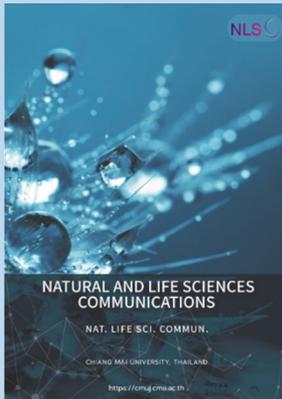


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## Corresponding author:

Jukkrit Wungrath,  
E-mail: [jukkrit.w@cmu.ac.th](mailto:jukkrit.w@cmu.ac.th)



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# Knowledge, Attitudes, and Practices Towards COVID-19 Among University Students in Thailand after the Peak Outbreak Period and Relaxation of Control Measures

Jukkrit Wungrath<sup>1\*</sup>, Patcharida Preeprame<sup>2</sup>, Siriporn Pengjan<sup>3</sup>, Kapatma Kaleekatapo<sup>4</sup>, Thitima Thasuwanain<sup>5</sup>, Anan Iftikhal<sup>6</sup>, and Penpek Chaisongmuang<sup>7</sup>

1 Faculty of Public Health, Chiang Mai University, Chiang Mai 50200 Thailand.

2 Faculty of Applied Arts and Architecture, Ubon Ratchathani University, Ubon Ratchathani 34190 Thailand.

3 Faculty of Liberal Arts and Management Science, Prince of Songkhla University, Suratthani Campus, Suratthani 84000 Thailand.

4 Faculty of Islamic Studies and Law, Fatoni University, Pattani 94160 Thailand.

5 Faculty of Public Health, Chiang Rai Rajabhat University, Chiang Rai 57100 Thailand.

6 Faculty of Public Health, Kasetsart University Chalermpkrakiat Sakon Nakhon Province Campus, Sakon Nakhon 47000 Thailand.

7 Faculty of Nursing, Ubon Ratchathani University, Ubon Ratchathani 34190 Thailand.

## ABSTRACT

This study investigates the knowledge, attitudes, and practices (KAP) towards COVID-19 among university students in Thailand after the peak outbreak period and the relaxation of control measures. A cross-sectional study was conducted between August 15 and 30, 2022, involving 2,175 university students from seven universities across four regions of Thailand. Data was collected using an online questionnaire distributed via popular social networking sites and university networks. Statistical analyses included descriptive statistics, Kruskal-Wallis tests, and linear regression to identify factors associated with KAP scores. The findings revealed that students generally maintain high levels of knowledge (91.17% aware that COVID-19 is a respiratory infectious disease) and positive attitudes towards preventive measures (50.75% strongly agree that COVID-19 is highly transmissible). However, there were discrepancies in attitudes towards mask usage (18.86% strongly disagree on its necessity) and vaccine acceptance (42.30% strongly disagree on the necessity of vaccination). Sociodemographic factors significantly influenced KAP scores, with females exhibiting higher attitude ( $P=0.032$ ) and practice ( $P=0.004$ ) scores, and students from the North-eastern region and those with higher education levels showing better knowledge and practices. The study highlights the need for targeted public health interventions to address discrepancies in preventive behaviors, particularly regarding mask usage and vaccine acceptance. Tailored educational programs, engagement with community and religious leaders, and region-specific strategies are essential to promote comprehensive adherence to COVID-19 preventive measures.

**Keywords:** COVID-19, Knowledge, Attitudes, Practices, University students, Relaxation, Control measures

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## INTRODUCTION

In response to COVID-19, countries, including Thailand, implemented measures like lockdowns, social distancing, travel restrictions, and closures of institutions to reduce virus transmission (Marome and Shaw, 2021). Thailand emphasized testing, contact tracing, and quarantine facilities to isolate cases, forming a comprehensive strategy to mitigate the pandemic's impact. The global vaccination campaign, marked by the rapid development of vaccines using mRNA, viral vector, and inactivated virus technologies, became a pivotal response effort (Kitphati et al., 2021; Marome and Shaw, 2021). These vaccines, quickly authorized for emergency use, proved effective in preventing COVID-19 and severe outcomes. Coordinated by the World Health Organization, the campaign addressed equitable distribution, logistical challenges, and vaccine hesitancy, aiming for herd immunity to control the virus spread by immunizing a significant population segment (World Health Organization, 2022; Thaikruea et al., 2022).

Two years into the pandemic, global data suggests an upward trajectory, with dropping case numbers and finally, easing restrictions (Wong et al. 2020). This movement toward normalcy seen in Thailand and elsewhere has been propelled by widespread vaccination and the natural receding of waves of infections. Conversely, lifting restrictions also risks complacency in continuing preventive measures. As new variants materialize, potentially altering both infectivity and susceptibility to immunization (Chen et al., 2022), the scientific community stresses the importance of continued vigilance. It is critical to balance the socio-economic cost of closures vs the public health need to curtail outbreaks (Kitphati et al., 2021; Chen et al., 2022).

In October 2022, the Thai Government announced COVID-19 as an endemic disease, eased compulsory mask-wearing requirements, and recommenced face-to-face teaching in universities. Nonetheless, this transition has been challenging for students' social interactions, finances, and academic achievement (Maser et al., 2019). Students in the university context — notable for their high social interaction and mobility — suffered specific challenges during the pandemic. The sudden transition to online learning and the closure of universities disrupted academic progress, mental health and social well-being, and a number of studies have reported higher levels of stress, anxiety and isolation. It also revealed inequities in access to technology and educational resources, underscoring the necessity for effective support systems (López-Valenciano et al, 2021); Birmingham et al, 2023. While Thailand is currently past the peak, compliance with COVID-19 prevention among students is crucial to preventing outbreaks in schools, colleges or other high-risk settings such as hostels or student housing (Pramukti et al., 2020; Merkuri et al., 2023). The potential lethargy in preventive behaviour highlights the need for targeted public health messaging and interventions that take into consideration the specific requirements of the student population (Ferdiansyah et al., 2020; Yorsaeng et al., 2022).

Globally, studies have documented varying levels of KAP in this population. For instance, Hasan et al. (2021) reported that university students in the United Arab Emirates possessed good COVID-19 knowledge but exhibited notable gaps in preventive practices. Similarly, Padmanaban et al. (2022) found comparable trends among higher education students in India, highlighting the need to consider population-specific factors.

Thai university students in the present study maintained high levels of COVID-19 knowledge and generally positive attitudes even after the peak outbreak and relaxation of control measures. However, discrepancies in preventive behaviors—especially in mask usage and vaccine acceptance—were observed. This aligns with Kaewkrajang et al. (2023), who noted that students remained cautious and supportive of preventive measures despite eased restrictions. Similar trends were reported by Hanvivattanakul et al. (2024) and Maleelai and Juntavaree (2024) during the pandemic's height. Additionally, sociodemographic factors such as gender,

education level, and university region significantly influenced KAP scores, with female students and those in health sciences demonstrating better adherence to preventive practices

This research aims to examine the knowledge (K), attitudes (A), and practices (P) towards COVID-19 among Thai university students after the outbreak's peak and relaxation of control measures. It seeks to identify knowledge, attitude, and practice gaps to inform targeted public health interventions. The study contributes to managing the transition to a post-pandemic world, emphasizing the importance of maintaining preventive behaviors to avoid reversing progress made in controlling the virus.

## MATERIAL AND METHODS

This cross-sectional study was conducted between 15 and 30 August 2022, with data collected through an online questionnaire using Google Forms.

### Samples and data collection

The research involved 162,387 students pursuing bachelor's, master's, and doctoral degrees across 7 universities in Thailand covering 4 regions of the country (Central, North, North-east and South), for the 2023 academic year.

To recruit participants, the research team contacted four regional university network leaders (one for Central, Northern, Northeastern and Southern Thailand) to share the survey. To reach out to the target population effectively, the online questionnaire was disseminated through popular apps such as Line, Facebook, and the official communication channels of the universities. A voluntary response sampling was used to recruit participants. People interested to respond the surveys clicked on the given link. Participants read informational material and electronically signed the informed consent before completing the questionnaire.

Sample size calculation using n4Study application, after considering the confidence level of 95%, with 5% margin of error, proportion of 50%, and the population size of 162,387 students, a total of 1,523 participants were estimated. As with similar large scale online survey studies carried out with university student populations, a 10% non-response rate was factored in for possible non-completion/exclusion. This resulted in a final estimated sample size of 1,675. Real number of responses received in actuality was 2,175 which was more than estimated. Overall 10% adjustment to sample size was considered, with adjustment as analysis in our recruitment. Hence, no additional sample size adjustment was performed and all completed responses were included in the final analysis.

The participants were selected according to the following criteria: they had to be 18 years or older, currently enrolled as a student according to the university's registration system, have returned to traditional classroom-based learning, be proficient in Thai, and have provided informed consent by clicking on the consent form within the Google Form. In addition, exclusion criteria were applied such that participants who did not provide informed consent, who were not enrolled in a recognized academic program, who submitted incomplete questionnaires, or who were unable to understand or complete the questionnaire due to cognitive impairment, language barriers, or lack of access to the necessary digital devices were excluded.

Before completing the questionnaire, we requested all interested participants to read an information sheet and provide their consent by clicking on an embedded form in the Google Form, before completing the questionnaire. The information sheet listed the study's goals, explained that participation was entirely voluntary, maintained confidentiality, described the expected length of time involved, and noted that participants could cease participation at any time without consequence. Formal consent was obtained via an electronic checkbox that participants were required to

check before being granted access to the survey. The survey programming meant that participants could close the browser window before submitting the form at any point before it was submitted and any responses they made would not be saved to the dataset. The survey system did not take identifying information and could only be submitted in Full Completion, so no follow-up measures needed to be taken to raise with those who withdrew (and partial data isn't stored). Responses to the survey were fully conditional upon completing the survey — one could not submit partial responses. Students participated in the study voluntarily and the study had no effect on their academic performance, daily life or employment or provide them any special treatment from their universities.

All responses were confidentially stored within the Google Forms system and were not made public. Access to the data was restricted to authorized researchers who had a password. The data was to be retained for one year, after which all information would be permanently deleted from both the Google Forms system and any other storage devices. Finally, a total of 2,175 students successfully completed and submitted their responses to the questionnaire.

### **Research instrument**

After reviewing and gathering information on COVID-19 from the WHO websites and numerous scientific articles a draft of the KAP questionnaire was developed (Kunno et al., 2022; Padmanaban et al., 2022; Sondakh et al., 2022; World Health Organization, 2022; Sirat et al., 2023).

#### **Part 1: Demographic data**

10 closed-ended and fill-in-the-blank questions consisting of gender, age, religion, university, education level, province of residence, number of family members, place of residence before returning to study, nature of the residence when returning to study, family members at risk from COVID-19, medical history of vaccination against COVID-19 and length of illness with COVID-19.

#### **Part 2: Knowledge towards Covid-19 after the peak outbreak period and relaxation of control measures**

15 questions each item in the knowledge domain asks respondents to determine the truth of the information written on the questionnaire by choosing one of three choices, namely (1) yes, (2) no (3) don't know. One score was given for yes and zero for no or don't know. The total score was between 0 and 15.

#### **Part 3: Attitude towards Covid-19 after the peak outbreak period and relaxation of control measures**

10 items on attitudes toward the respondent's information receiving and social interaction related to COVID-19 pandemic; and with the IOC was  $> 0.5$  for all items, Cronbach's  $\alpha$  was 0.85. Questions were implemented as a five-level Likert scale measurement as (1) Strongly disagree, (2) Disagree, (3) Neutral, (4) Agree, and (5) Strongly agree.

#### **Part 4: Practice towards Covid-19 after the peak outbreak period and relaxation of control measures**

15 items on practices that measure respondents' behavior in implementing health protocols during the pandemic. Questions were implemented as a five-level Likert scale measurement as (1) Never, (2) Rarely, (3) Sometimes, (4) Often, and (5) Always. The total score was between 1 and 60.

The total scores of each item were then converted to percentages (0–100%). The score  $< 60\%$  were classified as poor knowledge, negative attitude, or high-risk practices; the scores of 60.1–80% were moderate knowledge, moderate attitude, or

moderate-risk practices; and the scores of > 80.1% were good knowledge, positive attitude, or low-risk practices. (Hasan et al., 2021)

All items of KAP study were evaluated for internal reliability using Cronbach's alpha. The IOC was > 0.5 for all items, the coefficients for Cronbach's alpha for attitudes and practices toward COVID-19 were 0.88, 0.81 and KR-20 for knowledge was 0.85, respectively.

### **Statistical analysis**

The collected data were checked for completeness and errors. Each questionnaire was coded, and the data was entered and analyzed by using SPSS software version 25.0. The entered data was cleaned, and errors were corrected. All incomplete questionnaires were excluded from the data processing due to the original survey design which did not allow submission of questionnaires with blank fields. Any logically inconsistent responses (e.g., contradictory demographic information) were examined and excluded from analysis if they could not be reliably resolved. In conclusion, all analyzed data fulfilled criteria for both completeness and internal consistency. A *P*-value of less than 0.05 was considered statistically significant. Descriptive statistics were used to calculate frequencies and percentages. The Kruskal–Wallis test was used to compare differences in KAP scores across multiple independent groups (e.g., region, education level). This test was chosen over parametric alternatives such as one-way ANOVA because the KAP scores were derived from Likert-scale items, which are ordinal in nature. Furthermore, preliminary analysis using histogram inspection and the Shapiro–Wilk test indicated that the data were not normally distributed. Since the Kruskal–Wallis test does not assume normality and is more robust for ordinal data, it was deemed the most appropriate method for comparing group medians in this study. Linear regression analysis was used to identify factors associated with KAP score.

### **Ethical consideration**

The study was reviewed and approved by the Institutional Ethical Review Board of the Faculty of Public Health, Chiang Mai University (IRB No: ET04/2024). Consent from the participants was obtained by asking them to sign an online informed consent form by clicking on it. All human research procedures were in accordance with the ethical standards of the committee responsible for human experimentation (institutional and national) following the Helsinki Declaration of 1975, revised in 2013.

## **RESULTS**

### **Sociodemographic characteristics of the study participants**

Out of 2,175 participants, 72.83% were female, and 66.30% were aged between 20-25 years. The majority of participants (83.91%) identified as Buddhists. Participants primarily came from the Central region (32.37%). Over half (56.74%) were studying in health science areas. Most participants (88.46%) were pursuing a bachelor's degree. Regarding living arrangements, 66.80% lived in private dormitories, condominiums, or apartments, and 50.48% lived alone. Nearly all participants (99.22%) were vaccinated against COVID-19, and 70.67% had previously contracted the virus. As shown in Table 1.

**Table 1** Sociodemographic characteristics of the study participants (N = 2,175).

Variables	Frequency	Percentage
<b>Sex</b>		
Male	591	27.17
Female	1,584	72.83
<b>Age</b>		
<20	502	23.08
20-25	1,442	66.30
>25	231	10.62
<b>Religion</b>		
Buddhism	1,830	83.91
Christianity	209	9.58
Islam	119	5.46
Others	27	1.05
<b>University region</b>		
Central region	704	32.37
Northern region	554	25.47
North-eastern region	431	19.82
Southern region	486	22.34
<b>Area of Study</b>		
Health science area	1,234	56.74
Non health science area	941	43.26
<b>Education Level</b>		
Bachelor	1,924	88.46
Master	173	7.95
Doctoral	78	3.59
<b>Living Situation</b>		
Private Dorm, Condo, Apartment	1,453	66.80
University Dorm	394	18.11
Family Home	247	11.36
Other	81	3.72
<b>Co-residents</b>		
Living Alone	1,098	50.48
With 1 Person	384	17.66
With 2 People	289	13.29
With 3 People	168	7.72
With >3 People	236	10.85
<b>COVID-19 Vaccination Status</b>		
Yes	2,158	99.22
No	17	0.78
<b>Covid-19 Illness History</b>		
Ever	1,537	70.67
Never	638	29.33

### Knowledge towards Covid-19 after the peak outbreak period and relaxation of control measures

Table 2 presents the knowledge of the study participants regarding COVID-19 after the Peak Outbreak Period and Relaxation of Control Measures. A significant majority of the participants knew that COVID-19 is a respiratory infectious disease (91.17%) and recognized that there is currently no cure for COVID-19 (35.63%). Most participants were aware that COVID-19 can spread from person to person through inhalation and contact with bodily fluids such as mucus, saliva, and sputum (96.87%). Additionally, they understood that elderly people, those with low immunity, chronic diseases, and obesity are at higher risk of severe symptoms and death from COVID-19 (92.97%). The participants demonstrated knowledge about the necessity for products to contain at least 70% alcohol to be effective against COVID-19 (77.61%), and that asymptomatic COVID-19 patients can still spread the virus to others (87.68%). Key symptoms of COVID-19, such as cough, fever, and sore throat, were known by 96.78% of the participants. Moreover, 92.37% of the

participants acknowledged that people returning from outbreak areas or countries are at risk even if they show no symptoms, and 82.85% were aware of the existence of several vaccines that can prevent COVID-19 infection, each with varying effectiveness. Lastly, maintaining good health to boost immunity and prevent COVID-19 infection was recognized by 94.3% of the participants.

**Table 2.** Knowledge towards Covid-19 after the peak outbreak period and relaxation of control measures.

	<b>Knowledge</b>	<b>Yes N (%)</b>	<b>No N (%)</b>	<b>I Don't Know N (%)</b>
K1	COVID-19 is a respiratory infectious disease.	1,983 (91.17)	94 (4.32)	98 (4.51)
K2	There is currently no cure for COVID-19.	775 (35.63)	974 (44.78)	426 (19.59)
K3	COVID-19 can spread from person to person through inhalation and contact with bodily fluids such as mucus, saliva, and sputum.	2,107 (96.87)	33 (1.52)	35 (1.61)
K4	Elderly people, those with low immunity, chronic diseases, and obesity are at higher risk of severe symptoms and death from COVID-19.	2,022 (92.97)	47 (2.16)	106 (4.87)
K5	Products that can kill COVID-19 must contain at least 70% alcohol.	1,688 (77.61)	186 (8.55)	301 (13.84)
K6	Asymptomatic COVID-19 patients can still spread the virus to others.	1,907 (87.68)	144 (6.62)	124 (5.7)
K7	Key symptoms of COVID-19 are cough, fever, and sore throat.	2,105 (96.78)	29 (1.33)	41 (1.89)
K8	People returning from outbreak areas or countries are at risk even if they show no symptoms.	2,009 (92.37)	67 (3.08)	99 (4.55)
K9	There are currently several vaccines available that can prevent COVID-19 infection, each with varying effectiveness.	1,802 (82.85)	120 (5.52)	253 (11.63)
K10	Maintaining good health helps boost immunity and prevent COVID-19 infection.	2,051 (94.3)	54 (2.48)	70 (3.22)

### Attitude towards Covid-19 after the peak outbreak period and relaxation of control measures

Table 3 presents the attitudes of the study participants towards COVID-19 after the peak outbreak period and the relaxation of control measures. The majority of participants (47.24%) strongly agree that COVID-19 is a severe contagious disease that can be fatal, while only 3.36% strongly disagree. Similarly, 50.75% of participants strongly agree that COVID-19 is a highly transmissible disease, with only 1.24% strongly disagreeing. Regarding the necessity for strict isolation of COVID-19 patients, 37.47% agree, while 4.50% strongly disagree. The perception that COVID-19 is not as scary as it was during the peak outbreak is held by 37.36% of participants, while 6.26% strongly disagree. When it comes to preventive measures, 18.86% of participants strongly disagree that wearing a mask outside the home is necessary, whereas 22.23% agree. The importance of frequent hand washing with clean water and soap is strongly agreed upon by 56.32% of participants, with only 0.83% strongly disagreeing. Social distancing is considered important by 50.53% of

participants, who strongly agree, while 1.93% strongly disagree. The practice of eating hot food and using serving spoons is strongly agreed upon by 49.93% of participants, with 1.61% strongly disagreeing. In terms of social activities, 48.62% of participants always consider reducing social activities outside the home important, while 2.26% strongly disagree. Working from home to prevent COVID-19 is strongly agreed upon by 48.28% of participants, with 2.99% strongly disagreeing. The impact of COVID-19 on the economy and society is strongly acknowledged by 40.41% of participants, while 2.99% strongly disagree. Finally, 42.30% of participants strongly disagree on the necessity of receiving the COVID-19 vaccine as recommended by the Ministry of Public Health, while 40.26% agree on its importance.

**Table 3.** Attitude towards Covid-19 after the peak outbreak period and relaxation of control measures.

Attitude		Strongly Disagree	Disagree	Neutral	Agree	Strongly agree
		N (%)	N (%)	N (%)	N (%)	N (%)
A1	COVID-19 is a severe contagious disease that can be fatal.	73 (3.36)	103 (4.73)	180 (8.28)	790 (36.32)	1029 (47.24)
A2	COVID-19 is a highly transmissible disease.	27 (1.24)	63 (2.90)	120 (5.52)	872 (40.09)	1093 (50.75)
A3	Currently, people with COVID-19 must be strictly isolated from society or the community and should not meet or participate in any activities with others.	98 (4.50)	149 (6.85)	318 (14.63)	815 (37.47)	795 (36.55)
A4	Currently, COVID-19 is not as scary as it was during the peak outbreak.	136 (6.26)	210 (9.66)	395 (18.17)	812 (37.36)	622 (28.60)
A5	Currently, wearing a mask to prevent COVID-19 is not very necessary; it is not required to wear it all the time when outside the home. We can wear a mask at our convenience.	410 (18.86)	612 (28.13)	394 (18.12)	483 (22.23)	276 (12.70)
A6	Currently, frequent hand washing with clean water and soap helps prevent COVID-19 infection.	18 (0.83)	48 (2.21)	130 (5.98)	754 (34.66)	1225 (56.32)
A7	Currently, social distancing is still important and helps prevent COVID-19.	42 (1.93)	55 (2.53)	187 (8.60)	792 (36.41)	1099 (50.53)
A8	Currently, eating hot food and using serving spoons are still important and help prevent COVID-19.	35 (1.61)	52 (2.39)	179 (8.24)	823 (37.83)	1086 (49.93)
A9	Currently, reducing social activities outside the home is still important and helps prevent COVID-19.	51 (2.26)	60 (2.76)	212 (9.75)	794 (36.50)	1058 (48.62)
A10	Currently, working from home helps prevent COVID-19.	67 (2.99)	88 (4.05)	178 (8.18)	794 (36.50)	1048 (48.28)
A11	Currently, COVID-19 is a communicable disease that affects the economy and society in all aspects.	65 (2.99)	123 (5.65)	243 (11.17)	879 (40.41)	865 (39.78)
A12	It is still necessary to receive the COVID-19 vaccine as recommended by the Ministry of Public Health.	920 (42.30)	143 (6.57)	174 (7.99)	875 (40.26)	63 (2.90)

### Practice towards Covid-19 after the peak outbreak period and relaxation of control measures

Table 4 presents the practices of the study participants regarding COVID-19 after the peak outbreak period and the relaxation of control measures. The participants wearing masks when going outside was a common practice, with 56.32% always wearing masks and an additional 34.66% often wearing them. Similarly, hand hygiene was well-practiced, with 50.53% always washing their hands with soap and water, and 36.41% doing so often. The use of hand sanitizer was prevalent, with 49.93% of participants always using it, and 37.83% using it often. Participants also showed strong adherence to avoiding crowded places, with 48.62% always practicing this behavior and 36.50% doing so often. Social distancing was maintained by 48.28% of the participants always, and 36.50% often, indicating a high level of compliance with this preventive measure. Staying at home when feeling unwell was another behavior widely followed by the participants, with 40.41% doing so often and 39.78% always. However, avoiding touching the face with unwashed hands was less consistently practiced, with only 2.90% always and 40.26% often managing to do so, suggesting an area for potential improvement. Covering the mouth and nose when coughing or sneezing was a common practice among participants, with 56.32% always and 34.66% often doing so. Cleaning and disinfecting frequently touched objects and surfaces were widely practiced, with 50.53% always and 36.41% often adhering to this behavior. Participants were proactive in monitoring their health and seeking medical advice when symptoms appeared, with 49.93% always and 37.83% often following this practice. Additionally, 48.62% of participants always followed news and updates about COVID-19, and 36.50% did so often. Similarly, 48.28% always and 36.50% often followed guidelines and recommendations set by health authorities.

**Table 4.** Practice towards Covid-19 after the peak outbreak period and relaxation of control measures.

Practice	Never N (%)	Rarely N (%)	Sometimes N (%)	Often N (%)	Always N (%)
P1 Wear a mask when going outside.	18 (0.83)	1,225 (56.32)	754 (34.66)	130 (5.98)	48 (2.21)
P2 Wash hands with soap and water.	42 (1.93)	1,099 (50.53)	792 (36.41)	187 (8.60)	55 (2.53)
P3 Use hand sanitizer.	1,086 (49.93)	823 (37.83)	179 (8.24)	52 (2.39)	35 (1.61)
P4 Avoid crowded places.	1,058 (48.62)	794 (36.50)	212 (9.75)	60 (2.76)	51 (2.26)
P5 Maintain social distance.	1,048 (48.28)	88 (4.05)	178 (8.18)	794 (36.50)	67 (2.99)
P6 Stay at home if you feel unwell.	65 (2.99)	123 (5.65)	243 (11.17)	879 (40.41)	865 (39.78)
P7 Avoid touching face with unwashed hands.	920 (42.30)	143 (6.57)	174 (7.99)	875 (40.26)	63 (2.90)
P8 Cover mouth and nose when coughing or sneezing.	18 (0.83)	48 (2.21)	130 (5.98)	754 (34.66)	1,225 (56.32)
P9 Clean and disinfect frequently touch objects and surfaces.	42 (1.93)	1,099 (50.53)	792 (36.41)	187 (8.60)	55 (2.53)
P10 Monitor health and seek medical advice if symptoms appear.	35 (1.61)	52 (2.39)	179 (8.24)	823 (37.83)	1,086 (49.93)
P11 Follow the news and updates about COVID-19.	51 (2.26)	1,058 (48.62)	212 (9.75)	794 (36.50)	60 (2.76)
P12 Follow guidelines and recommendations by health authorities.	67 (2.99)	88 (4.05)	1048 (48.28)	794 (36.50)	178 (8.18)

### Comparison of sociodemographic characteristics and mean KAP score towards Covid-19 after the peak outbreak period and relaxation of control measures

Table 5 presents the Comparison of sociodemographic characteristics and mean KAP score. Significant findings revealed that females had higher attitude ( $P=0.032$ ) and practice ( $P=0.004$ ) scores compared to males, indicating better adherence to COVID-19 preventive measures. Knowledge scores varied significantly among different religious groups ( $P=0.031$ ), with Islam adherents having the highest scores. University region also influenced knowledge ( $P=0.004$ ) and attitude ( $P=0.012$ ) scores, with the North-eastern region scoring the highest in both domains. Education level was a significant factor for knowledge ( $P=0.021$ ) and practice ( $P=0.006$ ) scores, particularly higher among those with Master's and Doctoral degrees. These findings suggest that sociodemographic factors such as sex, religion, university region, and education level play a crucial role in shaping KAP related to COVID-19, underscoring the need for targeted interventions to address these disparities. The health science students had a significantly S. higher knowledge, attitude and practice score than the non-health science students ( $< .05$ ).

**Table 5.** Comparison of sociodemographic characteristics and mean KAP score towards Covid-19 after the peak outbreak period and relaxation of control measures.

Sociodemographic Characteristics	Knowledge		Attitude		Practice	
	Mean (SD)	P-value	Mean (SD)	P-value	Mean (SD)	P-value
<b>Sex</b>						
Male	12.77(0.55)	0.903	43.58(0.95)	0.032*	34.53(0.98)	0.004*
Female	12.76(0.47)		43.66(0.83)		36.65(0.89)	
<b>Age</b>						
<20	12.56(0.47)	0.113	42.64(0.87)	0.073	34.16(0.90)	0.301
20-25	12.59(0.51)		42.66(0.89)		34.13(0.94)	
>25	12.61(0.42)		42.53(0.69)		33.91(0.81)	
<b>Religion</b>						
Buddhism	12.56(0.46)	0.031*	43.63(0.87)	0.667	33.62(0.93)	0.105
Christianity	12.59(0.50)		43.74(0.89)		33.68(0.91)	
Islam	13.61(0.42)		43.50(0.78)		33.6 (0.72)	
Others	12.52(0.58)		43.55(0.97)		33.55(1.03)	
<b>University Region</b>						
Central	12.75(0.46)	0.004*	42.66(0.85)	0.012*	32.97(0.88)	0.287
Northern	13.58(0.50)		42.60(0.86)		33.03(0.94)	
North-eastern	13.71(0.42)		43.73(0.79)		32.86(0.83)	
Southern	12.70(0.58)		42.55(0.97)		33.15(1.03)	
<b>Education Area</b>						
Health science	14.66(0.57)	0.021*	46.65(0.84)	0.022*	35.60(0.71)	0.001*
Non-Health science	11.45(0.88)		42.59(0.73)		32.77(0.82)	
<b>Education Level</b>						
Bachelor	12.56(0.50)	0.021*	43.65(0.90)	0.010*	33.60(0.94)	0.006*
Master	14.66(0.39)		43.59(0.60)		33.77(0.72)	
Doctoral	14.56(0.37)		43.56(0.64)		34.83(0.74)	

## DISCUSSION

Thai university students were able to retain high levels of COVID-19 related knowledge despite the peak outbreak and the loosening of measures. This is consistent with the data reported by Hanvivattanakul et al., Maleelai and Juntavaree (2024), and Kaewchutima (2023), show continuous awareness. This may include continuous public health education, readily available information on the internet and through social media (Siewchaisakul et al., 2022) and individual and social responsibility. These findings were, in part, the results of the long-term effects of the pandemic (sustaining preventive behavior and vaccination campaigns) (Kaewkrajang et al., 2023). The high levels of knowledge point to the importance that ongoing education, easy access to information, and a nurturing academic environment (Kaewchutima et al., 2023) play for future efforts in public health.

Thai student reflects on cautious attitude towards COVID-19 on campus, even after peak outbreak and the easing of control measures this vigilance has been sustained in light of the high proportion of students that agreed strongly in relation to the severity of the virus (47.24%) and the high rate of transmissibility (50.75%). Our findings are in accordance with Kaewkrajang et al. (2023), who observed that even after restrictions were relaxed, students were still frightened and supportive of preventative measures.

There are several reasons that might account for these entrenched attitudes. Continuous education on public health has been essential in educating students about COVID-19 dangers, with universities and health authorities regularly making sure that information which is pertinent was readily available (He and Li, 2023). Additionally, the use of digital formats is ubiquitous among university students, allowing for real-time updates that ensure high levels of awareness (Manan et al., 2022). The academic setting provides an environment that further cultivates critical thinking and awareness, as students become more literate and cautious consumers of information. Moreover, a high sense of personal and social responsibility leads to their compliance on preventive measures (Zhu et al., 2021). Finally, the present pandemic continues to affect our daily life and keep public health as well as economic-related issues leading the headlines because of the remaining health risks and issues it implies (Tang et al., 2021; Ahmed, 2022).

Most students agree with preventive measures such as frequent hand washing (56.32%), social distancing (50.53%), and reducing social activities (48.62%). However, there are significant differences about wearing masks outside the home (18.86% strongly disagree) and getting COVID-19 vaccination (42.30% strongly disagree). These insufficiencies have highlighted the importance of educating the public and effectively communicating the need for compliance with preventive measures in response to vaccine hesitance. This divergence may be due to several reasons (Riggs et al., 2022; Durmuş Iskender et al., 2023). A reduced sense of risk after the peak in outbreaks and loosened control measures can promote complacency, and false information and myths on social media can cast doubt on mask effectiveness and vaccine safety. And fear of side effects, skepticism about vaccine effectiveness, distrust of health authorities and peer influences also factor in.

Some students may believe that other preventive measures, such as hand washing and social distancing, are sufficient, reducing adherence to mask-wearing and vaccination. Communication fatigue from prolonged exposure to public health messaging can also lead to desensitization. Furthermore, varying levels of trust in the government and healthcare systems could contribute to vaccine hesitancy (Cag et al., 2022). Some individuals may also have concerns about the speed at which the vaccines were developed and approved. Addressing these behaviors requires targeted educational efforts to correct misinformation, reinforce the importance of comprehensive preventive measures, and engage trusted figures to build trust and encourage compliance.

Misconceptions about the sufficiency of measures like hand washing and social distancing further reduce adherence to mask-wearing and vaccination (Muric et al., 2021). Additionally, communication fatigue from prolonged exposure to public health messaging can lead to desensitization. Addressing these behaviors requires targeted educational efforts to correct misinformation, reinforce the importance of comprehensive preventive measures, and engage trusted figures to build trust and encourage compliance (So et al., 2017).

The comparison of sociodemographic characteristics and mean Knowledge, Attitude, and Practice (KAP) scores towards COVID-19 reveals significant disparities influenced by factors such as sex, religion, university region, and education level. These findings underscore the need for targeted public health interventions. Females scored higher in attitude ( $P=0.032$ ) and practice ( $P=0.004$ ) than males, suggesting that women may be more adherent to COVID-19 preventive measures. This difference could be due to gender differences in health behaviors, where women generally exhibit greater health consciousness and risk-averse behaviors compared to men. Studies have shown that women are often more likely to comply with health recommendations and engage in preventive practices, which may be attributed to social and psychological factors (Ashour et al., 2023). Andersen et al. (2022) demonstrated that females respondents engaged in more protective behaviors compared to males and other races/ethnicities, which can be attributed to higher levels of fear and perceived risk associated with COVID-19.

Knowledge scores varied significantly among different religious groups ( $P=0.031$ ), with Islam adherents having the highest scores. This finding could reflect the role of religious communities in disseminating health information and fostering compliance with preventive measures. Religious leaders and organizations often serve as trusted sources of information and can influence healthy behaviors among their followers. The high knowledge scores among Muslim students might indicate effective communication and community engagement within these religious groups (Alkaff et al., 2022). According to Sisti et al. (2022), religious leaders and communities are highly trusted and effective in conveying COVID-19 information, which can lead to better adherence to health guidelines. In Northeast Nigeria, Islamic clerics played a crucial role in persuading people to accept COVID-19 preventive protocols through religious teachings, thereby increasing compliance with health measures (Sambo et al., 2022).

University region significantly influenced KAP scores, with students from the North-eastern region scoring highest in knowledge ( $P=0.004$ ) and attitude ( $P=0.012$ ). This variation may be attributed to differences in public health infrastructure, access to information, and local government responses (Odetokun et al., 2022). Regions benefiting from robust public health campaigns and better educational resources tend to exhibit higher KAP scores, as also noted by Ali et al. (2023). In addition, education level played a crucial role; students with Master's and Doctoral degrees demonstrated higher knowledge ( $P=0.021$ ) and practice ( $P=0.006$ ) scores compared to their peers. Higher education is closely linked to improved health literacy, critical thinking, and greater access to scientific information, which all contribute to better understanding and adherence to health guidelines (Ling et al., 2023; Wungrath et al., 2025). Consistent with these observations, Martini et al. (2023) found that individuals with advanced degrees had superior literacy and comprehension of COVID-19 preventive measures, reinforcing the significant impact of educational attainment on pandemic responses.

Discussion the results show that students in health science fields had significantly better COVID-19 knowledge, more positive attitude, and more effective practices than non-health science students after peak outbreak and relaxation of control measures. The significance level ( $<. 05$ ) shows that these differences are statistically significant, which implies that specific training received in health sciences is associated with a higher competency level. The better knowledge-related performance is probably attributed to an intensive curriculum that managed infectious diseases, practical training, currently utilized research, and

recommendations along with strong professional motivation to remain updated and act responsibly (Sirekbasan et al., 2021). Similarly, Luitel et al.(2022) noting that dental and medical students showed better knowledge and attitude when compared to non-health science counterparts, while health services vocational school students demonstrated better knowledge and attitude toward COVID-19, likely due to their conditions of study in health-based sciences.

In summary, the highlights of this study conclude that when compared to the period of severe outbreak and strict implementation of control measures, this study shows that Thai university students continue to maintain high levels of knowledge and positive attitudes towards COVID-19 preventive measures, even after the relaxation of control measures. However, after the relaxation, there has been a reduction in the strictness of some behaviors, such as wearing masks and accepting COVID-19 vaccines. Therefore, it can be concluded that while students still have knowledge and positive attitudes towards COVID-19 prevention after the relaxation of measures, there is a tendency to reduce some preventive practices. This situation may require additional campaigns and information to promote continuous adherence to preventive measures.

## **POLICY AND FURTHER STUDY RECOMMENDATIONS**

To address disparities in COVID-19 preventive measures, universities should implement mandatory modules on COVID-19 prevention in general education courses to ensure all students receive basic knowledge. Targeted health education programs should be developed, especially to engage men more effectively; this includes using male-specific communication channels and addressing concerns about masculinity and health-seeking behaviors. Collaborating with religious leaders can enhance the dissemination of accurate information within communities; provide religious leaders with up-to-date, accurate information and resources to share with their congregations. Strengthening regional public health infrastructure and tailoring campaigns to local needs are essential to support regions with lower KAP scores; this involves increasing funding for public health initiatives in these regions and conducting community-based needs assessments to tailor; this involves increasing funding for public health initiatives in these regions and conducting community-based needs assessments to tailor. Higher education institutions should integrate public health education to promote health literacy; establish peer education programs where students can educate their peers on COVID-19 prevention strategies. Comprehensive campaigns are needed to combat vaccine hesitancy by providing evidence-based information and engaging trusted figures. For example, strategies from countries like Portugal, which achieved high vaccine acceptance rates, could be adopted. These include proactive government communication, strong public trust in health authorities, and community-based outreach programs. Learning from Sweden's approach, which focused on clear, transparent, and consistent messaging, can also be beneficial.

Further studies should include longitudinal research to track changes in knowledge, attitudes, and practices (KAP) over time. An in-depth analysis of gender differences in attitudes and practices towards COVID-19 preventive measures is necessary. Investigating the impact of religious beliefs and community engagement on health behaviors can provide valuable insights. Examining regional disparities in public health responses and assessing the effectiveness of educational interventions on health literacy and preventive behaviors are also recommended. These studies will inform more effective and equitable public health policies.

## LIMITATIONS OF THE STUDY

This study has several limitations. Firstly, the cross-sectional design only captures data at one point in time, limiting causal inferences. Secondly, reliance on self-reported online questionnaires may introduce response and selection biases, excluding those with limited internet access. Thirdly, the sample was drawn from only seven universities, which may limit generalizability. Additionally, convenience sampling via social media may over represent more informed students. Lastly, the study did not explore the underlying reasons for sociodemographic differences in KAP scores. Future research should consider longitudinal designs and qualitative methods to address these issues and gain deeper insights.

## CONCLUSION

This study provides valuable insights into the knowledge, attitudes, and practices (KAP) towards COVID-19 among university students in Thailand after the peak outbreak period and the relaxation of control measures. The findings indicate that while students generally maintain high levels of knowledge and positive attitudes towards preventive measures, there are notable discrepancies, particularly regarding mask usage and vaccine acceptance. Sociodemographic factors such as sex, religion, university region, and education level significantly influence KAP scores, highlighting the need for tailored public health interventions. Addressing these disparities through targeted education, engagement with community leaders, and region-specific strategies will be crucial in promoting comprehensive adherence to COVID-19 preventive measures. Future research should employ longitudinal and qualitative methods to further explore these dynamics and inform more effective public health policies.

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## AUTHOR CONTRIBUTIONS

J.W. conceptualized and designed the study, supervised data collection, performed statistical analyses, and wrote the first draft of the manuscript. P.P., S.P., K.K., and T.T. contributed to data collection, literature review, and manuscript revisions. A.I. and P.C. assisted with statistical analysis, data interpretation, and manuscript editing. All authors reviewed and approved the final version of the manuscript.

## CONFLICT OF INTEREST

The authors declare that they have no competing interests.

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