

Personal protective equipment usage among Iranian police officers during COVID-19 pandemic; a cross-sectional study

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Abstract: **Objective:** Due to the important role of police during COVID-19 pandemics and lack of previous studies on the impact of personal protective equipment (PPE) in reduction of COVID-19 infection among police officers, we aimed to investigate the role of using PPE in prevention of COVID-19 infection among Iranian police personnel. **Methods:** This cross-sectional survey was conducted in Tehran, Iran during January 2021 to November 2022. The study sample consisted of police personnel who were active in field operations. Demographics (age, height, weight, gender, marital status, number of children and underlying diseases) and job characteristics such as frequency and type of operations, involvement of colleagues with COVID-19, and COVID-19 infection history, using PPE, types of used PPE (mask, face shield, gloves, etc), protective strategies (such as social distancing) and COVID-19 vaccination were recorded. Statistical analysis was performed with IBM SPSS Statistics for Windows, version 25.

Results: Totally, 340 participants were analyzed (33.54±9.74 years old, 91.2% males), of whom, 150 participants (44.1%) reported at least one episode of confirmed COVID-19 infection. The most common component of PPE used both during operations and daily life was face mask (44.7% and 75%, respectively). The most popular measure with higher adherence compared to others was social distancing with 70% popularity and an adherence score of 5.85±3.74. Three hundred subjects (88.2%) had received at least one dose of COVID-19 vaccine. Among PPE items, using face mask, washing hands with soap, social distancing and vaccination were significantly different between patients with and without prior COVID-19 infection ($p>0.05$).

Conclusion: The findings showed that use of PPE is significantly efficacious in reduction of COVID-19 infection among police officers. Therefore, despite difficulties of using PPE among police forces, it is strongly recommended for virus spread control in this population.

Keywords: COVID-19; Pandemics; Personal Protective Equipment; Police

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1. Introduction

Since the outbreak of a novel corona virus named as COVID-19 in late December 2019 in China, followed by declaration of pandemic in March 2020 by World Health Organization, world has faced a large-scale human disaster (1, 2). Due to the severity of the condition, high prevalence of the infection, rapid transmission of the virus and its routes and remarkable mortality rates, governments were forced to impose strict quarantine and lockdown regulations to control the spread (3-6).

Social distancing and home stay policies have been the cornerstone of the protective orders around the world but adherence to these rules is not feasible for all the people. Police officers not only could not work in social distancing conditions but also had to remain on duty as the essential service providers in the pandemic (7, 8). In addition to their usual tasks and duties, role of police in the implementa-

tion of COVID-19 spread control rules such as lockdown and quarantine was imperative (9). Their participation in COVID-19 management strategies and close contact with people regardless of COVID-19 infection status in the daily encounters of the police officers' job has led to classification of police as a high-risk group for COVID-19 infection (5, 7, 9). Many reports have been published regarding the COVID-19 infection or mortality in police forces across different regions of the world (10-13).

As stated, role of police has changed since the beginning of COVID-19 pandemic. This change necessitates the use of personal protective equipment (PPE) (including gloves, face shield, glasses, face mask, etc) by the police to mitigate the risk of infection and its related morbidities and mortality. Strict adherence to PPE usage causes difficulties in routine police activities and causes interference with active duties of a police officer (7, 11). In addition, despite effectiveness of PPE has been proved in reduction of COVID-19 infection

rates in groups such as healthcare providers (14-16), efficacy of PPE in reduction of COVID-19 infection has not previously been evidenced among police officers. Thus, due to importance of preserving police personnel's health during pandemic for providing better essential social services and lack of previous publications on the rate of adherence to PPE and its impact on COVID-19 infection rates in police officers, we aimed to investigate the role of using PPE in prevention of COVID-19 infection among Iranian police personnel.

2. Methods

2.1. Study design and setting

This cross-sectional study was conducted in Tehran, Iran during January 2021 to November 2022. This study was approved by the ethics committee of Baqiyatallah University of Medical Sciences (IR.BMSU.REC.1401.048). All methods were performed in accordance with the ethical principles for medical research involving human subjects. Informed consent was obtained from all the subjects.

2.2. Study population

The study sample consisted of police personnel who were active in field operations. For sampling of the participants, a list of all police personnel who were participating in field operations from February 2020 to to November 2021 (before the Omicron variant outbreak) was obtained. Then, 340 individuals were selected randomly from the list by a random number generator software.

Selected individuals were then invited for participation in the study. In case of unwillingness for enrollment in the study, another random individual was replaced to fully cover the required calculated sample size.

2.3. Data collection

Data was extracted from the EMR system using a standardized data collection document. Information on age (9), gender, place of inhabitation (home, nursing home or others) (10), the Identification of Seniors at Risk (ISAR) score for frailty (11), the Charlson Comorbidity Index (CCI) on admission (12), the Acute Physiology and Chronic Health Evaluation-II (APACHE-II) score (13, 14), the Glasgow Coma Scale (GCS) before intubation (15), indications for intubation, and diagnosis on admission (16-18), was retrieved.

The ISAR is a six-item tool, which quantifies frailty using commonly measured variables in the ED (19). The responses are dichotomized as "yes" or "no", and for each "yes" answer one point is a researcher-designed checklist was used to collect information from participants which was collected through in-person visit sessions. The checklist included questions on demographics (age, height, weight, gender, marital status, number of children and underlying diseases). The second part of checklist reviewed the job characteristics such as frequency and type of operations, involvement of colleagues with COVID-19, etc. The last part of checklist

evaluated COVID-19 infection, using PPE, types of used PPE (mask, face shield, gloves, etc), protective strategies (such as social distancing) and COVID-19 vaccination. Cases with positive reverse transcription polymerase chain reaction (RT-PCR) test or chest CT-scan findings compatible with COVID-19 disease features were considered as COVID-19 positive. Participants were asked to rate adherence to each component of PPE or preventive measures from never (0) to all the time (10) on a 10-point visual analog scale during operations and in daily life.

2.4. Statistical analysis

Statistical analysis was performed with IBM SPSS Statistics for Windows, version 25 (IBM Corp., Armonk, N.Y., USA). Descriptive analysis is presented in the form of frequency and percentage or mean and standard deviation. Independent t-test and chi-square test were used for comparison of continuous and categorical parameters. Normality of quantitative parameters were checked with Kruskal-Wallis test. In case of non-parametric distribution, Mann-Whitney U test was used. Regression analysis was used to assess the impact of independent variables in the risk of COVID-19 infection. P-value ≤ 0.05 was considered as statistical significance threshold.

3. Results

Totally, 340 participants were analyzed. Mean age of the individuals was 33.54 ± 9.74 years; 310 subjects (91.2%) were males.

Basic characteristics of the study population are reported in table 1. One hundred and fifteen participants (44.1%) reported at least one episode of confirmed COVID-19 infection. Among cases with history of COVID-19, 1.61 ± 0.80 episodes of COVID-19 infection had occurred. Myalgia (40%), weakness (37.4%) and fever (35.9%) were the most common reported symptoms of COVID-19 disease in our study population. One-hundred thirty-four participants (39.4%) reported requesting sick leave due to COVID-19 infection for a frequency of 1.56 ± 0.90 times, on average. 300 subjects (88.2%) had received at least one dose of COVID-19 vaccine. On average, 2.46 ± 1.09 doses of vaccine were injected.

Usage of PPE and adherence to its usage during operations and daily life was also evaluated. The most common component of PPE used both during operations and daily life was face mask (44.7% and 75%) but adherence to washing hands with soap was the highest daily life (6.86 ± 3.81). The details are listed in Table 2.

Three preventive measures were also evaluated. The most popular measure with higher adherence compared to others was social distancing with 70% popularity and an adherence score of 5.85 ± 3.74 . The details of analysis of these preventive measures are presented in Table 3.

PPE usage was compared between patients with and without history of COVID-19 infection. Among PPE items, using face mask, washing hands with soap, social distancing and vacci-

Table 1 Basic characteristics of the study population and COVID-19 disease (n=340)

Variable	Frequency (%)
Sex	
Male	310 (91.2)
Female	30 (8.8)
Marital status	
Single	132 (38.8)
Married	208 (61.2)
Child number	
0	172 (50.6)
1	62 (18.2)
2	83 (24.4)
3	18 (5.3)
Underline disease	
Diabetes mellitus	27 (7.9)
Hypertension	21 (6.2)
Asthma and respiratory diseases	17 (5.0)
Cardiovascular diseases	13 (3.8)
Renal disorders	12 (3.5)
Transplant history	2 (0.6)
Others	8 (2.4)
History of confirmed COVID-19	
Yes	150 (44.1)
No	190 (44.9)
Frequency of COVID-19 infection	
1	81 (23.8)
2	49 (14.1)
3	12 (3.5)
4	6 (1.8)
Diagnosis method	
Chest CT scan	5 (3.5)
RT-PCR	100 (69.4)
Both	39 (27.1)
Symptoms	
Myalgia	136 (40.0)
Weakness	127 (37.4)
Fever	122 (35.9)
Cough	94 (27.6)
Sore throat	94 (27.6)
Runny nose	81 (23.8)
Headache	81 (23.8)
Anosmia and ageusia	69 (20.3)
Diarrhea	51 (15.0)
Dyspnea	41 (12.1)
Nausea/vomiting	36 (10.6)
Treatment	
At home	154 (93.3)
Admission at COVID-19 ward	6 (3.6)
ICU admission	3 (1.8)
Contact with COVID-19 positive colleague	
Yes	164 (48.2)
No	176 (51.8)
Contact with COVID-19 positive family member	
Yes	111 (32.6)
No	229 (67.4)
Participation in indoor operations during last month	
<5 operations	95 (27.9)
5-10 operations	25 (7.4)
10-15 operations	14 (4.1)
>15 operations	42 (12.4)

Table 1 Basic characteristics of the study population and COVID-19 disease (n=340)

Variable	Frequency (%)
Participations in outdoor operations during last month	
<5 operations	79 (23.2)
5-10 operations	24 (7.1)
10-15 operations	18 (5.3)
>15 operations	48 (14.1)
Sick leave request due to COVID-19 infection	
Yes	134 (39.4)
No	206 (60.6)
COVID-19 vaccination	
One dose	12 (3.5)
Two doses	91 (26.8)
Three doses	159 (46.8)
Four doses	42 (12.4)
Post-vaccination COVID-19 infection	
After first dose	32 (34.4)
After second dose	41 (44.1)
After third dose	14 (15.1)
After fourth dose	6 (6.5)

RT-PCR: reverse transcription polymerase chain reaction;
ICU: intensive care unit

nation were significantly different between patients with and without prior COVID-19 infection. The details are demonstrated in Table 4.

Preventive measures were also compared between patients in terms of COVID-19 history. Analysis showed that social distancing was significantly more prevalent among patients without history of COVID-19 compared to others. The details of preventive measures in terms of COVID-19 infection history are presented in Table 5.

179 patients without history of COVID-19 infection (94.2%) had received vaccination while 121 patients with history of COVID-19 (80.7%) were vaccinated against COVID-19 ($p<0.001$). PPE use was also compared between patients infected with COVID-19 after vaccination. Face mask [121 subjects (49.2%) vs 31 subjects (33%), $p=0.007$] and washing hands [86 subjects (35%) vs 20 subjects (21.3%), $p=0.015$] were still significantly different between patients without and with history of post-vaccination COVID-19.

4. Discussion

The current study was performed to evaluate the impact of PPE in prevention of COVID-19 infection among police forces. We found out that face masks, washing hands, social distancing and vaccination can significantly impact infectivity with COVID-19.

Although policies of staying home and social distancing has been executed by governments all over the world, police forces had to remain on duty at the first line of essential service providers of societies during the COVID-19 pandemic (7, 9-13, 17). Nature of police job is associated with involvement

Table 2 Usage of PPE and adherence to its usage during operations and daily life

PPE	Adherence			
	During operation		In daily life	
	Frequency (%)	Score (mean±SD)	Frequency (%)	Score (mean±SD)
Face mask	152 (44.7)	6.00±3.96	255 (75.0)	6.78±3.59
Gloves	50 (14.7)	2.05±2.93	68 (20.0)	2.11±2.90
Face shield	6 (1.8)	0.80±2.10	14 (4.1)	0.72±1.86
Hand sanitizer gel	66 (19.4)	4.07±3.90	131 (38.5)	3.65±3.79
Hand alcohol spray	108 (31.8)	4.42±3.98	204 (60.0)	5.25±3.89
Washing hands with soap	106 (31.2)	5.90±4.15	234 (68.8)	6.86±3.81

Table 3 Preventive measures for COVID-19 infection

Preventive measure	Adherence	
	Frequency (%)	Score (mean±SD)
Social distancing	238 (70.0)	5.85±3.74
Avoiding crowded places	184 (54.1)	5.30±3.80
Avoiding travels	120 (35.3)	4.86±4.12

Table 4 PPE usage according to the status of COVID-19 infection history

Parameter	COVID-19 history		P
	Negative	Positive	
Adherence during operations; frequency (%)			
Face mask	101 (53.2)	51 (34.0)	< 0.001
Gloves	31 (16.3)	19 (12.7)	0.346
Face shield	2 (1.1)	4 (2.7)	0.262
Hand sanitizer gel	35 (18.4)	31 (20.7)	0.603
Hand alcohol spray	60 (31.6)	48 (32)	0.934
Washing hands with soap	74 (38.9)	32 (21.3)	< 0.001
Adherence During operations (score); mean±SD			
Face mask	6.60±3.89	5.24±3.94	0.002
Gloves	1.91±2.89	2.24±2.98	0.313
Face shield	0.76±2.13	0.84±2.06	0.734
Hand sanitizer gel	4.11±3.95	4.01±3.84	0.810
Hand alcohol spray	4.40±3.96	4.46±4.02	0.879
Washing hands with soap	6.34±4.24	5.34±3.96	0.027
Adherence in daily life; frequency (%)			
Face mask	158 (83.2)	97 (64.7)	< 0.001
Gloves	35 (18.4)	33 (22.0)	0.413
Face shield	6 (3.2)	8 (5.3)	0.316
Hand sanitizer gel	78 (41.1)	53 (35.3)	0.282
Hand alcohol spray	106 (55.8)	98 (65.3)	0.074
Washing hands with soap	147 (77.4)	87 (58.0)	< 0.001
Adherence in daily life (score); mean±SD			
Face mask	7.26±3.63	6.18±3.44	0.006
Gloves	1.94±2.94	2.33±2.84	0.224
Face shield	0.52±1.48	0.96±2.22	0.030
Hand sanitizer gel	3.87±3.94	3.37±3.60	0.224
Hand alcohol spray	5.01±4.02	5.54±3.71	0.213
Washing hands with soap	7.35±3.80	6.25±3.75	0.008

Preventive measures were also compared between patients in terms of COVID-19 history.

Analysis showed that social distancing was significantly more prevalent among patients without history of COVID-19 compared to others. The details of preventive measures in terms of COVID-19 infection history are presented in Table 5.

in close contact with individuals who could be potentially infected with COVID-19. Thus, the main concern of policy-makers have been prevention of COVID-19 infection in police forces and control of virus spread. Due to high frequency of police encounters with different people and places during

routine daily activities of their job, they are so vulnerable to being infected and highly susceptible for spreading virus. To mitigate the risk of virus transmission and infection, use of PPE has been taken into action by majority of police systems in the world. Although use of PPE has been reported

Table 5 PPE usage according to the status of COVID-19 infection history

Parameter	COVID-19 history		P
	Negative	Positive	
Preventive measures; frequency (%)			
Social distancing	147 (77.4)	91 (60.7)	0.001
Avoiding crowded places	107 (56.3)	77 (51.3)	0.360
Avoiding travels	63 (33.2)	57 (38.0)	0.354
Adherence to preventive measures (score); mean±SD			
Social distancing	6.25±3.78	5.35±3.63	0.028
Avoiding crowded places	5.03±3.80	5.65±3.78	0.135
Avoiding travels	4.75±4.07	5.00±4.18	0.573

to be associated with favorable health and safety outcomes in various groups such as healthcare providers (14, 15, 18), using PPE by police is associated with some considerations. Use of PPE by police leads to an appearance which may produce negative perceptions and attitudes toward them and weaken their power of interaction with society. In addition, use of PPE can negatively impact of operational abilities of police forces, especially in more demanding operations which needs speedy activities and timely reactions (19-23).

Considering problems of PPE use among police forces as well as some beliefs that using PPE is not efficacious in reduction of COVID-19 infection, we aimed to assess the relationship of PPE use and risk of COVID-19 infection among police forces. To date, no study has evaluated the extent of efficacy of PPE use in reduction of COVID-19 infection among police and military forces. In our study using face mask and washing hands during operations and in daily life has been significantly higher in patients without history of COVID-19. Using gloves, face shield, hand sanitizer gel or hand alcohol spray has not been shown to significantly differ between groups in terms of COVID-19 history. Gloves and face shields have less been used by police due to their interference with daily activities and difficulties with their use. So, no significant difference was observed between police officers with and without history of COVID-19 in terms of using gloves and face shields. Also, participants without positive history of COVID-19 have washed their hands with soap in addition to using hand sanitizer gels and alcohol spray but in patients who had been infected with COVID-19, it seems that have used gels and sprays instead of washing their hands which has resulted in higher risk of virus transmission. As well, social distancing and vaccination has been significantly more frequent in patients without history of COVID-19. Avoiding travels and crowded places have also not been significantly different according to COVID-19 prior infections. Consistent with our findings, in systematic review by Chu et al, physical distancing of 1 m or more (adjusted OR=0.18), face mask (adjusted OR=0.15) and eye protection (adjusted OR=0.22) were significantly correlated with lower risk of infection (14). Interestingly, beneficial impact of face masking and hand washing in COVID-19 infection reduction remained persistent even after vaccination.

5. Limitation

Our study had several limitations. First of all, the sample size of our study was relatively small for characterization of behavior of a widespread infection such as COVID-19. Secondly, we could not categorize and analyze COVID-19 cases based on the different waves of COVID-19 in Iran. The third limitation was lack of data on severity of COVID-19 infections in the assessed participants which limited the interpretability power of our findings.

6. Conclusion

Use of PPE –particularly face masks, washing hands, social distancing and vaccination- is significantly efficacious in reduction of COVID-19 infection among police officer in Iran. Despite difficulties of using PPE among police forces, it is strongly recommended for virus spread control in this population.

7. Declarations

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7.2. Authors' contributions

The conception and design of the work by All the authors; Data acquisition by MA and MFR; Analysis and interpretation of data by MA and MS; Drafting the work by MA; Revising it critically for important intellectual content by MS and MFR; All the authors approved the final version to be published; AND agree to be accountable for all aspects of the work.

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7.4. Conflict of interest

The authors declare that there is no conflict of interest.

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