Perception of Risk and Compliance With COVID-19 Safety Guidelines: A Cross-Sectional Survey Among Healthcare Workers in Ghana

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ABSTRACT: Although healthcare professionals are on the "frontline" of providing effective and quality healthcare delivery, they face several occupational risks when giving care, particularly during a global health crisis. This study examines healthcare workers' compliance with COVID-19 safety protocols and identifies factors associated with their perceived risk of COVID-19. Between October and December 2020, this cross-sectional survey utilized online and paper-type questionnaires in data collection. Non-probability sampling techniques were used in selecting clinical and non-clinical healthcare workers in various health facilities within 4 regions of Ghana. Logistic regression analysis was performed to identify the factors associated with the perceived risk of COVID-19. The results showed that healthcare workers are highly compliant with hand hygiene practices and wearing PPE. The category of health professional, number of working years, type of health facility, region of work, frequency of COVID-19 test, and compliance with hand hygiene practices were significantly associated with healthcare workers' perception of risk of COVID-19 at $P < .05$. Findings suggest that both individual and health system factors are significant in increasing the risk of COVID-19 among healthcare workers. Efforts at enforcing strict compliance with infection prevention should be implemented to protect all healthcare personnel.

KEYWORDS: COVID-19, healthcare workers, Ghana, perceived risk, compliance

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Background

Since the declaration of COVID-19 as a pandemic in March 2020 by the World Health Organization (WHO),[1] strict compliance to infection prevention and control (IPC) practices have been accentuated in all countries. In response to combating the transmission of the coronavirus among health workers, several IPC measures targeted at eliminating or minimizing the spread of the virus were recommended by the WHO. IPC is an essential component of the healthcare infrastructure that is concerned with preventing healthcare associated infection.[2] The guidelines associated with healthcare for suspected COVID-19 include ensuring triage; early recognition and source control; application of standard precautions for all patients; contact and droplet precautions; airborne precautions for aerosol-generating procedures; implementing administrative controls and using environment and engineering controls.[1] These safety precautions are protective only if they are strictly complied with.

Healthcare workers (HCWs) are at the frontline of the COVID-19 pandemic[1] because of their direct and indirect contact with both infected and asymptomatic clients in the hospital environment. Compared to non-healthcare workers, health professionals have the highest occupational hazards, risks, and exposure to contracting the coronavirus.[3,4] The incidence of HCWs contracting coronavirus has been reported in different settings.[5-9] Recent estimates provided by the Centers for Disease Control (CDC) as of April 5, 2023 indicate that approximately 1 140 052 HCWs in the United States have been infected with COVID-19 with 2475 deaths.[6] Gómez-Ochoa et al[5] in their systematic review and meta-analysis of the prevalence of COVID-19 among HCWs found the estimated prevalence of SARS-COV-2 infection to be 11% from samples of HCWs with nurses being the most populous group of HCWs infected.

In Ghana, recent estimates by the Ghana Health Service (GHS) indicate a low infection rate of COVID-19 among HCWs than the population.[10] For instance, as of 12th April 2023, the incidence of COVID-19 cases in the population was 171 527 with 1462 deaths. The Ghana Medical Association (GMA) and other health workers' associations projected approximately 779 health workers to have contracted COVID-19 as of 30th June 2020 with 9 deaths.[11] Of this number, 190 were doctors, 410 were nurses and midwives, 156 comprised of different categories of health workers, and 23 pharmacists. As of 28th February 2021, this figure had increased to 900 infections with less than 50 mortalities.

Several factors account for HCWs inability to fully comply with the COVID-19 safety protocols instituted in health facilities. For instance, a Cochrane review conducted by Houghton et al[12] to explore barriers and facilitators to HCWs adherence with IPC guidelines showed that, minimal support from management, insufficient isolation spaces, lack of quality and

adequate personal protective equipment (PPE), and fear of patients being stigmatized when PPE were used accounted for difficulties in compliance to IPC guidelines. In Ghana, the GMA reports that inadequate and erratic supply of PPE to HCWs both in quantity and quality, laxity in adherence to IPC guidelines, delay in COVID-19 tests and results, and inadequate contact tracing within facilities account for the high infection rate among health workers.[11] Evidently, these conditions increase HCWs exposure and risk of COVID-19.

Recent empirical evidence on compliance with COVID-19 IPC among HCWs have been investigated.[12-15] Other studies have also identified factors associated with preventive and adherence to IPC measures among HCWs.[6,16] For example, Agarwal et al[13] evaluated HCWs preventive practices during the coronavirus pandemic in India and found that age, gender, and occupational roles of HCWs were associated with the extent of adherence to IPC practices. Female HCWs above 31 years, nurses, and senior doctors were more compliant to COVID-19 preventive behaviors compared to other categories of health workers. Similar results have been reported in other studies.[17,18] Ashinyo et al[19] reported high compliance with hand hygiene, PPE use, and performance of aerosol generating procedures among health personnel at COVID-19 treatment centers in Ghana. However, lower compliance was found among non-clinical workers, HCWs who had inadequate PPEs, staff who had ever married, and pharmacists. Additionally, Ranjan et al[15] found that resident doctors were at a lower risk of COVID-19 compared to the other HCWs.

Several recent studies have investigated HCWs compliance with IPC[12-15] in varying contexts, while other studies have specifically examined the association between compliance to infection prevention practices and COVID-19.[20-24] However, a dearth of evidence exists with specific reference to Ghana and other Sub-Saharan African countries with respect to the general health sector workforce and their attitudes, perceived risks and related compliance to IPCs.[19,24] Further, few studies[21,23] have focused on nurses; the links between training on the use of PPE and COVID-19 infection and access to adequate PPE and IPC at the expense of the broader determinants of health worker perceptions of risk and general utilization of IPC. Thus, this study is timely and relevant particularly, in identifying and highlighting the plausible factors that significantly expose Ghanaian HCWs to becoming infected during a public health emergency. Further, our research builds on recently published studies of compliance to COVID-19 IPC practices among both clinical and non-clinical healthcare workers by investigating perceptions of their risk of COVID-19 in relation to compliance with IP protocols and practices. For this study, we examine 4 main infection prevention (IP) practices: hand hygiene, wearing of PPE, maintaining social distance, and disinfecting shared objects. We hypothesize that HCWs who always comply with these 4 IP practices are less likely to perceive themselves at risk of COVID-19 compared to those HCWs who are not compliant with these practices.

Methods

This cross-sectional survey was conducted between October and December 2020. Both web and paper-based questionnaires were used to obtain data from HCWs in government, private, quasi-government, and Christian Health Association of Ghana (CHAG) health facilities located in 4 regions of Ghana. The online survey via Google forms provided a convenient approach to obtain data from a cross-section of health personnel while minimizing face-to-face contacts. This data collection strategy was used in similar situations elsewhere.[25] The online questionnaire had specific initial instructions to guide and inform potential respondents regarding the honesty of responses, confidentiality, anonymity, voluntary participation, duration of completing questionnaire, and one-time submission of a completed questionnaire. Initially, the Google form was restricted to one response (respondents' email addresses) to reduce multiple responses. However, this restriction was removed following pre-test due to complaints of difficulties with non-functioning emails (including forgotten passwords, creating new email addresses) and the long procedure in navigating the questionnaire amidst limited time schedules. Paper-type questionnaires supplemented the online survey and were self-administered to study participants who could not access the online survey due to phone and technological barriers. Also, using the paper-type questionnaires facilitated ease of recruiting other categories of clinical and non-clinical staff whose nature and schedule of work presented challenges in participating in the study.

Four regions (Greater Accra, Ashanti, Central, and Western) were purposively selected because they were the epicenters with the highest incidence of the coronavirus infections at the time of the study. For instance, as of 8th April 2021, Greater Accra Region (GAR) had recorded 50 241 cases; Ashanti 15 379; Western 5717 and Central 3294.[26]

Eligible respondents included both clinical and non-clinical HCWs recruited from different health facilities in the country. Clinical staff should be providing direct patient care in any department/unit of the hospital such as physicians, general registered nurses, midwives, pharmacists, laboratory technologists, nurse aides or health assistants, and sonographers. On the other hand, non-clinical staff were personnel who did not directly provide patient care, but whose support services with other personnel and clients in the facility expose them to COVID-19, example, administrative support staff, laundry workers, and cleaners. At the time of the study, they should not have been infected with COVID-19 (inclusion criteria). To ensure that eligible respondents participated in the study, all 4 researchers sought approval from the heads of the participating facilities, virtually (phone calls, email, referral from colleagues) and in-person to request for the contact details of the heads of the units/departments in the facilities. The respective heads of these units/departments were invited by the researchers to contact, remind, and share the links to the Google form with both clinical and non-clinical staffs who met the inclusion criteria.

Also, we administered the paper-type questionnaires directly to eligible participants after permission from the heads of the facility and informed consent from the study respondents. This approach allowed verification, double checking, and completeness of the completed questionnaires before leaving the facility after questionnaire administration. Most questionnaires were self-administered while few respondents were guided to complete them.

The sample size was calculated using Cochran's formula $N = z^2 \times p(1-p)/d^2$ assuming a response rate of 50%, 95% confidence interval (CI), z of 1.96, and 5% margin of error. A further 10% was added to counteract any errors in completing the questionnaires, resulting in a final estimated sample size of 414.

Non-probability sampling techniques were used to recruit potential participants—purposive, convenience, and "chain referral" techniques. The aim was to complement and facilitate ease of access to data collection. For instance, the "chain referral" sampling strategy was purposed at reaching several other HCWs indirectly in the specified regions through peer and social networks, and groups. We anticipated that given the double burden of work (including shift system schedules) at this time, they may not be easily accessible to participate in the study, hence, these multiple sampling procedures.

We designed and pre-tested the questionnaire to correct any ambiguity in the wording of responses and to ensure that the items correctly measured the specific variables of interest. The questionnaire was in English and included questions on HCWs' background characteristics, and compliance with IPC practices which included: hand hygiene, PPE use (face masks), social distancing, and disinfection practices at the workplace. These 4 main IPC practices are the most basic yet importantly observed IPC measures observed by all categories of health workers in health facilities globally. The questionnaire comprised of 19 items with 2 sections: section A focused on participants background details such as age, sex, marital status, number of living children, highest educational level (completed), religious affiliation, category/type of HCW, number of years since being employed, type of health facility, and region of workplace (Table 1). Section B consisted of 8 items on compliance with hand hygiene practices, wearing of PPE (face masks), social distancing, and disinfection practices at the workplace (Table 2). The internal consistency with Cronbach's alpha coefficient on the 8-item compliance measures was .80.

This study is part of a larger study on HCWs knowledge, attitude, and perceived vulnerability to COVID-19 and the likelihood of COVID-19. It was approved by the University of Ghana Ethics Committee for the Humanities (ECH016/20-21) and the Ghana Health Service Ethics Review Committee (GHS-ERC 012/08/20). All ethical principles and considerations in the study were in accordance with the Declaration of Helsinki. Written informed consent was obtained from all the study participants prior to conducting the study. This study is reported in accordance with the checklist for reporting of survey studies (CROSS) guideline.[27]

Measures

Dependent and independent variable

The outcome variable was perceived risk of COVID-19. It was measured as a dichotomous variable: 1 = *Yes*, and 0 = *No*. The explanatory or predictor variables were the level of compliance constructs assessed by 8 items. These items focused on hand hygiene, wearing of face masks, social distancing, and disinfection practices. These items were assessed on a 3-point scale from *Not compliant at all = 0, Sometimes compliant = 1, and Always compliant = 2*. The control variables were age, sex, marital status, highest educational level, religious affiliation, category/type of HCW, number of years since being employed, type of health facility, and region of workplace. Questions on the frequency of COVID-19 tests, and ever tested for COVID-19 were included.

Analysis strategy

Prior to data analysis, the completed responses in Google forms were downloaded to MS Excel. Here, the questions were recoded into meaningful codes to reflect the variables of interest. Incomplete responses and missing information were deleted. These were then exported to STATA version 15 for further data cleaning and analysis. The data was checked for duplicate responses and further recoding and merging of variables were done. Data analysis involved univariate, bivariate, and multivariate analysis. Univariate analysis included simple descriptive statistics using frequencies to describe respondents background characteristics. Bivariate analysis was performed with chi-square tests to determine the association between the independent and dependent variables. Binary logistic regression analysis was performed to identify the factors associated with perceived risk of COVID-19 and to examine the effect of all the study variables on HCWs perceived risk of COVID-19. All analysis were performed in STATA version 15.

Results

Sample characteristics

Table 1 presents respondents characteristics. Of the 513 questionnaires that were distributed, a total of 497 health workers participated in the survey indicating a high response rate of 97% (the response rate is the ratio of the number of participants in the study to the number of participants who were asked to participate). Fifty-six percent were females, and the mean age was 32.2 years. Nearly half (49%) of the sample were clinical staff—general physicians, nurses, midwives, pharmacists, laboratory technicians and technologists, health assistants, and sonographers. The mean duration of active years spent in employment was 6 years. Of the participants recruited in the study, 60% were currently working in government hospitals compared to other hospitals such as CHAG, private, and quasi-government health facilities (14%, 13%, and 11%) respectively. At the time of the survey, slightly more than half of the sample had tested for

Table 1. Background characteristics of study participants.

VARIABLES	N (%)
Sex	
Female	280 (56.34)
Male	217 (43.66)
Marital status*	
Married	223 (44.87)
Not married (including ever married)	270 (54.33)
Age	
<30	204 (41.05)
30-39	233 (46.88)
40+	60 (12.07)
Number of living children	
0	211 (45.47)
1	65 (14.01)
2	87 (18.75)
3+	101 (21.77)
Religious affiliation*	
Christianity	452 (90.95)
Other	43 (8.65)
Type of HCW	
Clinical staff	244 (49.09)
Non-clinical support staff	253 (50.91)
Highest level of education (completed)	
Pre-tertiary	75 (15.09)
Tertiary	422 (84.91)
Number of years in active service	
Less than 1 y	32 (6.50)
1-3 y	192 (39.02)
4-6 y	89 (18.09)
7+	179 (36.38)
Health facility type	
CHAG	74 (14.89)
Government hospital	300 (60.36)
Private hospital	67 (13.48)
Quasi-governmental hospital	56 (11.27)
Region of workplace	
Ashanti	117 (23.54)
Central	124 (24.95)
Greater Accra	248 (49.90)
Western	8 (1.61)
Ever tested for COVID-19	
No	271 (54.53)
Yes	226 (45.47)
Frequency of COVID-19 test	
Never tested	264 (53.12)
Tested once	134 (26.96)
Tested twice and more	99 (19.92)

*Includes missing numbers.

COVID-19. Figure 1 shows the proportion of respondents who perceived their risk of COVID-19 (outcome variable).

Compliance With COVID-19 IPC Practices

Participants' responses to compliance with infection prevention measures are presented in Table 2. We classified high compliance as 80%, moderate compliance (79%-50%), and low compliance (less than 49%). Overall, HCWs were highly compliant with hand hygiene practices, and use of PPE (wearing face masks) with moderate compliance on social distancing (60%), disinfection practices of shared items (61.97%), and touched surfaces (63.98%).

Results of Bivariate Analysis

We performed bivariate analysis with chi-square tests to identify the factors associated with HCWs perceived risk of COVID-19. Two variables were excluded during the analysis—marital status and religious variables because of missing values. The results in Table 3 showed that age, years in service, category/type of HCW (clinical/non-clinical), region of workplace, ever tested for COVID-19, and frequency of COVID-19 test were significantly associated with HCWs perceived risk of COVID-19 at $P < .05$. For age, 62.2% of those aged 30 to 39 years perceived risk of COVID-19 compared to those below 30 years (48.5%). Sixty-six percent of healthcare workers with 7 and more years in service were more likely to perceive risk of COVID-19 relative to respondents with less than 1 year in service (25%). The study found a statistically significant association between type of health facility and healthcare workers perceived risk of COVID-19. This was 28.6 percentage points higher among those in Quasi-Government facility compared to CHAG facility. While 68.1% of healthcare workers in the Greater Accra region perceived to be at risk of COVID-19, compared to those in Ashanti region, this was 40.2%. A 45.1% of non-clinical staff compared to clinical staff of 66.8% perceived to be at risk of COVID-19. A proportion of 61.9% of respondents ever tested for COVID-19 relative to 50.5% who

Table 2. Compliance to COVID-19 IPC practices.

STATEMENTS	ALWAYS COMPLIANT	SOMETIMES COMPLIANT	NOT COMPLIANT AT ALL
	N (%)	N (%)	N (%)
Frequent handwashing with soap and water after attending to or touching patients/clients at the health facility	412 (82.90)	58 (11.7)	27 (5.43)
Frequent use of alcohol-based hand sanitizer after touching surfaces, shared objects at the health facility	416 (83.70)	57 (11.47)	24 (4.83)
Frequent use of alcohol-based sanitizer after touching or attending to patients/clients at the health facility	399 (80.28)	69 (13.88)	29 (5.84)
Regular use of recommended surgical face mask when interacting with colleagues and patients at the hospital	371 (74.65)	95 (19.11)	31 (6.24)
Regular use of recommended surgical face mask when attending to patients/clients at the health facility	400 (80.48)	73 (14.69)	24 (4.83)
Maintaining safe distance when interacting with others at the hospital	295 (59.36)	169 (34.0)	33 (6.64)
Disinfecting commonly used items (stationery, equipment, etc.) shared with colleagues at the hospital/health facility	308 (61.97)	151 (30.38)	38 (7.65)
Disinfecting shared and commonly used and touched surfaces at the hospital/health facility	318 (63.98)	138 (27.77)	41 (8.25)

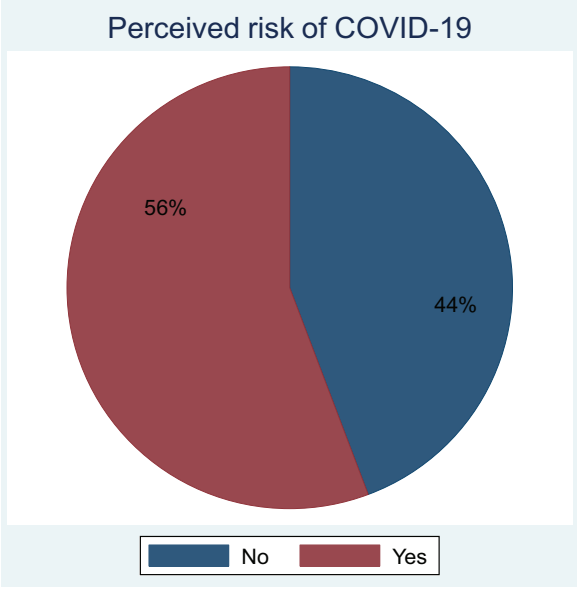

Figure 1. Proportion of respondents who perceived risk of COVID-19. Source: Knowledge, attitude, and perceived risk of COVID-19 study, 2020.

had never tested for COVID-19 perceived to be at risk of coronavirus. The frequency of COVID-19 test taken by health workers was significantly associated with perceived risk of COVID-19. Those who had tested for COVID-19 once were 18.7 percentage points less than their counterparts who had tested more than twice for COVID-19 to perceive risk of COVID-19. However, the IPC practices, respondent's sex, number of children, and educational level were not associated with perceived risk of COVID-19.

Results of Multivariate Analysis

Two multivariate regression models were performed to identify and examine the factors which significantly predict the outcome variable. The results from Model 1 (Table 4) show that, controlling for all socio-demographic variables, there is no statistically significant association between compliance to COVID-19 IPC practices and HCWs perceived risk of COVID-19 at $P < .05$. In Model 2, we included all the study variables in the model.

The results showed that, years in service, category/type of HCW, region of HCWs workplace, type of health facility, and frequency of COVID-19 test were significantly associated with HCWs perceived risk of COVID-19 at $P < .05$. Our results showed that health workers who had spent 7 and more (7+) years since being employed were as 4 times more likely as those who had spent less than a year in service to perceive the risk of COVID-19 (OR = 4.62 95%CI = 1.549-13.802). Compared to clinical workers, non-clinical HCWs perceived a lower risk of COVID-19 (OR = 0.46 95%CI = 0.286-0.734). HCWs working in government hospitals were as likely as HCWs in CHAG health facilities to perceive the risk of infection (OR = 1.97 95%CI = 1.059-3.659). We found that, compared to health workers in the Ashanti region, HCW in the Greater Accra region were 2

Table 3. Distribution of predictor variables and perceived risk of COVID-19.

BACKGROUND CHARACTERISTICS	PERCEIVED RISK OF COVID-19		*P*	X^2
	YES	NO		
Sex				
Male [Ref]	125 (57.60)	92 (42.40)	.460	0.545
Female	152 (54.29)	128 (45.71)		
Age				
<30 [Ref]	99 (48.53)	105 (51.47)	.016**	8.292
30-39	145 (62.23)	88 (37.77)		
40+	33 (55.0)	27 (45.0)		
Number of children				
0 [Ref]	108 (51.18)	103 (48.82)	.288	3.764
1	42 (64.62)	23 (35.38)		
2	48 (55.17)	39 (44.83)		
3+	53 (52.48)	48 (47.52)		
Educational level				
Secondary [Ref]	38 (50.67)	37 (49.33)	.338	0.919
Tertiary	239 (56.64)	183 (43.36)		
Years in service				
Less than 1 y [Ref]	8 (25.00)	24 (75.00)	.000**	22.604
1-3 y	98 (51.04)	94 (48.96)		
4-6 y	52 (58.43)	37 (41.57)		
7+	119 (66.48)	60 (33.52)		
Type of health facility				
CHAG [Ref]	32 (43.24)	42 (56.76)	.016**	10.286
Government	168 (56.0)	132 (44.0)		
Private	37 (55.22)	30 (44.78)		
Quasi-government	40 (71.43)	16 (28.57)		
Region of workplace				
Ashanti [Ref]	47 (40.17)	70 (59.83)	.000**	31.822
Central	61 (46.21)	71 (53.79)		
Greater Accra	169 (68.15)	79 (31.85)		
Type/category of HCW				
Clinical staff [Ref]	163 (66.80)	81 (33.20)	.000**	23.804
Non-clinical staff	114 (45.06)	139 (54.94)		
Ever tested for COVID-19				
Yes [Ref]	140 (61.95)	86 (38.05)	.011**	6.484
No	137 (50.55)	134 (49.45)		

(Continued)

Table 3. (Continued)

BACKGROUND CHARACTERISTICS	PERCEIVED RISK OF COVID-19		*P*	X^2
	YES	NO		
Frequency of COVID-19 test				
Twice and more [Ref]	71 (71.72)	28 (28.28)	.002**	12.923
Never	135 (51.14)	129 (48.86)		
Once	71 (52.99)	63 (47.01)		
IPC practices				
Hand hygiene				
Always compliant [Ref]	206 (58.52)	146 (41.48)	.144	3.8714
Sometimes compliant	38 (50.0)	38 (50.0)		
Not compliant at all	33 (47.83)	36 (52.17)		
Wearing face masks				
Always compliant [Ref]	198 (56.73)	151 (43.27)	.789	0.474
Sometimes compliant	40 (53.33)	35 (46.67)		
Not compliant at all	39 (53.42)	34 (46.58)		
Maintenance of social distance				
Always compliant [Ref]	173 (58.64)	122 (41.36)	.088*	4.8513
Sometimes compliant	83 (49.11)	86 (50.89)		
Not compliant at all	21 (63.64)	12 (36.36)		
Disinfection				
Always compliant [Ref]	160 (56.54)	123 (43.46)	.635	0.910
Sometimes compliant	87 (56.49)	67 (43.51)		
Not compliant at all	30 (50.0)	30 (50.0)		

**$P < .05$. *$P < .10$.

times more likely to perceive that they could become infected with COVID-19 (OR = 2.05 95%CI = 1.102-3.839). There was a strong association between the frequency of COVID-19 test and HCWs perceived risk of COVID-19 at $P < .05$. HCWs who had tested once for COVID-19 perceived themselves as having a lower risk of becoming infected compared to HCWs who had tested twice and more (OR = 0.49 95%CI = 0.262-0.942).

Regarding compliance with COVID-19 safety guidelines, only hand hygiene practices significantly predicted HCWs perceived risk of COVID-19 at $P < .05$. The results showed that, HCWs who *sometimes complied* with hand hygiene practices as well as those who were *not compliant at all* with hand hygiene practices had lower odds of perceiving infection with COVID-19 compared to those HCWs who always adhered to hand hygiene practices (OR = 0.39 95%CI = 0.184-0.830; OR = 0.47 95%CI = 0.245-0.892). Wearing PPE, maintaining social distance, and disinfection practices were not statistically significant at $P < .05$. This result suggests that our hypotheses were not supported.

Discussion

The study found that HCWs were highly compliant with hand hygiene practices and wearing face masks during patient care at the health facility. We find that these findings echo similar results in recent studies[19,13] although contrary results were reported elsewhere.[14] This suggests that health workers probably prioritize these infection preventive (IP) measures as more effective in minimizing the transmission of the coronavirus; hence, the high adherence practices. Also, health workers may find it relatively easy to observe hand hygiene practices and wearing face masks than disinfecting frequently shared items and maintaining social distance. Adherence to infection prevention is critical since suboptimal IPC measures have been found to be risk factors of COVID-19[6,16] and which could lead to hospital acquired infections. On the other hand, health

Table 4. Association between explanatory variables and perceived risk of COVID-19.

SOCIO-DEMOGRAPHIC FACTORS	MODEL 1 IPC PRACTICES		MODEL 2 ALL VARIABLES	
	OR	95%CI	OR	95%CI
Sex	—	—		
Male [Ref]	—	—	1.00	
Female	—	—	1.41	0.911-2.195
Age	—	—		
<30 [Ref]	—	—	1.00	
30-39	—	—	1.17	0.645-2.119
40+	—	—	0.61	0.243-1.534
Years in service	—	—		
Less than 1 y [Ref]	—	—	1.00	
1-3 y	—	—	2.20*	0.887-5.474
4-6 y	—	—	1.90	0.662-5.445
7+	—	—	4.62**	1.549-13.802
Educational level	—	—		
Secondary [Ref]	—	—	1.00	
Tertiary	—	—	0.91	0.487-1.709
Type of health facility	—	—		
CHAG [Ref]	—	—	1.00	
Government	—	—	1.97**	1.059-3.659
Private	—	—	1.94	0.831-4.538
Quasi-government	—	—	2.08*	0.873-4.979
Region of workplace	—	—		
Ashanti [Ref]	—	—	1.00	
Central	—	—	1.11	0.580-2.145
Greater Accra	—	—	2.05**	1.102-3.839
Type/category of HCW	—	—		
Clinical [Ref]	—	—	1.00	
Non-clinical	—	—	0.46**	0.286-0.734
Ever tested for COVID-19	—	—		
Yes [Ref]	—	—	1.00	
No	—	—	2.53	0.612-10.445
Frequency of COVID-19 test	—	—		
Twice and more [Ref]	—	—	1.00	
Never	—	—	1.16	0.267-5.038
Once	—	—	0.49**	0.262-0.942

(Continued)

Table 4. (Continued)

SOCIO-DEMOGRAPHIC FACTORS	MODEL 1 IPC PRACTICES		MODEL 2 ALL VARIABLES	
	OR	95%CI	OR	95%CI
IPC practices				
Hand hygiene				
Always compliant [Ref]	1.00		1.00	
Sometimes compliant	0.57*	0.301-1.082	0.39**	0.184-0.830
Not compliant at all	0.61*	0.349-1.076	0.47**	0.245-0.892
Wearing of PPE				
Always compliant [Ref]	1.00		1.00	
Sometimes compliant	1.00	0.535-1.881	0.82	0.399-1.694
Not compliant at all	0.99	0.488-2.030	0.76	0.340-1.713
Maintenance of social distance				
Always compliant [Ref]	1.00		1.00	
Sometimes compliant	0.67*	0.433-1.033	0.62*	0.370-1.024
Not compliant at all	1.38	0.561-3.384	1.15	0.429-3.091
Disinfection practices				
Always compliant [Ref]	1.00		1.00	
Sometimes compliant	0.70	0.376-1.325	0.55*	0.302-1.006
Not compliant at all	0.70	0.415-1.175	0.68	0.326-1.421

$R^2 = .1434$, $X^2 = 90.69$, N = 459; Outcome variable: No (Ref), Yes (1).
$^{**}P < .05$. $^{*}P < .10$.

system factors, behavioral characteristics, and availability of PPE could account for health workers' moderate adherence with social distancing and disinfection practices at the hospital such as difficulty in providing care while socially distanced, limited, or insufficient space within the ward.

Our results also showed that HCWs working in the Greater Accra Region (GAR) perceived a greater risk of becoming infected compared with other healthcare workers in the Ashanti and Central regions. Several explanations can be adduced for this finding. First, GAR is the epicenter of COVID-19 with the highest prevalence of COVID-19 infections in the country as of 19th April 2021.[10] Second, the health worker population distribution in the country is skewed to the GAR with a high proportion of health professionals (both clinical and non-clinical) working in the GAR.[28] Third, most public health facilities are concentrated in the GAR and Ashanti regions than the other regions in the country as well as other private, and faith-based hospitals. Thus, government hospitals record a high attendance of the insured and non-insured population for a wide range of health care services. Essentially, for HCWs working in the GAR of Ghana, all these myriad factors underscore their constant exposure to the risks of contracting COVID-19 since they more often provide health care for many possibly infected clients daily.

There was a strong association between the type of HCW and perceived risk of COVID-19. Compared to non-clinical staff, clinical HCWs were more likely to perceive the risk of becoming infected. During patient care, direct exposure to infected patients are unavoidable; except when strict observance to infection prevention is adhered to minimize the exposure and transmission of the virus. Clinical health professionals are directly involved in providing care to patients daily and this places them at the "front line" of contracting any type of infection when appropriate patient care procedures are not adhered to. As reported in other contexts, physicians, and nurses are characterized as having critical and essential roles in healthcare delivery, thus making them frontline staff.[1] Since the first cases of COVID-19 was recorded in Ghana, there has been no clear consensus on who a frontline HCW is despite the pre-existing roles and contributions played by all health workers in the country's health sector in mitigating the effects of the pandemic.

Health workers working in government health facilities perceived a higher likelihood of becoming infected compared to those working in CHAG and quasi-government hospitals. Availability of specialized services, geographical access, and cost (affordability) influence clients' choice of health facility. Since the pandemic, selected government-owned health facilities were designated for COVID-19 testing, treatment,

isolation, and management of cases. This could probably have given health workers a false sense of protection against becoming infected. But, inadequate supply and unavailability of PPE were reported in such facilities, increasing HCWs susceptibility to contracting the virus from symptomatic and asymptomatic individuals visiting such hospitals.

Furthermore, there was a significant relationship between compliance with hand hygiene practices and perceived risk of COVID-19. HCWs who were sometimes compliant and not compliant at all with hand hygiene practices were less likely to perceive a risk of becoming infected compared to those HCWs who were always compliant with hand hygiene practices. While this finding was not expected, it is supported by other studies which found HCWs practicing suboptimal handwashing practices, improper use, and reuse of PPE, and working in high-risk department as critical risk factors for infection.[6,19] Considering the 4 aspects of IPC measures examined in our study, the results suggests that adherence to hand hygiene practices alone is not a sufficiently protective measure against transmission of COVID-19. It is possible that health workers who always adhered to hand hygiene practices did so because of the nature of their work (for instance, being in a high-risk department, continuous exposure to patients) and which they felt increased their susceptibility to getting infected. Also, multiple factors could have mitigated against adherence to hand hygiene preventive practices such as fatigue, forgetfulness, apathy, negligence, and inadequate logistics (including PPE) as has been reported in studies elsewhere.[12,13]

Our study has a few limitations. First, like other studies which employed online-based data collection procedures, and given the non-probability sampling techniques, generalizations of the findings are limited. Second, due to statistical reasons, few potentially mediating variables were excluded during the statistical modeling such as HCWs knowledge of COVID-19 transmission, symptoms of COVID-19, average number of patients attended to daily, access to and availability of PPE. Third, the study acknowledges that study participants responses could be socially desirable, and/or misrepresent their actual behavior and IP practices at the health facility. Thus, the social desirability and response bias could potentially influence participants responses due to the approach to data collection.

Conclusions

Poor preventive behaviors and suboptimal compliance to COVID-19 guidelines at the health facility during patient care increases HCWs risk of the coronavirus. The results of our study imply that health system-related factors mostly contribute to influence HCWs risk of COVID-19 compared to individual-level factors. While these risk factors increase health professionals' vulnerability to the coronavirus, effective communicative strategies, management support, training, and behavioral communication change mechanisms are necessary to enforce compliance with COVID-19 protocols. Standard precautions in healthcare are work practices required for basic level IPC and a fundamental concept for the safety of both patients and HCWs in the delivery of care. They are based on the principle that all blood, body fluids, secretions, excretions including sweat, non-intact skin, and mucous membranes may contain transmissible infectious agents. For improved control of COVID-19 as well as other outbreaks, there should be continuous in-service training and IPC skills competence assessments in healthcare settings for both clinical and non-clinical HCWs. Further, more emphasis should be placed on infection prevention in the design and function of health infrastructure to address health system barriers to IP practices. Health facility managers could employ risk stratification measures to effectively inform the management, reporting, and preparedness of COVID-19 interventions to mitigate HCWs occupational risks during public health emergencies.

Future research could qualitatively explore HCWs barriers to non-compliance to COVID-19 safety guidelines. In addition, other researchers could design an experimental study on HCWs who have contracted and recovered from COVID-19 with HCWs who are not infected but perceive the risk of infection and the associated risk factors.

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Author's Contributions

EAK conceptualized the study and DOB, GAA, and NNAA designed the methodology and collected data for the study. EAK and DOB executed the statistical analysis. EAK drafted the manuscript. DOB, GAA, and NNAA reviewed and revised the manuscript. All authors read and approved the final manuscript.

Research Ethics and Patient Consent

The study was approved by the University of Ghana Ethics Committee for the Humanities (ECH016/20-21) and the Ghana Health Service Ethics Review Committee (GHS-ERC 012/08/20). Written informed consent was obtained from all study participants for both the paper-based and online questionnaires.

Availability of Data and Materials

The datasets used and/analyzed during the current study are available from the corresponding author on reasonable request.

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