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Compliance with COVID-19 health protocols in a restricted offline learning setting in Palembang, Indonesia: a structural equation modeling

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ABSTRACT

Background and purpose: The COVID-19 pandemic has brought about new-normal conditions across all sectors. At the onset of the return to offline learning, new health protocol regulations were introduced. This study aimed to predict student behaviour in the post-COVID-19 learning process using the Health Belief Model (HBM) within a restricted face-to-face learning context.

Methods: This cross-sectional survey involved 331 students from both public and private universities in South Sumatra Province, selected through convenience sampling from those participating in post-pandemic face-to-face learning. Data were collected between April and July 2022 using an online questionnaire that covered sociodemographic characteristics and perceptions based on the HBM framework. Descriptive analysis was conducted, and behavioural predictions were tested using Structural Equation Modelling (SEM).

Results: The majority of participants were female (54.4%), aged 18–21 years (64.4%), predominantly undergraduate students (84%), and residing in Palembang (63.3%). Regarding vaccination status, 54.4% had received the second dose, 39% the third dose, 5.7% only the first dose, and 0.9% were unvaccinated. Perceived benefits (β=0.129, p=0.034), cues to action (β=0.319, p<0.001), and self-efficacy (β=0.442, p<0.001) were found to be significant predictors of students' compliance with health protocols.

Conclusion: Students' compliance with health protocols is influenced by health-related information and their level of self-efficacy. The Health Belief Model proves effective in predicting this behaviour in a post-COVID-19 context. Policymakers are encouraged to promote compliance to health protocols through positive messaging, such as public service announcements.

Keywords: Health Belief Model, COVID-19, post-pandemic, health protocols, restricted learning process

INTRODUCTION

The education sector has been suffering due to the COVID-19 pandemic, especially during the three-year period since 2020.[1] In this sector, the pandemic affected several areas, such as administrative services and the core educational process.[2] Traditionally, education was conducted face-to-face, requiring physical presence in the classroom.[3] However, pandemic conditions restricted this arrangement, and everyone was required to implement health protocols to prevent the transmission of the virus.[4] A significant change in the education sector was the shift from face-to-face learning to online learning, along with the transition of administrative procedures from offline to online.

After the pandemic began to subside and social distancing regulations were gradually relaxed, the education process slowly returned to face-to-face learning. If face-to-face learning had not been reinstated, it could have led to learning loss or educational setbacks in both academic and non-academic aspects. According to a study by the Ministry of Education, Culture, Research, and Technology, recovery from learning loss may take up to nine years.[5] However, during this period, face-to-face teaching and learning processes had to be conducted by implementing strict health protocols to prevent transmission.[6]

In this new situation, students and all stakeholders must follow the protocols, as compliance to health protocols is important to optimize the purpose of face-to-face learning without increasing COVID-19 cases.[7] Compliance is related to the students' perception that it is essential to protect themselves and those around them from the threat of COVID-19.[8]

To explain this phenomenon, we use the lens of the Health Belief Model (HBM) theory. The HBM is a conceptual framework that has been widely used and empirically tested to explain and predict health prevention behaviors, focusing on belief patterns related to the relationship between health behaviors and the use of health services.[9] The Health Belief Model (HBM) is used to understand why individuals have difficulty following prevention programs in a health context.[10] The HBM then underwent development and adaptation for wider use related to individual preventive actions in health, including obesity prevention, HIV/AIDS prevention, and pandemic prevention such as H1N1.[11] The HBM has also become a commonly used framework for researching and understanding healthy behaviors within communities. Using this model, the present study aims to measure and predict students' compliance with health protocols on campus in the post-pandemic period.

METHOD

Design, sample and procedure

This study employed a cross-sectional survey design. The research was conducted in the City of Palembang, which was categorized under level 2 social distancing status, thus allowing limited face-to-face learning based on the Ministry of Home Affairs Decree Number 54/2021.[12] The population in this study were university student at all levels of education who carried out limited face-to-face learning in the city of Palembang (e.g. undergraduate, masters or doctoral student). According to the South Sumatra Provincial

Government, it is estimated that there are 84,938 students from both state universities and private universities.[13] A total of 331 students participated in this study; they were selected using non-probability sampling (convenience sampling). Data collection was conducted from April to July 2022. We shared a link containing the research questionnaire. Respondents gave their consent before filling out the questionnaire and submitting it through the system.

The HBM was used as the theoretical framework in this study, as it consists of several core constructs that explain individuals' engagement in preventive actions, their willingness to participate in screening procedures, and their efforts to control disease status.[14] The variables used in this study included perceived susceptibility (3 items – X1.1-3), perceived severity (3 items – X2.1-3), perceived benefits (3 items- X3.1-3), perceived barriers (4 items- X4.1-4), cues to action (3 items- X5.1-3), and self-efficacy (3 items – X6.1-3). Data were analyzed using Structural Equation Modeling (SEM). We used SPSS version 24 for data processing and analysis. The results of the SEM analysis, which tested the HBM variables, are presented in this study.

This study was approved by the Institutional Review Board of the Universitas Sriwijaya Ethics Committee (Registered Number: 1453/UN9.FE/TU.SK/2022). All procedures performed in studies involving human participants were conducted in accordance with the ethical standards of the institutional and/or national research committee, as well as with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

RESULT

Table 1 presents the demographic profiles of the respondents. There were slightly more female students (54.4%) than male students. The majority of respondents were aged 18–21 years (64.4%), followed by those aged 22–25 years (25.1%). Regarding educational characteristics, most respondents were undergraduate students (84%) and resided in the City of Palembang (63.3%). More than half of the respondents (54.4%) had received the second dose of the COVID-19 vaccine, 39% had received the third dose, 5.7% had only received the first dose, while 0.9% were unvaccinated (Table 1).

Table 1. Demographic characteristics of university's students in Palembang

Demographic Characteristics (n=331)	f	Percent (%)	Demographic characteristics (n=331)	f	Percent (%)
Sex			**Residence**		
Male	151	45.6	Palembang city	209	63.1
Female	180	54.4	Outside Palembang	122	36.9
Age			**Vaccine dose**		
< 18 years	1	0.3	None	3	0.9
18-21 years	213	64.4	First dose	19	5.7
22-25 years	83	25.1	Second dose	180	54.4
26-30 years	6	1.8	Third dose	129	39.0
31-40 years	20	6.0			
> 40 years	8	2.4			
Education					
Diploma	18	5.4			
Undergraduate	278	84.0			
Master	32	9.7			
Doctoral	3	0.9			

Table 2 presents the distribution of respondents' responses across items measuring constructs from the Health Belief Model (HBM) and compliance behavior, using a 5-point Likert scale.

The perceived susceptibility items showed that most respondents selected "disagree" or "neutral," suggesting a relatively low sense of vulnerability to illness post-pandemic. In contrast, responses to perceived severity were concentrated in the "agree" and "strongly agree" categories, indicating that students acknowledged the seriousness of potential health consequences. Regarding perceived benefits, the majority of students reported agreement, reflecting a positive perception of the effectiveness of health protocols. Conversely, perceived barriers received high levels of disagreement, particularly for item X4.3, where more than half of respondents strongly disagreed, implying minimal obstacles to compliance. Items related to cues to action also showed high agreement, highlighting the importance of external prompts such as information and reminders in influencing behavior. Self-efficacy items revealed strong confidence, with most respondents agreeing that they were capable of adhering to health protocols. Finally, responses on compliance behavior demonstrated a high level of agreement, suggesting that students maintained strong compliance to health protocols during restricted face-to-face learning after the COVID-19 pandemic (Table 2).

Table 2. Distribution of respondents' responses

Item (N=331)	F (%)				
	1	2	3	4	5
X1.1	85 (25.7)	80 (24.2)	100 (30.2)	45 (13.6)	21 (6.3)
X1.2	62 (18.7)	74 (22.4)	106 (32.0)	62 (18.7)	27 (8.2)
X1.3	102 (30.8)	78 (23.6)	99 (29.9)	43 (13.0)	9 (2.7)
X2.1	53 (16.0)	39 (11.8)	79 (23.9)	97 (29.3)	63 (19.0)
X2.2	39 (11.8)	26 (7.9)	75 (22.7)	110 (33.2)	81 (24.5)
X2.3	43 (13.0)	33 (10.0)	94 (28.4)	105 (31.7)	56 (16.9)
X3.1	32 (9.7)	21 (6.3)	79 (23.9)	97 (29.3)	102 (30.8)
X3.2	22 (6.6)	29 (8.8)	84 (25.4)	99 (29.9)	97 (29.3)
X3.3	26 (7.9)	34 (10.3)	84 (25.4)	97 (29.3)	90 (27.2)
X4.1	93 (28.1)	86 (26.0)	100 (30.2)	38 (11.5)	14 (4.2)
X4.2	66 (19.9)	90 (27.2)	96 (29.0)	58 (17.5)	21 (6.3)
X4.3	170 (51.4)	96 (29.0)	40 (12.1)	17 (5.1)	8 (2.4)
X4.4	99 (29.9)	94 (28.4)	100 (30.2)	30 (9.1)	8 (2.4)
X5.1	32 (9.7)	23 (6.9)	75 (22.7)	105 (31.7)	96 (29.0)
X5.2	29 (8.8)	21 (6.3)	75 (22.7)	108 (32.6)	98 (29.6)
X6.1	29 (8.8)	20 (6.0)	72 (21.8)	112 (33.8)	98 (29.6)
X6.2	28 (8.5)	27 (8.2)	96 (29.0)	111 (33.5)	69 (20.8)
X6.3	27 (8.2)	28 (8.5)	90 (27.2)	110 (33.2)	76 (23.0)
Y.01	31 (9.4)	19 (5.7)	82 (24.8)	118 (35.6)	81 (24.5)
Y.02	27 (8.2)	22 (6.6)	78 (23.6)	120 (36.3)	84 (25.4)
Y.03	30 (9.1)	21 (6.3)	84 (25.4)	109 (32.9)	87 (26.3)

Table 3 presents the reliability coefficients (Cronbach's Alpha) and Corrected Item-Total Correlation (CITC) values for each dimension and indicator of the Health Belief Model (HBM). All six dimensions demonstrated high internal consistency, with Cronbach's Alpha values exceeding the recommended threshold of 0.70. The perceived susceptibility dimension showed an alpha of 0.888, with CITC values ranging from 0.631 to 0.857. The perceived severity dimension had an alpha of 0.920, and its indicators also displayed strong CITC values, ranging from 0.774 to 0.858. Similarly, perceived benefits showed high reliability ($\alpha = 0.966$) with all CITC values above 0.77. The perceived barriers dimension also met reliability standards with an alpha of 0.832, and all item-total correlations were above 0.73. Notably, cues to action and self-efficacy showed very high internal consistency, with alpha values of 0.974 and 0.971, respectively, and CITC values above 0.95 for all items. These findings confirm that all HBM dimensions and their respective items are both valid and reliable for measuring students' health behavior in this study.

Table 3. Validity and reliability of HBM Dimension and its indicators

Dimensions	Alpha	Items	CITC
Perceived susceptibility	0.888	X1.1	0.677
		X1.2	0.631
		X1.3	0.857
Perceived severity	0.920	X2.1	0.858
		X2.2	0.774
		X2.3	0.789
Perceived benefit	0.966	X3.1	0.858
		X3.2	0.774
		X3.3	0.789
Perceived barrier	0.832	X4.1	0.744
		X4.2	0.808
		X4.3	0.848
		X4.4	0.736
Cues to action	0.974	X5.1	0.966
		X5.2	0.954
		X5.3	0.965
Self-efficacy	0.971	X6.1	0.952
		X6.2	0.956
		X6.3	0.964

* CITC= corrected item total correlation

Table 4 shows there were no significant differences in compliance behavior across demographic groups. The compliance score was obtained from the mean of three items measuring compliance with health protocols (Y.01–Y.03). Female students a slightly higher mean score (M = 3.653) compared to male students (M = 3.574). Regarding age, average compliance scores varied across groups, with students under 18 years reporting the highest mean (M = 5.000), though this subgroup was very small. The group aged 26–30 also showed a relatively high mean (M = 4.166. As for educational level, diploma students had the highest mean score (M = 3.814).

Table 5 and Figure 1 summarize the results of the Structural Equation Modeling (SEM) analysis examining the effects of each HBM dimension on compliance behavior. Among the six dimensions tested, perceived benefit (X3), cues to action (X5), and self-efficacy (X6) demonstrated statistically significant positive relationships with compliance behavior. Specifically, self-efficacy ($\beta = 0.442$, $p < 0.001$) emerged as the strongest predictor, followed by cues to action ($\beta = 0.319$, $p < 0.001$) and perceived benefit ($\beta = 0.129$, $p = 0.034$). These findings suggest that students who are confident in their ability to follow health protocols, who receive clear cues or prompts, and who believe in the benefits of the protocols are more likely to adhere to them. Conversely, perceived susceptibility (X1), perceived severity (X2), and perceived barriers (X4) did not show significant effects on compliance behavior, as their p-values exceeded the 0.05 threshold. These results indicate that although students may recognize risks or barriers, these perceptions alone are insufficient to influence their actual compliance behavior in the post-pandemic learning context.

Table 4. Difference between group (n=331)

Variable	Group	Mean*	Std. Dev	Levene test	ANOVA	
					F	Sig
Gender	Male	3.574	1.216	0.204	0.395	0.530
	Female	3.653	1.091			
Age (yr.)	< 18	5.000	.	0.015	0.718	0.610
	18-21	3.566	1.210			
	22-25	3.654	1.103			
	26-30	4.166	0.408			
	31-40	3.750	0.786			
	> 40	3.666	1.054			
Education	Diploma	3.814	1.200	0.090	0.511	0.675
	Undergraduate	3.586	1.179			
	Master	3.791	0.849			
	Doctoral	3.444	0.769			

Table 5. Structural Equation Modelling of HBM dimension and compliance behavior

Association	Estimate	S.E.	C.R.	P	Note
X1 → Y	-0.118	0.078	-1.524	0.128	Not significant.
X2 → Y	0.147	0.098	1.493	0.135	Not significant
X3 → Y	0.129	0.061	2.121	0.034	Significant
X4 → Y	-0.007	0.075	-0.087	0.930	Not significant
X5 → Y	0.319	0.064	4.958	<0.001	Significant
X6 → Y	0.442	0.060	7.330	<0.001	Significant

X1=Perceived susceptibility, X2=Perceived severity, X3=Perceive benefit, X4=Perceived barrier, X5=Cues to action, X6=Self efficacy, Y=Compliance behavior, SE=standard error, C.R.=critical ratio

Figure 1: The structural model of HBM dimension (X1-X6) and compliance behavior (Y)

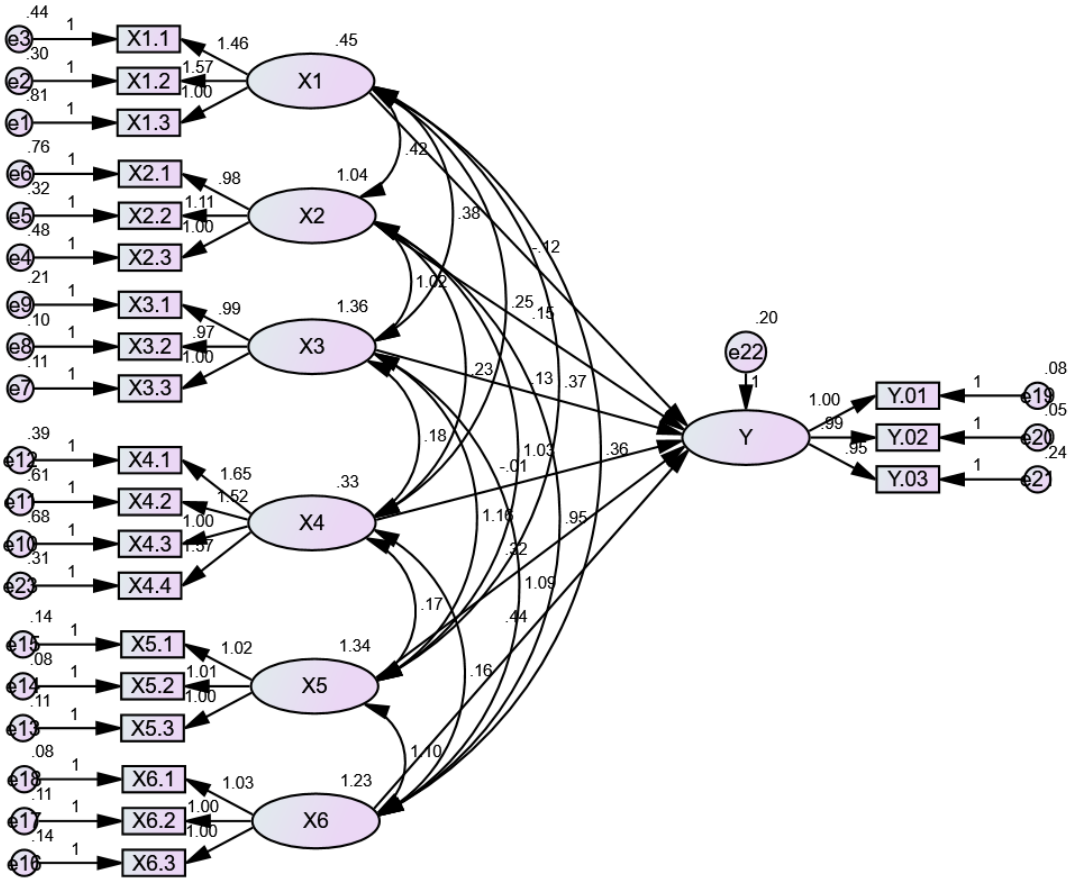

Table 6. Model fit measures of the SEM Analysis

Measure	Estimate	Threshold	Interpretation
CMIN	543.108	--	--
DF	188	--	--
CMIN/DF	2.889	Between 1 and 3	Excellent
CFI	0.961	>0.95	Excellent
SRMR	0.087	<0.08	Acceptable
RMSEA	0.076	<0.06	Acceptable

Table 6 presents the model fit indices for the Structural Equation Modeling (SEM) analysis. The model demonstrates an acceptable overall fit. The Chi-square to degrees of freedom ratio (CMIN/DF) is 2.889, which falls within the recommended range of 1 to 3, indicating a good model fit. The Comparative Fit Index (CFI) is 0.961, exceeding the 0.95 threshold and demonstrating excellent fit. The Standardized Root Mean Square Residual (SRMR) is 0.087, slightly above the preferred cutoff of <0.08, suggesting a marginal but still acceptable fit. The Root Mean Square Error of Approximation (RMSEA) is 0.076, which is within an acceptable

range, though slightly above the ideal threshold of <0.06. Taken together, these indices indicate that the structural model adequately fits the observed data and is appropriate for interpreting the relationships among the variables.

DISCUSSION

This was study focused on predicting students' compliance with health protocols in the campus environment following the COVID-19 pandemic. The analysis of group differences showed that demographic characteristics such as gender, age, and education level did not significantly influence students' compliance behavior with health protocols during restricted face-to-face learning. Although female students had a slightly higher mean score than male students, this difference was not statistically significant. This result contrasts with previous studies suggesting that women often exhibit greater health compliance due to heightened risk perception and stronger social responsibility.[8]

In terms of age, although students aged 26–30 years showed relatively higher compliance scores compared to other age groups, the differences were not significant. Similarly, no significant variation was found across education levels, despite diploma and master's students having slightly higher mean scores than their undergraduate and doctoral counterparts. These findings suggest that demographic factors may not play a dominant role in shaping compliance behavior. Instead, psychological and perceptual variables—such as perceived benefits, cues to action, and self-efficacy—appear to be stronger predictors of compliance, as demonstrated in the structural model results. Therefore, future interventions should prioritize targeting these cognitive-behavioral constructs rather than relying solely on demographic segmentation.

The Health Belief Model (HBM) framework was applied to understand the factors that influence individuals' compliance with health prevention programs within a health-related context.[10] The findings of this study highlight the significant roles of perceived benefits, cues to action, and self-efficacy in influencing students' compliance with COVID-19 health protocols during limited face-to-face learning. Perceived benefit reflects students' recognition of the positive outcomes associated with adhering to health protocols, which motivates their continued compliance.[10,15] Cues to action, such as reminders, health messages, and social influences, serve as external triggers that prompt students to maintain preventive behaviors.[11,16] Among these, self-efficacy emerged as the strongest predictor, underscoring the importance of students' confidence in their ability to successfully implement health protocols despite challenges.[10,11] These results align with previous research emphasizing that belief in the effectiveness of preventive measures, supportive environmental cues, and personal confidence are crucial determinants of health behavior compliance.[8] Therefore, interventions aimed at increasing compliance should focus on enhancing students' understanding of benefits, providing clear and consistent cues, and strengthening their self-efficacy to sustain protective behaviors in post-pandemic educational settings.

According to the result, perceived susceptibility did not significantly affect compliance to health protocol. Perceived susceptibility refers to a person's subjective perception of the risk of acquiring an illness or disease.[17] There is a wide variation in a person's feelings of vulnerability to an illness or disease. This suggests that an individual's perceived susceptibility to disease does not significantly influence their compliance behavior.

Perceive severity is also did not significantly affect compliance. Although, severity can be based on medical consequences, like death or disability, these results indicate that students' perceptions of health consequences do not affect compliance behavior. The same way happens to the perceived barrier, the result shown that perceived barrier did not have significant effect to compliance behavior These results indicate that the respondent's perception of the benefits received when participating in a behavior do not affect their compliance behavior.

In contrary, perceived benefit, cues to action and self-efficacy have significant effect to compliance behavior. Students' perceived benefits when complying with health protocols can influence their compliance behavior. perceived benefits are related to behavior in response to threats. This compliance behavior will be related to how students respond to health threats, both real and perceived as dangerous (for example: hand washing behavior will prevent them from the danger of contracting the COVID19 virus). In addition, cues to action is important to identify the stimulus needed to trigger the decision-making process to accept a recommended health action.[8] We found that both internal and external stimulus can affect student compliance behavior to health protocols. Last, the ability related to successful behavior change is self-efficacy. Self-efficacy has known to predict whether a person performs the desired behavior or not. Our result shown when a student is confident to take action, it will affect his behavior in health protocols.

This study has several limitations that need to be acknowledged. First, the use of a cross-sectional survey design relies entirely on self-reported data, which may be subject to social desirability bias or inaccuracies in respondents' perceptions. As a result, the reported compliance behavior may not fully reflect actual practices. Second, the study measured compliance as a perception-based construct rather than direct observation of behavior. Since compliance with health protocols involves habitual and sustained actions, relying solely on participants' perceptions limits the ability to capture the behavioral consistency over time. Third, the study was conducted in a specific geographic and institutional context—namely, university students in the city of Palembang. This limits the generalizability of the findings to other populations or regions with different social, cultural, or institutional characteristics.

CONCLUSION

The results of structural equation modeling showed that three HBM constructs—perceived benefits, cues to action, and self-efficacy—significantly influenced students' compliance with health protocols, with self-efficacy emerging as the strongest predictor. Conversely, perceived susceptibility, severity, and barriers were not found to have a significant effect. Furthermore, ANOVA tests revealed no significant differences in compliance behavior based on gender, age, or education level, indicating that adherence was relatively consistent across demographic groups. These findings confirm that psychological perceptions within the HBM framework play a more critical role in shaping compliance behavior than demographic factors in the context of limited face-to-face learning after the pandemic.

Future studies are suggested to adopt a longitudinal design in order to capture the continuity and stability of compliance behavior among university students over time, or incorporating observational or mixed-method approaches to complement self-reported data. Involvement of broader study population should be considered

to get better understanding.

COMPETING INTEREST

There was no conflict of interest declared in this study.

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AUTHOR'S CONTRIBUTION

NF developed research idea, draft the research, and data collection. MEF developed research concepts and designs, assisted in data analysis, analyzed data, provided suggestions, prepared and improved manuscripts. ZW and AH provided tips, information, and enhanced manuscripts.

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