

Effect of Interactive Web-based Educational Intervention on Preventive Practices of Covid-19 among Internship Students

Naglaa Kamel Abdallah Hussien ⁽¹⁾ Manal SA Hakami ⁽²⁾ Wael Alghamdi ⁽³⁾ Waled AM Ahmed ⁽⁴⁾

(1) Assistant Professor-Community Health Nursing-Faculty of Nursing-Damanhour University, Egypt

Assistant Professor-Department of Nursing, Faculty of Applied Medical Sciences, Al Baha University, Saudi Arabia.

(2) Assistant Professor-Department of Nursing, Faculty of Applied Medical Sciences, Al Baha University, Saudi Arabia.

(3) Associate Professor- Department of Nursing, Faculty of Applied Medical Sciences, Al Baha University, Saudi Arabia

(4) Community Medicine Department, Faculty of Medicine, Post-graduate Studies, Al-Saeeda University, Sanaa, Yemen.

Professor- Department of Nursing, Faculty of Applied Medical Sciences, Al Baha University, Saudi Arabia

Abstract

Background: Medical interns need to focus on training and service delivery because they are in the early stages of their careers. Ensuring that training is managed effectively, and interns are educated on COVID-19 is crucial. This study sought to determine the effect of an interactive web-based educational intervention on preventive practices of COVID-19 among internship students. **Materials and Methods:** This study employed a quasi-experimental (one group pre/post-test) research design. The study included all Applied Medical Sciences internship students at AL-Baha University. An intern's hand and respiratory hygiene compliance throughout the COVID-19 pandemic was assessed using a self-administrated online Google form. A post-test was conducted after implementing a web-based interactive COVID-19 preventive education intervention. The SPSS was used for analysis. **Results:** The interactive web-based educational intervention had a significant impact on the preventive practices of COVID-19 among internship students. After the intervention, there was a notable increase in the average hand hygiene score to 62.06 ± 5.69 ($z = 3.661^*$, $p < 0.001^*$). Similarly, the average respiratory etiquette score also significantly improved, to 94.34 ± 10.93 ($z = 3.521^*$, $p < 0.001^*$). Additionally, students residing in rural areas demonstrated a noteworthy association ($t = 3.063$, $P = 0.002$), and those aged above 22 also showed a significant correlation ($t = 2.808$, $P = 0.005$). Furthermore, previous training in hand hygiene ($t = 1.278$, $P = 0.003$) and respiratory etiquettes ($t = 1.871$, $P = 0.005$) were identified as significant determinants. **Conclusion:** The interactive web-based educational intervention had a significant positive impact on COVID-19 preventive practices among internship students. The hand hygiene and respiratory etiquette scores significantly improved, highlighting its effectiveness in promoting better hygiene practices. Moreover, certain student factors, such as residing in rural areas and being above 22 years old, were found to be significantly associated with preventive practices. This intervention improved internship students' COVID-19 preventive practices. **Recommendations:** Expanding the interactive web-based educational intervention application to the whole community via multimedia

Keywords: COVID-19, web-based, interns' students, Hand hygiene, respiratory etiquette

Introduction

Coronavirus disease of 2019 (COVID-19) is a significant international apprehension disease. According to some estimates, it reproduces more frequently than Severe Acute Respiratory Syndrome (SARS), and more people have reportedly contracted or died from it than from SARS. (Mahase, 2020a, Khademian et al., 2021) it was reported that SARS-CoV-2 genome is primarily mutated with deviation in G.C. and the GC3 values of virus. (Khattak et al., 2021b) The findings of one systematic review on the use of antiviral therapies for COVID-19 has shown that food and antiviral therapy use could help in the shortening period of hospitalization of COVID-19 patient and enhancing recovery (Rasheed et al., 2022).

In the fight against the COVID-19 pandemic, healthcare workers are on the front lines while most other public servants are at home. As a result, thousands of health workers worldwide are becoming infected with COVID-19 while providing clinical care to COVID-19 patients, and the situation is worse in developing nations with weak healthcare systems. (Ehrlich et al., 2020, Olum et al., 2020)

Medical interns need attention for both service delivery and training because they are at a constructive stage in their careers. It is crucial to make sure that their education is well-managed and that interns are educated on COVID-19 preventive measures in order to protect the next generation of healthcare

professionals who will master the response to potential pandemics. (Singaram et al., 2022)

Different healthcare organizations have different measures in place to protect medical interns. While some organizations decided to stick to their pre-outbreak timetable, others curtailed or postponed intern training, and several interns had their rotations canceled. (Choi et al., 2020, Bugis, 2020)

Ensuring that preventive practices are being followed by healthcare professionals is an efficient relief technique during a pandemic. The World Health Organization (WHO) applauds measures taken in infection control to combat the virus and stop its spread. This includes often washing your hands, according to respiratory etiquette guidelines, and maintaining physical distance from other people to prevent the spread. (World Health Organization, 2020b)

The Ministry of Health (MoH) in Saudi Arabia and other public health administrators around the world are actively attempting to reduce the prevalence of the Novel Corona Virus (2019-n CoV) by disseminating timely educational videos, leaflets, and social media updates to both the public and health care professionals. (Ibrahim and Hassanain, 2022, Sohrabi et al., 2020)

Virtual social networks have sparked an impressive quantity of social contact and have subsequently been utilized as a method to track a pandemic via benevolent close observation. The online resources can be utilized to train healthcare professionals, including young, newly graduated medical students who are unprepared to handle a pandemic, technicians, nurses, and janitors or security personnel. According to a survey from the United States of America (USA), the majority of participants said they would turn to the internet as their primary source of information in the case of a pandemic, making digital media an appropriate platform for such an intervention. (Al-Garadi et al., 2016, Rothe et al., 2020)

Since the COVID-19 epidemic has become a hazard to the general population and healthcare professionals globally, it is vital that public health and infection control measures be taken to stop the virus' transmission and reduce secondary infections. Healthcare workers and

their families are now extremely at risk due to COVID-19. Statistics from numerous countries in different WHO regions indicate that COVID-19 infections among healthcare professionals are higher than those in the general population, although not being fully representative. There is therefore a public health imperative for decision-makers to identify risk factors for this sensitive group in order to prevent workplace transmission. (Mahase, 2020b, Control and Prevention, 2020)

Whereas healthcare workers estimated by lesser than 3% of the populace in the great widely held countries and lesser than 2% in the majority of all low- and middle-income nations, about fourteen percent of COVID-19 cases stated to WHO are amongst healthcare workers. For that reason, it is essential to verify that healthcare professionals have received enough training to effectively deal with the COVID-19 epidemic. Every area of healthcare should place a high priority on occupational health and safety, ensuring that every healthcare worker complies with the precautions and safeguards against the COVID-19 pandemic. The hospital administration is responsible for ensuring that its staff members receive the most recent guidelines and instructions and receive infection control and prevention training. (World Health Organization, 2020c, World Health Organization, 2020a)

In the post-pandemic situation, the pandemic has likely gone through various stages including lockdown to vaccination. However, the situation has been improved, there is a need for preventive measures. The interns' students also need to be prepared to deal with new situations after the pandemic and it essential to measure the effectiveness of an interactive web-based educational intervention in enhancing COVID-19 preventive practices among those interns. Thus, the current study aimed to investigate the effect of interactive web-based educational intervention on preventive practices of COVID-19 among internship students. It was hypothesized that implementing interactive web-based educational training of preventive practices of COVID-19 among internship students will improve their practices on hand hygiene and respiratory etiquette.

Materials and Methods:

Study Design

A quasi-experimental (one group pre/posttest) research design was adopted.

Study Setting

The research was conducted at Al-Baha University's faculty of applied medical sciences in the Al Baha governorate.

Subjects

Internship Students affiliated with the pre-mentioned setting. The study's participants were all faculty of applied medical sciences internship students. They were chosen because they met the following inclusion criteria includes students who have a smart phone or computer, and consent to take part in the study.

Sampling Technique

The faculty of applied medical sciences is affiliated with Al-Baha University and is composed of many departments namely Laboratory Medicine, Public Health, Nursing, and Dental Health for both males and females. All internship students of the above-mentioned departments were included in the study.

Sample Size

All interns in the faculty (208 interns) were included in the study after the segregation of the pilot study (20 interns) from the total sample size.

Tools for Data Collection

The data was collected by questionnaire which was in English, and it was administered as self-administered online Google form sheet. It composed of two parts:

Part I: Sociodemographic data about the interns as age, sex, and residence.

Part II: To collect data about the interns' complying with hand and respiratory hygiene during the COVID-19 pandemic at hospital installations. The preventive practices of COVID-19 assessment sheet include Daily hand washing frequency, and Duration of hand hygiene, utilization of alcohol-based hand sanitizer in the absence of soap & water, wearing of Personnel Protective Equipment

(PPE), carefully doffing of PPE and the implementation and frequency of the respiratory etiquette preventive practices. Participants' response was either Yes (scored 1), or No (scored 0). Higher scores denoted better practices.

The validity and reliability of questionnaire

The questionnaire was developed by the researchers after going through the literature review. A number of five community health nursing professionals connected to the universities of Alexandria and Damnhour evaluated the study instrument's content validity. Each item's relevancy and clearance were evaluated by the jury. For relevance and clearance, the content validity index per item ranged from 0.8 to 1.0. The Cronbach Alpha Coefficient test was employed to measure the tool reliability acceptable reliability score ($r=0.82$)

Pilot study

It was conducted on 10% (20 interns' students) of the interns' students who were omitted from the actual study sample. It assessed the clarity and feasibility of the research instrument. Basically, the needed modifications were done. The participants were asked to complete the questionnaire and provide feedback. The Cronbach's alpha coefficient was measured for the questionnaire which was high indicating internal consistency.

Program of intervention : it was carried out according to the following phase:-

I. Needs assessment phase

The Google form spreadsheet was used to collect data before and after intervention. To distribute the URL for the pre-test with the students, a WhatsApp group was set up using students' mobile numbers which is available with internship supervisor at the faculty. They were then invited to participate in the study and they have the right to withdraw from the study at any phase.

II. Planning phase

The researchers designed the interactive digital-based educational intervention regarding COVID-19 preventive behaviors using the following stages.

III. Setting objectives

General objective: Improve the interns' students' preventive practices on COVID-19. Specific objectives: Recognize the COVID-19 epidemic, discuss the significance of adhering to the necessary hand hygiene standards and respiratory etiquette to reduce the transmission of COVID-19, list the potential signs and symptoms of COVID-19, discuss the preventive measures against Coronavirus infection, demonstrate the steps of hand hygiene, demonstrate the procedure of respiratory etiquette, demonstrate the procedure of donning and doffing of face mask and gloves.

IV. Preparation of the content and presentation methods

The researchers developed the information to address all the predetermined goals. It was created using an analysis of recent material about COVID-19 that was pertinent. It includes information on how adhering to the proper hand hygiene standards can help stop the spread of COVID-19. demonstration of the World Health Organization's recommended hand washing technique. (Pittet et al., 2009) respiratory hygiene and proper coughing techniques. The recommendations were modified from the respiratory hygiene page on the CDC website. (Control and Prevention, 2020)

V. Implementation phase

Beginning in September 2021 and lasting through December 2021, the fieldwork took place across three months. A total of eight subgroups were created from the entire sample, and each subgroup had four sessions on virtual platforms (Rafid blackboard) lasting roughly 35 to 40 minutes. This gave the entire sample a total of 36 sessions. To promote everyday communication with the pupils, both written and audio messages were sent through the WhatsApp group. The instructive movies, PowerPoint presentations, and images were sent through email. This web-based interactivity aimed to engage the participants actively, promote knowledge exchange, and facilitate discussions on hand hygiene, respiratory etiquettes, and other preventive measures related to COVID-19. Through these interactive platforms, the study sought to encourage the adoption and adherence to best practices during

the ongoing pandemic.

VI. Evaluation Phase

Three months after the intervention was put into place, the posttest was taken. To ensure that the study's objectives were met, it planned to compare the results with the test's baseline data.

Statistical analysis

The data analysis was performed using Statistical Package for Social Sciences (SPSS) software version 22.0, with quantitative data presented as percentages and frequencies. The significance level for all tests was set at 5%. To analyze the data, the researchers employed several appropriate statistical tests: McNemar and Marginal Homogeneity Test for assessing significance between different stages, Wilcoxon Signed Ranks Test for comparing non-normally distributed quantitative variables between two time periods, Mann Whitney Test for comparing non-normally distributed quantitative variables between two studied groups, and Kruskal Wallis Test for comparing non-normally distributed quantitative variables among more than two groups. Additionally, regression analysis was utilized to detect the most influential independent factors affecting hand hygiene and respiratory etiquette. Given the non-normal distribution of the data, non-parametric regression methods such as logistic regression or ordinal regression were used to ensure the validity and accuracy of the results.

Ethics approval and consent to participate: The study's protocols were reviewed and approved by the Ethics Committee authorities at Deanship of Scientific Research, Al-Baha University with number of (IRB: 42198696) date (13/02/1443). An initial section about the study's directions was included in the online questionnaire to inform the students about the study objectives. The methods and interventions in this study were carried out in accordance with the Declaration of Helsinki.

A written consent was obtained from students indicating that they agree to participate in this study before their participation.

Results

The study was conducted among 208 internship students who registered for internship

after excluding the students who participated in pilot study. The completion rate was 100% as pre and post study. Table (1) Illustrates descriptive analysis of data which reflects that nearly two-thirds (65.9%) of interns' students are from urban areas. More than half (56.3%) of them were aged (19-22) years with a mean age of 22.40 ± 1.10 . Additionally, more than half (55.8%) were male.

Figure (1) depicts that the majority (86.5%) of interns' students had received previous training on hand washing. Figure (2) represents that more than two-thirds (69.7%) of interns' students had received previous training on respiratory etiquette.

Table 2 presents the distribution of 208 inters students according to their hand hygiene preventive practices before and after a program intervention during the COVID-19 pandemic. Before the intervention, all students (100%) were already using alcohol-based sanitizer before and after examining a patient, as well as before touching their eyes, nose, and mouth, and after caring for a person with COVID-19 infection. However, only 96.2% of students were using sanitizer before performing aseptic tasks, and 88.9% were using it after contact with blood, body fluids, or contaminated surfaces. Additionally, 64.9% of students washed their hands less than five times a day, and 51.9% washed their hands for less than 20 seconds. After the intervention, all students (100%) improved their hand hygiene practices in all aspects, showing statistically significant improvement ($p \leq 0.05$) in using alcohol-based sanitizer before aseptic tasks, after contact with blood or contaminated surfaces, and the duration of handwashing. The program intervention had a positive impact on students' hand hygiene practices, leading to better compliance with preventive measures during the pandemic.

Table 3 displays the distribution of 208 inters students based on their respiratory etiquette preventive practices before and after a

program intervention. Prior to the intervention, 96.2% of students were wearing masks, 94.2% were carefully doffing masks, 84.1% were wearing face shields, and 88.0% were carefully doffing face shields. Regarding covering coughs or sneezes, 72.6% used tissues, 5.8% used sleeves, and 21.6% used hands. Additionally, 96.2% of students disposed of used tissues in the nearest trash bin. After the program intervention, all students (100%) wore masks, carefully doffed masks and face shields, and disposed of tissues properly. There were statistically significant improvements ($p \leq 0.05$) in carefully doffing face shields and using tissues to cover coughs or sneezes. The program intervention had a positive impact on students' respiratory etiquette practices, leading to better compliance with preventive measures during the COVID-19 pandemic.

Table 4 presents the impact of the intervention on the overall COVID-19 preventive practices score among 208 inters students. Before the intervention, the mean score for hand hygiene practices was 58.13 ± 6.55 , while after the intervention, it increased to 62.06 ± 5.69 . Similarly, the mean score for respiratory etiquettes improved from 86.80 ± 12.59 before the intervention to 94.34 ± 10.93 after the intervention. Both improvements were statistically significant, as indicated by the Wilcoxon signed ranks test ($p < 0.001$). The intervention had a positive and statistically significant impact on the overall COVID-19 preventive practices of the students, leading to higher scores in both hand hygiene and respiratory etiquettes.

Table 5 declares that the multivariate analysis model was statistically significant ($F=7.930$, $P=0.001$). The interns' students' factors that showed significant relation to the COVID-19 preventive practices were the place of residence being rural ($t=.3.063$ $P=0.002$), Age (>22) ($t=2.808$, $P=0.005$) Previous training on hand hygiene ($t=1.278$, $P=0.003$) and Previous training on respiratory etiquettes ($t=1.871$, $P=0.005$)

Table (1): Distribution of the studied interns' students according to their Socio demographic characteristics (n = 208)

| Sociodemographic characteristics | No. | % |
|----------------------------------|--------------|------|
| Place of residence | | |
| Urban | 137 | 65.9 |
| Rural | 71 | 34.1 |
| Age (years) | | |
| 19-22 | 117 | 56.3 |
| 23-24 | 91 | 43.8 |
| Min. – Max. | 19.0 – 24.0 | |
| Mean ± SD. | 22.40 ± 1.10 | |
| Median | 22.0 | |
| Gender | | |
| Male | 116 | 55.8 |
| Female | 92 | 44.2 |



Figure (1): Distribution of the interns' students according to previous training on hand washing

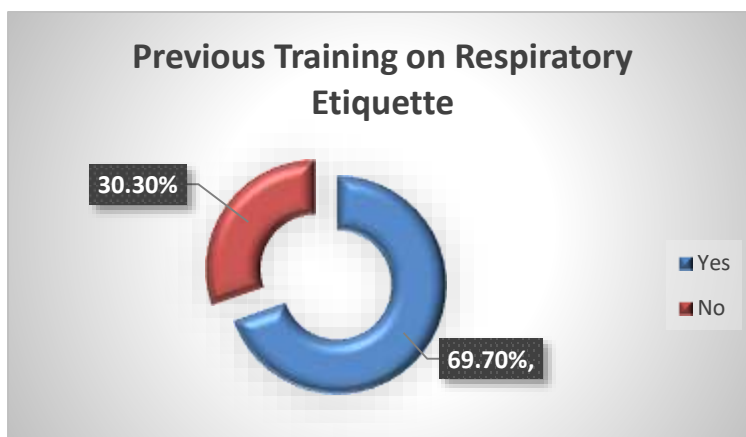


Figure (2): Distribution of the interns' students according to previous training on respiratory etiquette

Table (2): Distribution of the inters students according to hand hygiene preventive practices during COVID-19 Pre and post program intervention. (n = 208)

| Practices | Pre | | Post | | Test of Sig. | p |
|--|-----|-------|------|-------|--------------|--------|
| | No. | % | No. | % | | |
| Use of alcohol-based sanitizer before examining a patient | | | | | | |
| No | 0 | 0.0 | 0 | 0.0 | - | - |
| Yes | 208 | 100.0 | 208 | 100.0 | | |
| Use of alcohol-based sanitizer after examining a patient | | | | | | |
| No | 0 | 0.0 | 0 | 0.0 | - | - |
| Yes | 208 | 100.0 | 208 | 100.0 | | |
| Use of alcohol-based sanitizer before performing an aseptic task or handling invasive medical devices | | | | | | |
| No | 8 | 3.8 | 0 | 0.0 | McN | 0.008* |
| Yes | 200 | 96.2 | 208 | 100.0 | | |
| Use of alcohol-based sanitizer after contact with blood, body fluids or contaminated surfaces | | | | | | |
| No | 23 | 11.1 | 0 | 0.0 | McN | 0.001* |
| Yes | 185 | 88.9 | 208 | 100.0 | | |
| Wash hands or use sanitizer immediately after glove removal | | | | | | |
| No | 0 | 0.0 | 0 | 0.0 | - | - |
| Yes | 208 | 100.0 | 208 | 100.0 | | |
| Wash hands before touching your eyes, nose and mouth | | | | | | |
| No | 0 | 0.0 | 0 | 0.0 | - | - |
| Yes | 208 | 100.0 | 208 | 100.0 | | |
| Wash hands after caring for a person with confirmed or suspected COVID-19 infection | | | | | | |
| No | 0 | 0.0 | 0 | 0.0 | - | - |
| Yes | 208 | 100.0 | 208 | 100.0 | | |
| Daily frequency of hand washing | | | | | | |
| <5 times/day | 135 | 64.9 | 99 | 47.6 | 13.315* | 0.001* |
| >5 times/day | 73 | 35.1 | 109 | 52.4 | | |
| Duration of each hand washing | | | | | | |
| Less than 20 s | 108 | 51.9 | 16 | 7.7 | 73.938* | 0.001* |
| At least for 20 s | 100 | 48.1 | 192 | 92.3 | | |
| Wear gloves | | | | | | |
| No | 0 | 0.0 | 0 | 0.0 | - | - |
| Yes | 208 | 100.0 | 208 | 100.0 | | |
| Carefully doffing of gloves | | | | | | |
| No | 0 | 0.0 | 0 | 0.0 | - | - |
| Yes | 208 | 100.0 | 208 | 100.0 | | |

McN: McNemar test

p: p value for comparing between **Pre** and **Post**

*: Statistically significant at $p \leq 0.05$

Table (3): Distribution of the inters students according to respiratory etiquette preventive practices pre and post-program intervention. (n = 208)

| | Pre | | Post | | Test of Sig. | p |
|--|-----|------|------|-------|--------------|--------|
| | No. | % | No. | % | | |
| Wear mask | | | | | | |
| No | 8 | 3.8 | 0 | 0.0 | McN | 0.008* |
| Yes | 200 | 96.2 | 208 | 100.0 | | |
| Carefully doffing of mask | | | | | | |
| No | 12 | 5.8 | 0 | 0.0 | McN | 0.001* |
| Yes | 196 | 94.2 | 208 | 100.0 | | |
| Wear face shield | | | | | | |
| No | 33 | 15.9 | 0 | 0 | 0.058 | 0.810 |
| Yes | 175 | 84.1 | 208 | 100 | | |
| Carefully doffing of face shield | | | | | | |
| No | 25 | 12.0 | 0 | 0.0 | McN | 0.001* |
| Yes | 183 | 88.0 | 208 | 100.0 | | |
| Use of items to cover a cough or sneeze | | | | | | |
| Tissue | 151 | 72.6 | 184 | 88.5 | MH=148.0* | 0.001* |
| Sleeve | 12 | 5.8 | 16 | 7.7 | | |
| Hand | 45 | 21.6 | 8 | 3.8 | | |
| Use of nearest trash bin to dispose of the tissue after use | | | | | | |
| No | 8 | 3.8 | 0 | 0.0 | McN | 0.008* |
| Yes | 200 | 96.2 | 208 | 100.0 | | |

MH: Marginal Homogeneity Test

McN: McNemar test

p: p value for comparing between Pre and Post

*: Statistically significant at $p \leq 0.05$ **Table (4):** Impact of intervention on the overall COVID-19 preventive practices score (n = 208)

| Preventive practices | Pre Mean \pm SD | Post Mean \pm SD | Z | p |
|------------------------|-------------------|--------------------|--------|---------|
| Hand hygiene | 58.13 \pm 6.55 | 62.06 \pm 5.69 | 3.661* | <0.001* |
| Respiratory etiquettes | 86.80 \pm 12.59 | 94.34 \pm 10.93 | 3.521* | <0.001* |

SD: Standard deviation

Z: Wilcoxon signed ranks test

p: p value for comparing between Pre and Post

*: Statistically significant at $p \leq 0.05$ **Table (5):** Multivariate Linear regression for COVID-19 preventive practices

| | B | Beta | t | p | 95% CI | |
|--|--------|--------|--------|--------|--------|--------|
| | | | | | LL | UL |
| Place residence (rural) | -4.496 | -0.197 | 3.063* | 0.002* | -7.390 | -1.601 |
| Age (>22) | 1.779 | 0.180 | 2.808* | 0.005* | 0.530 | 3.028 |
| Gender | 1.678 | 0.077 | 1.190 | 0.235 | -1.102 | 4.459 |
| Previous training on hand hygiene | 3.640 | 0.099 | 1.278 | 0.003* | 0.257 | 3.976 |
| Previous training on respiratory etiquettes | 3.668 | 0.147 | 1.871 | 0.005* | 7.535 | 1.198 |
| $R^2=0.217, F=7.930^*, p<0.001^*$ | | | | | | |

B: Unstandardized Coefficients

Beta: Standardized Coefficients

F,p: f and p values for the model

 R^2 : Coefficient of determination

t: t-test of significance

C.I: Confidence interval

LL: Lower limit

UL: Upper Limit

*: Statistically significant at $p \leq 0.05$

Discussion

In general, numerous judgments appear to support the idea that disseminating health information via electronic media is an efficient step that may be performed to stop COVID-19 from spreading among healthcare professionals. It has been shown that using online educational resources is very helpful for health emergencies and giving concerned parties access to timely information. (Simon et al., 2015)

Our study intended to investigate the effect of interactive web-based educational intervention on preventive practices of COVID-19 among internship students. To perform a brief web-based module on hand hygiene and respiratory etiquettes among healthcare personnel during patient engagement for the aim of our study, similar electronic media were used. (Abbas et al., 2020, Mileder et al., 2020) Within our research, we opted to communicate with the students of our interns who operate in COVID-19 areas via online tools (Rafid blackboard) so they could brush up on their understanding of the organization's hassle-free preventive measures. For the same reason, we also selected to employ the Zoom and Google Meet services. Following that, the current study showed that participants' perceptions of and frequency of practicing hand hygiene and respiratory etiquette during COVID-19 were considerably enhanced by the interactive web-based education. This was further confirmed by the significant mean change of hand hygiene and respiratory etiquettes which increased post-intervention ($z = 3.661^*$, $p < 0.001^*$ & $z = 3.521^*$, $p < 0.001^*$ respectively). This could reflect the significance of the digital intervention in improving interns' students' preventive practices from a scientific point of view.

In accordance, a similar study was conducted on healthcare workers from Pakistan. (Ahmed et al., 2020) The results of this study displayed that, as predictable, an increase in participants who were committed to appropriate preventive procedures against COVID-19 containing adequate handwashing and respiratory etiquette after implementing the educational program. The researchers recommended that training programs concerning COVID-19 prevention would be

helpful in alleviating the spread of the virus among healthcare workers.

It is worth mentioning that the current study portrayed that the intervention significantly improved the participants' frequency of all items related to respiratory etiquette preventive practices during COVID-19. It is in line with a study conducted in India, 66.1% of healthcare professionals scored above 70% on the post-test, compared to 38.8% on the pre-test. We were able to identify training gaps and specific training goals for future training as a result of the findings of our research. (Sharma et al., 2021, Sharma et al., 2020)

In the Kingdom of Saudi Arabia, the term "internship" refers to the one-year period of required supervised hospital training required to earn a bachelor's degree in applied medical sciences or medicine and surgery. (Abdulghani et al., 2014) According to certain studies, medical students, interns, and recent graduates can help stop the COVID-19 pandemic from spreading. (Mahase, 2020b) Hospitals have taken several preventative measures in response to the pandemic to slow the spread of COVID-19. These steps include training interns' students in COVID-19 prevention techniques and taking precautions with regard to their safety. (Kumar and Agarwal, 2020)

However, interns' learners lack the necessary training to help in the pandemic fight; Surprisingly, the present study showed that interns' students' COVID-19 preventive activities prior to educational intervention were acceptable. There may be a fruitful result of the Saudi Ministry of Health's rapid dissemination of information which delivered reliable information about COVID-19 through their websites to help health workers to be mindful of updates concerning COVID-19 preventive practices. (Quadri et al., 2020) Additional confirmation is validated by the participants of the present study had received training on hand washing and respiratory etiquette (86.5% and 69.7% respectively) which parallel to the previously mentioned hospital precautions implemented in response to the pandemic.

On the contrary, a comparable study was carried out in Switzerland on medical colleges to evaluate the fundamental hand hygiene practices among medical students of various

specialties, and it recognized the need for additional training of medical students regarding the fundamental hand hygiene to stop the spread of infectious diseases. (Róžańska et al., 2015) However, a study was carried out in Singapore to evaluate the knowledge and attitudes of final-year medical students regarding hand cleanliness in the wake of an influenza epidemic. (Hsu et al., 2011) The importance of alcohol-based hand sanitizers in maintaining hand cleanliness was acknowledged by many of the interns.

The previous studies conducted in Pakistan showed that public have good knowledge and acceptable attitude towards COVID 19 full features, (Khattak et al., 2021a) while others have many concerns about the vaccination against the disease due to expected side effects (Khattak et al., 2022b). Furthermore, the cancer patients in Pakistan were fully aware of COVID-19 preventive measures (Khattak et al., 2022a).

Fortunately, our study declared that the age of interns' students was a factor significantly associated with COVID-19 preventive practices ($t=2.808$, $P=0.005$), which is in harmony with the findings of other studies. (Tadesse et al., 2021, Ferdous et al., 2020, Tamire and Legesse, 2020) This may be explained by the fact that increased experience among older age.

According to a study carried out in Ethiopia, the participants of the current study who were of urban origin also had noticeably higher preventative behaviors for the COVID-19 pandemic ($t=3.063$ $P=0.002$). (Angelo et al., 2021) Due to the presence of various causal elements, urban regions typically have a higher burden of the COVID-19 pandemic than rural areas. There may be frequent awareness campaigns employing a variety of information-dissemination techniques in urban settings. Last but not least, gender was a descriptive feature that strongly influenced the COVID-19 preventative practices, which was in line with a conclusion of a study conducted in India and China. (Maheshwari et al., 2020, Shi et al., 2020)

In the post-pandemic situation, the study could provide an insight into interns' students dealing with protective measures in hospitals and to apply essential measures for COVID-19

preventive practices. By emphasizing the significance of these preventive practices and identifying factors influencing compliance, the study's results could contribute valuable addition to public health and the culture of infection control and preparedness.

The study encountered several limitations. It was conducted at one university which limits its generalizability, it is also based on self-administered online survey which could be associated with selection bias that limits the study randomization where a selected number of participants were enrolled who have access to WhatsApp groups.

Conclusion:

The interactive web-based educational intervention was successful in enhancing preventive measures of COVID-19 among internship students. Additionally, the interns' students' factors that showed significant relation to the COVID-19 preventive practices were the place of residence being rural ($t=3.063$ $P=0.002$), Age (>22) ($t=2.808$, $P=0.005$) Previous training on hand hygiene ($t=1.278$, $P=0.003$) and Previous training on respiratory etiquettes ($t=1.871$, $P=0.005$).

Recommendations:

1. Expanding the interactive web-based educational intervention application to the whole community via multimedia.
2. Develop of an educational module for the preventive and protective practices against the COVID 19 used as a guideline in the hospitals.
3. Responsible authorities can take a decision to develop media-based awareness programs for public mobilization for the containment of COVID-19 virus, based on the identified role of social media through research findings.

List of abbreviations:

- COVID-19: Corona Virus Disease 2019
- McN: McNemar test
- USA: United States of America
- SPSS: Statistical Package of Social Sciences
- SARS: Sever Acute Respiratory Syndrome
- WHO: World Health Organization

Declarations:**Acknowledgement:**

The authors are grateful to the study participants who voluntarily took part in the study. The authors would like to express their gratitude to contributors in this research Fahad A Alghamdi, Maha Ali, Hanan Alharbi, Amal Alsulami, Amal Mohammed, Ahmed Jarelnape, Aida Ahmed, Osman Mohammed, H Elhaj, Duria Merghani, Niemat Dinar.

Declaration of Interest statement

The authors declare that there is no conflict of interest related to this study.

Data Availability Statement

The data are available upon request, please contact the corresponding author for data.

Funding:

The authors declare that no funding received for this study.

References

- ABBAS, K., NAWAZ, S. M. A., AMIN, N., SOOMRO, F. M., ABID, K., AHMED, M., SAYEED, K. A., GHAZANFAR, S. & QURESHI, N. 2020. A web-based health education module and its impact on the preventive practices of health-care workers during the COVID-19 pandemic. *Health education research*, 35, 353-361.
- ABDULGHANI, H. M., IRSHAD, M., AL ZUNITAN, M. A., AL SULIHEM, A. A., AL DEHAIM, M. A., AL ESEFIR, W. A., AL RABIAH, A. M., KAMESHKI, R. N., ALROWAIS, N. A. & SEBIANY, A. 2014. Prevalence of stress in junior doctors during their internship training: a cross-sectional study of three Saudi medical colleges' hospitals. *Neuropsychiatric disease and treatment*, 10, 1879-1886.
- AHMED, N., SHAKOOR, M., VOHRA, F., ABDULJABBAR, T., MARIAM, Q. & REHMAN, M. A. 2020. Knowledge, awareness and practice of health care professionals amid SARS-CoV-2, corona virus disease outbreak. *Pakistan Journal of Medical Sciences*, 36, S49.
- AL-GARADI, M. A., KHAN, M. S., VARATHAN, K. D., MUJTABA, G. & AL-KABSI, A. M. 2016. Using online social networks to track a pandemic: A systematic review. *Journal of biomedical informatics*, 62, 1-11.
- ANGELO, A. T., ALEMAYEHU, D. S. & DACHO, A. M. 2021. Knowledge, attitudes, and practices toward covid-19 and associated factors among university students in Mizan Tepi University, 2020. *Infection and drug resistance*, 14, 349.
- BUGIS, B. A. 2020. The impact of the COVID-19 pandemic on internship activities at health organizations in Saudi Arabia. *Hospital topics*, 99, 22-28.
- CHOI, B., JEGATHEESWARAN, L., MINOCHA, A., ALHILANI, M., NAKHOUL, M. & MUTENGESA, E. 2020. The impact of the COVID-19 pandemic on final year medical students in the United Kingdom: a national survey. *BMC medical education*, 20, 1-11.
- CONTROL, C. F. D. & PREVENTION 2020. Coronavirus disease 2019 (COVID-19): prevention & treatment. *Archived from the Saeed et al., Afro-Egypt J Infect Endem Dis*, 10, 65-92.
- EHRlich, H., MCKENNEY, M. & ELKbuli, A. 2020. Protecting our healthcare workers during the COVID-19 pandemic. *The American journal of emergency medicine*, 38, 1527.
- FERDOUS, M. Z., ISLAM, M. S., SIKDER, M. T., MOSADDEK, A. S. M., ZEGARRA-VALDIVIA, J. & GOZAL, D. 2020. Knowledge, attitude, and practice regarding COVID-19 outbreak in Bangladesh: An online-based cross-sectional study. *PloS one*, 15, e0239254.
- HSU, L., JIN, J., ANG, B., KURUP, A. & TAMBYAH, P. 2011. Hand hygiene and infection control survey pre-and peri-H1N1-2009 pandemic: knowledge and perceptions of final year medical students in Singapore. *Singapore medical journal*, 52, 486.

- IBRAHIM, A. M. & HASSANAIN, M. A. 2022. Assessment of COVID-19 precautionary measures in sports facilities: A case study on a health club in Saudi Arabia. *Journal of Building Engineering*, 46, 103662.
- KHADEMIAN, F., ASLANI, A. & BASTANI, P. 2021. The effects of mobile apps on stress, anxiety, and depression: overview of systematic reviews. *International journal of technology assessment in health care*, 37.
- KHATTAK, S., FAHEEM, M., NAWAZ, B., KHAN, M., KHAN, N. H., ULLAH, N., KHAN, T. A., KHAN, R. U., HALEEM, K. S. & REN, Z.-G. 2022a. Knowledge, Attitude, and perception of cancer patients towards COVID-19 in Pakistan: a cross-sectional study. *International Journal of Environmental Research and Public Health*, 19, 7926.
- KHATTAK, S., IDREES, M., IQBAL, H. I., KHAN, M., ASSAD, N., KHAN, M. N., YOUSAF, M. T., FAROOQ, M., YANG, C.-Y. & WU, D.-D. 2022b. Assessment of attitudes and intentions towards COVID-19 vaccines and associated factors among general populations of Pakistan: A cross-sectional study. *Vaccines*, 10, 1583.
- KHATTAK, S., KHAN, M., USMAN, T., ALI, J., WU, D.-X., JAHANGIR, M., HALEEM, K., MUHAMMAD, P., RAUF, M. A. & SADDIQUE, K. 2021a. Assessment of general populations knowledge, attitude, and perceptions toward the coronavirus disease (COVID-19): a cross-sectional study from Pakistan. *Frontiers in medicine*, 8, 747819.
- KHATTAK, S., RAUF, M. A., ZAMAN, Q., ALI, Y., FATIMA, S., MUHAMMAD, P., LI, T., KHAN, H. A., KHAN, A. A. & NGOWI, E. E. 2021b. Genome-wide analysis of codon usage patterns of SARS-CoV-2 virus reveals global heterogeneity of COVID-19. *Biomolecules*, 11, 912.
- KUMAR, A. & AGARWAL, D. 2020. Commentary: Restructuring residency training in ophthalmology during COVID-19 era: Challenges and opportunities. *Indian Journal of Ophthalmology*, 68, 1005.
- MAHASE, E. 2020a. Coronavirus: covid-19 has killed more people than SARS and MERS combined, despite lower case fatality rate. British Medical Journal Publishing Group.
- MAHASE, E. 2020b. Covid-19: medical students to be employed by NHS as part of epidemic response. *BMJ: British Medical Journal (Online)*, 368.
- MAHESHWARI, S., GUPTA, P. K., SINHA, R. & RAWAT, P. 2020. Knowledge, attitude, and practice towards coronavirus disease 2019 (COVID-19) among medical students: A cross-sectional study. *Journal of Acute Disease*, 9, 100.
- MILEDER, L. P., SCHUTTENGRUBER, G., PRATTES, J. & WEGSCHEIDER, T. 2020. Simulation-based training and assessment of mobile pre-hospital SARS-CoV-2 diagnostic teams in Styria, Austria. *Medicine*, 99.
- OLUM, R., CHEKWECH, G., WEKHA, G., NASSOZI, D. R. & BONGOMIN, F. 2020. Coronavirus disease-2019: knowledge, attitude, and practices of health care workers at Makerere University Teaching Hospitals, Uganda. *Frontiers in public health*, 8, 181.
- PITTET, D., ALLEGRANZI, B. & BOYCE, J. 2009. World Health Organization world alliance for patient safety first global patient safety challenge core group of experts. The World Health Organization guidelines on hand hygiene in health care and their consensus recommendations. *Infect Control Hosp Epidemiol*, 30, 611-622.
- QUADRI, M. F., JAFER, M. A., ALQAHTANI, A. S., ODABI, N. I., DAGHRIRI, A. A. & TADAKAMADLA, S. K. 2020. Novel corona virus disease (COVID-19) awareness among the dental interns, dental auxiliaries and dental specialists in Saudi Arabia: A nationwide study. *Journal of infection and public health*, 13, 856-864.
- RASHEED, A., NOOR, M., USMAN, T., BILQEES, R., AFNAN, M., GUL, S., KHAN, N. U., KHATTAK, S., KHATTAK, I. & SHAH, A. A. 2022. Drugs being tested against COVID-19 to slow down its spread and find effective treatment: A systematic review.

- ROTHE, C., SCHUNK, M., SOTHMANN, P., BRETZEL, G., FROESCHL, G., WALLRAUCH, C., ZIMMER, T., THIEL, V., JANKE, C. & GUGGEMOS, W. 2020. Transmission of 2019-nCoV infection from an asymptomatic contact in Germany. *New England journal of medicine*, 382, 970-971.
- RÓŽAŇSKA, A., WÓJKOWSKA-MACH, J. & BULANDA, M. 2015. Medical students' knowledge of the very basic principles of hand hygiene. *Antimicrobial Resistance and Infection Control*, 4, 1-1.
- SHARMA, G. D., TALAN, G., SRIVASTAVA, M., YADAV, A. & CHOPRA, R. 2020. A qualitative enquiry into strategic and operational responses to Covid-19 challenges in South Asia. *Journal of Public Affairs*, 20, e2195.
- SHARMA, R., MOHANTY, A., SINGH, V., GUPTA, P. K., JELLY, P., GUPTA, P. & RAO, S. 2021. Effectiveness of video-based online training for health care workers to prevent COVID-19 infection: An experience at a tertiary care level institute, Uttarakhand, India. *Cureus*, 13.
- SHI, Y., WANG, J., YANG, Y., WANG, Z., WANG, G., HASHIMOTO, K., ZHANG, K. & LIU, H. 2020. Knowledge and attitudes of medical staff in Chinese psychiatric hospitals regarding COVID-19. *Brain, Behavior, & Immunity-Health*, 4, 100064.
- SIMON, T., GOLDBERG, A. & ADINI, B. 2015. Socializing in emergencies—A review of the use of social media in emergency situations. *International journal of information management*, 35, 609-619.
- SINGARAM, V. S., NAIDOO, K. & RAMRATHAN, L. 2022. Medical internship training during the COVID-19 pandemic-A case of 'sacrificial pawns' or not? *African Journal of Primary Health Care & Family Medicine*, 14, 1-8.
- SOHRABI, C., ALSAFI, Z., O'NEILL, N., KHAN, M., KERWAN, A., AL-JABIR, A., IOSIFIDIS, C. & AGHA, R. 2020. World Health Organization declares global emergency: A review of the 2019 novel coronavirus (COVID-19). *International journal of surgery*, 76, 71-76.
- TADESSE, A. W., ABEBE, N. M., TADESSE, S. E., WUBE, M. C. & ABATE, A. A. 2021. Preventive practice and associated factors towards COVID-19 among college students in Amhara Region, Ethiopia: a cross-sectional study. *Ethiopian Journal of Health Sciences*, 31.
- TAMIRE, A. H. & LEGESSE, T. K. 2020. Knowledge, attitudes, and practices towards coronavirus disease-19 among health professionals in Addis Ababa. *EDITORIAL BOARD*, 343.
- WORLD HEALTH ORGANIZATION 2020a. Coronavirus disease (COVID-19) outbreak: rights, roles and responsibilities of health workers, including key considerations for occupational safety and health.
- WORLD HEALTH ORGANIZATION 2020b. Novel Coronavirus (2019-nCoV): situation report, 11.
- WORLD HEALTH ORGANIZATION 2020c. Shortage of personal protective equipment endangering health workers worldwide. 2020.