ORIGINAL ARTICLE

Predictors of Adherence to Personal Preventive Behaviors Among Nursing Students Based on Health Belief Model: Cross Sectional Study During the Second Wave of COVID-19 Pandemic in Indonesia

Akbar Satria Fitriawan[1], Wiwit Ananda Wahyu Setyaningsih[2], Erni Samutri[3], Dedi Kurniawan[4], Fitrio Deviantony[5], Gatot Suparmanto[6], Bayu Fandhi Achmad[7], Eriyono Budi Wijoyo[8]

[1] Department of Nursing, Faculty of Health Sciences, Universitas Respati Yogyakarta, Yogyakarta 55282, Indonesia.
[2] Department of Anatomy, Faculty of Medicine, Public Health and Nursing, Universitas Gadjah Mada, Yogyakarta 55281, Indonesia.
[3] Department of Maternity Nursing, Faculty of Health Sciences, Universitas Alma Ata, Yogyakarta 55184, Indonesia
[4] Department of Mental Health Nursing, Kepanjen School of Health Sciences, Malang 65163, Indonesia.
[5] Department of Mental Health Nursing, Faculty of Nursing, Universitas Jember, Jember 68121, Indonesia.
[6] Department of Basic Nursing, Faculty of Health Sciences, Universitas Kusuma Husada, Surakarta 57136, Indonesia.
[7] Department of Basic and Emergency Nursing, Faculty of Medicine, Public Health and Nursing, Universitas Gadjah Mada, Yogyakarta 55281, Indonesia.
[8] Department of Mental Health Nursing, Faculty of Health Sciences, Universitas Muhammadiyah Tangerang, Tangerang 15118, Indonesia

ABSTRACT

Introduction: Personal preventive behaviors was cited as effective strategy to prevent the SARS-CoV-2 transmissions. When vaccine become available, preventive behavior must still be implemented to significantly decreased the COVID-19 infection risk in the emergence of novel SARS-CoV-2 variants of concern with immune escape phenotype. The Health Belief Model (HBM) is the most widely recognized behaviour theory, but its capacity to predict the preventive behaviours have been inconsistent. This study aimed to assess predictors adherence to COVID-19 preventive behaviour among nursing students based on HBM during the second wave of COVID-19 in Indonesia. **Methods:** An online cross-sectional study was conducted from May to September 2021. Undergraduate nursing students (n=1,413) from 10 universities in Indonesia was recruited using consecutive sampling. Online self-administered questionnaire was used to collect the data. Binary logistic regression was employed to analyse the association between sociodemographic and HBM construct with adherence to preventive behaviors. **Results:** Most of the students (n=804; 56.9 %) had poor adherence to COVID-19 preventive behaviors, and poor physical distancing identified as the most dominant non-adherence type (n=774; 54.8 %). First year students (AOR=1.313; 95%CI: 1.020-1.690), low perceived susceptibility (AOR=1.530; 95%CI: 1.193-1.962), low perceived severity (AOR= 1.756; 95%CI: 1.337-2.307), low perceived effectiveness (AOR=1.910; 95%CI: 1.315-2.777), and low self-efficacy (AOR=4.795; 95%CI: 3.566-6.447) significantly associated with poor adherence ($p<0.05$). Nagelkerke R square value was 0.313 suggesting that the whole model explained 31.3% of variance in adherence. **Conclusion:** Intervention that targeting health belief model could be useful to increased adherence level to COVID-19 preventive measures among nursing students.
Malaysian Journal of Medicine and Health Sciences (2023) 19(4):237-246. doi:10.47836/mjmhs19.4.35

Keywords: COVID-19, Prevention, Adherence, Health Belief Model, Nursing Students

Corresponding Author:
Wiwit Ananda Wahyu Setyaningsih, MSc
Email: wiwit.ananda.w@ugm.ac.id
Tel: +62-2746492521 / +62-87834466361

INTRODUCTION

In December 2019, novel human coronavirus (2019-nCoV) and later renamed as Severe Acute Respiratory Syndrome Coronavirus-2 (SARS-CoV-2) was discovered as the pathogen causing Coronavirus Disease-2019 (COVID-19) in human (1,2). The global pandemic of COVID-19 was declared in March 2020 by World Health Organization (WHO), after this virus spread to nearly every country around the world and has continued causing high morbidity and mortality (3). To halt the spreading of the disease, personal preventive behaviors regarded as an important strategy to prevent the SARS-CoV-2 transmission at the early phase of pandemic before the vaccines were developed and widely available (4). SARS-CoV-2 is highly virulent enveloped positive single-strand RNA virus (2,5) and

transmitted from human-to-human via 2 main routes of transmissions: droplet routes (6–8) and direct contact with contaminated inanimate object and surface (8–10). Based on SARS-CoV-2 transmission route, WHO recommended several COVID-19 transmission preventive measures that should be implemented by public simultaneously such as frequent hand washing using soap or hand-sanitizer, wearing face mask, social distancing, avoiding crowded, and stay at home (4,11). Previous meta-analysis study elucidated that optimum implementation of preventive behaviors was effective in reducing COVID-19 infection risk (11), suggesting that high degree of adherence to preventive behaviors playing a critical role in the effort to prevent SARS-COV-2 transmissions.

Adherence defined as the extent to which the persons' health behaviour corresponds with agreed recommendations from a healthcare provider (12). Low adherence to preventive health behaviour has been observed in various conditions and possess the great challenge to the successful prevention and management of those conditions (13). In the term of COVID-19 prevention, lack of adherence to COVID-19 preventive behaviors has been observed since the start of the pandemic (4,14–16), and after vaccination programs were started (16,17). Vaccinated individuals may have lower perceived health risk and may feel less motivated to adhere with preventive behaviors (16). Highly mutation nature of SARS-CoV-2 particularly in Spike gene RNA sequence resulting in the emergence of numerous novel SARS-CoV-2 variant of concern (VoC) and sub-variant with high transmission ability and/or immune escape phenotype, which in turn could potentially decrease the efficacy of antibody therapy and vaccine (18–21). If a novel variant emerges, vaccinated individuals may still be at high risk of infection and transmitting the virus. Compared to high income countries, lower-middle income and low-income countries are more vulnerable and will continue to face greater challenges if a novel variant becomes dominant in the population due to the less effective health systems and limited access to antivirals and new vaccines (22). Achieving whole population vaccination will take longer time in most of the countries (23). The high adherence level to preventive behavior must still be implemented even after vaccination to significantly decrease the infection risk, as demonstrated in several studies (11,23,24). To end this pandemic in the emergence of new variants, a combination of preventive measures and accelerating mass vaccinations should be implemented effectively until population immunity is achieved (25).

Adherence toward preventive health behaviors is a complex and multi-factorial problem that can be influenced by various critical factors (26). The Health Belief Model is a widely recognized health behaviour theory and has been extensively used to predict the adherence to preventive health behaviors in various disease (13) such as influenza (27), cancer (28,29), hypertension (30), and diabetes mellitus (31). The HBM suggests that individual adoption of preventive health behaviour is affected by six factors: perceived barriers to action, perceived benefits of action, perceived susceptibility to the disease, perceived severity of the disease, self-efficacy, and cues to action (13,15). However, findings from empirical study conducted to assess the viability of the HBM to predict preventive health behaviors have been inconsistent and sometimes addressed contradictory(13,29). Moreover, previous meta-analysis study found that the impact of each HBM construct on predicting preventive behaviour was fairly small and the capacity of the HBM in its entirety to predict preventive behaviour were weaker in comparison to other health behaviour theories (13), which raising the question regarding the ability of this model to predict COVID-19 preventive behaviors.

Since the start of the COVID-19 pandemic, the Indonesian government employed an online learning policy to prevent SARS-CoV-2 transmission in education sectors. But following employment of the mass COVID-19 vaccination programs, the Indonesian government allows the implementation of traditional face-to-face learning with strict COVID-19 preventive protocols. Nursing education institutions in Indonesia also plan to conduct offline learning in the near future. In order to prevent the SARS-CoV-2 infection risk, face-to-face learning should be conducted with the adherence to COVID-19 preventive measures as recommended by the government. Our present study captured the adherence behaviors to COVID-19 preventive protocols among nursing students during the second wave of COVID-19 pandemic as the result of substantial increased SARS-CoV-2 delta infection rate in Indonesia, and predictors of these behaviors based on the Health Belief Model (HBM). This study will provide information as a basis to develop effective strategies to increase adherence behaviour, considering there may be need to tighten and extend this behaviour in the future if the new variant has emerged and become dominant in the population.

MATERIALS AND METHODS

Study Design

This observational analytic study was conducted with a quantitative approach and cross-sectional design to identify the association between HBM predictors and adherence to SARS-CoV-2 transmission prevention measures among nursing students during the second wave of COVID-19 pandemic in Indonesia.

Study Setting and Period

We conducted this study in 10 universities that offer nursing education in the Special Region of Yogyakarta Province, Central Java Province, East Java Province, West Java Province, and Riau Province, Indonesia. The data were collected between May until September 2021

during the substantial increased of SARS-CoV-2 delta (B.1.617.2) infection cases (regarded as second wave) in Indonesia. At this time, the Indonesian government employed large scale social restriction in the country and all activity should implemented COVID-19 preventive protocols.

Sample Size Calculation and Sampling Technique

We used rules of thumb for calculating minimal sample size in observational study that involves logistic regression analysis, which states as follows: n = 100 + 50(i) where i refers to the number of independent variables in the final model (32). In this study, the number of independent variables that were included in the final logistic regression model was 8, so the minimum sample size required for this study was n = 100 + 50(8) = 500. Consecutive sampling technique was used to recruit the participants. All active undergraduate nursing students, ≥18 years old, had academic level from 1st semester to 8th semester, had active WhatsApp number that can be contacted, and voluntarily willing to participate as research respondents were included in this study. The students who could not be contacted via WhatsApp call, did not fill out the informed consent form, or did not fill out the questionnaire completely were excluded from the study.

Data Collection

In this study, we used an online questionnaire to collect the data due to the pandemic situation that required social distancing. A Google Form was used to develop the online questionnaire. The data regarding nursing students' identity, active status in learning process, academic level, phone number, and email address were obtained from the academic and student affairs section of each university. This data then was screened to determine the nursing students who met the inclusion criteria.

Before the study, we contacted each of the participants via WhatsApp to explained information related to the study and asked for their willingness to participate in the study. If they agreed to participate, we shared Google Form link that contained the inform consent form to the participants via WhatsApp and they were asked to complete it first. Afterward, we shared the study questionnaire link to the participants via WhatsApp and they were asked to fill out the questionnaire completely.

Instrument

The questionnaire consisted of four sections: sociodemographic characteristic questionnaire, COVID-19 vaccination and COVID-19 infection status, health belief model questionnaire, and adherence toward SARS-CoV-2 transmission prevention measure questionnaire. In the first section, the sociodemographic data was assessed through seven questions to obtain the following information: age, gender, family income, type of university, academic level, financial difficulties during pandemic, and primary information source regarding COVID-19.

The second section was comprised of four questions to assess the COVID-19 vaccination status and COVID-19 infection status among the nursing students. The first question asks about whether the nursing student has already received the COVID-19 vaccine. The second question asks about the number of vaccine doses they have received. The third question asks about the type of vaccine they have received. The fourth question asks about history COVID-19 infection status.

The third section is comprised of 12 item questions to assess aspects of the HBM which were adopted from a previous study (4,33). We assessed respondents' perceptions regarding their susceptibility to COVID-19 infection by asking, "How likely do you think you are to get infected with COVID-19?". This question has 5 response choices as follows: "very unlikely", "unlikely", and "more or less likely" were considered as low susceptibility, while "very likely" and "extremely likely" responses were considered as high susceptibility (4). Respondents' perceptions about severity of COVID-19 were assessed by asking the participants, "How serious do you consider Coronavirus Disease-2019 (COVID-19) infection to be?". This question has 5 response choices as follows: "nothing serious", "a little bit serious", and "somewhat serious" were considered as low severity, while "very serious" and "extremely serious" were considered as high severity (4). We assessed respondents' perceptions regarding effectiveness of COVID-19 preventive strategy by asking, "How effective do you think the COVID-19 preventive measures recommended by the government are?". This question has 5 response choices as follows: "not at all," "a little", and "somewhat" were considered as low effectiveness, whereas "much' and "very much" were considered as high effectiveness (4). The self-efficacy to perform COVID-19 transmission prevention behavior was assessed by the question, "How confident are you that you could decrease your chance of COVID-19 infection by performing preventive measures?". This question has 5 response choices as follows: "not at all", "a little bit", and "somewhat confident" were considered as low self-efficacy, whereas "very" and "extremely confident" were considered as high self-efficacy (4). Respondents' perceptions about barriers in practicing COVID-19 preventive measure were assessed using an instrument which was adopted from a previous study (33). This instrument consisted of 8 item questions asking about various barriers in practicing preventive behaviour, and each item measured on 5-point Likert scale ranging from strongly disagree (1 point) to strongly agree (5 point) (33). The total score above the mean score was considered as high barriers, while total score below the mean score was considered as low barriers.

The fourth section was a questionnaire to assess

adherence to COVID-19 prevention measures which was adopted from a previous study (4). In this questionnaire, we assessed the adherence level to COVID-19 prevention measure through the question, "What preventive actions do you currently use to avoid COVID-19 infection?". This question was followed by 4 items consisting of preventive behaviors recommended by Indonesia government as follows: 1) Frequent washing of hands using soap or hand sanitizer; 2) Wearing a face mask all the time when going out and interact with others; 3) Maintaining a physical distance of at least 2 meters from others in public areas; and 4) Not meeting with groups of more than five people. Each item has answer choice "yes" or "no". The adherence level was then categorized into two groups: "Poor adherence" and "Good adherence". If there was at least 1 item question with responses "no", we considered it as Poor adherence. If the respondents' responses for all of the item questions was "yes", we considered it as "Good adherence". The adherence level in this study was categorized based on the WHO recommendations that the public should adhere to all of the preventive measure and perform them simultaneously to prevent the COVID-19 transmission (4,24). This categorization is also justifiable in the absence of evidence on the higher effectiveness of one preventive behaviour compared to the others (11).

Statistical Analysis

The statistical analysis used IBM SPSS for Windows Version 24 (IBM Corp, Armonk, NY). We performed descriptive analysis to obtain frequency and percentage. Binary logistic regression was performed to determine the predictors of adherence to COVID-19 transmission prevention measures. All independent variables with the Chi-square test $p<0.25$ were entered into the logistic regression analysis. We obtained the adjusted odd ratio (aOR) and confidence interval level (CI) was set at 95% and p-value less than 0.05 was considered statistically significant. Hosmer and Lemeshow Test was employed to analyse the goodness of fit. Nagelkerke R square was obtained to provide the amount of variation in the dependent variable explained by the model.

Ethical Considerations

Ethical clearance was obtained from the Health Research Ethics Committee, Universitas Respati Yogyakarta, Indonesia (ethical number: 239.3/FIKES/PL/XII/2021). Informed consents were obtained from each of participants before the study. The confidentiality of participants information and data were assured.

RESULTS

Sociodemographic Characteristic

A total of 1,413 undergraduate nursing students participated in this study, and the sociodemographic characteristics are shown in Table I. The average age of the participants was 19.8 years (SD=1.44). The Bachelor of Nursing Course in Indonesia is a four-year programme, and most of the nursing students participating in this study were first year students (n=546; 38.6%), female (n=1,174; 83.1%), and students at a private university (n=1,192; 84.4%). The monthly family income for most of the participants were between IDR 2-3 million (n=412; 29.2%) and most of them had financial difficulties during the pandemic (n=1,102; 77.8%). Based on the source of information, most of the participants got information about COVID-19 primarily from social media (n=1,364; 96.5%).

Table I: Sociodemographic characteristics of the study participants (n = 1,413)

Characteristic	Frequency (n)	Percentage (%)
Age, in years; mean (SD)	19.8 (1.44)	
Sex		
Female	1174	83.1
Male	239	16.9
Place residing during the COVID-19 pandemic		
At own home	973	68.9
Other places (i.e. relative house, dormitory, rented house, etc.)	440	31.1
Monthly income of the family (IDR)		
Under 1 million	298	21.1
1 – 2 million	272	19.2
2 – 3 million	412	29.2
3 – 4 million	171	12.1
4 – 5 million	151	10.7
Above 5 million	109	7.7
Academic level		
First year	546	38.6
Second year	322	22.8
Third year	298	21.1
Fourth year	247	17.5
Type of university		
Public	221	15.6
Private	1192	84.4
Financial difficulties during the COVID-19 pandemic		
Yes	1102	77.8
No	311	22.2
Primary source of information about COVID-19 based on type		
Social media	1364	96.5
Television	49	3.5

Abbreviations: SD: standard deviation; IDR: Indonesian Rupiah.

COVID-19 Vaccination Status and COVID-19 Infection Status of the Participants

Table II shows the information regarding COVID-19 vaccination status among the nursing students. At the time of the study, 3 type of SARS-CoV-2 vaccines had been available for mass vaccination program in

Table II: COVID-19 vaccination status (n=1,413)

Information related COVID-19 vaccination	Frequency (n)	Percentage (%)
Have you been vaccinated with COVID-19 vaccine ?		
No	591	41.8
First dose	535	37.9
Second dose	287	20.3
If you have been vaccinated, what type of COVID-19 vaccine have you got ?		
Sinovac/CoronaVac	669	47.3
AstraZeneca (ChAdOx1 nCoV-19)	130	9.3
Moderna	23	1.6
Have you ever diagnosed with COVID-19 in the past ?		
No	1221	86.4
Yes	192	13.6

Indonesia: Sinovac, AstraZeneca, and Moderna. Based on the Guidelines from Indonesian Ministry of Health, these vaccines must be given two times for person ≥18 years old. Our study found that during the second wave of COVID-19 pandemic in Indonesia, only 287 (20.3%) respondents had received two doses of the SARS-CoV-2 vaccine and regarded as fully vaccinated. 192 (13.6%) respondents reported that they had COVID-19 infection in the past.

Health Belief Model Related to COVID-19 Infection

Table III shows the information regarding the HBM related to COVID-19. Our study found that most of the participants perceived themselves not susceptible to COVID-19 (n=825, 58.4%), perceived COVID-19 infection as high severity (n=1,079; 80.4%), having low barriers to implement preventive behaviors (n=818; 57.9%), perceived that COVID-19 preventive measures recommended by government are effective (n=1,067, 75.5%), and had high self-efficacy to adhering COVID-19 preventive measure (n=735, 52.0%).

Table III: Health Belief Model Related to COVID-19 (n=1,413)

Health Belief Model	Frequency (n)	Percentage (%)
Perceived susceptibility to COVID-19		
Low susceptibility	825	58.4
High susceptibility	588	41.6
Perceived severity to COVID-19		
Low severity	334	23.6
High severity	1079	76.4
Perceived barriers to preventive measures		
Low barriers	818	57.9
High barriers	595	42.1
Perceived effectiveness to COVID-19		
Low effectiveness	346	24.5
High effectiveness	1067	75.5
Self-efficacy		
Low self-efficacy	678	48.0
High self-efficacy	735	52.0

Adherence Toward COVID-19 Transmission Prevention Measures

The adherence toward COVID-19 transmission prevention measures among nursing student is shown in Table IV. Most of the participants (n=804; 56.9%) had poor adherence in implementing COVID-19 preventive measures. Based on prevention activity, most of the participants (n=1,260; 89.2%) reported that they always wear face mask when going out and interact with other people. Remarkably, most of the participants (n=727; 51.5%) reported that they did not practice frequent hand washing as recommended. Most of the participants reported that they did not implement physical distancing more than two meters when interacting with other people (n=774; 54.8%), suggesting that poor physical distancing was the most dominant type of non-adherence among nursing students. As many as 577 respondents (40.8%) did not avoid crowds of more than 5 people.

Table IV: Adherence toward COVID-19 prevention measure (n=1,413)

COVID-19 Preventive Measure	Yes		No	
	n	%	n	%
Frequent washing of hands using soap or hand sanitizer	686	48.5	727	51.5
Wearing a face mask all the time when going out and interact with others	1260	89.2	153	10.8
Maintaining a physical distance of at least 2 meters from others in public areas	639	45.2	774	54.8
Not meeting with groups of more than five people	836	59.2	577	40.8

Adherence to preventive behavior	Good Adherence (%)	Poor Adherence (%)
	609 (43.1)	804 (56.9)

Factors Associated with Adherence to COVID-19 Transmission Prevention Measures

We employed binary logistic regression to analyse the association between sociodemographic and HBM predictors with adherence to COVID-19 prevention measure. A total of 8 independent variables with the result Chi-Square analysis of p<0.25 were selected for multivariate analysis (Table V).

The first-year nursing students had 1.313 times higher risk of having poor adherence to COVID-19 preventive measure compared to second year students and above (AOR= 1.313; p= 0.035; 95%CI: 1.020-1.690). Nursing students who perceived that they were not susceptible to COVID-19 infection had 1.530 times higher risk of having poor adherence to COVID-19 preventive measure compared to their counterparts (AOR= 1.530; p= 0.001; 95%CI: 1.193-1.962). Nursing students who perceived that COVID-19 infection was not serious had 1.756 times higher risk of having poor adherence to COVID-19 preventive measure compared to their counterparts (AOR= 1.756; p= 0.001; 95%CI: 1.337-

Table V: Results of binary logistic regression analysis for the association between independent predictors and adherence to COVID-19 preventive measure

Predictors	COR [95% CI]	*p*	AOR [95% CI]	*p*
Age				
≥20 years	**Reference**		**Reference**	
<20 years	1.154 [0.903-1.476]	0.243	1.046 [0.768-1.425]	0.774
Sex				
Female	**Reference**		**Reference**	
Male	1.205 [0.907-1.601]	0.197	1.353 [0.976-1.877]	0.070
Academic Level				
Second, Third, and Fourth Year	**Reference**		**Reference**	
First Year	1.347 [1.083-1.675]	0.007	1.313 [1.020-1.690]	**0.035**
Perceived Susceptibility				
High susceptibility	**Reference**		**Reference**	
Low susceptibility	1.605 [1.293-1.994]	0.001	1.530 [1.193-1.962]	**0.001**
Perceived Severity				
High severity	**Reference**		**Reference**	
Low severity	1.980 [1.525-2.572]	0.001	1.756 [1.337-2.307]	**0.001**
Perceived Barriers				
Low barriers	**Reference**		**Reference**	
High barriers	1.180 [0.910-1.531]	0.211	1.059 [0.791-1.417]	0.702
Perceived Effectiveness				
High effectiveness	**Reference**		**Reference**	
Low effectiveness	2.963 [2.256-3.892]	0.001	1.910 [1.315-2.777]	**0.001**
Self-efficacy				
High self-efficacy	**Reference**		**Reference**	
Low self-efficacy	5.427 [4.076-7.227]	0.001	4.795 [3.566-6.447]	**0.001**

Abbreviations: COR: crude odds ratio; AOR: adjusted odds ratio; CI: confidence interval.

2.307). The odds of poor adherence to COVID-19 preventive measure were 1.910 times higher among nursing students that perceived preventive measure as not effective compared to their counterparts (AOR= 1.910; p= 0.001; 95%CI: 1.315-2.777). Nursing students who had low self-efficacy in performing preventive measures had 4.795 times higher risk of having poor adherence to COVID-19 preventive measures compared to those who had high self-efficacy (AOR= 4.795; p= 0.001; 95%CI: 3.566-6.447). The AOR result also suggested that self-efficacy had the strongest association with adherence level. The value of Nagelkerke R square was 0.313 suggesting that the whole model explained 31.3% of variance in poor adherence to COVID-19 preventive measure. Hosmer and Lemeshow test showed the result of p=0.840 indicated that this model was fit.

DISCUSSION

Our study found that most of the nursing students in Indonesia had poor adherence to COVID-19 preventive measures. Consistent with our finding, a study conducted by Shah et al. found that only 33% of respondents performed all preventive behaviour simultaneously (14). In this study, we found that most of the nursing students had poor hand washing practice. Our finding was consistent with Shitu et.al study which found that only 32.7% of students performed frequent hand washing practice (34). Contrarily, a study conducted by Albaqawi et al. in Saudi Arabia found that 72.3% of nursing students had a high adherence toward hand washing practice, and it was the most frequently performed behaviour among nursing students (35). Poor hand hygiene adherence has been well documented among health care workers and contribute to hospital infection including in Indonesia (36). Frequent hand washing with soap or alcohol-based hand sanitizers for at least 20 second is important strategy to prevent viral transmissions (9) because contamination of frequent use surfaces in healthcare, public, and home settings by SARS-CoV-2 act as potential source of viral transmission (10). SARS-CoV-2 can survive on the surfaces of inanimate object like metal, glass, or plastic for up to 9 days in room temperature (9).

Our study found that most of the students did not perform physical distancing of at least 2 meters, suggesting that keeping a safe physical distancing was identified as the most dominant non-adherence type among nursing students. Non-adherence to physical distancing has been consistently observed in previous study (14,37–39). In their study, Shah et.al found that only 44.4% of

the respondent performed recommended 1.5 m physical distancing (14). In another study, Shitu et.al found that only 26.2% of students performed safe physical distancing (34). Adherence to physical distancing can be challenging because it imposes various difficulties such as social isolation, job loss, and negative mental health effects (37). Maintaining physical distancing cited as an important and effective strategy to prevent SARS-CoV-2 transmission (7,11). The 1–2 m physical distancing threshold is based on the physics of droplet transport and assumed that respiratory droplet did not travel more than 2 m (11,13). WHO recommended physical distancing threshold a 3-foot (1-m), whereas the recommended physical distancing in the US was 6-foot (2-m) and varied between 1.5 to 2 m in European countries (7).

Remarkably, our study found that wearing face masks was identified as the most performed behaviour among nursing students. Similarly, studies in Hongkong (40) and South Korea (41) identified wearing face masks as the most commonly reported preventive measure. Our study suggested that nursing students still are wearing face mask but neglecting other preventive strategies such as hand wash and physical distancing. To significantly decreased the final SARS-CoV-2 infection risk, it is important to incorporated face mask, hand hygiene, and physical distancing simultaneously (4,11).

Our study found that being a first-year student was significantly associated with poor adherence to COVID-19 preventive behaviour. A previous study conducted among nursing students in Saudi Arabia found that academic level was associated with preventive behaviour (35). Another study at South Korea also found that individuals with higher educational backgrounds had higher adherence to COVID-19 preventive behaviors (41). Generally, the higher academic level among nursing students is associated with higher knowledge regarding COVID-19, and higher COVID-19 knowledge are associated with preventive behaviours (35). Individuals with higher education levels are more likely to have a better assessment of risk management and are more likely to be exposed to information relating to preventive behaviors (41).

In the HBM, perceived susceptibility defined as individuals' subjective perceptions regarding the risk of acquiring an illness or disease (41). Our study demonstrated that perception of low susceptibility toward COVID-19 infection was significantly associated with poor adherence to COVID-19 preventive behaviour. Similar results were also found in other studies conducted in South Korea (41) and US (42,43), revealing that less susceptible individuals were more likely to have lower COVID-19 prevention behaviors. The HBM suggest that if people regarded themselves as susceptible to illness (perceived susceptibility), they will be more likely to take preventive behaviors (13).

In the HBM, perceived severity defined as individuals' subjective perceptions regarding the serious consequences of the illness or disease (41). Our study demonstrated that perception of low COVID-19 severity was significantly associated with poor adherence to COVID-19 preventive behaviour. Our finding was consistent with several studies (4,42–44). The HBM suggest that if people believe that the disease would have serious consequences on them (perceived severity), they will be more likely to take preventive behaviour (13).

Similar to previous studies conducted in Mexico (4), US (43), Korea (45), Italy (44), and China (46), our study found that perceiving preventive measure as not effective was significantly associated with poor adherence to COVID-19 preventive measures. In their study, Shah et al. found that perceiving preventive action as a benefit was significantly associated with preventive behaviour (14). According to the HBM, if someone believes that a particular health behaviour would reduce their susceptibility to disease, reduce the severity of the disease, and/or lead to other positive outcomes, they will be more likely to engage in that health behaviour (13).

Our study demonstrated that self-efficacy was significantly associated with adherence level. Our finding is consistent with previous studies conducted in Italy (44), China(47), and South Korea (41) which found that self-efficacy acted as an important determinant in adherence to COVID-19 preventive behaviour. Similar to previous study (44), our finding also suggesting that self-efficacy was the strongest predictor of adherence preventive behaviors. Self-efficacy is defined as a personal belief in the person's capacity to execute a specific action, skill, or performance and to achieve specific goals (48). When someone has a high self-efficacy, they tend to have higher commitment, demonstrating more effort to achieve their goals, and persisting longer when facing difficulties, thus they are more eager to participate and can have excellent performance (48,49). Contrarily, individuals who have low self-efficacy may become afraid and avoid their tasks, tend to avoid challenges, to postpone actions, and to give up without completion (48,49). Individuals with higher confidence will likely have better adherence to preventive health behaviour (47).

This study has several limitations. First, cross-sectional design used in this study meant that our study cannot demonstrated causal relationship. Second, our study employed non-probability sampling to recruit the participant which limit the generalizability of the result. Third, online self-administered questionnaire was used to collect the data that could result in recalled bias and social desirability bias and may affected responses. Fourth, standardized and validated instrument to assess independent and dependent variables was still unavailable at the time of the study. Fifth, the low

Nagelkerke R Square value obtained in our study suggested that there could be other variables beyond HBM that playing important role in affecting adherence behaviour.

Our study highlighted that nursing education institution should provide educational intervention that targeting HBM for nursing students before offline learning implementation. Several studies demonstrated that HBM-based education program could effectively increase the wide range of preventive behaviors recommended in several disease such as influenza (27), cancer (28), hypertension (30), and diabetes mellitus (31). Since our study obtained low Nagelkerke R Square value, we also suggested to explore other determinant of adherence to COVID-19 preventive measures based on other health behavior theory beyond HBM in the future.

CONCLUSION

Our study provides evidence that low adherence to COVID-19 transmission preventive measures was being observed among nursing students in Indonesia during the second wave of COVID-19 pandemic. Inability to keep physical distancing was identified as the most common non-adherence type. First year students, low perceived susceptibility, low perceived severity, low perceived effectiveness, and low self-efficacy were identified as predictors of poor adherence to COVID-19 preventive measures. Moreover, self-efficacy was identified as the strongest predictor of adherence. Our study highlighted that nursing education institution should develop HBM-based education program to increased adherence level to COVID-19 preventive measurement among nursing students if traditional face-to-face learning will be implemented in the near future. We also suggested to explore other determinant of adherence behaviour to COVID-19 preventive measures beyond HBM in the future.

ACKNOWLEDGEMENTS

The authors would like to express the gratitude to the Office of Research and Publication (ORP) Universitas Gadjah Mada for assisting in the language editing.

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