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ORIGINAL ARTICLE

Self-reported adherence of healthcare workers to infection prevention and control practices during the early waves of the COVID-19 pandemic in Egypt

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Abstract

***Introduction*:** Considering the absence of effective treatment, the World Health Organization had recommended stringent infection prevention and control (IPC) measures against coronavirus disease 2019 (COVID-19) to reduce its transmission. The non-adherence of healthcare workers (HCWs) to these measures had been reported as a major cause of infection.

***Aim*:** To assess the level of self-reported adherence of HCWs to IPC measures during their social life and work time.

***Methods*:** This cross-sectional study included 559 HCWs (411 females and 148 males) working at 39 hospitals across different Egyptian governorates. A predesigned structured questionnaire about COVID-19 IPC measures was completed by trained interviewers.

***Results*:** Washing hands before eating (98.2%), using soap for hand wash (97.9%), washing hands after returning home (96.6%), and wearing a face mask when going outside in public places (83.7%) were the commonest daily-life practices among the 559 studied HCWs, while the least common was social distancing (46.0%). Less than half of the studied HCWs were adherent to the proper duration of handwashing ($P < 0.01$). Only 5.9% of the studied HCWs usually wore full personal protective equipment (PPE) at work ($P = 0.051$). The highest percentages of HCWs working at outpatient clinics and laboratories (98.1% each) 'sometimes' used PPE ($P = 0.017$). There was a significant difference in self-reported adherence to wearing face masks at hospitals according to specialties ($P < 0.01$). HCWs working at intensive care units (ICUs) recorded the highest attendance rates at IPC training (53.8%, $P = 0.012$). A relatively higher percentage of HCWs at COVID-19 isolation hospitals wore PPE (15.7%) versus 2.2–4.7% in other hospitals ($P = 0.015$).

Conclusion: The majority of HCWs sometimes complied with wearing PPE (93.6%). HCWs were more adherent to wearing masks at hospitals (94.6%) compared to community settings (42.9%). Older age and female gender were significantly associated with self-reported adherence to some IPC measures. Hand hygiene training session emphasizing the proper duration of hand wash is mandatory.

Keywords: *infection prevention and control; COVID-19; healthcare workers; self-reported adherence; Egypt*

To access the supplementary file, please visit the article landing page

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Coronavirus disease 2019 (COVID-19) is a highly communicable infection caused by the severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2). It ranks the ninth deadly pandemic in history (1). Undoubtedly, healthcare workers (HCWs) are among the most severely hit by the pandemic as they face the occupational risk of becoming infected with COVID-19, and at worst, dying (2). The World Health Organization (WHO) defines HCWs as 'all people engaged in actions whose chief goal is to enhance health'. This encompasses doctors, nurses, technicians, and paramedical staff such as support staff and hospital administrators (3). The WHO surveillance data reported 80,000 to 180,000 COVID-19 deaths out of 135 million HCWs worldwide, between January 202 and May 2021 (4).

SARS-CoV-2 is transmitted from patients to HCWs in healthcare settings due to working in close proximity to patients or their bodily secretions. Throughout unprotected exposure to a confirmed COVID-19 case or

unrecognized COVID-19 patient, different sizes of liquid particles from patients' mouths or noses spread during coughing, sneezing, breathing, talking, or intubation (short-range within 1 m). Moreover, aerosol transmission at longer distances (beyond 1 m) can occur in healthcare settings, where procedures that generate aerosols are performed (5).

The WHO had recommended the rational implementation of specific infection prevention and control (IPC) measures to reduce the transmission of SARS-CoV-2 among HCWs. These measures include standard droplet-contact and airborne precautions, universal masking policies, and training and educating HCWs on hand hygiene and the use of personal protective equipment (PPE). PPE includes gloves, medical masks, goggles or a face shield, and gowns, as well as PPE for specific procedures such as respirators (i.e. N95 or filtering facepiece FFP2 standard or equivalent) and aprons. Other measures include appropriate engineering controls, such as including designated donning and doffing areas and separate entrance ways for HCWs than those used by patients and visitors where possible; environmental cleaning and disinfection of both patient and staff areas, especially high touch surfaces (2–3 times daily); disinfection of rooms after each outpatient visit; waste management strategies to ensure that potentially contaminated waste (including used PPE) is promptly removed from staff or patient care environments; and adequate ventilation of the rooms at the workplace (5). Inconsistent use of PPE and inadequate physical distancing were documented as the main causes of COVID-19 infection of HCWs (6, 7).

The protection of HCWs remains a challenge in most countries. In a vicious cycle, shortages of HCWs had forced staff to adapt to the significantly higher workload and longer shifts for extended periods of time, with inadequate PPE supply, which led to reduction of HCW compliance to the recommended IPC measures. This calls the attention to investigate HCWs' practices during the COVID-19 pandemic in different Egyptian hospitals. Some studies assessed certain practices of HCWs such as wearing the face mask and washing hands in Egypt (8, 9). However, comprehensive analysis of different practices of HCWs during their social life and in healthcare settings is still scarce. The present study aimed to investigate the self-reported adherence of a sample of Egyptian HCWs to some lifestyle behaviors and IPC measures in healthcare settings.

Methods

This cross-sectional survey-based study was conducted between January and June 2021. This period coincided with the second and third waves of the COVID-19 pandemic in Egypt. This study was a part of another project which enrolled 559 HCWs (10).

Data collection

Before research implementation, a pilot study was conducted on a group of 20 HCWs in one of the university hospitals to test for the feasibility of recruitment as well as validation of the questionnaire. A predesigned structured questionnaire was completed through interviewing HCWs by trained interviewers. The study questionnaire comprised sociodemographic information: age, sex, marital status, residence, and education. Some data about the work setting of HCWs were included as were the occupation (physicians, nurses, pharmacist, etc.) and the type of hospital (COVID-19 isolation, screening/referral, or mixed hospitals). HCWs from intensive care units (ICUs), emergency rooms, internal medicine wards, outpatient clinics, radiology, and laboratory departments were included. Another section of the questionnaire comprised questions related to lifestyle behaviors (practicing social distancing of at least 1 m), eating outdoors, wearing masks when going outside in public places, washing hands for at least 20 sec, use of soap and hand disinfectant, and IPC measures at work (wearing PPE at the hospital, temperature screening, environmental disinfection, well-ventilation of the rooms, attendance at IPC training programs, and satisfaction with implementation of IPC measures).

Ventilation of the rooms was assessed according to the WHO guidelines (11), where the minimum recommended ventilation rate in non-residential settings is 10 L/second/person, and cross ventilation should be enabled, either through doors or the use of pedestal fans. The interviewers explained the guideline for all HCWs before asking them to assess whether rooms are well ventilated or not. The answer was either 'yes' or 'no'. The opinion of HCWs regarding the implementation of IPC measures in their health facilities was assessed by direct interview using the closed ended question 'Do you think there is implementation of IPC measures in your health care facility?' The response was either 'yes' or 'no'. Satisfaction with the implementation of IPC measures of the respondents was assessed using a closed-ended question: 'Rate your satisfaction with IPC measures?' Satisfaction with IPC measures and attendance at IPC training programs were rated as follows: none; poor =<25%, fair = 25% – <50%, good = 50% – <75%, and excellent = ≥75%. HCWs' self-reported adherence to safety practices was recorded in as rarely (0% – <20%), sometimes (20% – <80%), or usually (≥80%).

Statistical analysis

Data were fed to statistical software IBM SPSS version 22 (IBM, Armonk, NY, USA). Descriptive analysis based on frequency and percent distribution was done for all variables, including sociodemographic and behavioral data. Quantitative variables were expressed by the mean and standard deviation (SD), while categorical variables by

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absolute and relative frequency. Cross-tabulation and Chi-squared (χ^2) test were used to analyze the associations between self-reported adherence to IPC measures and the characteristics of participants. Statistical analysis was done using two-tailed tests. A *P*-value less than 0.05 was considered statistically significant.

Ethical considerations

This study was conducted in compliance with the Helsinki Declaration and was approved by the Institutional Review Board (IRB) Committee, Faculty of Medicine, Alexandria University – IRB number: 00012098, FWA number: 00018699, and serial number: 0305136. Administrative approval was taken from each healthcare setting prior to study onset. Anonymity and confidentiality were confirmed, and a written informed consent was obtained from all participants.

Results

A total of 559 HCWs were enrolled in this study. Their ages ranged from 20 to 72 years (mean 42.19 ± 10.51 years). About three-fourths of the participants were females (73.5%) and married (75.5%). Most study participants reported having a university degree (76.4%). Forty-three percent of HCWs were physicians, 17.9% were nurses, and the remaining were technicians, pharmacists, or others.

Common daily-life practices among the 559 studied HCWs were: washing hands before eating (98.2%), using soap for hand wash (97.9%), washing hands after returning home (96.6%), and wearing a face mask when going outside in public places (83.7%). The least common practice was social distancing (46.0%). Less than half of the studied HCWs (46.0%) were adherent to the proper duration of handwashing ($P < 0.01$). Self-reported adherence to wearing masks when going outside in public places ($P = 0.034$) and washing hands before eating ($P = 0.049$) were significantly associated with older age (mean 42.96 ± 10.54 and 42.31 ± 10.49, respectively) (Table 1). The abstinence from eating outdoors was also associated with older age (mean 41.39 ± 9.98) ($P < 0.01$). Self-reported adherence to some practices such as abstinence from eating outdoors ($P < 0.01$), wearing masks when going outside in public places ($P < 0.01$), washing hands after returning home ($P < 0.01$) was significantly associated with the female gender (Figure 1).

Only 5.9% of the studied HCWs 'usually' wore full PPE at work. Use of face masks and gloves was the highest reported (94.6 and 64%, respectively). Only 39.9% of HCWs attended IPC training. Females were more adherent to wearing masks and attending IPC training ($P = 0.048$ and 0.031, respectively), while males were more compliant to wearing caps and gowns ($P = 0.014$ and $P < 0.01$, respectively) (Table 2).

Table 1. Self-reported adherence of healthcare workers to some safety practices according to their age

Practices	Age (years) Mean ± SD	Total *n* = 559		Test of significance (*P*-value)
		No.	%	
Practicing social distancing				
Rarely	42.3 ± 11.22	10	1.8	ANOVA = 1.169 *P* = 0.216
Sometimes	41.23 ± 10.65	292	52.2	
Usually	43.28 ± 10.24	257	46.0	
Eating outdoors				
Rarely	46.05 ± 11.14	146	26.1	ANOVA = 1.784 *P* < 0.01
Sometimes	41.39 ± 9.98	361	64.6	
Usually	36.92 ± 8.74	52	9.3	
Wearing a face mask when going outside in public places				
Rarely	38.86 ± 1.95	7	1.3	ANOVA = 1.447 *P* = 0.034
Sometimes	38.19 ± 9.82	84	15.0	
Usually	42.96 ± 10.54	468	83.7	
Washing hands before eating				
Sometimes	35.7 ± 9.48	10	1.8	*t*-test = 1.977 *P* = 0.049
Usually	42.31 ± 10.49	549	98.2	
Washing hands after returning home				
Sometimes	37.68 ± 10.63	19	3.4	*t*-test = 1.907 *P* = 0.057
Usually	42.35 ± 10.48	540	96.6	
Duration of hand washing				
<20 sec	40.34 ± 10.47	302	54.0	*t*-test = 3.895 *P* < 0.01
≥20 sec	43.77 ± 10.29	257	46.0	
Use of soap for handwashing				
Sometimes	37.92 ± 9.94	12	2.1	*t*-test = 1.424 *P* = 0.154
Usually	43.77 ± 10.29	547	97.9	
Use of antiseptic for hand washing				
Rarely	42.14 ± 11.2	14	2.5	ANOVA = 0.903 *P* = 0.654
Sometimes	40.83 ± 10.62	140	25.0	
Usually	42.66 ± 10.43	405	72.5	

Compared to other HCWs, physicians were usually adherent to social distancing (51.9%, $P = 0.017$), use of hand disinfectants (74.5%, $P = 0.011$), and wearing face masks when going outside in public places (87.9%, $P = 0.023$). All technicians and 99% of nurses usually washed hands after returning home ($P < 0.01$) (Table 3). Self-reported adherence to certain IPC measures was significantly associated with different occupations (Supplementary Table 1).

Most HCWs (98.7%) reported that adequate IPC measures were implemented at their hospitals regardless of hospital type. Overall, some of the most frequently self-reported IPC measures were well-ventilation of rooms (91.1%), daily environmental disinfection (84.6%), and the application of body temperature screening (72.5%). More than half of HCWs (56.4%) reported good satisfaction with IPC practices, with the highest percentage among those working at COVID-19 isolation hospitals (59.6%); however, this was not

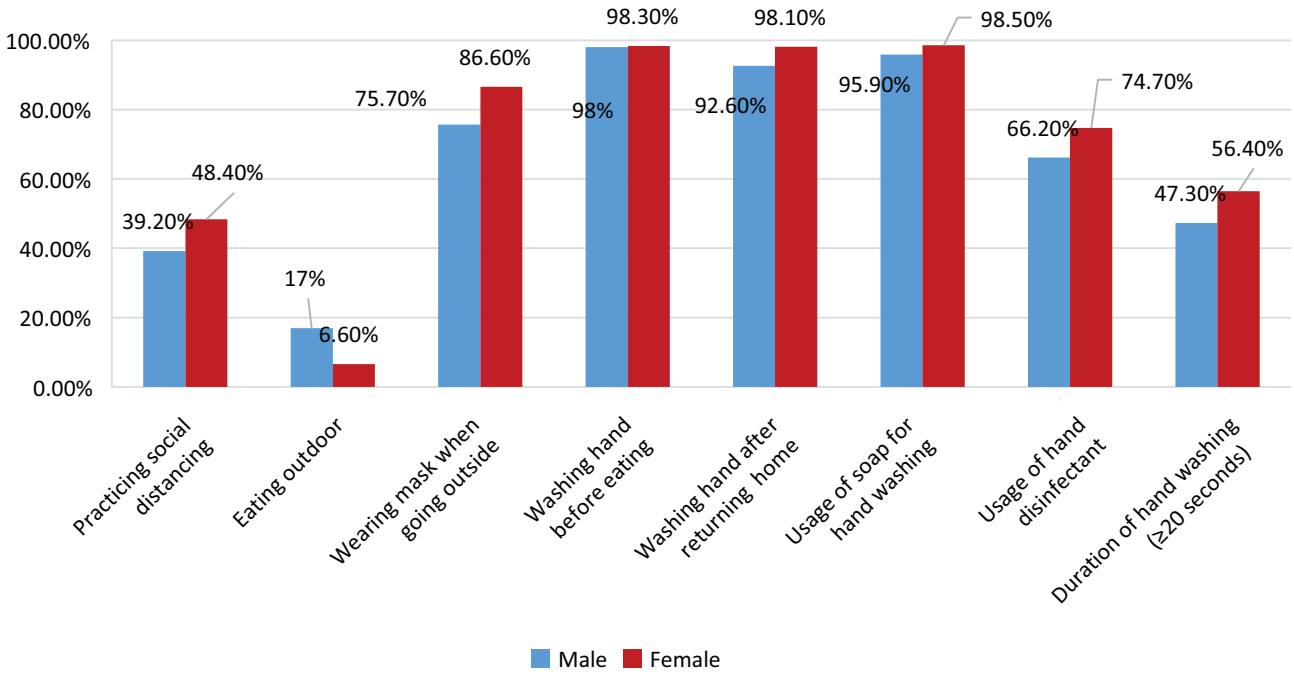

Fig. 1. Adherence of HCWs to safety practices according to gender.

statistically significant (P = 0.069). Body temperature screening differed according to the type of hospital, with the highest percentage at screening/referral hospitals (82.9%, $P < 0.01$). A relatively higher percentage of HCWs at COVID-19 isolation hospitals wore PPE (15.7%) versus 2.2–4.7% in other hospitals (P = 0.015) (Table 4). Compared to other hospitals, HCWs working at COVID-19 isolation hospitals reported significantly higher percentages of attending IPC training programs (51.7%, P = 0.034). Self-reported adherence to wearing face masks, gloves, gowns, and goggles varied significantly between hospitals, and surprisingly, the highest percentages were not at COVID-19 isolation hospitals ($P < 0.001$ – < 0.01) (Supplementary Table 2).

Although it was not statistically significant, all HCWs working at ICUs and outpatient clinics reported implementation of adequate IPC measures (P = 0.917). The highest percentages of HCWs working at outpatient clinics and laboratories (98.1% each) 'sometimes' used PPE, followed by those working at radiology departments (98%) (P = 0.017). There was a significant difference in self-reported adherence to wearing a face mask at hospitals according to specialties, where all HCWs working at ICUs, 99% of those working at laboratories, and 98.1% of nurses usually wore face masks ($P < 0.01$). Moreover, self-reported adherence to wearing gloves, caps, gowns, and goggles differed significantly according to specialties ($P < 0.001$). HCWs working at ICUs recorded the highest attendance rates of IPC training (53.8%, P = 0.012) (Table 5).

Discussion

During the early phases of the COVID-19 pandemic, infections of HCWs across 195 countries had been reported mainly in nurses, while deaths were more frequently in doctors, especially general practitioners due to the high flow of patients and the increased risk of viral transmission with less self-reported adherence to IPC measures (12). In Egypt, the infection rate among HCWs ranged from 3.7 to 20% in different healthcare settings, with 400 reported deaths during the study period, according to the Egyptian Medical Syndicate (EMS) (13, 14).

During the study period, all healthcare facilities followed key WHO IPC recommendation, in particular isolation facilities for COVID-19 patients; contact, droplet, and airborne precautions; adequate environmental cleaning; disinfection and ventilation; and physical distancing, where possible, for at least 1 m (15). In addition, HCWs were the highest priority population for vaccination (Oxford/AstraZeneca [AZD1222] and Sinopharm BBIBP were the available COVID-19 vaccines during the study period) (16). Obviously, the compliance of HCWs with IPC guidelines reduced the risk of contact with patients' body fluids and infection rates (17).

The Ministry of Health and Population launched the 'Health of Egypt/Egypt's Health' mobile application, which was approved by the WHO. It aims to provide citizens with information on the main incidents to slow down and control the spread of COVID-19 in the community setting, in the form of closure of all schools, universities,

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Table 2. Self-reported adherence of healthcare workers to infection prevention and control (IPC) measures during their work time

IPC measures	Gender				Total *n* = 559		Test of significance (*P*-value)
	Male *n* = 148		Female *n* = 411				
	No.	%	No.	%	No.	%	
Use of PPE at work							
Rarely	0	0.0	3	0.7	3	0.5	Fisher's exact = 4.87
Sometimes	14	9.5	19	4.7	523	93.6	*P* = 0.051
Usually	134	90.5	389	94.6	33	5.9	
Wearing face masks at hospital							
Rarely	2	1.4	3	0.7	5	0.9	Fisher's exact = 6.618
Sometimes (in patients' rooms)	12	8.1	13	3.2	25	4.5	*P* = 0.048
Usually	134	90.5	395	96.1	529	94.6	
Wearing face shield at hospital in patient care areas							
No	95	64.2	267	65.0	362	64.8	X^2 = 0.029
Yes	53	35.8	144	35.0	197	35.2	*P* = 0.866
Wearing gloves at hospital							
No (36%)	53	35.8	148	36.0	201	36.0	
Yes (64%)							X^2 = 0.148
Single	82	55.4	231	56.2	313	56.0	*P* = 0.929
Double	13	8.8	32	7.8	45	8.0	
Wearing caps at hospital							
No	103	69.6	327	79.6	430	76.9	X^2 = 6.09
Yes	45	30.4	84	20.4	129	23.1	*P* = 0.014
Wearing gowns at hospital							
No	79	53.4	271	65.9	350	62.6	X^2 = 7.331
Yes	69	46.6	140	34.1	209	37.4	*P* < 0.01
Wearing goggles at hospital							
No	129	87.2	372	90.5	501	89.6	X^2 = 1.312
Yes	19	12.8	39	9.5	58	10.4	*P* = 0.252
Infection control training attendance							
No	100	67.6	236	57.4	336	60.1	X^2 = 4.672
Yes	48	32.4	175	42.6	223	39.9	*P* = 0.031

and mosques, along with the cancellation of cultural events and tourist trips. Moreover, regular checking of temperature when visiting any premises and a negative COVID-19 test or a proof of a WHO-approved COVID-19 vaccination were required for entry to Egypt (18). In parallel to these measures, Egypt started an extensive health education campaign using newspapers, radio, television, and social media to increase public awareness about hand hygiene (19).

Most viruses, including SARS-CoV-2, can be inactivated by soap and water. Therefore, hand washing is mandatory for HCWs to prevent infections primarily transmitted by close contact with droplets (20). Fortunately, the common practice among all studied HCWs was hand washing either before eating (98.2%) or after returning home (96.6%), which exceeds the frequency of self-reported adherence in Saudi Arabia (80%) (21). This result did not show good congruence with Engdaw et al. from Ethiopia, who reported a 14.9% prevalence of hand hygiene compliance among HCWs assessed using observational checklist (22), or with the 24.9% shown by Papagiannis et al. in Greece (23), which was assessed by self-reporting by HCWs. This aspect of safety practices showed wide variation internationally because it is dependent not only on hand hygiene knowledge but also on hospital infrastructure and the availability of adequate soap and water supply (24). Regrettably, less than half of the studied HCWs (46.0%) in our study were adherent to the proper duration of hand washing. A much higher percentage was reported by Galal et al. at Cairo University Children's Hospital (87%) (9). Our result indicates that HCWs are aware of the importance of handwashing to prevent COVID-19 infection, yet they may not be as equally aware of the importance of the optimal duration for handwashing to be effective. We, therefore, recommend educating them on the importance

Table 3. Self-reported adherence of healthcare workers to social and infection prevention and control (IPC) measures according to their occupation

Social and infection prevention practices		Total		Occupation					Test of significance (*P*-value)
		n = 559		Physician	Nurse	Technician	Pharmacist	Others*	
		No. (%)		239 (42.8)	100 (16.3)	59 (8.2)	68 (11.6)	93 (18.4)	
		No.	%	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)	
Practicing social distancing	Rarely	10	1.8	2 (0.8)	0 (0.0)	2 (3.4)	1 (1.5)	5 (5.4)	Fisher's exact = 16.942
	Sometimes	292	52.2	113 (47.3)	60 (60.0)	29 (49.2)	35 (51.5)	55 (59.1)	*P* = 0.017
	Usually	257	46.0	124 (51.9)	40 (40.0)	28 (47.5)	32 (47.1)	33 (35.5)	
Eating outdoors	Rarely	146	26.1	58 (24.3)	22 (22.0)	21 (35.6)	9 (13.2)	36 (38.7)	X^2 = 21.655
	Sometimes	361	64.6	154 (64.4)	69 (69.0)	36 (61.0)	54 (79.4)	48 (51.6)	*P* < 0.01
	Usually	52	9.3	27 (11.3)	9 (9.0)	2 (3.4)	5 (7.4)	9 (9.7)	
Wearing a face mask when going outside in public places	Rarely	7	1.3	2 (0.8)	0 (0.0)	0 (0.0)	0 (0.0)	5 (5.4)	Fisher's exact = 15.683
	Sometimes	84	15.0	27 (11.3)	19 (19.0)	11 (18.6)	9 (13.2)	18 (19.4)	*P* = 0.023
	Usually	468	83.7	210 (87.9)	81 (81.0)	48 (81.4)	59 (86.8)	70 (75.3)	
Washing hands before eating	Sometimes	10	1.8	7 (2.9)	0 (0.0)	0 (0.0)	2 (2.9)	1 (1.1)	Fisher's exact = 4.412
	Usually	549	98.2	232 (97.1)	100 (100.0)	59 (100.0)	66 (97.1)	92 (98.9)	*P* = 0.244
Washing hands after returning home	Sometimes	19	3.4	8 (3.3)	1 (1.0)	0 (0.0)	1 (1.5)	9 (9.7)	Fisher's exact = 11.813
	Usually	540	96.6	231 (96.7)	99 (99.0)	59 (100.0)	67 (98.5)	84 (90.3)	*P* < 0.01
Duration of hand washing	<20 sec	302	54.0	126 (52.7)	52 (52.0)	37 (62.7)	32 (47.1)	55 (59.1)	X^2 = 4.43
	≥20 sec	257	46.0	111 (47.3)	48 (48.0)	22 (37.3)	36 (52.9)	38 (40.9)	*P* = 0.351
Use of soap for handwashing	Sometimes	12	2.1	7 (2.9)	2 (2.0)	0 (0.0)	0 (0.0)	3 (3.2)	Fisher's exact = 3.126
	Usually	547	97.9	232 (97.1)	98 (98.0)	59 (100.0)	68 (100.0)	90 (96.8)	*P* = 0.405
Use of hand antiseptic	Rarely	14	2.5	5 (2.1)	0 (0.0)	0 (0.0)	1 (1.5)	8 (8.6)	Fisher's exact = 14.393
	Sometimes	140	25.0	56 (23.4)	26 (26.0)	18 (30.5)	17 (25.0)	23 (24.7)	*P* = 0.011
	Usually	405	72.5	178 (74.5)	74 (74.0)	41 (69.5)	50 (73.5)	62 (66.7)	
Use of PPE at work	Rarely	3	0.5	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	3 (3.2)	Fisher's exact = 14.354
	Sometimes	523	93.6	13 (5.4)	4 (4.0)	1 (1.7)	5 (7.4)	10 (10.8)	*P* = 0.021
	Usually	33	5.9	226 (94.6)	96 (96.0)	58 (98.3)	63 (92.6)	80 (86.0)	

*Employees and office personnel.

of handwashing for at least 20 sec, as recommended by the WHO. Self-reported adherence to frequent ('usually') use of hand antisepsis using alcohol-based hand rub reached 72.5%, which was lower than the 94.8% reported by Al Mutairi et al. (25). The major determinants of the use of alcohol-based hand rubs are the cost and availability of these products (25).

Masks are often worn to prevent transmission of infection via droplets in the community or healthcare settings. It might be suggested that the use of face masks in the community is less effective in transmitting COVID-19 than in healthcare settings. During the study period, a risk-based approach was considered in mask use in the community setting; the general public should wear a non-medical mask in indoor settings (shops, shared workplaces, and schools), with restricted number of attendees to maintain physical distance of at least 1 m. In outdoor settings, mask use was recommended when physical distancing could not be maintained. Within a health facility, a universal masking approach by all patients, staff, caregivers, and visitors was followed (26). In the current study, the most frequent safety practice was hand washing, followed by wearing face masks at hospitals (94.6%) and when going outside in public places (83.7%) followed hand washing in the frequency of the applied safety practice. Comparable percentages (83%) were reported by Galal et al. from Egypt (9) and Chughtai et al. from Vietnam (68–77%) (27). The higher percentage of self-reported adherence to wearing face masks at hospitals in the present study might be due to the fear of HCWs getting infected from patients. A few HCWs did not use masks during work at hospitals. Prolonged use of masks, respirators, and goggles might cause skin irritation such as eczema, itching as well as fogginess caused by goggles (28). This discomfort might be a reason for their inconsistent use by HCWs, especially if working for long hours. Moreover, lack of resources in some healthcare settings might make these measures unavailable at times. The WHO announced the shortage of PPE in March 2020, which might have affected HCWs in several countries.

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Table 4. Relation between infection prevention and control (IPC) measures and type of hospital

Variable		Total respondents		Type of hospitals					Test of significance (*P*-value)
				COVID-19 isolation	Screening/ referral of suspected cases	Mixed (receive COVID-19 and other patients)	Do not receive COVID-19 patients	Others*	
				89 (15.9)	41 (7.3)	338 (60.5)	46 (8.2)	45 (8.1)	
		No.	%	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)	
Satisfaction with IPC measures	No	17	3.0	0 (0.0)	4 (9.8)	7 (2.1)	3 (6.5)	3 (6.7)	Fisher's exact = 22.556 $P = 0.069$
	Poor	10	1.8	1 (1.1)	2 (4.9)	5 (1.5)	1 (2.2)	1 (2.2)	
	Fair	45	8.1	10 (11.2)	3 (7.3)	26 (7.7)	5 (10.9)	1 (2.2)	
	Good	315	56.4	53 (59.6)	19 (46.3)	194 (57.4)	26 (56.5)	23 (51.1)	
	Excellent	172	30.8	25 (28.1)	13 (31.7)	106 (31.4)	11 (23.9)	17 (37.8)	
Environmental disinfection	No	10	1.8	1 (1.1)	1 (2.4)	(1.5)	1 (2.2)	2 (4.4)	Fisher's exact = 12.87 $P = 0.259$
	Every day	473	84.6	70 (78.7)	37 (90.2)	293 (86.7)	36 (78.3)	37 (82.2)	
	Every week	59	10.6	12 (13.5)	3 (7.3)	33 (9.8)	7 (15.2)	4 (8.9)	
	Every month	17	3.0	6 (6.7)	0 (0.0)	7 (2.1)	2 (4.3)	2 (4.4)	
Well ventilation of rooms	No	50	8.9	7 (7.9)	4 (9.8)	35 (10.4)	2 (4.3)	2 (4.4)	Fisher's exact = 2.755 $P = 0.598$
	Yes	509	91.1	82 (92.1)	37 (90.2)	303 (89.6)	44 (95.7)	43 (95.6)	
Body temperature screening	No	154	27.5	32 (36.0)	7 (17.1)	85 (25.1)	10 (21.7)	20 (44.4)	$x^2 = 5.101$ $P < 0.01$
	Yes	405	72.5	57 (64.0)	34 (82.9)	253 (74.9)	36 (78.3)	25 (55.6)	
Use of PPE at work	Rarely	3	0.5	1 (1.1)	0 (0.0)	2 (0.6)	0 (0.0)	0 (0.0)	Fisher's exact = 16.157 $P = 0.015$
	Sometimes	523	93.6	74 (83.1)	40 (97.6)	320 (94.7)	45 (97.8)	44 (97.8)	
	Usually	33	5.9	14 (15.7)	1 (2.4)	16 (4.7)	1 (2.2)	1 (2.2)	

*Employees and office personnel.

HCWs are usually more careful than the general population to wear masks as they are at the front lines in caring for patients with COVID-19 infection. In this regard, an Ethiopian study reported lower self-reported adherence to wearing face masks among the general population (32.4%) due to decreased affordability (29).

Older age was associated with better anti-COVID-19 practices. This could be explained by the fact that older groups might suffer from serious chronic illnesses; therefore, they perceived the increased risk of developing more serious complications from COVID-19 and thus were more adherent to practicing precautionary measures (30). In the current study, self-reported adherence to wearing face masks when going outside in public places ($P = 0.034$) and washing hands before eating ($P = 0.049$) were significantly associated with older age. Moreover, there was a significant difference between male and female HCWs in terms of self-reported adherence to certain safety practices, where females were more adherent to wearing masks at work and during their social life, washing hands after returning home, and attending IPC training. The possible justification might be that females are more involved in the family and childcare, and they bear the burden of transmission of the disease to their children if they do not implement greater self-reported adherence toward mitigation measures of COVID-19. These findings were parallel to those reported in several studies (31–34). Males were more compliant with wearing caps and gowns ($P = 0.014$ and $P < 0.01$, respectively), which might be associated with a higher percentage of male surgeons who usually use surgical gowns during operative procedures. It should be noted that the type of gowns either isolation or surgical should be based on the level of contamination risk and gowns availability. Non-sterile, disposable isolation gowns can be used by HCWs who care for patients with suspected or confirmed COVID-19. Surgical gowns should be prioritized for surgical sterile procedures (35).

Social distancing had been established as a control measure of the COVID-19 pandemic as it prevents close contact with infected individuals (36). In our study, only 46% of HCWs usually adhered to social distancing, contrary to 96.4% of HCWs in the United States (37). This may be attributed to the overcrowded nature of different Egyptian governorates, which makes social distancing and avoidance of physical contact somewhat difficult. However, physicians were usually adherent to social distancing at work compared to other HCWs (51.9%, $P = 0.017$), which might reflect their better understanding and attitude toward COVID-19 mode of transmission compared to other less-educated HCWs (employees and office personnel).

Table 5. Relation between self-reported adherence to infection prevention and control (IPC) measures and specialties of healthcare workers

Self-reported practices		Total		Healthcare worker specialties (n = 559)							Test of significance (P-value)
				ICUs	Emergency room	Outpatient clinics	Wards	Laboratory	Radiology	Others*	
				26 (4.7)	80 (14.3)	54 (9.7)	74 (13.2)	105 (18.8)	50 (8.9)	170 (30.4)	
		No.	(%)	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)	
Implementation of adequate IPC measures	No	7	1.3	0 (0.0)	2 (2.5)	0 (0.0)	1 (1.4)	1 (1.0)	1 (2.0)	2 (1.2)	Fisher's exact = 2.459 P = 0.917
	Yes	552	98.7	26 (100.0)	78 (97.5)	54 (100.0)	73 (98.6)	104 (99.0)	49 (98.0)	168 (98.8)	
Use of PPE at work	Rarely	3	0.5	0 (0.0)	3 (3.8)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	Fisher's exact = 20.166 P = 0.017
	Sometimes	523	93.6	24 (92.3)	68 (85.0)	53 (98.1)	68 (91.9)	103 (98.1)	49 (98.0)	158 (92.9)	
	Usually	33	5.9	2 (7.7)	9 (11.3)	1 (1.9)	6 (8.1)	2 (1.9)	1 (2.0)	12 (7.1)	
Wearing face mask at hospital	Rarely	5	0.9	0 (0.0)	3 (3.8)	0 (0.0)	1 (1.4)	0 (0.0)	1 (2.0)	0 (0.0)	Fisher's exact = 22.751 P < 0.01
	Sometimes	25	4.5	0 (0.0)	9 (11.3)	1 (1.9)	6 (8.1)	1 (1.0)	1 (2.0)	7 (4.1)	
	Usually	529	94.6	26 (100.0)	68 (85.0)	53 (98.1)	67 (90.5)	104 (99.0)	48 (96.0)	163 (95.9)	
Wearing face shield in patient care areas	No	362	64.8	14 (53.8)	58 (72.5)	35 (64.8)	40 (54.1)	77 (73.3)	30 (60.0)	108 (63.5)	x^2 = 11.164 P = 0.083
	Yes	197	35.2	12 (46.2)	22 (27.5)	19 (35.2)	34 (45.9)	28 (26.7)	20 (40.0)	62 (36.5)	
Wearing gloves at hospital	No	201	36.0	3 (11.5)	54 (67.5)	11 (20.4)	16 (21.6)	15 (14.3)	17 (34.0)	85 (50.0)	x^2 = 91.451 P < 0.001
	Single	313	56.0	20 (76.9)	22 (27.5)	37 (68.5)	49 (66.2)	78 (74.3)	30 (60.0)	77 (45.3)	
	Double	45	8.0	3 (11.5)	4 (5.0)	6 (11.1)	9 (12.2)	12 (11.4)	3 (6.0)	8 (4.7)	
Wearing caps at hospital	No	430	76.9	16 (61.5)	74 (92.5)	37 (68.5)	47 (63.5)	89 (84.8)	33 (66.0)	134 (78.8)	x^2 = 31.388 P < 0.001
	Yes	129	23.1	10 (38.5)	6 (7.5)	17 (31.5)	27 (36.5)	16 (15.2)	17 (34.0)	36 (23.1)	
Wearing gowns at hospital	No	350	62.6	8 (30.8)	60 (75.0)	39 (72.2)	31 (41.9)	77 (73.3)	26 (52.0)	109 (64.1)	x^2 = 39.934 P < 0.001
	Yes	209	37.4	18(69.2)	20 (25.0)	15 (27.8)	43 (58.1)	28 (26.7)	24 (48.0)	61 (35.9)	
Wearing goggles at hospital	No	501	89.6	21 (80.8)	78 (97.5)	42 (77.8)	65 (87.8)	93 (88.6)	44 (88.0)	158 (92.9)	x^2 = 18.210 P < 0.01
	Yes	58	10.4	5 (19.2)	2 (2.5)	12 (22.2)	9 (12.2)	12 (11.4)	6 (12.0)	12 (10.4)	
IPC training attendance	No	336	60.1	12 (46.2)	60 (75.0)	31 (57.4)	38 (51.4)	64 (61.0)	36 (72.0)	95 (55.9)	x^2 = 16.287 P = 0.012
	Yes	223	39.9	14 (53.8)	20 (25.0)	23 (42.6)	36 (48.6)	41 (39.0)	14 (28.0)	75 (44.1)	

*Employees and office personnel.

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The studied HCWs demonstrated poor self-reported adherence to 'usually' wearing PPE (5.9%), while the majority of them (93.6%) sometimes complied with wearing PPE. This finding agreed with Galal et al. (9) from Egypt who mentioned that 78% of nurses and 68% of physicians correctly used PPE. The lower compliance to wearing full PPE in the present study may be explained by the small percentage of HCWs working at COVID-19 hospitals (15.9%) as they are the ones who need to wear full PPE. However, this low percentage (5.9%) is worrisome, as it had a deleterious effect on the life of HCWs. It could also be due to one of the main perceived barriers that faced the application of IPC measures in Egypt: shortages of PPE, insufficient training, lack of knowledge, and overcrowded hospitals (14). United Nations Children's Fund (UNICEF) had delivered essential PPE to the Egyptian Ministry of Health and Population to support the frontline HCWs (38), and this was reflected in the present study by the relatively higher percentage of HCWs working at COVID-19 isolation hospitals who usually wore PPE (15.7%) compared to lower percentages (2.2–4.7%) in other hospitals ($P = 0.015$). This is because the priority, in this time period, was to supply COVID-19 hospitals with PPE. Neuwirth et al. agreed with this observation where self-reported adherence to wearing PPE at COVID-19 wards reached 85% compared to 76% at non-COVID-19 wards (39).

It is generally accepted that nurses are more adherent to IPC measures, compared to physicians (40). Thus, it is not surprising that a previous study reported that physicians were less adherent to COVID-19 IPC measures, such as reusing a mask and not cleaning and disinfecting the patient's environment (21). Ragusa et al. from Italy recorded higher self-reported adherence of nurses to hand washing due to adequate training; however, their performance worsened during the COVID-19 pandemic due to reorganization in the wards, understaffing, and patient overflow (41). These findings were not reflected in the current survey, where physicians were the most represented HCWs sector accounting for 239 (42.8%) of participants, and they reported a higher percentage of self-reported adherence to social distancing (51.9%, $P = 0.017$), and use of hand disinfectants (74.5%, $P = 0.011$) compared to other HCWs. In addition, all technicians and 99% of nurses usually washed their hands after returning home ($P < 0.01$). Similarly, in a study conducted in Jamaica, 87% of physicians and 88% of nurses washed their hands after contact with body fluids (42). On the contrary, Mohammed et al. from Assiut University Hospitals recorded that 88.2–93.9% of HCWs were non-compliant to IPC practices (8).

Stringent IPC measures, education, and supzervision are more likely to be followed in areas with a higher risk of infection transmission. This was reflected in the present study, where HCWs working at ICUs and laboratories were significantly more adherent to wearing face masks ($P < 0.01$). This agreed with Ragusa et al. (41) from Italy who found that HCWs in ICUs positively changed their safety behavior during the pandemic period. Some of the most frequently reported IPC measures in the current study were ventilation of rooms (91.1%) and daily environmental disinfection of surfaces (84.6%). A very similar percentage of cleaning and disinfection of the patient's environment (84%) had been reported in a previous study (21).

Generally, IPC training is recommended for medical and non-medical staff. In the present study, only 39.9% had attended IPC training, with a significantly higher percentage of attendance among those working at COVID-19 isolation hospitals (51.7%, $P = 0.034$) and those working at ICUs (53.8%, $P = 0.012$). In Saudi Arabia, higher percentage of HCWs had attended IPC training (66.5%) (24).

Although it was not statistically significant, more than half of HCWs (56.4%) were satisfied with IPC practices, with the highest percentage among those working at COVID-19 isolation hospitals (59.6%). A comparable percentage (62.6%) was reported by Galal et al. (9) at Cairo University Children's Hospital. A higher satisfaction level among medical and paramedical staff (87.5 and 91.7%, respectively) was reported at Suez Canal University hospitals (43). A lower percentage (39.4%) was reported at Zagazig University (14).

Subjective assessment of some variables such as satisfaction with the implementation of IPC measures was one of the main limitations of the present study. Another limitation was that the number of physicians was more than that of nurses and other HCWs and did not reflect the actual distribution of HCWs. This study had a unique point as it described the self-reported adherence of HCWs to IPC practices during their social life and at work.

In conclusion, the majority of HCWs reported that adequate IPC measures were implemented at their hospitals. The self-reported adherence to certain practices such as wearing face masks and handwashing was described. Practicing social distancing might be hindered by the overcrowded nature of different Egyptian governorates. Revision of the educational programs for proper hand hygiene should be further implemented.

Conflict of interest and funding

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References

1. Piper K. Here's how Covid-19 ranks among the worst plagues in history. 2021. Available from: https://www.vox.com/future-perfect/21539483/covid-19-black-death-plagues-in-history [cited 8 September 2021].
2. Nguyen LH, Drew DA, Graham MS, Guo CG, Ma W, Mehta RS, et al. Risk of COVID-19 among frontline healthcare workers and the general community: a prospective cohort study. Lancet Public Health 2020; 5: E475–83. doi: 10.1101/2020.04.29.20084111
3. World Health Organization. Health workers: A global profile. 2020. Available from: https://apps.who.int/iris/bitstream/handle/10665/250368/9789241511131-eng.pdf [cited 30 September 2021].
4. World Health Organization. The impact of COVID-19 on health and care workers: a closer look at deaths. World Health Organization; 2021. Available from: https://apps.who.int/iris/handle/10665/345300. License: CC BY-NC-SA 3.0 IGO [cited 15 October 2021].
5. World Health Organization. Infection prevention and control during health care when coronavirus disease (COVID-19) is suspected or confirmed. 2021. Available from: https://apps.who.int/iris/rest/bitstreams/1356030/retrieve [cited 15 October 2021].
6. World Health Organization. Risk assessment and management of exposure of healthcare workers in the context of COVID-19. 2020. Available from: https://apps.who.int/iris/handle/10665/331496 [cited 30 August 2021].
7. Ehrlich H, McKenney M, Elkbuli A. Protecting our healthcare workers during the COVID-19 pandemic. Am J Emerg Med 2020; 38: 1527–8. doi: 10.1016/j.ajem.2020.04.024
8. Mohammed G, Hassan A, Abo Elmagd N, Gamal N, Mohammed Saleh Z, Khalil S. COVID-19: Knowledge, perception and infection control practice of health care workers (A suggested ward-based educational package). Assiut Sci Nur J 2020; 8(22): 175–87. doi: 10.21608/asnj.2020.39657.1035
9. Galal YS, Abuelhamd WA, Hamid TAA, Elsayed NR. Coronavirus disease 2019: Knowledge, attitude, practice, and perceived barriers among health care workers at Cairo University Children Hospital, Egypt. Maced J Med Sci 2021; 9(E): 80–8. Available from: https://oamjms.eu/index.php/mjms/article/view/5703
10. El-Ghitany EM, Farghaly AG, Farag S, Hashish MH, Charl F, Omran EA. Prevalence of severe acute respiratory syndrome coronavirus 2 spike antibodies in some healthcare settings in Egypt. J Egypt Public Health Assoc 2022; 97(1): 11. doi: 10.1186/s42506-022-00106-4
11. World Health Organization. Roadmap to improve and ensure good indoor ventilation in the context of COVID-19. 2021. Available from: https://www.who.int/publications/i/item/9789240021280 [cited 8 September 2021].
12. Bandyopadhyay S, Baticulon RE, Kadhum M, Alser M, Ojuka DK, Badereddin Y, et al. Infection and mortality of healthcare workers worldwide from COVID-19: a systematic review. BMJ Glob Health 2020; 5(12): e003097. doi: 10.1136/bmjgh-2020-003097
13. Daily News. 30% of COVID-19 related deaths among healthcare workers were women: Planning Minister. 2021. Available from: https://dailynewsegypt.com/2021/03/21/30-of-covid-19-related-deaths-among-healthcare-workers-were-women-planning-minister/ [cited 30 August 2021].
14. Elgibaly O, Daef E, Elghazally SA, Hassan HM, ElsaidTash RM, Bahgat SM, et al. Knowledge, perception, and confidence of healthcare workers about COVID-19 preventive measures during the first wave of the pandemic: a cross-sectional study from Egypt. Germs 2021; 11(2): 179–88. doi: 10.18683/germs.2021.1255
15. World Health Organization. Infection prevention and control guidance for long-term care facilities in the context of COVID-19: Interim guidance. License: CC BY-NC-SA 3.0 IGO. World Health Organization; 2020. Available from: https://apps.who.int/iris/handle/10665/331508 [cited 30 August 2021].
16. Deif I. Guide to COVID-19 vaccination in Egypt: What we need to know. 2021. Available from: https://english.ahram.org.eg/News/402519.aspx [cited 23 August 2021].
17. Sridhar MR, Boopathi S, Lodha R, Kabra SK. Standard precautions and post-exposure prophylaxis for prevention of infection. Indian J Paediatr 2004; 71: 617–25. doi: 10.1007/BF02724121
18. Abdel-Salam W. Ministry of Health launches the 'Egypt's Health' application for inquiries and advice about Corona. Youm7; 2020. Available from: https://www.youm7.com/story/2020/4/14/ [cited 30 September 2021].
19. El-Sheikh S. Daily news Egypt: what has happened in Egypt since discovering 1st COVID-19 case? Egypt has taken several measures on economic, medical, social, educational levels. 2020. Available from: https://wwww.dailynewssegypt.com/2020/03/24/what-has-happened-in-egypt-since-discovering-1st-covid-19-case [cited 30 August 2021].
20. Centers for Disease Control and Prevention. Clean hands count for safe healthcare. 2020. Available from: https://www.cdc.gov/patientsafety/features/clean-hands-count.html [cited 30 August 2021]
21. Albeladi FI, Alluli MM, Daghriri KA, Almalki YH, Wafi MY, Otaif FA, et al. Level of self-reported adherence to COVID-19 preventive measures among health care workers in Saudi Arabia. Cureus 2021; 13(6): e15969. doi: 10.7759/cureus.15969
22. Engdaw GT, Gebrehiwot M, Andualem Z. Hand hygiene compliance and associated factors among health care providers in Central Gondar zone public primary hospitals, Northwest Ethiopia. Antimicrob Resist Infect Control 2019; 8: 190. doi: 10.1186/s13756-019-0634-z
23. Papagiannis D, Malli F, Raptis DG, Papathanasiou IV, Fradelos EC, Daniil Z, et al. Assessment of knowledge, attitudes, and practices towards new coronavirus (SARS-CoV-2) of health care professionals in Greece before the outbreak period. Int J Environ Res Public Health 2020; 17(14): 4925. doi: 10.3390/ijerph17144925
24. Almohammed OA, Aldwihi LA, Alragas AM, Almoteer AI, Gopalakrishnan S, Alqahtani NM. Knowledge, attitude, and practices associated with COVID-19 among healthcare workers in hospitals: A cross-sectional study in Saudi Arabia. Front Public Health 2021; 9: 643053. doi: 10.3389/fpubh.2021.643053
25. Al Mutairi SM, Alotaibi A, Kofi M, Alsuraimi A, Bawazir A. To what extent the hand hygiene among health care workers become the core of best practice in the COVID-19 era? Int Arch Nurs Health Care 2020; 6: 144. doi: 10.23937/2469-5823/1510144
26. World Health Organization. Mask use in the context of COVID-19: Interim guidance. World Health Organization; 2020. Available from: https://apps.who.int/iris/handle/10665/337199. License: CC BY-NC-SA 3.0 IGO [cited 30 September 2021].

27. Chughtai AA, Seale H, Dung TC, Hayen A, Rahman B, Raina MacIntyre C. Compliance with the use of medical and cloth masks among healthcare workers in Vietnam. Ann Occup Hyg 2016; 60(5): 619–30. doi: 10.1093/annhyg/mew008
28. World Health Organization. COVID-19: Occupational health and safety for health workers: interim guidance. 2021. Available from: https://www.who.int/publications/i/item/WHO-2019-nCoV-HCW_advice-2021-1 [cited 30 September 2021].
29. Azene ZN, Merid MW, Muluneh AG, Geberu DM, Kassa GM, Yenit MK, et al. Correction: Self-reported adherence towards COVID-19 mitigation measures and its associated factors among Gondar City residents: A community-based cross-sectional study in Northwest Ethiopia. PLoS One 2021; 16(8): e0256954. doi: 10.1371/journal.pone.0256954
30. Al-Mohrej OA, Al-Shirian SD, Al-Otaibi SK, Tamim HM, Masuadi EM, Fakhoury HM. Is the Saudi public aware of Middle East respiratory syndrome? J Infect Public Health 2016; 9: 259–66. doi: 10.1016/j.jiph.2015.10.003
31. Nivette A, Ribeaud D, Murray AL, Steinhoff A, Bechtiger L, Hepp U, et al. Non-compliance with COVID-19-related public health measures among young adults: Insights from a longitudinal cohort study. Soc Sci Med 2021; 268: 113370. doi: 10.1016/j.socscimed.2020.113370
32. Solomou I, Constantinidou F. Prevalence and predictors of anxiety and depression symptoms during the COVID-19 pandemic and compliance with precautionary measures: Age and sex matter. Int J Env Res Publ Health 2020; 17(14): 4924. doi: 10.3390/ijerph17144924
33. van Rooij B, de Bruijn AL, Reinders Folmer C, Kooistra E, Kuiper ME, Brownlee M, et al. Compliance with COVID-19 mitigation measures in the United States (April 22, 2020). Amsterdam Law School Research Paper No. 2020-21, General Subseries Research Paper No. 2020-03, UC Irvine School of Law Research Paper No. 2020-33. Available from SSRN: https://ssrn.com/abstract=3582626.
34. Al-Hanawi MK, Angawi K, Alshareef N, Qattan AMN, Helmy HZ, Abudawood Y, et al. Knowledge, attitude and practice toward COVID-19 among the public in the Kingdom of Saudi Arabia: A cross-sectional study. Front Public Health 2020; 8: 217. doi: 10.3389/fpubh.2020.00217
35. Centers for Disease Control and Prevention. Strategies for optimizing the supply of isolation gowns. 2021. Available from: https://www.cdc.gov/coronavirus/2019-ncov/hcp/ppe-strategy/isolation-gowns.html [cited 20 October 2021].
36. Wilder-Smith A, Freedman DO. Isolation, quarantine, social distancing and community containment: pivotal role for old-style public health measures in the novel coronavirus (2019-nCoV) outbreak. J Travel Med 2020; 27(2): taaa020. doi: 10.1093/jtm/taaa020
37. Shah SU, Xiu Ling Loo E, En Chua C, Sen Kew G, Demutska A, Quek S, et al. Association between well-being and compliance with COVID-19 preventive measures by healthcare professionals: A cross-sectional study. PLoS One 2021; 16(6): e0252835. doi: 10.1371/journal.pone.0252835
38. United Nations International Children's Emergency Fund. UNICEF provides essential medical supplies to healthcare workers during COVID-19 pandemic and secures support to vulnerable children. 2020. Available from: https://www.unicef.org/egypt/press-releases/unicef-provides-essential-medical-supplies-healthcare-workers-during-covid-19 [cited 30 August 2021].
39. Neuwirth MM, Mattner F, Otchwemah R. Self-reported adherence to personal protective equipment use among healthcare workers caring for confirmed COVID-19 and alleged non-COVID-19 patients. Antimicrob Resist Infect Control 2020; 9(1): 199. doi: 10.1186/s13756-020-00864-w
40. Sundaram RO, Parkinson RW. Universal precaution compliance by orthopaedic trauma team members in a major trauma resuscitation scenario. Ann R Coll Surg Engl 2007; 89(3): 262–7. doi: 10.1308/003588407X168370
41. Ragusa R, Marranzano M, Lombardo A, Quattrocchi R, Bellia MA, Lupo L. Has the COVID 19 virus changed self-reported adherence to hand washing among healthcare workers? Behav Sci 2021; 11(4): 53. doi: 10.3390/bs11040053
42. McGaw CD, Tennant I, Harding HE, Cawich SO, Crandon W, Walters CA. Healthcare workers' attitudes to and compliance with infection control guidelines in the operating department at the university hospital of the West Indies, Jamaica. Int J Infect Control 2012; 8(3): 1–9. doi: 10.3396/ijic.v8i3.10411
43. Elbqry M, Elmansy F, Elsayed A, Mansour B, Tantawy A, Bahi El Din M, et al. Effect of COVID-19 stressors on healthcare workers' performance and attitude at Suez Canal university hospitals. Middle East Curr Psychiatry 2021; 28(1): 4. doi: 10.1186/s43045-021-00084-x

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