Knowledge, Attitudes, and Practices of Medical Interns Toward COVID-19 in Saudi Arabia: A Cross-Sectional Survey, April-May 2020

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Abstract

Background: COVID-19 is a highly infectious, rapidly spreading disease without any proven vaccine or treatment. Poor knowledge, attitude and practices (KAP) toward COVID-19 prevention measures among healthcare workers may lead to further transmission of the disease. Lack of attention towards non-frontline healthcare workers may put them at higher risk of infection from undetected cases. Here, we evaluate medical interns' KAP toward COVID-19 prevention measures in the Kingdom of Saudi Arabia (KSA).

Methods: We conducted a cross-sectional online survey. We distributed a structured questionnaire to the medical interns through different social media. Data was collected between April and May 2020. We estimated the prevalence of good KAP toward COVID-19 prevention measures. We did *T*-test or ANOVA to investigate the mean differences in KAP between socio-demographic groups. In addition, we did multivariable logistic regression analysis to investigate the socio-demographic determinants of good KAP.

Results: Of the total 250 participants, 60% were males, 64% were aged between 20 and 25 years, and 90% was Saudi. 24% interns are relying on social media, newspaper, television or friends as primary source of COVID-19 information, while others are relying on formal sources like official websites of national and international bodies. Overall, the prevalence of good knowledge, attitude and practices are 38% (95% CI: 32.2-44.2), 55.2% (48.9-61.3) and 24% (19.1-29.7), respectively. Graduating from government universities are associated with higher odds of good knowledge (aOR: 3.87; 95% CI: 1.05-14.22) and positive attitude (aOR: 4.84; 95% CI: 1.28-18.23) than private or foreign universities. While, practicing in the west region- Mecca and Medina (aOR: 2.35; 95% CI: 1.05-5.23); and the North region-Hail, Jouf, Tabuk & Northern borders (aOR: 3.2; 95% CI: 1.32-7.75) are associated to higher odds of moderate/good practice compared to practicing in the central region- Riyadh and Qassim.

Conclusions: Our findings reveal gaps in KAP among medical interns. Medical interns in Saudi Arabia are not deployed as front-line health worker to combat COVID-19. However, community transmission of COVID-19 make it critical to improve KAP of medical interns toward COVID-19 prevention measures. Repeated training to improve KAP and competency of the medical interns in this regard are warranted.

Background

Coronavirus disease-2019 (COVID-19) is a new highly infectious viral disease of the respiratory system and is caused by novel Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) [1]. The outbreak of COVID-19 was first reported late December 2019 in Wuhan, China. Later, it spread in other parts of China and throughout the world. Consequently, the World Health Organization (WHO) declared it a pandemic on March 11, 2020 [1]. The primary mode of transmission of the virus causing COVID-19 is respiratory droplets and contact routes [2]. Limited evidence suggests that there is also a possibility of fecal-oral transmission [3]. Severe COVID-19 patients are more contagious than mild ones. However, asymptomatic infected persons can also shed infectious virus [4]. Incubation period of SARS-Cov-2 is

between 2–14 days with a median of 5 days [5]. The most common clinical manifestations of COVID-19 are fever, fatigue, cough, myalgia, and dyspnea, while the less common manifestations are sputum production, headache, diarrhea and hemoptysis [6]. To date there is no effective vaccine against COVID-19 and treatment options are experimental. COVID-19 patients are currently managed with supportive care and antibiotics to counter secondary bacterial infections [7].

In Saudi Arabia, the first COVID-19 case was confirmed on March 2, 2020. As of June 26, 2020, the outbreak of COVID-19 is reported in all regions of the Kingdom with 170,639 confirmed cases; 1,428 deaths and 117,882 recoveries [8].

Healthcare professionals often come at close, repeated and or prolonged contact with diagnosed or undiagnosed COVID-19 patients [9]. Therefore, they are at a higher risk of getting infection. Globally, many healthcare professionals have already been infected with SARS-CoV-2 while treating patients [10]. This high rate of SARS-CoV-2 infection among healthcare professionals probably attributable to a lack of adherence to safety guidelines including a lack of access to or use of appropriate personal protective equipment (PPE) [11]. In this context, ensuring safety of healthcare professionals is of prime importance for continued quality healthcare services and to control further spread of the disease [9]. To prevent disease transmission in healthcare settings, the WHO recommends the use contact and droplet precautions by healthcare professionals while treating COVID-19 patients. WHO also recommends the correct use of PPE including choosing the right PPE for the setting, putting on, removing and disposing PPE correctly. In addition, healthcare professionals must adhere to hand hygiene and other IPC measures correctly [10].

Although healthcare professionals are at the higher risk of getting infection, previous studies with healthcare professional showed that there were gaps in knowledge and attitude toward Middle East Respiratory Syndrome (MERS) and other emerging infectious diseases in Saudi Arabia [12–14] and SARS in Taiwan [15]. Another hospital-based study in Riyadh, Saudi Arabia reported good knowledge and attitude, but poor practices toward MERS among healthcare professionals [16].

In order to facilitate the management of the covid-19 outbreak in Saudi Arabia, there is an urgent need to understand the awareness of COVID-19 among the healthcare professionals including medical interns at this critical moment. To our knowledge, ours is the first study in Saudi Arabia to assess medical interns' KAPs toward COVID-19. The aim of this study is to evaluate the knowledge, attitude and practices of medical interns toward COVID-19 and investigate it socio-demographic determinants in the kingdom of Saudi Arabia during the COVID-19 outbreak period in 2020. This study findings are expected to inform the authorities to organize necessary educational programmes for the medical interns to ensure best practice in controlling the COVID-19 epidemic in the Kingdom.

Methods

Study design, sampling and population

We conducted a cross-sectional survey of knowledge, attitude and practices toward COVID-19 of 261 medical interns in Saudi Arabia. Medical interns are the trainee doctors who have successfully completed medical schooling and are engaged in a year of additional training at hospitals before residency. They do not get the graduation certificate until they successfully finish this internship year. Because of the curfew and other lockdown measures imposed in Saudi Arabia to control the COVID-19 epidemic we employed a convenient, non-probability sampling technique to enroll medical interns who meet the inclusion criteria. Medical interns from all over the Kingdom of Saudi Arabia who completed their study from any public, private or foreign medical colleges recognized by the Saudi Ministry of Education were eligible to participate in the survey. Medical interns who were not training in either a public or private hospital in Saudi Arabia during the survey were excluded from the study. Characteristics of the participants are presented in Table 1. 261 intern medical doctors from all over Saudi Arabia participated in this study. However, 11 respondents were dropped from further analysis because of incomplete responses. Among them, 64% were aged between 20 and 25 years; 60% were male; about 90% were single and over 90% were Saudi. 86% of the medical interns were graduated from government universities in Saudi Arabia and the rest were graduated from private universities in Saudi Arabia or from any foreign universities. 97.6% interns were training in public hospitals (Table 1).

Table 1
Characteristics of the participants, KAP of medical interns toward COVID-19, cross-sectional survey, KSA, April-May 2020

Variables		Frequency (percent)
Age	20–25 years	160 (64)
	25–30 years	86 (34.4)
	30–35 years	4 (1.6)
Gender	Male	150 (60)
	Female	100 (40)
Marital Status	Single	224 (89.6)
	Married	26 (10.4)
Nationality	Saudi	227 (90.8)
	Non-Saudi	23 (9.2)
University	Government	215 (86)
	Private	26 (10.4)
	Foreign	9 (3.6)
Region	Central (Riyadh & Qassim)	103
	Eastern	103 (41.2)
	West (Mecca & Medina)	22 (8.8)
	North (Hail, Jouf, Tabuk & Northern borders)	50 (20.0)
	South (Asir & Najran)	34 (13.6)
	Central (Riyadh & Qassim)	41 (16.4)
Employer	Government hospital	244 (97.6)
	Private hospital	6 (2.4)

Data collection

We developed a structured online survey using an online survey administration app, the Google Forms. We distributed the link of the questionnaire to medical interns all over Saudi Arabia via social medias like whatsapp, twitter and Facebook. We promoted our online survey through our professional networks such as vice dean and head of the department of different medical colleges in Saudi Arabia. In addition, we advertised our survey through the medical interns' social media groups. We collected data between April and May 2020. Prior to data collection we pretested the questionnaire in a convenience sample of 20

medical interns. These interns were not included in our final survey. Following pretesting we made minor modification of the questionnaire to improve clarity and understanding of the questions by the interns.

The questionnaire and variables

The questionnaire we used consisted of two parts. The first part includes sociodemographic information of the participants- age in years, gender, nationality, area of residence, marital status, name of the university, type of the training hospital. These sociodemographic variables were treated as explanatory variables. While, the second part consists of the questions to assess the medical interns' knowledge, attitude and practice about COVID-19. This section is developed following the WHO and Saudi Ministry of Health guidelines on the prevention and control of COVID-19. Knowledge, attitude and practices of medical interns toward COVID-19 were used as dependent variables.

Ten questions were used to assess knowledge. Knowledge questions covered symptoms, transmission mode and prevention strategies of COVID-19. Correct response had a value of 1, wrong response had a value of -1 and don't know response had a value of 0 (knowledge aggregated score ranged from - 10 to 10 points). We classified medical interns' overall knowledge as good if the score was between 80 and 100% (8–10 points), moderate if the score was between 50 and 79% (5–7 points), and poor if the score was less than 50% (< 5 points). Attitude towards COVID-19 was evaluated using 10 questions. Responses were graded on a 3-point Likert scale; an agreement scale ranging from 1 for positive attitude to -1 for negative attitude (attitude aggregated score ranged from - 10 to 10 points). We classified the overall level of attitude as positive if the score was 80–100% (8–10 points), moderate if the score was 60–79% (6–7 points) and negative if the score was less than 60% (< 6 points). In addition, we assessed practice using seven questions regarding preventive measures as well as source of knowledge about COVID-19. Good practice was awarded 1 point, while bad practice was awarded - 1 point (practice aggregated score ranged from - 7 to 7 points). We classified medical interns' overall practice as good if the score was between 80 and 100% (5.6–7 points), moderate if the score was between 50 and 79% (3.5–5.5 points), and poor if the score was less than 50% (< 3.5 points).

Data management and analysis

Data were downloaded and coded in Excel file. Later, Excel data file was converted to IBM SPSS Statistics 20. 261 medical interns submitted the online form but during data cleaning 11 participants were identified with incomplete information, hence removed from further analysis. We did descriptive analysis of all categorical data and reported both frequency and percentage. We analyzed and reported prevalence of good knowledge, positive attitude and moderate and good practice in percentage with 95% confidence interval. We computed and reported mean and standard deviation (SD) for both total and subgroups knowledge, attitude and practice score. We performed *T-test* or ANOVA to analyze the relationship between the dependent (knowledge, attitude and practice), and explanatory (sociodemographic characteristics of the participants) variables. Mean differences were considered statistically significant if $p < 0.05$. In addition, we performed multi-variable logistic regression analysis to investigate the

sociodemographic determinants of knowledge, attitude and practice. We reported adjusted odds ratio (OR) with 95% CI. We considered the differences as statistically significant for a two-tailed test if $p < 0.05$.

Ethical issues

We received ethical approval from the subcommittee of Health Research Ethics, Deanship of Scientific Research, Qassim University, Saudi Arabia. First page of the online survey form included informed consent statements. Proceeding further by the interns implied their consent for participation. We informed the participants about the purpose of the survey, approximate time to complete the survey and guaranteed anonymity and confidentiality. It was made clear that participating or not participating in this survey will not affect their internship in any way.

Results

Knowledge

To evaluate knowledge, we posed key questions on COVID-19 symptoms, vulnerable groups, mode of transmission and prevention strategies. We found that nearly all the medical interns (99.2%) correctly identify the population vulnerable to COVID-19 and know the importance of hand hygiene to reduce the chance of getting the infection. However, only 61.6% can report all the events require practicing of hand hygiene. Most of them (96%) know the main manifestations of the disease, and 64.8% knows that GI symptoms is part of COVID-19 symptoms. Among the interns, 94% recognizes that 1–2 meters is the minimum social distancing between two persons to prevent transmission; 61.2% interns correctly report that respiratory droplets via direct contact with infected persons or indirect contact with surfaces contaminated by the virus are the mode of transmission of the virus causing COVID-19; while, 62% correctly reports that airborne transmission of SARS-CoV-2 is not possible in general contexts. We found that the proportion of medical interns know the minimum time required for hand washing using soap and water and hand sanitizing using alcohol-based hand sanitizer are 73.6% and 67.2%, respectively (Table 2).

Table 2
Knowledge of medical interns toward COVID-19, cross-sectional survey, KSA, April-May 2020

Knowledge items (correct response)	Response		
	Correct FrEq. (%)	Incorrect FrEq. (%)	Don't know FrEq. (%)
Fever, dry cough, muscle ache, shortness of breath, and fatigue are the main symptoms of COVID-19 (yes)	240 (96)	8 (3.2)	2 (0.8)
GI symptoms is part of COVID-19 symptoms (yes)	162 (64.8)	55 (22)	33 (13.2)
Elderly, immunocompromised, pregnant, and people with chronic illness are at higher risk of developing severe disease and complications if infected (yes)	248 (99.2)	1 (0.4)	1 (0.4)
SARS-CoV-2 is transmitted through respiratory droplets via direct contact with infected person or indirect contact with contaminated surfaces (yes)	153 (61.2)	81 (32.4)	16 (6.4)
Airborne transmission is possible for SARS-CoV-2 in general context (no)	155 (62)	80 (32)	15 (6)
Washing hands with soap and water or rubbing hands with alcohol-based sanitizer reduce chances of getting infected with SARS-CoV-2 (yes)	248 (99.2)	1 (0.4)	1 (0.4)
Hand hygiene must be practiced after blowing your nose, coughing or sneezing; visiting a public place; touching surfaces outside of the home or money; before, during and after caring for a sick person and before and after eating (yes to all events)	154 (61.6)	96 (38.4) *	0
Minimal hand washing time with soap and water (40–60 seconds)	184 (73.6)	66 (26.4)	0
Minimal hand sanitizing time using alcohol-based hand sanitizer (20–30 seconds)	168 (67.2)	82 (32.8)	0
Minimum social distancing between two persons (1–2 meter)	235 (94)	15 (6)	0
*said no to at least one of the events			

Based on their total knowledge score, we classified the interns as having good, moderate or poor knowledge. We found that the mean knowledge score of the interns is 6.1 ± 2.7 on a scale of -10 to 10 and only 38% (32.2–44.2) interns has good knowledge with a score of at least 80%. To investigate the mean differences in knowledge score between groups we did *T*-test or ANOVA. We found that Saudi interns and interns graduated from Saudi public universities has significantly higher knowledge score compared to non-Saudi interns and interns graduated from private or foreign universities, respectively (Table 5).

Table 5
Knowledge, attitude and practices of medical interns toward COVID-19 in KSA, cross-sectional survey,
April-May 2020

	Knowledge score [^]	Good knowledge	Attitude score [^]	Positive attitude	Practice score [^]	Moderate/good practice [^]
Variables	Mean (SD)	Percent (95% CI)	Mean (SD)	Percent (95% CI)	Mean (SD)	Percent (95% CI)
Total	6.1 (2.7)	38 (32.2–44.2)	7.2 (2.4)	55.2 (48.9–61.3)	1.7 (2.9)	24 (19.1–29.7)
Age						
20–25	6.1 (2.8)	37.5 (30.3–45.3)	7.3 (2.5)	61.9 (54.1–69.1)	1.6 (2.9)	24.4 (18.3–31.7)
25–30	6.2 (2.5)	38.9 (29.3–49.4)	6.9 (2.2)	43.3 (33.4–53.8)	1.8 (2.9)	23.3 (15.7–33.3)
Nationality						
Saudi	6.3 (2.6)*	40.5 (34.3–47.1)	7.1 (2.4)	53.7 (47.2–60.2)	1.7 (2.9)	24.7 (19.5–30.7)
Non-Saudi	3.9 (2.7)*	13.0 (4.1–34.3)	7.6 (2.1)	69.6 (47.9–85.1)	1.4 (2.9)	17.4 (6.5–38.9)
Gender						
Male	6 (2.8)	39.3 (31.8–47.4)	7.1 (2.5)	53.3 (45.3–61.2)	1.5 (3)	22 (16–29.4)
Female	6.2 (2.6)	36 (27.1–46)	7.3 (2.3)	58 (48–67.3)	1.8 (2.8)	27 (19.1–36.6)
Marital status						
Single	6 (2.7)	37.1 (31–43.6)	7.2 (2.4)	55.8 (49.2–62.1)	1.7 (2.9)	23.7 (18.5–29.7)
Married	6.4 (2.2)	46.2 (28–65.4)	6.9 (2.5)	50 (31.3–68.7)	1.4 (3.4)	26.9 (13.2–47.2)
University*						
Private or foreign	4.5 (2.5)*	14.3 (6–30.4)	6.7 (2.3)	48.6 (32.5–65)	1.7 (2.9)	22.9 (11.7–39.8)

	Knowledge score [^]	Good knowledge	Attitude score [^]	Positive attitude	Practice score [^]	Moderate/good practice [^]
Govt.	6.3 (2.6)*	41.9 (35.4–48.6)	7.2 (2.4)	56.3 (49.5–62.8)	1.7 (2.9)	24.2 (18.9–30.4)
Region						
Central	6.2 (2.6)	37.9 (29–47.7)	7.3 (2.2)	56.3 (46.5–65.6)	1.1 (2.9)	16.5 (10.5–25.1)
East	6.1 (2.6)	31.8 (15.6–54)	6.8 (2.9)	54.5 (33.6–74)	1.5 (2.7)	18.2 (6.8–40.4)
West	6.7 (2.5)	44 (30.8–58.1)	7.2 (2.2)	58 (43.8–70.9)	2.3 (2.3)	32 (20.5–46.2)
North	5.4 (3.2)	32.4 (18.7–49.9)	6.8 (2.9)	55.9 (38.8–71.6)	2.4 (3.1)	38.2 (23.4–55.6)
South	5.7 (2.7)	39 (25.3–54.8)	7.2 (2.3)	48.8 (33.8–64)	1.8 (3.1)	24.4 (13.5–40)
<p>* mean difference is significant for a two-tailed test at $p < 0.001$</p> <p>[^] Knowledge and attitude was scored on a scale of -10 to 10, while practice was scored on scale of -7 to 7</p>						

We performed multivariable logistic regression analysis to investigate the socio-demographic determinants of COVID-19 knowledge among medical interns. We found that the odds of good knowledge among interns graduated from Saudi public universities are 3.87 (95% CI: 1.05–14.22) time the odds of interns graduated from Saudi private universities or foreign universities, adjusting for the effect of other variables included in the model. However, there is no significant differences in COVID-19 knowledge between age groups, gender, marital status, nationality and region (Table 6).

Table 6

Determinants of KAP toward COVID-19 among medical interns, multivariable logistic regression analysis, cross-sectional survey, KSA, April-May 2020

	Knowledge	Attitude	Practice
Variables	aOR (95% CI)	aOR (95% CI)	aOR (95% CI)
Age			
20–25 years	1	1	1
> 25 years	0.96 (0.54–1.7)	0.51 (0.29–0.9)	0.94 (0.49–1.82)
Gender			
Male	1	1	1
Female	0.81 (0.46–1.4)	1.06 (0.6–1.85)	1.29 (0.68–2.45)
Marital status			
Single	1	1	1
Married	1.6 (0.68–3.78)	1 (0.42–2.36)	1.14 (0.44–2.96)
Nationality			
Saudi	1	1	1
Non-Saudi	0.63 (0.12–3.26)	6.92 (1.44–33.22) *	0.58 (0.12–2.83)
University			
Private or foreign	1	1	1
Government	3.87 (1.05–14.22) *	4.84 (1.28–18.23) *	0.66 (0.2–2.24)
Region			
Central (Riyadh & Qassim)	1	1	1
Eastern	0.85 (0.3–2.37)	0.92 (0.35–2.41)	1.17 (0.35–3.92)
West (Mecca & Medina)	1.31 (0.64–2.67)	1.27 (0.62–2.62)	2.35 (1.05–5.23) *
North (Hail, Jouf, Tabuk & Northern borders)	0.64 (0.28–1.48)	0.87 (0.39–1.94)	3.2 (1.32–7.75) *
South (Asir & Najran)	0.77 (0.35–1.68)	0.73 (0.34–1.57)	1.8 (0.71–4.54)

Attitude

We posed statements to assess medical interns' attitudes toward COVID-19 prevention strategies and their believe and awareness of the strategies being implemented by their hospital. Regarding declaring recent travel history, 92% interns think that they should declare their recent travel history before rejoining work even if they do not have any COVID-19 symptom. Regarding asymptomatic virus carrier, 90% believe that they can be a virus carrier even if they do not have fever or cough. 73% interns rightly think that they do not need to wear N95 mask at work all the time to avoid getting infected with SARS-CoV-2. 97% medical interns believe that appropriate social distancing can reduce their risk of getting infected or infecting others with SARS-CoV-2. 92% medical interns think they should stay home, isolate themselves, and inform their superior if they develop fever or cough even if they have not been exposed to COVID-19 patients or recently returned from a travel. 97% of the interns believe that quarantining suspected COVID-19 cases for 14 days can reduce the spread of the infection. Regarding prevention strategies in place in hospital, 72% intern believe that their hospitals have taken all the necessary protective measures to protect healthcare providers and patients from getting infected with SARS-CoV-2. 94% interns think that it's their social responsibility to protect public health by following the government's recommendations to control the spread of COVID-19. The least proportion of positive attitude are regarding the interns' awareness about the measures taken by their hospitals to address COVID-19 pandemic (61.2%) as well as visual triage checklist from the Saudi Ministry of Health for COVID-19 patients (62%) (Table 3).

Table 3
Attitude of medical interns toward COVID-19, cross-sectional survey, KSA, April-May 2020

Attitude items (positive attitude)	Attitude		
	Positive FrEq. (%)	Negative FrEq. (%)	Don't know FrEq. (%)
I don't need to declare recent travel history before rejoining work if I have no symptoms (disagree)	229 (91.6)	17 (6.8)	4 (1.6)
I can't be a virus carrier if I don't have symptoms of fever or cough (disagree)	226 (90.4)	22 (8.8)	2 (0.8)
I need to wear N95 mask at work all time to avoid getting infected with SARS-CoV-2 (no)	182 (72.8)	50 (20)	18 (7.2)
I think social distancing can reduce my chances of getting infected or infecting others with SARS-CoV-2 (yes)	242 (96.8)	6 (2.4)	2 (0.8)
I should stay home, isolate myself, and inform my superior if I have fever or cough even if I have not been exposed to COVID-19 patients or recently returned from travel (yes)	230 (92)	10 (4)	10 (4)
I think quarantine of suspected COVID-19 cases for 14 days can reduce the spread of the infection (yes)	243 (97.2)	3 (1.2)	4 (1.6)
I believe that my hospital has taken all the necessary protective measures to protect healthcare providers and patients from getting infected with SARS-CoV-2 (yes)	179 (71.6)	35 (14)	36 (14.4)
I felt that I have social responsibility to protect public health by following the government's recommendations to control the spread of COVID-19 (yes)	236 (94.4)	8 (3.2)	6 (2.4)
I am aware about visual triage checklist from the Saudi Ministry of Health for COVID-19 patients (yes)	155 (62)	71 (28.4)	24 (9.6)
I am aware about the measures taken by my hospital to address COVID-19 pandemic (yes)	153 (61.2)	63 (25.2)	34 (13.6)

Based on their total attitude score, we classified the interns as having positive, moderate or negative attitude. We found that the mean attitude score of the interns is 7.2 ± 2.4 on a scale of -10 to 10 and only 55.2 (95% CI: 48.9–61.3) interns has positive attitude with a score of at least 80%. To investigate the mean differences in total attitude score between groups we did *T*-test or ANOVA. Mean differences in total attitude score between different socio-demographic groups are not significant ($p > .05$) (Table 5).

We performed multivariable logistic regression analysis to investigate the socio-demographic determinants of medical interns' attitude toward COVID-19 prevention strategies. We found that the odds of positive attitude among non-Saudi interns are 6.92 (1.44–33.22) times the odds of positive attitude among Saudi interns, given that the effect of all other variables in the model are held constant. In addition, the odds of positive attitude among the interns graduated from Saudi public universities are

4.84 (1.28–18.23) times the odds of positive attitude among the interns graduated from Saudi private universities or foreign universities, adjusting for the effect of other variables included in the model. However, there is no significant differences in attitude toward COVID-19 prevention strategies between age groups, gender, marital status and region (Table 6).

Practices

To assess medical interns' practices, we posed 7 questions. We found that among the interns 92% practice social distancing and avoid going out unnecessarily; 91% became more vigilant about washing their hands. However, only 33% interns have got fitted for N95 mask. Regarding improving knowledge, we found that 70%, 51% and 20% interns respectively attended training on hand hygiene, safely wearing and removing face masks or N95 mask and gloves and taking nasopharyngeal swab safely. We also found that 76% interns use official websites of the Saudi ministry of health, WHO or other international societies, hospital resources including website, emails, and posters as their primary source of information on COVID-19. While, others were relying on social media, newspaper and television, friends or family (Table 4).

Table 4
Practices of medical interns toward COVID-19, cross-sectional survey, KSA, April-May 2020

Practice items (good practice)	Practice	
	Good	Bad
	FrEq. (%)	FrEq. (%)
I have been practicing social distancing and avoiding going out unnecessarily (yes)	230 (92)	20 (8)
I have been more vigilant about washing my hands (yes)	228 (91.2)	22 (8.8)
I have got fitted for N95 mask (yes)	83 (33.2)	167 (66.8)
No, I didn't want to	-	27 (10.8)
No, I don't have access to fitting test/hospital doesn't have N95 masks	-	83 (33.2)
No, I have a beard and I didn't want to shave it	-	24 (9.6)
No (other reasons)	-	33 (13.2)
I attended training on hand hygiene during COVID-19 pandemic (yes)	174 (69.6)	76 (30.4)
I attended training on wearing and removing face mask (or N95 mask) and gloves safely during COVID-19 pandemic (yes)	127 (50.8)	123 (49.2)
I attended training on performing nasopharyngeal swab safely (yes)	50 (20)	200 (80)
I have obtained knowledge about COVID-19 pandemic mainly from (official websites of Saudi MoH, WHO, CDC or other international societies, hospital resources including website, emails, and posters)	190(76)	60 (24) *
*Social media, newspaper, television, friends or family		

Based on their total practice score, we classified the interns as having good, moderate or poor practice. We found that the mean practice score of the interns is 1.7 ± 2.9 on a scale of -7 to 7 and only 24% (95% CI: 19.1–29.7) interns has moderate or good practice with a score of at least 50%. To investigate the mean differences in total practice score between groups we did *T*-test or ANOVA. Mean differences in total attitude score between different socio-demographic groups are not significant ($p > .05$) (Table 5).

We performed multivariable logistic regression analysis to investigate the socio-demographic determinants of medical interns' practice toward COVID-19 prevention strategies. We found that the odds of moderate/good practice in the west region (Mecca and Medina) are 2.35 (95% CI: 1.05–5.23) times the odds of moderate/good practice in the central region (Riyadh and Qassim), given that the effect of all

other variables in the model are held constant. In addition, the odds of moderate/good practice in the North (Hail, Jouf, Tabuk & Northern borders) region are 3.2 (95% CI: 1.32–7.75) times the odds of moderate/good practice in the central region, adjusting for the effect of other variables included in the model. However, there is no significant differences ($p > .05$) in practice toward COVID-19 prevention strategies between age groups, gender, marital status, type of university and nationality (Table 6).

Discussion

COVID-19 is a rapidly evolving global health crisis. Healthcare professionals are at the forefront of the COVID-19 outbreak response. Hence, their risk of infection is greater than the general population [17]. Therefore, it is vital that healthcare professional have adequate KAP regarding diagnosis, treatment and prevention of COVID-19. Here we assessed the KAP of medical interns toward COVID-19 prevention in KSA. Our results reveal that there are gaps in KAP of medical interns training in KSA regarding COVID-19 prevention. To the best of our knowledge, this is the first study in KSA to assess medical interns' KAP regarding COVID-19. Our results have implications for the relevant authorities in KSA.

Healthcare professionals' good knowledge, attitude and practice in complying precautionary measures helps to create awareness among patients and community people [18]. Medical interns in KSA are not deployed as frontline healthcare professional to combat COVID-19. However, evidence suggests that there are high chances of having undiagnosed COVID-19 patient contact at some point of time in healthcare settings [19]. Therefore, they are at risk of contracting and spreading the infection. Evidence suggests that non-frontline healthcare workers have lower confidence in protecting themselves from the virus [20]. On the other hand, frontline healthcare workers receive greater material support and care from the health systems, and they are more confident in their ability to protect themselves from the virus [21].

Knowledge forms positive attitudes and promotes positive behaviors [22]. Our results suggest gaps between the current evidence on COVID-19 and the depth of knowledge among medical interns- particularly about the mode of transmission, the events require practicing hand hygiene, and minimum time requires to disinfect hands with soap and water or with alcohol-based hand sanitizer. However, over 99% interns know the population most vulnerable to COVID-19 infection and complications. This is much higher than that reported in Vietnam, where only 79% hospital healthcare workers correctly identified the vulnerable population [23]. Over 99% interns know that washing hands with soap and water or rubbing hands with alcohol-based sanitizer reduce chances of getting infected with SARS-CoV-2. This is like that of reported by Giao et al in Vietnam among hospital health workers [23]. We found that 96% of medical interns in KSA know the main symptoms of COVID-19 which is higher than the proportion reported among hospital health workers in other countries [23, 24]. We found that 61% of the interns know the mode of transmission of SARS-CoV-2. This proportion is higher than the proportion (39%) reported by Bhagavathula et al. among doctors and allied health workers of different countries [25], but lower than the proportion (98%) of dental practitioners as reported by a multinational study [26]. Studies from other countries also reported a similar proportion (62–67%), such as among medical students in India [27] and among hospital healthcare workers in Vietnam [23].

We found that the vast majority (97%) of the interns have positive attitude towards the efficacy of quarantine of suspected COVID-19 cases for 14 days in reducing the spread of the infection. A lower percentage (66%) was reported among hospital healthcare workers in Vietnam [23]. In addition, most of the medical interns (92%) positively believe that there is a need to declare recent travel history before rejoining work even if having no symptoms. This agrees with the findings reported by Bhagavathula et al. [25]. Similarly, healthcare workers in Henan, China [52] believes that visitors with any close contact with a confirmed case or recent travel to an area with community transmission should disclose their exposure history. Most medical interns in KSA are positive toward staying home, isolating him/herself, and informing his/her superior if having fever or cough even if they have not been exposed to COVID-19 patients or recently returned from a travel. This agrees with a Vietnam study [23], where 98% health workers accept isolation in health facilities if getting COVID-19 exposure. More than two thirds of the medical interns in KSA (73%) rightly think that there is no need to wear N95 mask at work all time to avoid getting infected with SARS-CoV-2. This is in line with the findings of Modi et al in India [27]. In Uganda [24], 17% healthcare workers believe that wearing general medical masks is not protective against COVID-19 contrary to findings by Ng et al. [28], which showed adequate protection. In addition, WHO recommends rational use of masks and other PPE in both healthcare and community settings [10]. The surprising negative attitude of our studied group was about participants' awareness about the measures taken by their hospitals to address COVID-19 pandemic as well as visual triage checklist from the Saudi MoH for COVID-19 patients. This indicates the importance of improved communication and training provisions and materials on COVID-19 by the hospitals to strengthen preventive strategies including raising awareness of health workers including medical interns.

Our findings suggest that over 90% medical interns in KSA are proactively practicing social distancing or avoiding going out unnecessarily and practicing hand hygiene more vigilantly than any previous time. Similar findings are also reported among hospital healthcare workers in Uganda [24]. However, our findings suggest gaps in getting fitted for N95 mask, attending training on performing nasopharyngeal swab, hand hygiene and safe use of masks. It is important to note that one third of the interns reported that the reason behind not getting fitted for N95 mask is not having access to fitting test or their hospital didn't provide them with N95 masks. Healthcare professionals come in close contact with different patients. Hence, at the time of epidemic they have a higher risk of exposure to infected cases and are at higher risk of getting an infection. In this regard, the COVID-19 epidemic offers a unique opportunity to the Saudi MOH to provide all health settings with the required PPE for the healthcare workers to protect their safety and control the spread of the infection in the healthcare settings.

For prevention and control of infectious disease in healthcare settings, healthcare workers should place a high value on safely putting on, removing and disposing PPE [29]. When removing contaminated PPE such as gowns, gloves, medical masks, and face shield in high-risk settings, it is necessary to follow strict safety regulations to prevent further contamination and spread of infection [29]. However, we found that only half of the medical interns in KSA attended training on wearing and removing face mask (or N95 mask) and gloves safely during the COVID-19 pandemic. Kumar et al. [30] reported that 89% of healthcare workers in an orthopedic surgery setting in Pakistan believe that they know the proper steps of wearing a

surgical face mask; however, only 35% performed well in answering the procedural questions. Another study in India, reported that only 45% healthcare workers are aware of the correct procedure for the application of a mask/respirator [27]. A study with healthcare workers in China suggests that careful removal of PPE is positively associated with higher education level and work experience [20]. Therefore, hospital administration should arrange repetitive training and demonstrated competency in putting on and removing PPE for healthcare workers [29], specially targeting novices like medical interns.

One of the very vital practices to prevent transmission of COVID-19 from patients to patients, patients to healthcare workers and vice versa is hand hygiene. Hand hygiene must be practiced after blowing nose, coughing or sneezing; visiting a public place; touching surfaces outside of the home or money; before, during and after caring for a sick person and before and after eating. We found that only 62% correctly identified all presented events require practice hand hygiene. In contrary only 70% attended training on hand hygiene during COVID-19 pandemic.

Our findings reveal that although majority of the interns rely on formal websites and resource for COVID-19 information, 24% relies on social media, newspaper, television, friends or family for the same. Use of social medias and informal network is evident among healthcare workers in other countries too [23–25]. This finding has implications for the Saudi MoH and hospitals. It is important to consider a variety of channels, including official websites and social media, to update and disseminate knowledge and learning materials about this epidemic. Overall, our findings show that the prevalence of moderate or good practice among medical interns in KSA is only 24%. This gaps in practice might be attributable to their lack of experience and not being deployed to treat COVID-19 patients directly. Studies suggest that good practice is associated with age of the healthcare workers [24], work experience, working time [20] and qualification [24]; all of which are deficient among medical interns.

Regarding overall knowledge, attitude and practice, our results suggest that prevalence of good knowledge, attitude and practice among medical interns are 38%, 55% and 24%, respectively. This is much lower than the prevalence estimate reported by studies conducted in other countries [18, 20, 23, 24, 26, 30]. However, in our study, interns responded greater or similar proportion of correct answers. Low prevalence of good KAP in our study is largely attributable to the methodological differences in calculating total knowledge, attitude and practice between our study and the other. We used more criteria of scoring. In our study, negative score was given for wrong answers, whereas in other studies wrong answer received zero. This stricter scoring criteria contributed to lower total knowledge score in our study. We argue that it is vital to give negative score when assessing KAP of healthcare professionals. Since poor KAP of healthcare professional may lead to catastrophic consequences. Knowledge of COVID-19 is evolving everyday this perhaps explain the knowledge gaps regarding COVID-19 among healthcare professional globally. Health authorities must regularly update information and disseminate up-to-date information to all healthcare professionals including medical interns.

Our multivariable logistic regression analysis suggests significant association between knowledge and the type of graduating medical colleges; and attitude and the type of medical colleges. Medical interns

graduated from government colleges are more likely to have good knowledge and positive attitude toward COVID-19 prevention and control measures than interns from private or foreign colleges. This could be attributable student recruitment strategies, quality of faculty, resources and overall academic environment in governmental colleges. However, this need further investigation since only 14% of the participants were from private or foreign medical colleges. Our findings also suggest that non-Saudi medical interns are more likely to positive attitude toward COVID-19 prevention measures compared to Saudi interns. This might be attributable to perceived lack of support from friends and family in times of a personal crisis when living in a foreign country without or with only immediate family members. Regarding practice, our result suggests significant association between region and moderate/good practice. Medical interns from the west (Mecca and Medina) and the north (Hail, Jouf, Tabuk & Northern borders) regions are more likely to have moderate/good practice than the interns from the central region (Riyadh and Qassim). During the time of data collection west and north regions were the worst hit by COVID-19 than the central and other regions of KSA. This perhaps explain the more careful practice of the interns from west and north region. Other studies found that the most significant associated factors with KAP scores were age of the healthcare workers (more than 40 years with knowledge and practice), qualification (holding a diploma with practice) [24], occupation (pharmacists with knowledge and attitude) [23] or working experiences and job category [43] (5–9 years of experience and frontline status with attitude and practice) [20].

Our study findings should be interpreted with caution because of its methodological limitations. Given the lockdown measures in KSA and the urgent need to know the COVID-19 KAP status of this neglected healthcare professional group, we did a rapid online survey using the popular social medias to recruit participants. Nevertheless, the study participants are from all over KSA, thus, generalization of the results is possible.

Conclusions

Uur findings have highlighted the gaps in KAP among medical interns toward COVID-19 prevention. Although, in KSA medical interns are not deployed to treat COVID-19 patients community transmission in all regions of KSA implies that they are also at risk of exposure while treating non-COVID-19 or undiagnosed COVID-19 patients. Knowledge of COVID-19 are rapidly developing, hence it is the responsibility of the hospital authority to keep prevention protocol up-to-date and communicate up-to-date information to all healthcare workers including medical interns.

Abbreviations

KSA
The Kingdom of Saudi Arabia
KAP
Knowledge, attitude and practices
OR

Odds ratio
aOR
Adjusted odds ratio
MoH
Ministry of Health
WHO
World health organization
COVID-19
Coronavirus disease 2019
PPE
Personal Protective Equipment

Declarations

Ethics approval and consent to participate: This research did not involve any human or animal experiment. We received ethical approval from the subcommittee of Health Research Ethics, Deanship of Scientific Research, Qassim University, Saudi Arabia. First page of the online survey form included informed consent statements. Proceeding further by the interns implied their informed consent for participation. We informed the participants about the purpose of the survey, approximate time to complete the survey and guaranteed anonymity and confidentiality. It was made clear that participating or not participating in this survey will not affect their internship in any way.

Consent for publication: not applicable

Availability of data and materials: data used in this study is available from the corresponding author on reasonable request.

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Authors' contributions: SA designed the study, developed the questionnaire and collected data. IM analyzed and interpreted data and prepared the manuscript. MA wrote the first draft of methodology and discussion. RA conducted the pilot test and collected data. FA wrote first draft of literature review. All authors provided feedback in all sections. All authors read and approved the final manuscript.

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