Knowledge of the primary healthcare physicians in the Al-Baha Region about COVID-19 personal protective measures

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Abstract

Background: Healthcare professionals are particularly more vulnerable to Covid-19 pandemic infection, since they are on the front lines. The relatively high morbidity and mortality among healthcare workers all over the world because of Covid-19 is a major cause of concern. Objectives: To explore the awareness of the healthcare workers in primary care settings regarding COVID-19 as well as the role of personnel protective equipment (PPE) as protective measures and to discover any defects for further intervention. Material and Methods: Cross-sectional study design was carried out in the Al-Baha Region, Southwest of Saudi Arabia. It included a representative random sample of healthcare workers working at primary health care (PHC) centers belonging to the Ministry of Health. A self-administered valid questionnaire was utilized in the present study, which included three main parts: demographic data of the healthcare workers; questions to assess their knowledge about the current COVID-19 pandemic (four multiple choice questions); and questions to assess knowledge about personal protective measures and hand hygiene (ten questions). Results: The study included 451 participants. The age of more than half of the participants (51.7%) ranged between 31 and 45 years. Females represented 53.2% of them. Physicians, nurses, and pharmacists represented 36.1%, 24.2%, and 23.3% of the participants, respectively. History of attending infection control training activity in the previous 12 months was reported by 38.1% of the participants. Overall, 74.5% and 19.1% of the participants expressed a poor level of knowledge regarding the current COVID-19 pandemic and PPE/personal hygiene, respectively. Older healthcare workers (HCWs) (> 45 years), non-Saudi nationals, dentists, moderately experienced healthcare workers (6–10 years), and those who attended infection control training courses were more knowledgeable about the current COVID-19 pandemic and its self-protective measures compared to others. Conclusion: Most of the primary healthcare staff in the Al-Baha Region expressed a poor level of knowledge about the current COVID-19 pandemic and a moderate level regarding PPE and personal hygiene. Some indicators for poor knowledge were identified.

Keywords: Covid-19 pandemic, healthcare workers, knowledge, personal hygiene, personal protective equipments

Introduction

COVID-19 is a virus belonging to the Coronaviridae family, which is a large family of enveloped, positive-sense single-stranded

Ribonucleic acid (RNA) viruses.[¹] It seems to have originated from animals (bats) and transmitted to humans, and the first reports of cases came from Wuhan, Hubei Province in China.[³]

The mode of transmission of coronaviruses is mostly through large respiratory droplets and contact transmission, but airborne and faeco-oral routes have also been proposed. [²] COVID-19 caused the current pandemic and was initially called

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2019-nCoV, and after that, the International Committee on Taxonomy of Viruses (ICTV) named it syndrome coronavirus 2 (SARS-CoV-2).[3] It is a new strain of the virus discovered near the end of 2019 without previous history of human affection, and before it, two variants of the virus were known to affect humans, named the severe acute respiratory syndrome-coronavirus (SARS-CoV) and the Middle East respiratory syndrome-coronavirus (MERS-CoV).[4] Its incubation period ranges from 0 to 14 days.[4]

Healthcare workers (HCWs) are particularly more vulnerable to this infection since they are on the frontlines. The risk of infection includes exposure to the pathogen, and the precipitating factors include fatigue, long working hours, stressful working environment, burnout, as well as exposure to physical and psychological violence.[4]

The suggested minimal personnel protective equipment (PPE) to protect HCWs from contact, droplet, and airborne transmission are the following:[7]

- For respiratory protection: Filtering face-piece (FFP2 or FFP3) respirator (valved or non-valved). Face masks (surgical or procedural masks) are recommended in case of unavailability of an FFP2 or FFP3 respirator.
- For eye protection: Goggles or a face shield
- For body protection: Long-sleeved water-resistant gown.
- For hand protection: Gloves

International recommendations suggest proper hand hygiene (HH) using an alcohol-based solution before wearing the PPE for dealing with a confirmed or suspected COVID-19 case.[8] It has been documented that correct wearing and removing of the PPE will protect the healthcare worker from contamination.[9]

The relatively high morbidity and mortality among HCWs all over the world and the Kingdom of Saudi Arabia (KSA) is not an exception because Covid-19 is a major cause of concern. Therefore, this study was carried out to explore the awareness of the HCWs in primary care settings in Al-Baha city, Saudi Arabia, regarding COVID-19, as well as the role of PPE as protective measures, to discover any defects for further intervention.

**Material and Methods**

This cross-sectional study was carried out in the Al-Baha Region, which is located in the southwest of Saudi Arabia.[10] In the Al-Baha Region, there are 94 primary health care (PHC) centers belonging to the Ministry of Health (MOH). All HCWs working at these centers ($n = 1310$), 250 physicians, 60 dentists, and about 1000 nurses, technicians, and pharmacists were eligible for inclusion. There are no specific exclusion criteria, apart from absence from work or none willing to participate in the study.

The sample size was computed utilizing the online Raosoft sample size calculator for the population survey with the following assumption: margins of errors as 5%, confidence level as 95%, the prevalence of adequate awareness as 71.2%, according to a recently published study from India.[9] Accordingly, the minimum sample required was 140 physicians, 51 dentists, and 240 nurses, technicians, and pharmacists.

Two-stage sampling technique was applied to select HCWs from PHC centers in the Al-Baha region. In the first stage, 50 primary healthcare centers were chosen through a simple random technique from a list including all the PHC centers. In the second stage, a consecutive sample of all HCWs working in the selected PHC centers was included till the sample size was completed (the sample was proportional to the total number of HCWs in each job category).

A self-administered questionnaire adapted from various studies carried out in Pakistan,[11] India,[4] recommendations of the ECDC,[15] and the Saudi Safety guide for healthcare professionals[16] was utilized in the present study. It includes three main parts:

- Demographic data of the healthcare workers (age, gender, nationality, marital status, educational level, profession, experience in healthcare after graduation, and history of attending infection control training activity in the previous 12 months).
- Questions to assess their knowledge about the current COVID-19 pandemic (four multiple-choice questions)
- Questions to assess knowledge about personal protective measures and HH (ten questions).

The questionnaire was face validated by three consultants (Family Medicine, Infectious diseases, and Community Medicine).

The participants’ responses were scored in the way that the correct answers were given a score of “1” whereas wrong answers were given a score of “0”. The total score and its percentage of the 14 questions were computed. Those who scored over 80% were regarded as having good knowledge, between 60 and 80% were regarded as having moderate knowledge, while those who scored below 60% were regarded as having poor knowledge.[11]

- “Contact case is a case with a confirmed COVID-19 case in the 14 days prior to the onset of symptoms”.
- “Suspect case is any person meeting the clinical criteria with an epidemiological link or any person meeting the diagnostic imaging criteria”[14]

Before giving the questionnaires to HCWs, informed consent was asked from all of the chosen subjects; all of them had the right not to participate in the study or to withdraw from the study prior to completion. The researcher explained the purpose of the study to all respondents. Permission to utilize the questionnaire was requested from authors in India and Pakistan through e-mail communication.

The statistical Package for Social Sciences (SPSS) software version 26.0 was used for data entry and analysis. Descriptive statistics (e.g., number, percentage) and analytic statistics using the
Chi-square test were applied, and $P$ values ≤ 0.05 were considered statistically significant.

**Results**

The study included 451 participants. Table 1 presents their socio-demographic characteristics. The age of more than half of the participants (51.7%) ranged between 31 and 45 years. Females represented 53.2% of them. Almost two-thirds (63.6%) were Saudi nationals, and 54.1% were married. Most of the participants (70.3%) were Bachelor’s holders. Physicians, nurses, and pharmacists represented 36.1%, 24.2%, and 23.3% of the participants, respectively. Experience in years in healthcare after graduation exceeded ten years among 35.5% of the participants. History of attending infection control training activity in the previous 12 months was reported by 38.1% of the participants.

**Assessment of knowledge**

**Knowledge about the current COVID-19 pandemic**

From Table 2, it is shown that the majority of the participants (86.5%) could recognize that medical advice is indicated in cases if a person has been in close contact with a person known to have COVID-19 or currently residing in an area with ongoing COVID-19 infection or recent travel from an area with the ongoing spread of COVID-19. Two-thirds (67.6%) knew that being within approximately two meters of a patient with COVID-19 for a prolonged period of time and/or having direct contact with infectious secretions (sputum, serum, blood) from a patient having COVID-19 is considered “closer contact”. On the other hand, only 27.3% could know the virus causing COVID-19 infection, and only 19.1% knew that the main method of transmission of the virus from person to person is via respiratory droplets.

Overall, most of the participants (74.5%) expressed a poor level of knowledge, whereas a good level was reported among only 4.4% of them about the current COVID-19 pandemic, as shown in Figure 1.

The association between participants’ nationality and level of knowledge about the current COVID-19 pandemic was statistically significant, $P = 0.041$. Regarding participants’ profession, the highest rate of a good level of knowledge was observed among dentists (11.4%) opposed to none among paramedical participants, $P = 0.041$. More experienced healthcare workers (>10 years) were more knowledgeable about the current COVID-19 pandemic compared to the lowest experienced group (≤5 years), as a good level of knowledge was observed among 5.6% and 3.7% of the two groups, respectively ($P = 0.048$) [Table 3].

**Knowledge about personal protective measures and hand hygiene**

The majority of the physicians knew properly, that white side facing in is the correct way of using a surgical face mask to protect against COVID-19, and leaving the patient’s room, writing the patient chart, using the computer, and answering the phone are the wrong things to do while wearing gloves (86.5%). The surgical mask should cover the nose, mouth, and chin for proper wearing (84.9%); gown, gloves, goggle, N95/surgical mask, and gloves are PPEs and should be worn by individuals transporting patients who are confirmed with or under investigation for COVID-19 within a healthcare facility (84.7%). The cloth facial mask is not as effective as a regular surgical facial mask (81.6%). However, only 34.1% could recognize that they can wear a surgical mask for 8 hours [Table 4].

**Figure 1:** Overall level of knowledge of the participants regarding the current COVID-19 pandemic
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Overall, 22.2% of the participants expressed a good level of knowledge about PPE and personal hygiene [Figure 2].

One-third of HCWs aged over 45 years, compared to only 15.7% of those aged between 18 and 30 years, expressed a good level of knowledge about PPE and personal hygiene, $P < 0.001$. Non-Saudi HCWs showed a higher significant rate of a good level of knowledge regarding PPE and personal hygiene compared to Saudis (29.9% vs. 17.8%), $P < 0.001$.

Regarding participants’ profession, the highest rate of a good level of knowledge was observed among nurses (31.2%), while the lowest one was observed among pharmacists (11.4%), $P = 0.001$. More experienced healthcare workers (>10 years) were more knowledgeable about PPE and personal hygiene compared to the lowest experienced group (≤5 years), as a good level of knowledge was observed among 26.3% and 14.1% of the two groups, respectively ($P = 0.005$). Participants who attended infection control training courses were more knowledgeable regarding PPE, and personal hygiene, as a good level of knowledge was observed among 30.2% of them.

Table 2: Responses of the participants to statements and questions regarding the current COVID-19 pandemic

| Knowledge statements and questions | Response | Right answers | No. (%) |
|-----------------------------------|----------|---------------|---------|
| The virus causing COVID-19 infection is called: | Severe Acute Respiratory Syndrome coronavirus-2 (SARS-Cov-2) and 2019-nCov | 123 | 27.3 |
| The main method of transmission of virus from person to person is via | Respiratory droplets | 86 | 19.1 |
| Which is considered as “Close contact”? | Being within approximately 2 meters of a patient with COVID-19 for a prolonged period of time and/or having direct contact with infectious secretions (spitum, serum, blood) from a patient with COVID-19 | 305 | 67.6 |
| Reported illness has ranged from mild to severe symptoms of cough, fever, and breathlessness, which can appear 2-14 days after exposure. For which of the following situations is medical advice indicated? | Have been in close contact with a person known to have COVID-19, Currently residing in an area with ongoing COVID-19 infection and recent travel from an area with ongoing spread of COVID-19 | 390 | 86.5 |

Table 3: Factors associated with knowledge regarding the current COVID-19 pandemic among the participants

| Overall knowledge about the current COVID-19 pandemic | Poor n=336 n (%) | Moderate n=95 n (%) | Good n=20 n (%) | P |
|-----------------------------------------------------|-----------------|------------------|----------------|----|
| Age in years | | | | |
| 18-30 (n=140) | 111 (79.3) | 23 (16.4) | 6 (4.3) | 0.455 |
| 31-45 (n=233) | 169 (72.5) | 55 (23.6) | 9 (3.9) | 0.955 |
| >45 (n=78) | 56 (71.8) | 17 (21.8) | 5 (6.4) | |
| Gender | | | | |
| Male (n=211) | 157 (74.4) | 44 (20.9) | 10 (4.7) | 0.041 |
| Female (n=240) | 179 (74.6) | 51 (21.3) | 10 (4.2) | |
| Nationality | | | | |
| Saudi (n=287) | 223 (77.7) | 50 (17.4) | 14 (4.9) | 0.926 |
| Non-Saudi (n=164) | 113 (68.9) | 45 (27.4) | 6 (3.7) | |
| Marital status | | | | |
| Single (n=207) | 156 (75.4) | 42 (20.3) | 9 (4.3) | 0.763 |
| Married (n=244) | 180 (73.8) | 53 (21.7) | 11 (4.5) | |
| Educational level | | | | |
| Secondary school/Diploma (n=62) | 48 (77.4) | 13 (21.0) | 1 (1.6) | |
| Bachelor (n=317) | 237 (74.8) | 65 (20.3) | 15 (4.7) | |
| Master/PhD/Fellowship (n=72) | 51 (70.8) | 17 (23.6) | 5 (6.6) | |
| Profession | | | | |
| Physician (n=163) | 110 (67.5) | 45 (27.6) | 8 (4.9) | |
| Nurse (n=109) | 87 (79.8) | 17 (15.6) | 5 (4.6) | 0.041 |
| Dentist (n=35) | 26 (74.3) | 5 (14.3) | 4 (11.4) | |
| Pharmacist (n=105) | 85 (81.0) | 18 (17.1) | 2 (1.9) | |
| Technician (n=22) | 13 (59.1) | 8 (36.4) | 1 (4.5) | |
| Paramedical (n=17) | 15 (88.2) | 2 (11.8) | 0 (0.0) | |
| Experience in years in healthcare after graduation | | | | |
| ≤5 (n=135) | 112 (83.0) | 18 (13.3) | 5 (3.7) | 0.048 |
| 6-10 (n=156) | 109 (69.9) | 41 (26.3) | 6 (3.8) | |
| > 10 (n=160) | 115 (71.9) | 36 (22.5) | 9 (5.6) | |
| Attending infection control training activity | | | | |
| No (n=279) | 209 (74.9) | 59 (21.1) | 11 (3.9) | |
| Yes (n=172) | 127 (73.8) | 36 (20.9) | 9 (5.2) | 0.811 |
Table 4: Responses of the participants to statements and questions regarding personal protective measures and hand hygiene

| Knowledge statements and questions | Right answers                                | No. | %  |
|-----------------------------------|----------------------------------------------|-----|-----|
| Which is the correct way of using surgical face mask to protect against COVID-19? | White side facing in                          | 390 | 86.5 |
| The sequence of donning or wearing Personal Protective Equipment (PPE) is | Gown-Mask-Goggles                             | 326 | 72.3 |
| After hand washing, your used tissue paper should be disposed to: | Blue bag                                      | 255 | 56.5 |
| For proper wearing, to which extent the surgical mask should cover? | Nose, mouth, and chin                         | 383 | 84.9 |
| Which of the following is the right thing to do while wearing gloves? | All no (Leaving the patient’s room, write the patient chart, using the computer and answering the phone | 390 | 86.5 |
| How long can you wear a surgical mask | 8 hours                                       | 154 | 34.1 |
| Alcohol hand rub practice requires: | 20-30 seconds                                 | 277 | 61.4 |
| Is the cloth facial mask as effective as a regular surgical facial mask | No                                            | 268 | 81.6 |
| What PPE should be worn by healthcare professionals providing care to asymptomatic patients with a history of exposure to COVID-19 who are being evaluated for non-infectious complaints (e.g., hypertension) | Gown, gloves goggle, N95/surgical mask and gloves | 382 | 84.7 |

Figure 2: Overall level of knowledge of the participants regarding personal protective measures and hand hygiene

Figure 3: Overall knowledge about Covid-19 and its self-protective measures among the participants

compared to only 17.2% of those who did not attend such courses, \( P < 0.001 \) [Table 5].

**Total knowledge about the COVID-19 pandemic and its self-protective measures**

The total knowledge about the COVID-19 pandemic, its self-protective measures was poor among 36.1% of the participants, as shown in Figure 3.

HCWs aged over 45 years were more likely compared to those aged 18–30 years to express a good level of knowledge about the current COVID-19 pandemic and its self-protective measures (19.2% vs. 9.3%), \( P < 0.001 \). Saudi HCWs showed a higher significant rate of poor level of knowledge regarding the current COVID-19 pandemic and its self-protective measures compared to non-Saudis (43.6% vs. 23.2%), \( P < 0.001 \). Regarding participants’ profession, the highest rate of a good level of knowledge was observed among dentists (20%), while the lowest one was observed among paramedical persons (5.9%), \( P = 0.004 \). Moderately experienced healthcare workers (6–10 years) were more knowledgeable about the current COVID pandemic and its self-protective measures compared to the lowest experienced group (≤ 5 years), \( P < 0.001 \). Participants who attended infection control training courses were more knowledgeable regarding the current COVID-19 pandemic and its self-protective measures, as a good level of knowledge was observed among 17.4% of them compared to only 9.3% of those who did not attend such courses, \( P = 0.002 \) [Table 6].

**Discussion**

COVID-19 infection can be transmitted among HCWs due to three main factors, which are lack of isolation room facilities, environmental contamination, as well as overcrowding,[13] in addition to an important factor which is the inadequate knowledge and practice of some HCWs regarding measures of infection control.[15] As a consequence, high morbidity and mortality were observed among HCWs. Therefore, the present study was conducted to explore the awareness and knowledge of the HCWs in primary care settings in the Al-Baha Region, Saudi Arabia, regarding COVID-19 as well as the role of PPE as protective measures.

In the present study, most of the HCWs in PHC settings (74.5%) expressed a poor level of knowledge about the current COVID-19 pandemic. Conflicting results have been reported worldwide in this regard. Some studies have documented
adequate knowledge regarding COVID-19 among HCWs, whereas others, in accordance with the present one, have documented poor knowledge in this regard. It has recently been reported that insufficient knowledge of HCWs about the current Covid-19 pandemic as well as its vaccinations resulted in low coverage of COVID-19 vaccines.

According to the Center for Disease Prevention and Control (CDC), a “close contact” is defined as: “being within approximately two meters of a COVID-19 case for a prolonged period of time or having direct contact with infectious secretions of a COVID-19 case." The term “close contact”, is very important in infection control regarding the COVID-19 pandemic; it was defined properly by almost two-thirds of the current study.

Table 5: Factors associated with knowledge regarding personal protective measures and hand hygiene among the participants

| Overall knowledge about PPE and personal hygiene | P       |
|-----------------------------------------------|--------|
| Poor n=86 n (%) | Moderate n=265 n (%) | Good n=100 n (%) |
| Age in years |
| 18-30 (n=140) | 41 (29.3) | 77 (55.0) | 22 (15.7) | <0.001 |
| 31-45 (n=233) | 39 (16.7) | 142 (60.9) | 52 (22.3) | | |
| >45 (n=78) | 6 (7.7) | 46 (59.0) | 26 (33.3) | | |
| Gender |
| Male (n=211) | 44 (20.9) | 121 (57.3) | 46 (21.8) | 0.663 |
| Female (n=244) | 42 (17.5) | 144 (60.0) | 54 (22.5) | | |
| Nationality |
| Saudi (n=287) | 74 (24.7) | 165 (57.5) | 51 (17.8) | <0.001 |
| Non-Saudi (n=164) | 15 (9.1) | 100 (61.0) | 49 (29.9) | | |
| Marital status |
| Single (n=207) | 42 (20.3) | 123 (59.4) | 42 (20.3) | 0.625 |
| Married (n=244) | 44 (18.0) | 142 (58.2) | 58 (23.8) | | |
| Educational level |
| Secondary school/Diploma (n=62) | 15 (24.2) | 33 (53.2) | 14 (22.6) | 0.098 |
| Bachelor (n=317) | 60 (18.9) | 195 (61.5) | 62 (19.6) | | |
| Master/PhD/Fellowship (n=72) | 11 (15.3) | 37 (51.4) | 24 (33.3) | | |
| Profession |
| Physician (n=163) | 23 (14.1) | 100 (61.3) | 40 (24.5) | 0.001 |
| Nurse (n=109) | 14 (12.8) | 61 (56.0) | 34 (31.2) | | |
| Dentist (n=50) | 5 (14.3) | 22 (62.9) | 8 (22.9) | | |
| Pharmacist (n=105) | 36 (34.3) | 57 (54.3) | 12 (11.4) | | |
| Technician (n=22) | 4 (18.2) | 15 (68.2) | 3 (13.6) | | |
| Paramedical (n=17) | 4 (23.5) | 10 (58.8) | 3 (17.6) | | |
| Experience in years in healthcare after graduation |
| ≤5 (n=135) | 38 (28.1) | 78 (57.8) | 19 (14.1) | 0.005 |
| 6-10 (n=156) | 27 (17.3) | 90 (57.7) | 39 (25.0) | | |
| >10 (n=160) | 21 (13.1) | 97 (60.6) | 42 (26.3) | | |
| Attending infection control training activity |
| No (n=279) | 45 (16.1) | 186 (66.7) | 48 (17.2) | <0.001 |
| Yes (n=172) | 41 (23.8) | 79 (45.9) | 52 (30.2) | | |

was observed among paramedical professionals, whereas the highest level was observed among dentists. Comparable results have been observed in a recent Indian study, where the lowest awareness level about the COVID-9 pandemic was reported among the non-clinical/administrative staff, while the highest level was observed among undergraduate medical students. Despite the fact that this group is not actively contributing in patient management, they have high opportunity to get and spread infection through contact with both patients and healthcare providers.

Concerning knowledge regarding PPE and HH, the highest level of good knowledge was reported among nurses, followed by physicians, whereas the lowest level was reported among pharmacists and technicians. In another Saudi study carried out in Jazan, physicians and nurses were more knowledgeable regarding PPE and HH compared with other HCWs.

Proper practicing of HH is considered a fundamental step in preventing the spread of infection as the WHO defined “Five Moments of HH” that must be carried out. Additionally, the CDC recommends alcohol-based hand rubs in most situations. In the current study, 61.4% of the HCWs could...
recognize that alcohol hand rub practice requires between 20 and 30 seconds, and 56.5% knew properly that after hand washing, the used tissue paper should be disposed to a blue bag. These findings indicate a moderate level of knowledge regarding HH.

Ortega *et al.* (2020)\(^{29}\) reported that the best way to prevent COVID-19 infection among HCWs is a competent practice in donning, doffing, and proper use of PPE. In the current study, the wearing of PPE by individuals transporting patients who are confirmed with or under investigation for COVID-19 within a healthcare facility was recognized by most of the HCWs (84.7%) while wearing them by HCWs providing care to asymptomatic patients with a history of exposure to COVID-19 who are being evaluated for non-infectious complaint was recognized by about half of the participants (51.4%).

Overall, the present study revealed that only 22.2% of the HCWs expressed a good level of knowledge about PPE and personal hygiene, whereas 19.1% expressed poor knowledge. In Bangladesh,\(^{34}\) 99.5% of HCWs had good knowledge regarding PPE, most probably because they included only young HCWs in the front line of facing the infection. Variable rates regarding good knowledge of PPE were reported in China (88.4%),\(^{31}\) Iran (56.5%),\(^{35}\) Pakistan (93.2%),\(^{36}\) and Turkey (90%),\(^{37}\)

In a study carried out recently in India,\(^{38}\) less than half of HCWs (45.4%) were aware of the proper sequence for the application of a mask/respirator, and 52.5% were aware of the proper HH technique.\(^{38}\) In Pakistan, a good level of knowledge of HCWs concerning the proper use of surgical face masks to prevent the spread of the COVID-19 infection was reported among 35.2%, while average and poor knowledge were reported among 45.4% and 19.3% of them, respectively.\(^{36}\) Also, in Bangladesh,\(^{36}\) despite a good level of knowledge about PPE in general, the knowledge regarding the proper donning and doffing of PPE was insufficient. In the current study, the sequence of donning or wearing PPE was recognized by most of the participants (72.3%). Many studies have recommended that HCWs must be familiar with all the precautions regarding PPE to save them from the COVID-19 pandemic.\(^{32-34}\)

In this study, older and more experienced HCWs were more knowledgeable about PPE and personal hygiene compared to their peers. The same has been documented in other Saudi studies carried out in Makkah,\(^{38}\) AlQassim,\(^{34}\) and Riyadh.\(^{37}\)
Furthermore, in the present study, the finding that non-Saudi HCWs were more knowledgeable regarding PPE and personal hygiene compared to Saudis could be seen in the light of the effect of age and experience as most of the older and more experienced HCWs were non-Saudis.

The present study revealed that HCWs who attended infection control training courses were more knowledgeable regarding PPE and personal hygiene than their peers. The same has been observed in studies carried out in Venezuela, and Nepal. Some others reported that the absence or deficiency of training in infection control is a barrier to prevention and control adherence to infection practice.

**Strengths and limitations**

Among the strengths of the present study is the inclusion of all different categories of HCWs with different qualifications; this ensures a high standard of representation. However, the study has some important limitations that should be mentioned. The use of a self-administered questionnaire is subjected to bias in assessing knowledge compared to face-to-face interviews. Furthermore, in this study, we did not investigate the practice of PPE and HH and correlated them with the level of knowledge. Finally, the application of a cross-sectional design in this study is subjected to the inherited disadvantage of testing association and not causality between independent and dependent variables.

**Conclusion**

Most of the PHC staff in the Al-Baha Region expressed poor knowledge about the current COVID-19 pandemic, particularly Saudi nationals, paramedical, and less experienced staff. On the other hand, most of them expressed moderate knowledge regarding PPE and personal hygiene. Older HCWs, non-Saudi nationals, nurses, more experienced HCWs, and those who attended infection control training courses were more knowledgeable regarding PPE and personal hygiene compared to their peers. Therefore, we recommended organizing and implementing regular training programs regarding the COVID-19 pandemic and its protective measures (PPE and HH) for HCWs and assigning continuous medical education hours for such activities to encourage HCWS to attend, with special attention should be given to Saudi, less experienced and paramedical staff in these health education activities. At policy makers’ level, ensuring availability and appropriate utilization of PPE and products of personal hygiene at PHC settings is needed. Monitoring and evaluation are needed to ensure the proper practice of PPE and HH, and finally, further research is recommended, including observation of the practice of the PHC staff regarding the use of PPE and the application of personal hygiene.

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**Conflicts of interest**

There are no conflicts of interest.

**References**

1. Wang Y, Liu D, Shi W, Lu R, Wang W, Zhao Y, et al. Virus Evolution, Volume 3, Issue suppl_1, 1 March 2017, vew036.046. Available from: https://doi.org/10.1093/vew/vew036.046.

2. World Health Organization (WHO). Coronavirus disease 2019 (COVID-19). Situation report - 29 2020 [updated 19 February 2020]. Geneva: WHO; 2020. Available from: https://www.who.int/docs/default-source/coronaviruse/situation-reports/20200219-sitrep-30-covid-19.pdf?sfvrsn=6e50645_2. [Last accessed on 2020 Feb 25].

3. Cascella M, Rajnik M, Cuomo A, Dulebohn SC, Di Napoli R. Features, Evaluation and Treatment Coronavirus (COVID-19). Treasure Island, FL: Stat Pearls Publishing; 2020.

4. Modi PD, Nair G, Uppe A, Modi J, Tuppekar B, Ghardure AS, et al. COVID-19 awareness among healthcare students and professionals in Mumbai Metropolitan Region: A questionnaire-based Survey. Cureus 2020;12:e7514.

5. World Health Organization (WHO). Coronavirus disease (COVID-19) outbreak 2020. Geneva: WHO; 2020. Available from: https://www.who.int/emergencies/diseases/novel-coronavirus-2019. [Last accessed on 2020 Feb 24].

6. The World Health Organization (WHO). Coronavirus disease (COVID-19) outbreak: Rights, roles and responsibilities of health workers, including key considerations for occupational safety and health. Available from: https://www.who.int/publications/i/item/coronavirus-disease-(covid-19)-outbreak-rights-roles-and-responsibilities-of-health-workers-including-key-considerations-for-occupational-safety-and-health. [Last accessed 2020 Mar 18].

7. European Centre for Disease Prevention and Control. Guidance for Wearing and Removing Personal Protective Equipment in Healthcare Settings for the Care of Patients with Suspected or Confirmed COVID-19. Stockholm: ECDC; 2020.

8. World Health Organization (WHO). WHO Guidelines on hand hygiene in health care 2009. Geneva: WHO; 2009. Available from: https://apps.who.int/iris/bitstream/handle/10665/44102/9789241597906_eng.pdf?sequence=1. [Last accessed on 2020 Feb 25]

9. European Centre for Disease Prevention and Control (ECDC). Safe use of personal protective equipment in the treatment of infectious diseases of high consequence 2014. Stockholm: ECDC; 2020. Available from: https://www.ecdc.europa.eu/sites/default/files/media/en/publications/Publications/safe-use-of-ppe.pdf. [Last accessed on 2020 Feb 25].

10. KNOEMA. Al-Baha-Saudi population. Available from: https://knoema.com/atlas/Saudi-Arabia/Al-Baha-Saudi-population.

11. Kumar J, Katto M, Siddiqui AA, Sahito B, Jamil M, Rasheed N, et al. Knowledge, attitude, and practices of healthcare workers regarding the use of face mask to limit the spread of the new coronavirus disease (COVID-19). Cureus 2020;12:e7737.

12. ECDC. Guidance for wearing and removing personal protective equipment in healthcare settings for the care
of patients with suspected or confirmed COVID-19. ECDC Technical Report, February, 2020. Available from: https://www.ecdc.europa.eu/en/publications-data/ guidance-wearing-and-removing-personal-protective-equipment-healthcare-settings.

13. Wu Z, McGoogan JM. Characteristics of and important lessons from the coronavirus disease 2019 (COVID-19) outbreak in China: Summary of a report of 72 314 cases from the Chinese center for disease control and prevention. JAMA 2020;323:1239-42.

14. European Centre for Disease Prevention and Control. Case definition for coronavirus disease 2019 (COVID-19), as of 3 December 2020. Available from: https://www.ecdc.europa.eu/en/covid-19/surveillance/case-definition.

15. Ayinde O, Usman AB, Aduroja P, Gbolahan A. A cross-sectional study on Oyo state health care workers knowledge, attitude and practice regarding corona virus disease 2019 (COVID-19). Res Square 2020. doi: 10.21203/rs.3.rs‑23501/v1.

16. Kamate SK, Sharma S, Thakar S, Srivastava D, Sengupta K, Hadi AJ, et al. Assessing knowledge, attitudes and practices of dental practitioners regarding the COVID‑19 pandemic: A multinational study. Dent Med Probl 2020;57:11-7.

17. Olum R, Chekwech G, Wekha G, Nassozi DR, Bongomin F. Coronavirus disease-2019: Knowledge, attitude, and practices of health care workers at Makerere University Teaching Hospitals, Uganda. Front Public Health 2020;8:181.

18. Zhang M, Zhou M, Tang F, Wang Y, Nie H, Zhang L, et al. Knowledge, attitude, and practice regarding COVID‑19 among healthcare workers in Henan, China. J Hosp Infect 2020;105:183-7.

19. Mendoza Millán DL, Carrión-Nessi FS, Mejia Bernard MD, Marcano-Rojas MV, Omaña Ávila OD, Doval Fernández JM, et al. Knowledge, attitudes, and practices regarding COVID‑19 among healthcare workers in Venezuela: An online cross-sectional survey. Front Public Health 2021;9:633723.

20. Bhagavathula AS, Aldhaelea WA, Rahman J, Mahabadi MA, Bandari DK. Knowledge and perceptions of COVID‑19 among health care workers: Cross-sectional study. JMJR Public Health Surveill 2020;6:e19160.

21. Saqlain M, Munir MM, Rehman SU, Gulzar A, Naz S, Ahmed Z, et al. Knowledge, attitude, practice and perceived barriers among healthcare workers regarding COVID-19: A cross-sectional survey from Pakistan. J Hosp Infect 2020;105:419-23.

22. Burki T. COVID-19 in Latin America. Lancet Infect Dis 2020;20:547-8.

23. Alhumaid S, AlMutair A, AlAlawi Z, Alsuiliman M, Ahmed GY, Rabban AA, et al. Knowledge of infection prevention and control among healthcare workers and factors influencing compliance: A systematic review. Antimicrob Resist Infect Control 2021;10:866.

24. Michel-Kabamba N, Nyatu NR, Leon-Kabamba N, Katumbo-Mukemo A, Mukuku O, Ngoyi-Mukonkole J, et al. Occupational COVID‑19 prevention among congolese healthcare workers: Knowledge, practices, PPE compliance, and safety imperatives. Trop Med Infect Dis 2021;6:6.

25. Center for Disease Control and Prevention (CDC). Information for healthcare professionals. [Mar; 2020];CDCDCDC. Available from: https://www.cdc.gov/coronavirus/2019‑ncov/hcp/index.html 2020.

26. Asaad AM, El-Sokkary R, Mahdi A, El-Shafei M. Knowledge and attitudes towards Middle East respiratory syndrome-coronavirus (MERS-CoV) among health care workers in south-western Saudi Arabia. East Mediterr Health J 2020;26:435-42.

27. Modi PD, Kumar P, Solanki R, Modi J, Chandramani S, Gill N. Hand hygiene practices among Indian medical undergraduates: A questionnaire-based survey. Cureus 2017;9:e1463.

28. CDC. Frequently asked questions about hand hygiene for healthcare personnel responding to COVID-2019. CDC. 2020. Available from: https://www.cdc.gov/coronavirus/2019-ncov/infection-control/hcp-hand-hygiene-faq.html.

29. Ortega R, Gonzalez M, Nozari A, Canelli R. Personal protective equipment and Covid‑19. N Engl J Med 2020;382:e105.

30. Hossain MA, Bin Rashid MU, Khan MAS, Sayeed S, Abdul Kader M, Haulader MDH. Healthcare workers' knowledge, attitude, and practice regarding personal protective equipment for the prevention of COVID‑19. J Multidiscip Healthc 2021;14:229-38.

31. Wang J, Zhou M, Liu F. Reasons for healthcare workers becoming infected with novel coronavirus disease 2019 (COVID‑19) in China. J Hosp Infect 2020;105:100-1.

32. Basheet IA, Nassar R, Barakat M, Alqudah R, Abufarha R, Mukattash TL, et al. Pharmacists' readiness to deal with the coronavirus pandemic: Assessing awareness and perception of roles. Res Social Adm Pharm 2021;17:514-22.

33. Dawoud D. Emerging from the other end: Key measures for a successful COVID‑19 lockdown exit strategy and the potential contribution of pharmacists. Res Social Adm Pharm 2020;17:1950-3.

34. Kara E, Demirkan K, Ünal S. Knowledge and attitudes among hospital pharmacists about COVID-19. Turkish J Pharm Sci 2020;17:242-8.

35. Alkot M, Albuouq MA, Shakuri MA, Subahi MS. Knowledge, attitude, and practice toward MERS-CoV among primary health-care workers in Makkah Al-Mukarramah: An intervention study. Int J Med Sci Public Health 2016;5:952-9.

36. Khan MU, Shah S, Ahmad A, Fatokun O. Knowledge and attitude of healthcare workers about Middle East Respiratory Syndrome in multispeciality hospitals of Qassim, Saudi Arabia. BMC Public Health 2014;14:1281.

37. Almutairi KM, Al Helih EM, Moussa M, Boshiaqah AE, Saleh Alajlan A, Vinluan JM, et al. Awareness, attitudes, and practices related to coronavirus pandemic among public in Saudi Arabia. Fam Community Health 2015;38:332-40.

38. Richa N, Kalyan S, Kalidas A, Pramod P, Bhojraj A, Nabin P, et al. Knowledge, attitude and practice regarding COVID-19 among healthcare workers in Chitwan, Nepal. Res Square 2020. doi: 10.21203/rs.3.rs‑26774/v1.

39. Houghton C, Meskell P, Delaney H, Smalle M, Glenton C, Booth A, et al. Barriers and facilitators to healthcare workers' adherence with infection prevention and control (IPC) guidelines for respiratory infectious diseases: A rapid qualitative evidence synthesis. Cochrane Database Syst Rev 2020;4:CD013582.