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# Risk factors of COVID-19 infection among policemen: A case-control study

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## ABSTRACT

**Objective:** To investigate the risk factors and protective measures of COVID-19 among policemen in an eastern state of India.

**Methods:** This case-control study was conducted in Bihar, located in the eastern part of India. In total, 6 confirmed COVID-19 cases (the case group) and 11 negative contacts of these cases (the control group) of Bihar Military Police participated in the study.

**Results:** All subjects were male with a median age of 51 (range: 23-60) years. Among these 6 confirmed cases, 5 cases were asymptomatic. One third (33.3%) of the case group and the majority (90.9%) of the control group reported maintenance of physical distance of at least 1 meter with others all the time, which was significantly different ( $P=0.028$ ). There was no other statistically significant difference between the case group and the control group.

**Conclusions:** Physical distancing is the most effective public health measure to control contagious diseases like COVID-19, especially in the absence of an effective vaccine in police settings.

**KEYWORDS:** COVID-19; Police; Epidemiology; Risk factors; Protective factors

## 1. Introduction

COVID-19 is a contagious disease and has caused an overwhelming burden of healthcare systems throughout the world[1]. As of 4:00 p.m., September 16, 2020, Indian standard time, about thirty million of COVID-19 cases and one million related deaths were reported from 213 different countries and territories[2]. Respiratory droplets and social contacts are major routes of transmission of the disease[3]. In the absence of an effective vaccine and treatment for COVID-19, most of the affected countries were forced to implement partial or full lockdown to minimize social

contact and contain the virus[1,4].

India is one of the leading countries suffering from COVID-19 pandemic. The country had implemented lockdown strategy at a very early stage of the pandemic except for healthcare, goods transport, media, law and order-related services with some restrictions[5]. Policemen are involved in law and order related services. During lockdown, they ensure people's compliance with social distancing and mobility restriction in addition to their regular services[6]. Due to their job particularity, policemen are involved in more direct social interactions and are at higher risk of COVID-19 infection. With the spread of the pandemic and increasing relaxations of several services during the lockdown, policemen are becoming more susceptible to COVID-19 infection[7,8]. Even a single infected policeman can pose a significant risk of infection among his/her colleagues and social contacts. Living in the same residential areas or barracks, sharing common toilets and transport vehicles, and food messes make the risk of infection higher among policemen[9,10].

Located in the eastern part of India, Bihar has the third-highest population density in India[11]. Like other affected states, the Bihar government has deployed thousands of policemen to restrict social mobility, implement social distancing measures, and maintain law and order[12]. Recently COVID-19 cases have been reported among policemen of Bihar Military Police (BMP) in Patna district of Bihar[13]. It is worrying that except one all other confirmed cases

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were asymptomatic. Effective public health measures were needed to control COVID-19 infection in BMP. Thus, we undertook an epidemiological investigation among COVID-19 cases and their negative contacts in BMP till May 8, 2020, to explore the risk factors and protective factors for COVID-19 infection among them, and help to lay down effective control measures.

## 2. Subjects and methods

### 2.1. Study design

This case-control study was conducted among COVID-19 patients and the negative contacts in BMP in Patna city, Bihar state.

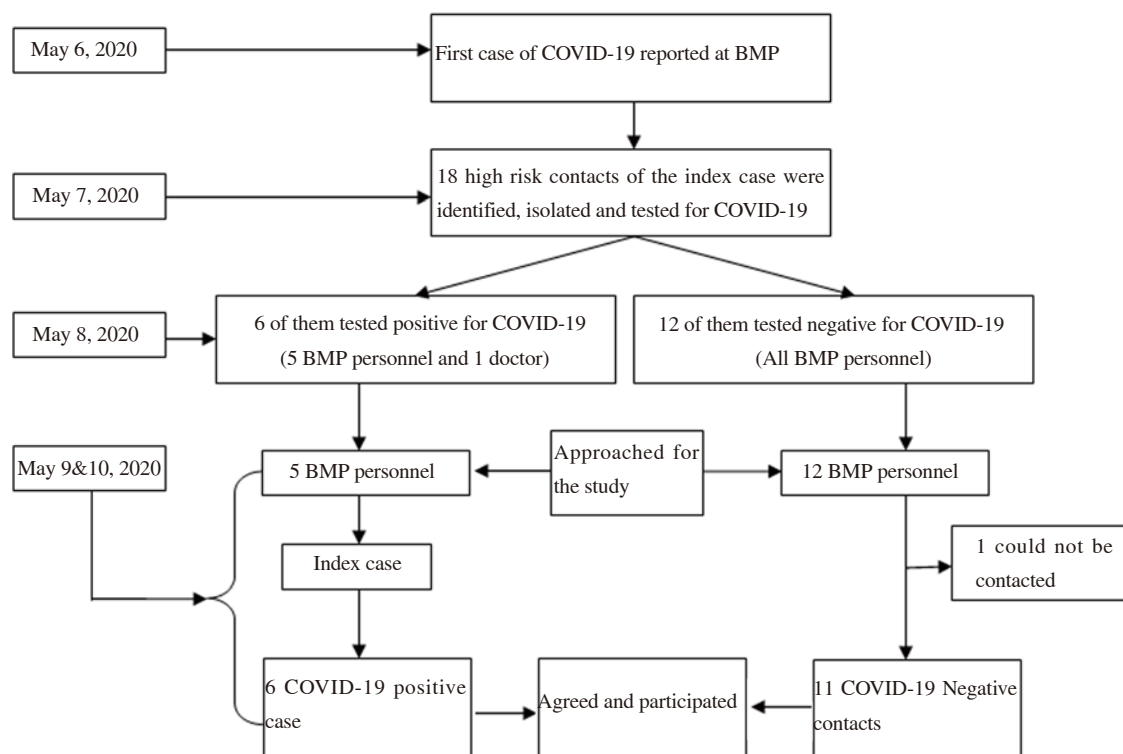
### 2.2. Data collection

We interviewed the subjects telephonically using a structured schedule. Qualitative responses were documented, analyzed, and reported thematically. The structured schedule consisted of age, gender, years of service, comorbidity, addiction profile, living condition, social distancing practices, personal protective measure, personal hygiene, duty stations during lockdown, type of transport for commute, travel history during lockdown, sickness absenteeism in the preceding year (as a proxy indicator of their immunity) and self-reported anthropometric measurements like height, weight and waist circumference. All the study subjects were tested for COVID-19 using real-time reverse transcription-polymerase chain reaction test. Throat swabs for the real-time reverse transcription-

polymerase chain reaction test were collected by a trained otolaryngologist<sup>[14]</sup>.

### 2.3. Participants

On May 5, 2020, a sixty-year-old retired BMP policeman presented with fever and dry cough at the flu corner of All India Institute of Medical Sciences (AIIMS), Patna which was set for screening COVID-19. The policeman was symptomatic (fever and cough), and symptoms started from May 1, 2020. He initially went to Bihar Military Command Hospital (BMCH), Patna, seeking treatment. From there he was referred to AIIMS-Patna to be screened for COVID-19. Considering the symptoms and examination result met COVID-19 testing criteria, he was admitted to an isolation ward, and the throat swab sample was sent for testing. This policeman was retired from BMP service on March 31, 2020, but due to the nationwide lockdown, he could not go back to his native place and was forced to live in a BMP barrack along with other in-service policemen. On May 6, 2020, he was confirmed with positive result of COVID-19 test. Then 18 suspected high-risk contacts were quarantined and screened for COVID-19 on May 7, 2020. These 18 high-risk contacts consisted of 17 in-service BMP policemen and a doctor who initially examined the patient without adequate personal protective measures. On May 8, 2020, 6 out of 18 tested were reported to be COVID-19 positive, including the BMCH doctor. On 9th and 10th May 2020, we interviewed all quarantined BMP cases. Except for one negative case, the rest were interviewed telephonically. These 17 cases were divided into two groups: the case group with 6 COVID-19 cases and the control group with 11



**Figure 1.** The study flowchart. BMP: Bihar Military police.

negative contacts (Figure 1).

Some definitions used in the study are as following. Obese: Those who had BMI  $\geq 25$  kg/m<sup>2</sup>[15]. Centrally obese: Those who have reported their waist circumference  $>90$  cm[16].

2.4. Ethical approval

Ethical approval of the Intuitional Ethics Committee of AIIMS-Patna (AIIMS/Pat/IEC/2020/476) was taken before drafting and submission of this manuscript. The consent was obtained from all participants and confidentiality was assured during data collection. The study was conducted as per the Declaration of Helsinki.

2.5. Statistical analysis

Data were analyzed using IBM SPSS (Chicago, USA) (version16). All descriptive data were expressed as median (IQR) and frequency (percentage). Bivariate analysis was performed using the Mann-Whitney *U* test (for continuous variables) and Fishers Exact Test (for categorical variables). The minimum acceptable confidence level was  $\alpha=0.95$  for all statistics, and the significance difference was confirmed when was  $P<0.05$ .

3. Results

Out of all participants, 9 (52.9%) [participants (P-1 to P-9)] resided in the same barrack and 4 (23.5%) (P-10 to P-13) resided in tents adjacent to the barrack. Others resided in different areas inside the same campus namely another barrack (P-14) (approximately 50 m away), storeroom (P-15) (approximately 100 m away), drivers barrack (P-16) (approximately 150 m away), and a family quarter (P-17) (approximately 800 m away). There were about ten public toilets and bathrooms (approximately 100 m away) shared by approximately 150 persons. There were three canteens for the residents inside the campus, along with a milk parlor. The

floor area of the barrack of P-1to P-9 was approximately 525 square feet (ft) [length (L): 35 ft, width (W): 15 ft]. There were in total 5 windows (L: 4ft, W: 3ft) and 1 entrance door (L: 7ft. W: 4ft) in the barrack. The total space of door and windows was less than one-fifth of the floor space. So, there was a lack of ventilation. The approximate distance between beds inside the barrack was 1 m. The arrangement of beds of P-1 to P-9 inside the barrack with respect to the door and windows is depicted in Figure 2.

All the study subjects were male with a median age of 51 (range: 23-60) years. Most of them were sergeant (47.1%) followed by officer (23.5%) and assistant sub-inspector (17.6%) with median years of service of 29 (range: 1-35) years. Considering their duty stations during the lockdown, 4 (23.5%) of them were deployed at various market places (*i.e.* vegetable market, fruit market, *etc.*). Three of them were deployed at government offices and police stations outside the campus. Among those who were assigned inside the campus, 3 (17.6%) were at armoury while 7 (41.2%) were at offices. Two-fifth (41.2%) of them used mass transport to commute while others walked to their duty stations as they were inside the BMP campus. None of them had taken sick leave in the preceding year while two of them had diabetes. Two-fifth of them (41.2%) were obese, while 52.9% of them had central obesity. More than half of them (58.8%) were addicted to Khaini (a kind of chewable tobacco). The majority of them (70.6%) maintained respiratory etiquette and physical distancing with others. The median frequency of daily handwashing with soap water and weekly frequency of cloth washing was 6 (IQR: 5-10) and 2 (IQR: 1-3) times respectively. At the same time, 70.6% of them reported alcohol-based sanitizer use after touching or handling objects with bare hands. All of them reported use of cloth masks while only half of them (58.8%) used both masks and gloves (Table 1 and Table 2). A total of 33.3% of cases and 90.9% of the controls reported maintenance of physical distancing of at least 1 m with others all the time. The difference was statistically significant between two groups ( $P=0.028$ ). There was no significant difference in other variables between the case group and the control group (Table 3).

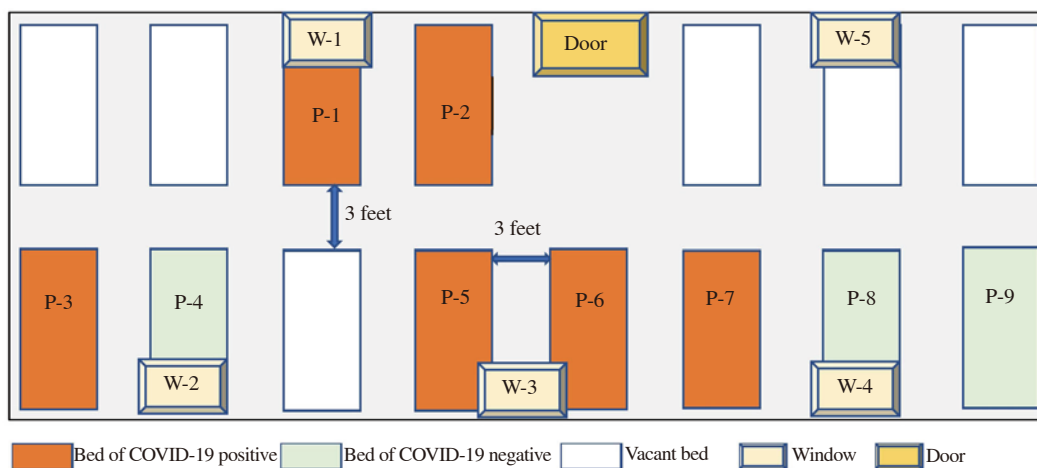


Figure 2. The arrangement of the barrack. P: Participants; W: Window.

**Table 1.** Individual characteristics of the study participants (n=17).

Participant number	COVID status	Presenting symptoms	Age	Comorbidity	BMI	WC	RE	PD	HWFD	SU	PPMU
P-1	Positive	Fever and cough	60	DM	23.0	89	√	×	5	×	M
P-2	Positive	Asymptomatic	36	×	21.6	86	×	×	5	√	M
P-3	Positive	Asymptomatic	57	×	26.2	91	√	√	3	×	M
P-4	Negative	Asymptomatic	50	×	19.8	84	√	√	5	√	M, G
P-5	Positive	Asymptomatic	30	×	24.8	91	×	√	10	√	M, G
P-6	Positive	Asymptomatic	50	×	26.7	96	√	×	6	×	M
P-7	Positive	Asymptomatic	52	×	24.1	96	√	×	10	√	M, G
P-8	Negative	Asymptomatic	54	DM	28.3	102	√	√	8	√	M
P-9	Negative	Asymptomatic	51	×	22.7	86	√	√	8	√	M, G
P-10	Negative	Asymptomatic	55	×	20.9	86	√	√	3	√	M, G
P-11	Negative	Asymptomatic	55	×	31.4	107	√	√	6	√	M
P-12	Negative	Asymptomatic	57	×	34.1	96	×	√	12	×	M, G
P-13	Negative	Asymptomatic	52	×	23.1	91	√	√	6	√	M, G
P-14	Negative	Asymptomatic	48	×	23.3	81	√	√	6	√	M, G
P-15	Negative	Asymptomatic	46	×	21.3	91	×	√	10	√	M, G
P-16	Negative	Asymptomatic	23	×	25.5	81	×	√	10	√	M, G
P-17	Negative	Asymptomatic	50	×	28.1	86	√	×	8	×	M

DM: Diabetes mellitus; BMI: Body mass index; WC: Waist circumference, RE: Respiratory etiquette; PD: Physical distance; HWFD: Handwashing frequency per day; SU: Sanitizer used; PPMU: Personal protective measures used; M: Mask; G: Gloves.

**Table 3.** Characteristics and COVID-19 status of the participants (n=17).

Variables	Case group [n (%)/Median (IQR)]	Control group [n (%)/Median (IQR)]	$U/\chi^2$	P-value
Age (year)	51 (34-58)	51 (48-55)	32.000	0.961*
Service duration (years)	29 (11-35)	30 (20-34)	27.000	0.591*
Used common transport for commuting to the duty station	2 (33.3)	5 (45.5)	0.235	1.000#
Average daily duty duration (h)	8 (4-11)	8 (4-8)	25.500	0.462*
Deployed at market places	1 (16.7)	3 (27.3)	0.243	1.000#
Addiction	2 (33.3)	8 (72.7)	2.487	0.162#
Comorbidities	1 (16.7)	1 (9.1)	0.215	1.000#
Obese	2 (33.3)	5 (45.5)	0.235	1.000#
Centrally obese	4 (66.7)	5 (45.5)	0.701	0.620#
Maintained respiratory etiquette all the time	4 (66.7)	8 (72.7)	0.069	1.000#
Maintained physical distancing with others all the time	2 (33.3)	10 (90.9)	6.199	0.028#
Used both mask and gloves	2 (33.3)	8 (72.7)	2.487	0.162#
Frequency of hand wash with soap and water in a day	5 (4-10)	8 (6-10)	25.000	0.462*
Used alcohol-based hand sanitizer after touching a surface by bare hand	3 (50.0)	9 (81.8)	1.893	0.169#
Cloth washing frequency in a day	2 (1-3)	2 (1-3)	32.500	0.961*

\*: Mann-Whitney U test; #: Fishers Exact Test. IQR: Interquartile range.

#### 4. Discussion

This epidemiological investigation was conducted among BMP policemen quarantined for COVID-19. In the present study, all the six cases and three controls resided in the same barrack. These three controls maintained habits of physical distancing, frequent handwashing with soap-water or sanitization by alcohol-based hand rub, and use of cloth mask. These measures could protect people from infection. The other eight controls lived either in tents adjacent to the barrack or in a distant place. Thus, social distance is important for control of COVID-19 infection, which is in line with other studies[17,18]. In the present study, the distance between beds is approximately one meter for P-1 to P-9, which is as per WHO recommendations on physical distance for COVID-19 infection prevention[19].

We found that those using both gloves and masks were at a lower risk of COVID-19 infection. Mask can block respiratory

droplets while gloves prevent direct physical contact of hand. Both respiratory droplets and physical contact are major routes of COVID-19 transmission[3]. Currently, the WHO and the Center for Disease Control both recommend use of a face mask or cover, especially during a visit to a public place or social gathering[20-22]. Policemen are generally transported to their duty stations in groups of 30-35 by van or bus where keeping social distance with each other is merely impossible. In such circumstances, use of masks and gloves could lower the chance of COVID-19 transmission. In the present study, frequency of handwashing and sanitizer use were higher in controls compared with the positive cases. Handwashing and sanitizer use are important measures of prevention from contagious respiratory diseases like COVID-19[23,24].

Although the difference in the incidence of obesity was not statistically significant between two groups in our study, other studies supported that those who were centrally obese were at higher risk of developing COVID-19 infection[25,26]. Obesity,

**Table 2.** Key comments on various practices related to COVID-19 prevention and perceived source of infection.

Variables	Key comments
Social distance	<p>P-4: "When policemen come to the armoury to submit issued guns and bullets, I ask them to keep guns and bullet in a table far away from me. After they depart, I used to collect the guns and bullets...."</p> <p>P-9: Several times I have told the higher officials that "sir, you deploy us to maintain physical distancing among peoples at marketplaces, but you transport 30-35 of us to our duty stations in a single bus where we literally sit on each other..."</p> <p>P-11: "I am working in this profession for many years. I know how to protect myself from the corona. Although it is being said that there should be at least one-meter distance in between two persons, I used to maintain at least five-meter distance with others...."</p> <p>P-13: "We were deployed at market places to assure physical distancing among people. So, we know the importance of physical distancing in the prevention of corona."</p>
Personal protective measures	<p>P-3: I use cloth mask supplied by the government, but I do not like using gloves as it is uncomfortable to wear...."</p> <p>P-5: "During office hours I am used to wear cloth mask, so I sneeze and cough inside it. However, after duty, I do not cover my mouth in case of sneeze or cough..."</p> <p>P-9: "We are used to sanitize our hands and wear a mask before boarding the crowded bus which leaves us to our duty stations..."</p> <p>P-11: "I have bought an N-95 mask in March. Since then, I use it in my duty hours while I used to cover my face with a cloth while I visit crowded places inside the barrack..."</p> <p>P-13: "We are used to wear cloth masks and cotton gloves supplied by the government. I am used to washing the mask and gloves daily with antiseptic solution after return from my duty..."</p>
Hand washing and sanitisation	<p>P-3: "I am not used to wash or sanitize my hands during duty hours. I only wash my hands after defecation and eating food...."</p> <p>P-8: "I was not used to wear gloves as it was not supplied. So, I am used to wash my hands with soap and water and followed by the use of hand sanitizer...."</p> <p>P-10: "After handling anything, I immediately use alcohol hand sanitizer to sanitize my hands...."</p> <p>P-12: "I was not supplied with hand sanitizer. So, I am used to wash my hands with soap and water if I have touched any suspicious item with bare hands...."</p>
The perceived source of infection	<p>P-1: "I do not know where did I get this infection. I have not visited any place outside the campus. I always tried to maintain social distancing with others and I am used to wear face masks sometimes. However, still, it is difficult to maintain social distancing in the barrack where we have to share common toilets and food messes...."</p> <p>P-2: "One night when I was sleeping in my bed adjacent to the P-1's bed, he was coughing like anything. He used to cough earlier also, but we ignored that. One night I was frightened by the intensity of cough of P-1. The next day, I decided to sleep inside the canteen, leaving my bed at the barrack...."</p> <p>P-8: "We were instructed to defer visit to our native places during corona. Nevertheless, who listens, P-2 recently visited his native place at Buxar...."</p>

especially central obesity, increases the risk of metabolic disorders like diabetes[27], and it is reported that people with diabetes are more prone to COVID-19 infection[28]. Diabetes and other such chronic inflammatory metabolic disorders are determinant of disease severity and mortality of COVID-19 infection, and

special attention should be paid to diabetics and even prediabetics patients[29]. In the present study, 58.8% of participants were addicted to Khaini, a chewable form of tobacco. Tobacco is an established risk factor for COVID-19 infection[30], and the effect of chewable tobacco is still needed to be studied further.

Regarding the source of infection, P-2 said that he got infected from P-1 who reported no travel history during the lockdown. Meanwhile, P-8 opined out that P-2 recently visited his native place in Buxar, which was the government notified active hotspot for COVID-19[31]. Although the date of the visit was not clear, we assumed that P-2 got infected during this visit and became an asymptomatic carrier. Later on, he might have infected his colleagues. There may be other possibilities, which need further in-depth investigation.

With regard to limitations, this was a case-control study that cannot establish a temporal association between COVID-19 infection and its various attributes. Secondly, all the data were self-reported by participants. Living conditions and COVID-19 related practices (*i.e.* physical distancing, hand washing, sanitizer use, mask use, *etc.*) were not observed. Their anthropometric indices were not measured either. So, there may be reporting and social-desirability related biases. Lastly, the study sample size was small. To conclude, maintaining physical distance is an effective measure to control contagious diseases like COVID-19, especially in the absence of an effective vaccine. Maintenance of physical distance along with other proven preventive measures like frequent hand washing and use of face cover or mask could significantly reduce the chance of COVID-19 infection among policemen.

### Conflict of interest statement

The authors report no conflict of interest.

### Authors' contributions

All authors had full access to the data, contributed to the study, approved the final version for publication, and take responsibility for its accuracy and integrity. Concept or design: N.A.; Acquisition of data: B.B.; Analysis or interpretation of data: B.B.; Drafting of the manuscript: B.B.; Critical revision of the manuscript for important intellectual content: N.A., B.B.

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