive sampling technique was used to determine the research respondents. Respondents involved came from various higher education institution. Respondents' inclusion criteria included health students, both diploma and bachelors who have not graduated, Indonesian citizens, and come from higher education institution in the Malang area. The exclusion criteria for respondents were postgraduate students, not from non-health majors, had been dropped out, and did not fill in complete demographic data.

Instruments and Data Collection Procedures

The instrument used in this study was a combined questionnaire consisting of three parts: (a) demographic information of the respondents; (b) knowledge about COVID-19; and (c) distrust of CT about COVID-19. The first part consists of several items that ask about gender, age, the length of their study, degree program, and type of institution of the respondent. The second part is questionnaire consists of 18 items of knowledge about the etiology, symptoms, risk groups, transmission, and prevention of COVID-19. This questionnaire has been developed in previous studies.[35] This questionnaire can access knowledge about COVID-19 well because it has good values of Goodness-of-fit (χ^2/df= 1.871, RMSEA SRMR= 0.047, AGFI= 0.91, GFI= 0.93). The third part consists of eight items that ask respondents' level of agreement with CT about COVID-19. This questionnaire has also been developed in previous studies.[34] This questionnaire has good values of Goodness-of-fit (χ^2/df= 2.527, RMSEA SRMR= 0.014, CFI=0.964, AGFI= 0.940, TLI= 0.947, GFI= 0.969, and NFI= 0.943) so that it can measure the level of CT distrust. Instruments were transformed to Google Form and instrument links were distributed through lecturers at healthcare higher education institution in Malang via WhatsApp. After that, the lecturers distribute the link to their students.

Data Processing and Analysis

The data was downloaded in CSV format and the data pre-processing activities were carried out in Microsoft Excel. The demographic data were analyzed using frequency and percentage. Knowledge data was changed to 0 (incorrect answer) and 1 (right answer). CT data was converted to numbers 0, 1, and 2 where the most inaccurate response in each item will get a score of 0 while the most accurate response gets a score of 2. Both knowledge and CT data were totaled separately and transformed into a scale of 0 to 100. Scores of both aspects then categorized as good and poor based on the Bloom cut-off point (if the accuracy of the answer reaches 80% it will be categorized as good). Furthermore, the percentage of students who get good and poor categories in both aspects was visualized using a pie graph. Furthermore, to describe student achievement scores, knowledge and CT score data were analyzed using several descriptive statistics.

To analyze the effect of demographic factors on knowledge and CT, one-way ANOVA test was conducted. If a significant effect was found on a variable consisting of more than two groups, the Least Significant Difference (LSD) test was run. Furthermore, to analyze the direction, strength, and significance of the relationship between knowledge and distrust of CT, Pearson Product Moment correlation analysis and the calculation of the determination coefficient were carried out.

Results

Respondent's Demographic

After the instruments were distributed and the data were processed in the pre-processing stage, as many as 230 respondent data were left. This number has exceeded the minimum sample size that has been targeted. The majority of respondents were female students (96.5%). The number of students below/equal to 20 years old with students above 20 years old was almost equal. Furthermore, 52.6% of respondents were diploma students and the remaining 47.4% were bachelor students. They came from polytechnics (53.9%) and colleges (46.1%). In more detail, the demographic distribution of the respondents is presented in **Table 1**.

Table 1. Demographics of Health Students involved in This Study (n = 230)

Variables	Frequency (n)	%
Gender		
Male	8	3.5
Female	222	96.5
Age (years old)		
Less than/equal to 20	110	47.8
More than 20	120	52.2
Year in Higher Education		
One	51	22.2
Two	32	13.9
Three	58	25.2
Four	34	14.8
Five	29	12.6
More than five	26	11.3
Degree Program		
Diploma	121	52.6
Bachelor	109	47.4
Higher Education Institution		
Polytechnic	124	53.9
Colleges	106	46.1

Respondent Score Category

The mean of students' knowledge score reached 78.67 ± 11.44. However, out of 230 students, only 47.38% of respondents scored in the good category. On the other hand, the mean of CT score was only 54.43. Although there were some students whose scores reach 100, only 7.39% of respondents score in the good category.

The Effect of Demographic Factors on Knowledge and CT about COVID-19

The mean and standard deviation of knowledge and CT scores in each group are presented in **Table 2**, while the results of the one-way ANOVA test are presented in **Table 3**. Based on **Table 2**, students with a four-year study had the highest mean knowledge scores, while students with the five-year study had the highest CT score. On the other hand, bachelor students have higher mean knowledge and CT scores than diploma students. Furthermore, students from polytechnics had higher knowledge and CT scores than students from colleges. However, based on **Table 3**, not all demographic factors have a significant influence on students' knowledge and CT scores.

Table 2. Comparison of Mean and Standard Deviation of Knowledge and CT Scores in each Group

Independent Variables	Knowledge		Distrust in CT	
	Mean	*SD*	Mean	*SD*
Year in Higher Education				
One	78.65	9.32	55.88	17.78
Two	81.08	6.44	54.30	11.82
Three	74.90	14.84	53.45	14.77
Four	82.03	10.42	52.57	15.08
Five	81.61	9.17	56.25	15.67
more than five	76.50	12.80	54.33	14.44
Degree Program				
Diploma	77.00	12.78	53.93	15.27
Bachelor	80.53	9.46	54.99	15.07
Institution Type				
Polytechnic	82.21	8.41	56.65	14.12
Colleges	74.53	13.05	51.83	15.95

Based on **Table 3**, students' knowledge was significantly influenced by the duration of their course (p = 0.018), degree program (p = 0.019), and institution type (p < 0.001). However, their distrust of CT was only significantly affected by institution type (p = 0.016). Because the length of the study consisted of more than two groups and this variable had a significant effect on the knowledge score, the LSD test was carried out on these data. Based on LSD test results, students who have been studying for four years have a significantly higher knowledge than students who have been in higher education for three years.

Table 3. Summary of the of the One-Way ANOVA Results on Knowledge and CT data

Independent Variables	Degree of Freedom		Knowledge		Distrust in CT	
	Between Groups	*Within Groups*	*F*	*p*	*F*	*p*
Year in higher education	5	224	2.802	0.018	0.324	0.898
Degree program	1	228	5.578	0.019	0.281	0.596
Institution type	1	228	28.934	<0.001	5.922	0.016

Correlation between Knowledge and distrust in CT

The summary of the correlation test results along with the calculation of the determination coefficient is presented in **Table 4**. The results of the correlation test obtained a positive *R* value so that an increase in knowledge scores will be followed by an increase in students' distrust of CT. However, this correlation was not significant (p = 0.062). The determination coefficient also only reached 0.027 so that student knowledge only contributed 2.7% to their distrust of CT about COVID-19.

Table 4. The Summary of Correlation Test Results

Statistics	Value
R	0.123
P	0.062
R^2	0.027

Discussion

Students' knowledge about disease becomes their provision to behave appropriately to prevent and cope with the spread of the disease. In this study, the knowledge of healthcare students about COVID-19 was still not optimal. Students whose knowledge category was classified

as good do not reach 50%. The finding is in line with study that have also analyzed the level of knowledge of healthcare worker about COVID-19 conducted by Bhagavathula et al. (2020). However, several other studies have reported different conditions. Some of these studies were conducted in Egypt [27], Pakistan [28], and China.[37] The difference in the findings was caused by the different characteristics of the respondents involved. In the study of Hamza et al. (2020), The respondents involved were final year medical students. The presence of first year and second year students in this present study can contribute to the increasing number of students whose knowledge was categorized as poor. On the other hand, research by Saqlain et al. (2020), and Zhang et al. (2020) involved healthcare worker.

Beside knowledge, the level of student distrust of CT regarding COVID-19 is also less than expected. Students whose CT scores were in the good category do not reach 10%. One of the reasons for the high level of trust in CT is the high CT exposure they receive. In today's digital era, healthcare students often get various information through the internet. In fact, previous research reports that the internet is the main source for students to find information about COVID-19.[38] The problem is, the internet has become the main medium for the spread of CT during the pandemic. CT is easily found on various websites to social media.[15,17,21]

The length of the study cannot be positioned as one of the factors that determine the level of distrust of CT because the results of the analysis inform that this factor did not have a significant effect on CT scores. On the other hand, differences in the length of study can cause significant differences in the students' knowledge. The length of study is related to the amount of knowledge acquired and learned by students. Although COVID-19 is a new disease that has not been studied in classroom, students who have studied various concepts in the health sector will be easy to understand general information about COVID-19 as an infectious disease. In line with the length of study, the degree program was not able to have a significant effect on distrust of CT even though the knowledge between diploma and bachelor students was significantly different. The significant effect of the degree program on student knowledge about COVID-19 is in line with previously published Knowledge, Attitude and Practice (KAP) research.

One of the CTs that was questioned in the research instrument used in this study was CT related to the involvement of the pharmaceutical industry in the COVID-19 pandemic. This CT is one of the most trusted CT by the public.[23] In fact, conspiracies that lead people to distrust the pharmaceutical industry have emerged and developed before the COVID-19 pandemic occurred.[39] Belief in this conspiracy will lead people to be reluctant to seek treatment and trust health products produced by the pharmaceutical industry.

In addition to CT about the pharmaceutical industry, the CT that was questioned in the instrument is CT about vaccines. CT about vaccines was also developing before COVID-19 appeared. This CT is also one of the easiest CTs to find on various social media, such as YouTube[17] and Twitter.[24] If someone believes in CT they will be reluctant to join the vaccination program.[40] The large number of students who also believe in CT also indicates their low understanding of how vaccines and the immune system work.

The number of students who believe in CT indicates that their thinking skills [41] and their literacy [42] are less than optimal. As healthcare students, they should have a scientific attitude. With a scientific attitude, students are expected not to easily trust information from less credible sources. Furthermore, if their thinking skills are empowered, they will analyze the information they can critically before they believe it.[43] In addition, if their scientific literacy and health literacy are good, they should easily determine which information is science-based and which is not science-based.[44]

The large number of health students who believe conspiracy theories about health is a serious problem that must be addressed. If students who are pursuing

higher education in the health sector easily believe about CT regarding health, then they cannot become agents who are able to correct the misinformation that is spread in their community. In addition, as future health workers, besides being required to have a good level of knowledge about disease, healthcare students are also expected to not easily believe information that is not in line with findings in the health sector.

In response to the findings of this research, several policies and follow-ups need to be formulated or recommended. Although the results of the analysis inform that knowledge was not significantly correlated with disbelief about COVID-19, the *p-value* of the results of the analysis is almost significant (p = 0.062). These results indicate the potential influence of the knowledge on the level of distrust to CT. This statement is in line with previous publications which state that acceptance of CT is an indicator of low conceptual mastery.[45] If so, one of the efforts to fortify health students from CT is to increase their understanding of important concepts as opposed to CT. The curriculum needs to design lectures that are able to facilitate students to understand and criticize important concepts related to CTs around the world of health.

To improve students' critical thinking skills, universities also need to apply certain appropriate forms of learning. Problem-based Learning (PBL) and Project-based Learning (PjBL) are recommended to be implemented more widely in health universities in Indonesia. Both of these learning models have been applied in various health universities abroad.[46,47] Through these two learning models, lecturers can bring contextual problems to the classroom [48,49] and encourage students to use their thinking skills to overcome these problems.[50,51] The application of these two learning models is also reported to improve student literacy.[52,53] By applying these two learning models, lecturers can present problems related to CT around pandemics or other health issues. Thus, they will be more aware of the inaccuracies of CT scattered around them.

This study also reports that institution type has a significant effect, both on the level of knowledge and the level of student distrust of CT. In response to this finding, it is necessary to analyze the curriculum of these two types of institutions. Whatever the type of institution, health colleges must be able to prepare their students to be able to act appropriately when the next pandemic occurs. It is difficult to predict when the next pandemic or epidemic will occur. Therefore, healthcare students must be trained to be able to act appropriately when the condition occurs again. Guest lecture activities that discuss various infectious diseases and diseases that have the potential to become pandemics also need to be held regularly. In addition, webinars discussing new diseases also need to be held by various health institutions.

In connection with the proliferation of conspiracy theories and other misinformation during the pandemic in this digital era, health colleges also need to prepare students who are not easily influenced by this misleading news. Empowerment of digital literacy and information literacy needs to be familiarized during lectures.[54] It is also necessary to increase basic literacy related to disease, such as health literacy [55], science literacy [56], to genetic literacy.[57]

Apart from the important findings that have been reported from this study, some limitations also need to be addressed. First, this study only involves a number of respondents with a limited population coverage. Further studies involving broader respondents need to be carried out to obtain a more comprehensive condition about of CT. In addition, this study only involved diploma and bachelor students. The involvement of postgraduate program students also needs to be considered in further research to analyze the effect of the degree program more thoroughly. Finally, the dependent variable studied in this study is only three demographic factors, so it is not possible to find many factors that can significantly affect the level of distrust of CT. Therefore, further research that explore several other factors that are capable of being significant

predictors for distrust in CT needs to be designed.

Conclusion

This study has analyzed the level of knowledge and distrust of healthcare students towards CT about COVID-19. Both the level of knowledge and distrust of students towards CT did not reach 50%. The length of study and the degree program only had a significant effect on the level of student knowledge, while the institution type had a significant effect on the level of knowledge and the level of student distrust of CT about COVID-19. Students with three years of study had a significantly lower mean knowledge than students with four years of study. Bachelor students have significantly higher knowledge than diploma students. On the other hand, polytechnic students had significantly higher knowledge and distrust of CT than college students. Furthermore, students' knowledge of COVID-19 was not significantly correlated to their distrust of CT.

The low percentage of students who do not believe in CT indicates that the healthcare curriculum is not well designed to prepare students who can counteract misinformation. Therefore, it is necessary to reformulate the curriculum in healthcare higher education institution that are able to equip students in the next pandemic. In addition, research related to the factors that influence the level of student distrust in CT needs to be conducted more frequently. The findings of these studies can be the basis for universities to optimize their curriculum.

Ethics approval

The respondent's personal data is kept confidential. Data reporting is done anonymously. In addition, all respondents knew the purpose of the study and agreed to be the research subject.

Availability of data and materials

Raw data can be accessed at https://shorturl.at/ouMUY.

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Author Contribution

AF designed the research, prepare the instrument, analyzed the data, and composed a manuscript. J.S. collected the data. All authors approved the final manuscript.

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