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Hand hygiene knowledge, attitude, and practice before, during and post COVID-19: a cross-sectional study among university students in the United Arab Emirates

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SUMMARY

Aims: Hand hygiene (HH) is an essential practice to evade the transmission of germs and minimize community-acquired infections. This study assesses the knowledge, attitude and practice (KAP) of HH and other health and safety measures before, during, and after the COVID-19 pandemic. in university students in the United Arab Emirates (UAE).

Methods: A cross-sectional questionnaire study was conducted between December 2022 and March 2023, targeting university students from all disciplines and study levels. A 44-item questionnaire was used which included student demographics, knowledge, attitude, and practice of HH, as well as the anticipated risk of COVID-19 morbidity and mortality. Participants consented before commencing the questionnaire, and the collected data were analysed using the student's t-test and ANOVA test, as required.

Results: A total of 378 responses were received nationwide, with a valid response rate of 98%. The HH knowledge revealed an average score of 62%, which was significantly higher in students with moderate family income. Additionally, the average attitude score was 74.7%, as measured on the Likert scale, and the score lacked any correlation with the other variables. HH practice showed an average score of 86.8%, which was correlated with the students' gender and field of study.

Conclusions: This study showed a moderate level of knowledge, a good attitude, and good practice around HH and other safety measures among the UAE's university students. Socioeconomic status, gender, and field of study influenced the study outcomes. This

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study highlights the need for effective awareness campaigns to reinforce students' health and safety, especially for male and non-health science students, in order to protect against communicable diseases.

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Introduction

COVID-19 is an infectious disease caused by the severe acute respiratory syndrome coronavirus-2 (SARS CoV-2), which is a member of the SARS coronavirus family [1]. Individuals infected with COVID-19 typically experience a range of symptoms, ranging from minor manifestations to more severe forms of the disease. The SARS-CoV-2 virus is mainly transmitted through respiratory droplets that spread during coughing or sneezing. The virus can also spread via contaminated hands and objects [2].

The first cases of COVID-19 in the United Arab Emirates (UAE) were reported on January 27, 2020. The latest data on the National Emergency Crisis and Disaster Management Authority of the UAE (dated 24th May 2023) indicates approximately 1.07 million cases were confirmed positive for COVID-19, with approximately 1.06 million individuals who successfully recovered, 10,156 individuals were actively infected and the number of fatalities due to COVID-19 was 2,349 [3]. The Government of the United Arab Emirates (UAE) implemented a strategy to mitigate the transmission of COVID-19. This comprised preventive measures such as practicing proper hand hygiene, maintaining physical distance, and wearing suitable masks in public settings.

The World Health Organization recommends handwashing as a highly effective and cost-efficient approach for the prevention of disease transmission [4]. According to a recent investigation, the adoption of hand hygiene practices and other preventative measures, such as using face masks and physical distancing, are linked to a reduction in both COVID-19 and other respiratory illnesses [5]. Additionally, recent studies demonstrated the significance of HH in the prevention of other infections such as gastrointestinal, ocular, oral-transmitted, as well as respiratory infections [6,7]. Therefore, compliance with hand hygiene practices is vital to reduce the spread of infection and to preserve the health and safety of the community.

The primary objective of this research was to investigate the student knowledge, perception, and practice of HH and safety measures and to correlate these behaviours with gender, socioeconomic factors, and the level and field of study. Given their dynamic nature and propensity for rapid learning, understanding these factors is crucial for enhancing students' HH consciousness efforts [2]. The regular and proper execution of handwashing is a vital skill that contributes to maintaining a state of good health [8]. Regular and correct handwashing is one of the initial steps employed to safeguard communities from various contagious illnesses [9].

In general, there is a positive correlation between inadequate hand hygiene practices and the prevalence of communicable diseases, including food-borne, severe acute respiratory syndrome (SARS), H1N1 influenza, norovirus, cholera, dysentery, meningitis, shigellosis, and multi-resistant *Staphylococcus aureus* enteritis [10–12]. Universities play a

leading role in the advancement of health education and the implementation of infection control initiatives [8]. Students have the opportunity to acquire knowledge, develop skills, and adopt positive lifestyle behaviours related to handwashing, sanitization, coughing and sneezing etiquette, avoiding smoking, healthy diet, physical activities, sleep hygiene, and other lifestyle skills [13]. However, there have been notable disparities observed in terms of student knowledge, attitudes, and practice regarding HH across genders and academic disciplines. Researchers have indicated that the implementation of interventions related to handwashing and personal hygiene among university students has resulted in a noteworthy decrease in sick leave and absenteeism rates [14]. Furthermore, the enhanced KAP of HH not only served to inspire the students but also enabled them to effectively transfer these habits to their communities [15,16]. This study aims to assess the level of knowledge, attitude, and practice of HH among university students in the United Arab Emirates (UAE), given the scarcity of recent research on this topic. Additionally, the study will also explore the students' adherence to other hygiene practices related to COVID-19.

Methods

Instrumentation and measurements

This cross-sectional questionnaire-based study was conducted from December 2022 to March 2023. The study aimed to gather data from university students in the United Arab Emirates (UAE) across all fields of study and different academic levels. Students from diverse universities in the UAE were invited to participate in the study by completing a Google® form containing an informed consent and a set of questions. Participants demonstrated a comprehensive understanding of the study's purpose, and they submitted their informed consent prior to responding to the questionnaire.

Survey questions

The survey comprised 44 questions that in four groups: demographic characteristics (Q1-Q9); knowledge regarding the correct procedure as well as efficacy of hand hygiene (Q10-Q18); attitude towards hand hygiene and safety measures during and after the COVID-19 pandemic (Q19-Q31); general hand hygiene practices and specific situations in daily life (Q32-Q42); and the perceived risk of COVID-19 morbidity and mortality based on the individual circumstances of the participants (Q43-Q44).

Inclusion and exclusion criteria

The study included university students at both the undergraduate and postgraduate levels of various genders and academic disciplines.

Data analysis

The data analysis was performed using the Jamovi 2.3.18 program (www.jamovic.org). Welch's tests, Student t-tests, and ANOVA tests were applied as appropriate, to evaluate the disparities among variables. Variables having a *P*-value less than 0.05 were deemed to have statistically significant differences. The study utilised odds ratios to assess the relationship between independent variables and outcome variables, with a confidence level of 95%. The multiple logistic regression model was updated by incorporating socio-demographic factors, including gender, kind, and level of study, and age. Independent predictors were identified as variables with a significance level (*P*-value) of less than 0.05 in multiple logistic regression analysis.

Ethical considerations

The study received ethical approval from the Ethical Research Committee (ERC) at the principal investigator's university, under the reference number M-F-H-7-Nov-2022.

Consent

Prior to providing responses, participants provided informed consent before the commencement of the survey.

Results

Sociodemographic characteristics

Out of 378 students invited to participate, 370 signed the consent form, completed the questionnaire, and submitted it successfully, with a response rate of 98%. Participants were from more than fifteen universities in the UAE. Of all complete responses, 69.7% were female, 28.9% were male, and 1.4% were undisclosed (Table I). The highest percentage were ≤ 21 years of age (65%), followed by the age range of 22–25 years (18%), older than 25 years (11%), and the lowest percentage were students less than 18-years-old (6%). Students were also classified according to residency. Sharjah, Ajman, Abu Dhabi, and Dubai Emirates were represented with 28%, 24%, 23%, and 20% respectively. The rest of students (5%) resided in other UAE Emirates (Al Fujairah, Ras Al Khaimah, and Om Al Quwain), Table I. Regarding the university of study, participants were studying at Ajman University (61%), American University of Sharjah (8%), Sharjah University (7%), UAE University (6%), Gulf Medical University (2%), and $\leq 1\%$ of the participants were at other universities, Figure 1. Regarding employment, 83% of students were studying only, and 17% were studying and working (representing majority of the post-graduate students). The health sciences major represented the students' main-stream (59%), followed by engineering and architecture (20%), arts and humanities (9%), life sciences (7%), and minority of students were in social sciences (5%), Table I. Financially, students were categorised into five sections based on monthly family income, as shown in Figure 2B.

For COVID-19 history, 57% of students reported a current or past COVID-19 infection, while the rest denied any known COVID-19 infection history (43%). In contrast, 81% reported a

Table I
Socio-demographics of the study sample (n=370)

Parameter	n (%)
Age (years)	
≤ 18	22 (6)
19–21	240 (65)
22–25	67 (18)
≥ 26	41 (11)
Gender	
Male	107 (29)
Female	259 (70)
Undisclosed	4 (1)
Emirate of residence	
Sharjah	104 (28)
Ajman	88 (24)
Abu Dhabi	85 (23)
Dubai	74 (20)
Other	19 (5)
Household (AED/month)	
0–18K	96 (26)
19–30K	88 (24)
31–50K	88 (24)
51–100K	70 (19)
>100K	26 (7)
Working status	
Studying only	306 (83)
Studying and working	64 (17)
Levels of study	
Undergraduate	351 (95.5)
MSc student	14 (4)
PhD student	5 (1.5)
Fields of study	
Health sciences	217 (59)
Engineering and Architecture	72 (20)
Arts and humanities	33 (9)
Life sciences	27 (7)
Social sciences	21 (6)
Having family member(s) at high COVID-19 infection risk	
Yes	165 (45)
No	176 (48)
Not sure	29 (8)
Has a current of past COVID-19 infection	
Yes	121 (57)
No	130 (35)
Not sure	29 (8)
Having a family member with current or past COVID-19 infection	
Yes	301 (81)
No	59 (16)
Not sure	10 (3)

history of COVID-19 infection for one or more of their family members, and 19% had COVID-19-free family members, Table I.

To study the possible association of the students' employment status on the chance of COVID-19 acquisition, two-way ANOVA test was utilised, and the data showed a significant difference between the two groups (Table II), corroborating the hypothesis that as the contact rate with public increases, the chance of getting infected increases too.

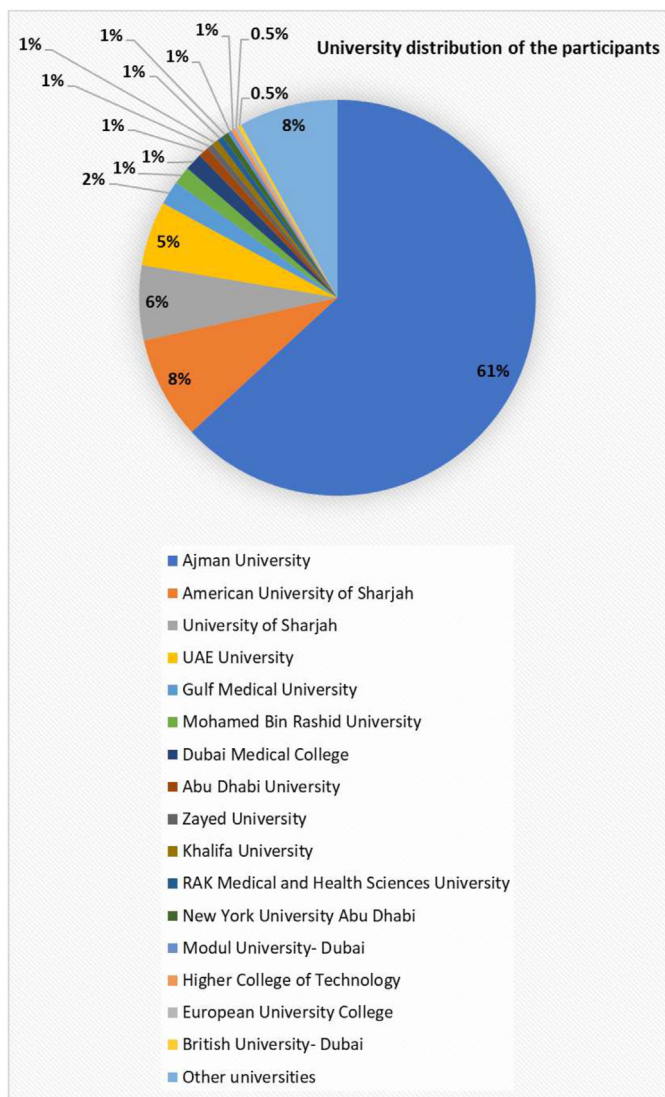


Figure 1. Participants' university distribution. Universities presented as percentage of students who participated in the survey (n=370).

Student knowledge

Data showed that 94% of students were knowledgeable about HH including hand washing (HW) and hand sanitizing (HS), and 52% were aware that HW with soap and water is the best method for HH. Moreover, 92% of participants knew the correct steps of HW and HS, and 53% knew the main types of microorganisms eliminated by proper HH, 33% did not know about them, and 14% were unsure. In contrast, only 24% knew the sanitization effect mediated by optimum HH.

When questioned about their information about HH that supports their healthy living, 89% of students confirmed, 3% denied and the rest were unsure about their information confidence. Additionally, 92% of students knew the effectiveness of HH on disease prevention, while 3% and 5% did not know or were unsure, respectively. Moreover, 76% knew that wearing gloves does not replace HH, and only 15% of students obtained their HH knowledge from university-organised health awareness campaigns (Figure 2A). To evaluate the average

knowledge score of the group, we allocated three points to the correct answer, one point to unsure answer, and zero points to the incorrect one, except in question 8, where the scores given were 0, 1, and 3 respectively. The calculated average score of knowledge for the study group was 62%, which indicates a moderate level of awareness among the study group.

Statistical analysis was also done to estimate the level of knowledge among students from different socioeconomic backgrounds. Statistics showed that students of monthly family income of 30K–50K had the highest level of knowledge, followed by a family income of 51–100K, then an income of >100K, followed by an income of 19–30K, and the lowest level of knowledge was for students of a family income of 18K or less. This clarifies the effect of student socioeconomic background on the access to correct information, and level of awareness about health and personal hygiene, in favor of the middle and moderately high-income groups (Figure 2B).

Student attitude towards HH

The Likert scale was employed to evaluate the student attitude toward HH and other safety precautions. The majority of students strongly agree with the necessity of HH for both the community health (66%; n=244), and personal safety (76%; n=281). While most of students support the protective potential of HH regarding COVID-19 (70%; n=259), but they were less sure about the HH preventive potential for the other communicable diseases (65%; n=240). In contrast, the majority of students disagree about the statement that HH is a wasting of resources (such as water and tissues) and time, as the disagreement range was 58% (n=215) and 64% (n=237), respectively. The students' positive attitude toward their friends' HH, face masks (FM), and physical distancing (PD) behaviours was variable, while the positive attitude was 66% (n=244) regarding HH, it was only 53% (n=196) and 50% (n=185) for FM and PD, respectively. A similar attitude was reported for the community leaders' behaviours toward safety precautions. While all measures were followed by community leaders, FM was the highest, followed by PD, then HH, with the corresponding percentage of 56% (n=207), 55% (n=204) and 53% (n=196) respectively. The last question was about the students' role-modeling behaviour, where 75% (n=277) of responses agreed or strongly agreed with the importance of being a role model in the community (Figure 3). The calculated average students' attitude was 74.7%, by allocating 3, 2, or 1 point to strongly-agree, agree, and neutral responses respectively, except in question number 5 and 6, where 3, 2, or 1 point were allocated to strongly disagree, disagree, or neutral responses, respectively.

Regression analysis of student attitude showed no significant difference based on gender, socioeconomic status, field or level of study (student t-test and One-Way ANOVA test have been used for analysis).

Student practice of HH and safety measures

One of the most critical parts of the study is evaluating the student practice of HH and safety measures and measuring the change in these practices during and after COVID-19 pandemic. The students demonstrated good practice which may be explained by the heightened awareness resulting from the media, social media, university campaigns, and work placement.

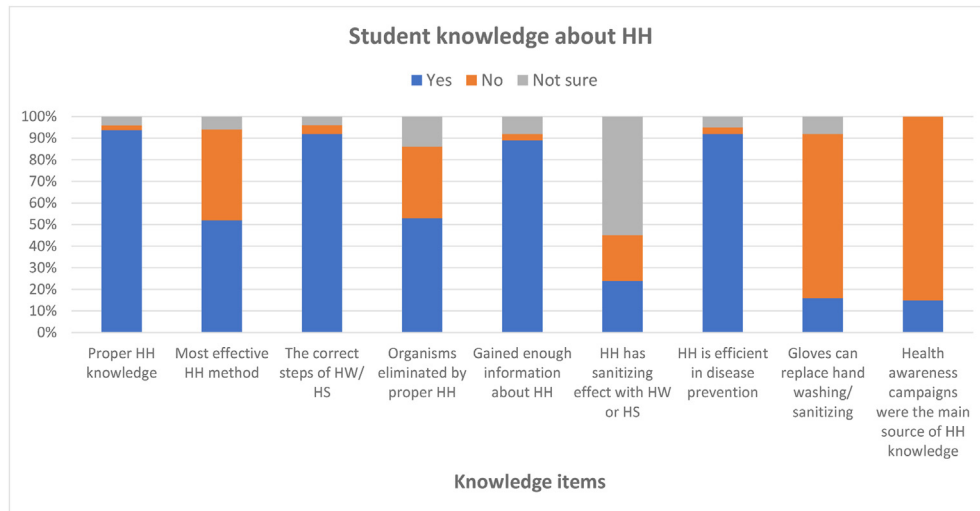


Figure 2A. Student knowledge about HH. Summary of the student responses to HH’s knowledge. Nine-questions were used to assess the knowledge. HH: hand hygiene, HS: hand sanitizing, HW: hand washing. The calculated average score of knowledge was 62%, where three points were allocated to the correct answer, one point to the unsure answer, and zero point to the incorrect one except in question 8, where the scores given were 0, 1, and 3 respectively.

Students reported a high level of hand, self, and environment hygiene and the intention to keep this level even after the COVID-19 pandemic era. The calculated average HH practice score was 86.8%, where yes, unsure, and no answers were given 3, 1, and 0 score respectively. The only occasion where the practice level was below 67% was in the lathering and hand rubbing procedures of HW or HS respectively, where the reported duration was different from the WHO’s recommendations (15–20 seconds). In addition, data showed a poor

HH practice before COVID-19 pandemic (a score of 62%) as there was not enough awareness about the importance of HH for health and safety, Figure 4A.

Moreover, the gender-based HH and safety measures practice were analysed using paired student t-test. Female students showed significantly higher practice levels than male counterparts, (Figure 4B).

Student perception of COVID-19 incidence and severity

Based on their individual, domestic, or occupational circumstances, participants reported their COVID-19 exposure risk as high, medium or low. Risk levels were calculated as 21%, 39% and 40% for high, medium and low susceptibility to COVID-19 infection respectively, Table III. Of those who are at higher risk, only 2% do think they might get fatal consequences, 35% might get mild to moderate, and 55% might get low-degree COVID-19 infections in the future, Table III. By analyzing different levels of perceived COVID-19 susceptibility, medical students showed significant higher level (73%) than the other majors’ students (27%) (P=0.001). This might be explained by the perceived hazard of frequent exposure of medical students to patients during their workplace training.

Discussion

HH knowledge, attitude, and practice (KAP) across university students from different study programs in the UAE has not been studied in detail post COVID-19 pandemic. In the current study, we tested the KAP of a cohort of students for HH during and after COVID-19. A similar study in Saudi Arabia assessed HH knowledge and compliance amongst undergraduate medical students during their clinical phase of training using the WHO’s “Five Moments for HH”. In this study, compliance was measured during practical exam sessions and only 29% of participants were able to correctly identify all the five indications for hand hygiene, indicating a poor level of knowledge. HH compliance was also found to be equally as poor at 17% [17].

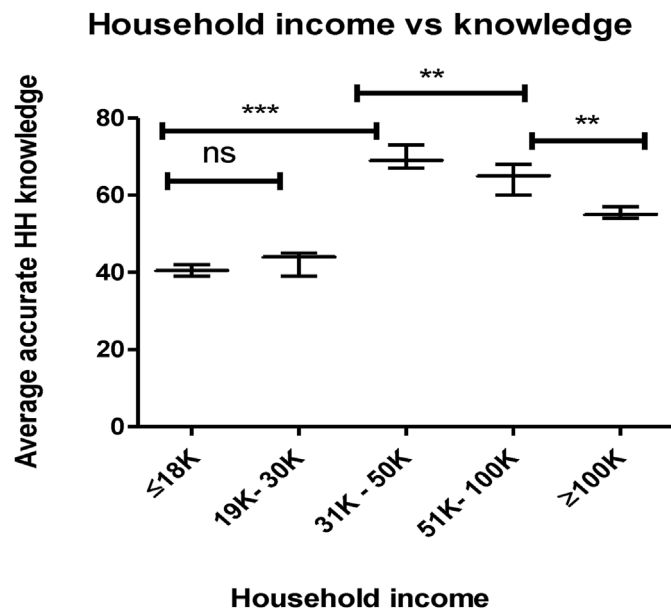


Figure 2B. Students’ family income versus correct knowledge. Household income in AED/month versus knowledge score. ns: non-significant, **=P<0.005 (=0.0029), ***=P<0.001 using Two Ways ANOVA test. Data presented as knowledge score (Mean ± SEM). Where yes, not sure, and no responses were given 3, 1 and 0 score respectively except in question 8, where the scores given were 0, 1, and 3 respectively.

Table II
Data of COVID-19 history correlated with the student employment status

Status of COVID-19	Study only	Study and work	Total	P-value
Past or current COVID-19 infection	172 (56%)	39 (60%)	305	< 0.0001
No previous COVID-19 infection	133 (44%)	26 (40%)	65	< 0.0001

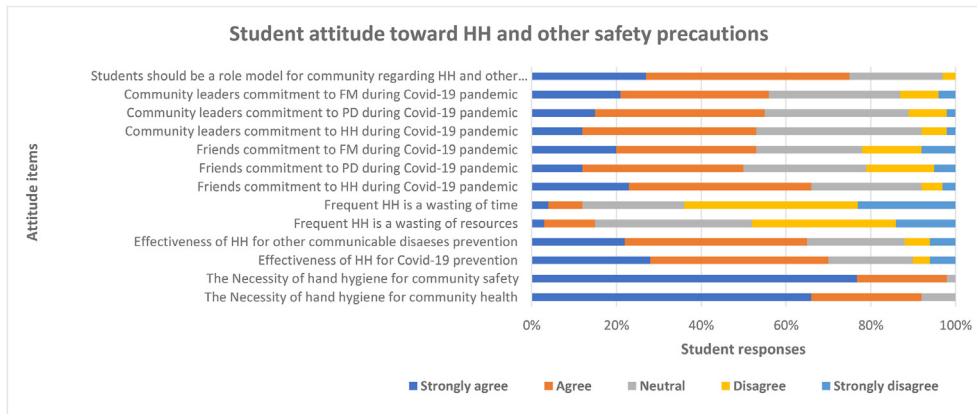


Figure 3. Student attitude toward HH and other safety precautions. *Student attitude measured on Likert scale, HH: hand hygiene, FM: face masks, PD: physical distancing.*

In contrast, our data on medical students showed a good knowledge of hand hygiene. Likewise, a cross-sectional study in India evaluated HH’s KAP amongst medical and nursing students using a WHO HH-questionnaire. In comparison to our study, only 9% of participants had good knowledge regarding HH, in which nursing students’ knowledge ($P = 0.023$) and attitude ($P < 0.05$) were significantly better than medical students. A German study reported on the beliefs of medical students regarding HH during their first clinical year in a hospital setting [17]. Overall, only 21% (18/85) of medical students marked all of the indications for hand hygiene correctly, whilst 67% identified the WHO’s “Five Moments for HH”. A UK study found that 58% of medical students were unaware of correct indications for alcohol-based hand rub and half of the students reported a perceived lack of teaching on infection control and HH during their education [18]. These

studies suggested a lack of knowledge in developed as well as developing countries concerning HH indications amongst medical students and differ from the results of our study that included not only medical students, but also students from all majors and levels of study.

In the current study, 370 completed responses out of 378 (98%) from more than fifteen universities in the UAE were received, representing good sample heterogeneity. The participants were from almost all fields, with the health sciences represented 59% ($n=218$), and the student majority were studying at Ajman University (61%; $n=226$), and of age ≤ 21 years old (65%; $n=241$). We received responses from both undergraduate and postgraduates, working and non-working students from different socioeconomic backgrounds, and these variables had a great influence on some of the measured outcomes contributing to the novelty of the study.

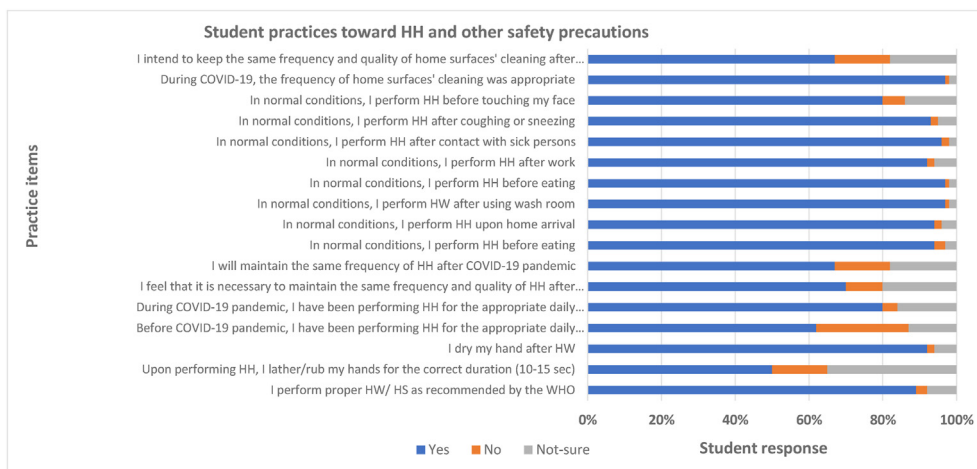


Figure 4A. Student practice of HH and other safety precautions. *Student practice of HH, and safety and hygiene measures. HH: hand hygiene, HW: hand washing, HS: hand sanitizing.*

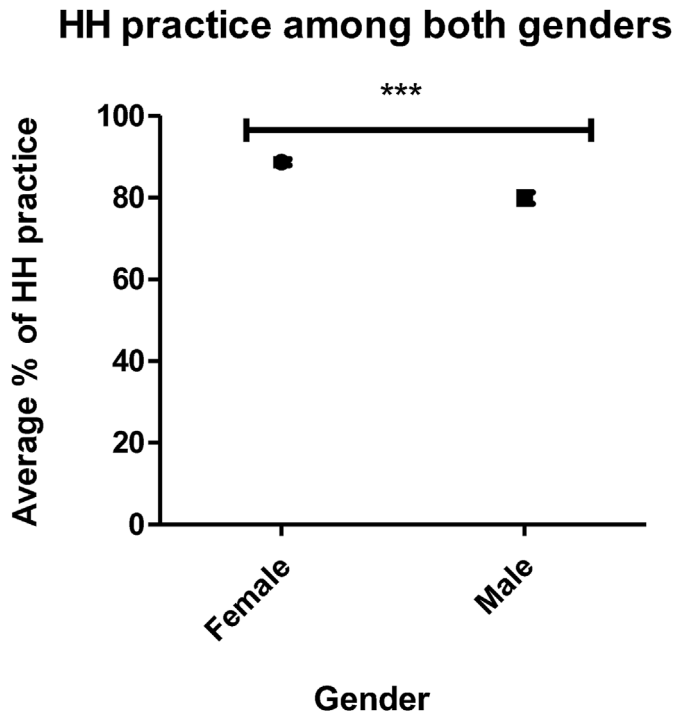


Figure 4B. Gender-based HH and safety measures' practice. *Gender-based HH and safety measures' practice. Analysed using paired student t-test, *** $P < 0.0001$, data presented as practice score (Mean \pm SEM). Where yes, unsure, and no were given 3, 1, and 0 score respectively.*

In general, students from all groups showed a good level of knowledge in two out of nine questions about HH. All questions regarding HH information, HH health and safety importance, the best way to achieve optimum sanitization, the correct steps of HW and HS, the types and percentage of organisms eliminated by correct HH, the effectiveness of HH in maintaining safe and healthy life, whether HH could be safely replaced by wearing gloves, and the authenticated resources of their information, were answered correctly by 89% (n=329), 52% (n=192), 92% (n=340), 53% (n=196), 24% (n=89), 92% (n=340), 76% (n=281), and 15% (n=55) of students respectively. These

Table III
Student perception of susceptibility and severity of COVID-19 infection

Perceived future susceptibility to COVID-19 infection	
Level	Percentage
High	21%
Moderate	39%
Low	40%
Perceived severity (if any) of COVID-19 infection	
Level	Percentage
Fatal	2%
Mild- moderate	35%
Very low	55%
No	8%

Perceived future COVID-19 susceptibility, and the perceived COVID-19 severity by participating students based on their personal, domestic, or occupational hazards.

data confirm the effectiveness of the governmental and the other organised health and safety awareness campaigns targeting students and other community sectors amid and post COVID-19 pandemic. To study the socioeconomic effects on the level of knowledge, data analysis showed a significant difference in the level of knowledge in favour of the middle and high household income groups. A possible explanation for this observation is the higher level of education and social awareness that are associated with higher income families were mostly associated with a better knowledge and self-care background than other socio-economic classes.

The UAE students demonstrated moderate knowledge score (62%) which is comparable to students from Jordan [19], while greater than Saudi [20] and Pakistani students [21]. UAE students reported lower knowledge than other health sciences major students from Jordan [22] and Iran [23]. Additionally, sequential regression analysis revealed a significant association of gender and study major with the knowledge score, and the latter being the best predictor. Despite providing adequate information on the UAE's Ministry of Education website, media channels, and other sources, this study highlights the need to provide further knowledge awareness related to health safety and hygiene particularly for non-health science major students.

Regarding students' attitude toward HH, the calculated average score of Likert scale was 74.7%, where UAE students demonstrated and reported moderately-high attitudes by themselves, their close-friends and community leaders toward HH and safety measures. Although lower than the average score among other countries' students, such as Jordanian students, suggesting the need to raise our students' awareness in this area of health and safety.

Moreover, HH and safety precautions' practice were analysed and revealed an average practice score of 86.8% which is higher than reported in other studies and may contribute to reducing the risk of spread of COVID-19 and other infectious diseases. Interestingly, the female students' practice was significantly higher than their males' counterpart in most of the situations amid and post COVID-19 pandemic. This is similar to the finding from Jordanian students [24]. However, superior when compared with other studies reporting unsatisfactory practice [21]. This may be explained by the UAE student population being younger and perhaps more up to date with the health awareness information and the importance of health and safety precautions being embedded within the diverse UAE culture.

The cost implications of the study findings

It is crucial to estimate the economic value of such HH/HS awareness campaigns to enhance the knowledge, attitude and practice of infection control principles among different parts of the community. It is well established that overall financial benefits can be achieved if governments direct funding to infectious disease management and resources needed in outbreaks including education and providing the required sterilisation, sanitization, and disinfection consumables [25].

Study limitations

There were few respondents from universities other than the top four (Ajman, Sharjah, American University in

Sharjah, and UAE Universities) and these universities are not significantly represented in this study. Furthermore, the respondents from Ajman University were mostly from the health sciences colleges who are knowledgeable in infection prevention and control and might be less-representative of the general student population, so increasing the possibility of selection bias.

Conclusions

Unexpected emergencies, such as large-scale pandemics, assess the integrity of awareness campaigns conducted regularly, especially in the dynamic and socially active population of university students. However, it is essential to regularly investigate the community awareness about the importance and integrity of personal hygiene. In this study, data was collected from a diverse section of university students in UAE. All students demonstrated adequate knowledge as evident by their knowledge scores. Furthermore, it is fulfilling to discover that the students also possessed good attitudes and low-risk practice toward prevention of COVID-19 and other communicable diseases.

It was apparent that health science students scored better in the HH's KAP than students of other non-health majors, especially in the knowledge domain. The findings of this study reflect the importance of developing appropriate educational programs and providing protective health measures and tools by the universities for their faculty, staff, and students, especially with consideration of the post-COVID-19 era. Suggested strategies could include flyers, posters, seminars or short infographics on social channels to disseminate correct information about coughing, sneezing and hand shaking etiquettes, handwashing and self-hygiene practice, and physical distancing to enhance safe lifestyle and habits that protect from communicable diseases transmission.

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Author contributions

All authors have critically reviewed and approved the final draft and are responsible for the content and similarity index of the manuscript.

YSM: conceptualization, study design, data interpretation, original draft preparation, project administration, reviewing, and editing. **AS** and **GA:** data analysis and interpretation, original draft preparation, reviewing, and editing. **MAB:** data acquisition, data interpretation, reviewing, and editing. **HA, SS**

and **EYA:** data acquisition, reviewing, and editing manuscript. **EMN, KF** and **HT:** study design, manuscript reviewing, correcting, and editing manuscript. **IB:** data interpretation, original draft preparation and editing. **DP:** data interpretation, original draft preparation, reviewing, and editing. All authors contributed to the article and approved the re-submitted version.

Consent to participate

Informed consent was provided and signed by the participants before opting to the questionnaire.

Ethical approval

Approval was obtained from the Ajman University's REC under the reference number M-F-H-7-Nov.

Consent for publication

All authors approved the manuscript for publication.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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