Original Article

The prevalence and risk factors of diabetes and hypertension among police personnel: A population-based cross-sectional study

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Abstract

Background: Police personnel represent a special occupational group who because of the nature of their jobs are at an increased risk of lifestyle disorders such as diabetes and hypertension. Although studies have been conducted to assess the health status of police personnel in India, most of them suffer from small sample sizes, selection bias, and poor generalizability. **Objectives:** This large-scale study evaluated the prevalence of diabetes and hypertension along with their risk factors among police personnel in Mumbai, India. **Methods:** A population-based cross-sectional study was conducted in 3474 police personnel. The key risk factors of interest were age, gender, and body mass index (BMI). Binary logistic regression was used to quantify the relationship between the independent variables (age, gender, and BMI) and the dichotomous dependent variables (diabetes and hypertension). **Results:** 86.3% were males while 13.7% were females. The mean age was 41.6 years. In total, 48.7% of participants were overweight while 19.9% were obese. Totally, 29.2% of participants were pre-diabetic/diabetic and 55.2% were hypertensive. Using adjusted logistic regression, participants with > = 55 years were 7.9 and 3.7 times more likely to have diabetes and hypertension respectively compared to those with < = 34 years. Similarly, obese individuals were 1.6 and 3.1 times more likely to have diabetes and hypertension respectively compared to those with normal BMI. **Conclusions:** This study demonstrates a high prevalence of cardiovascular risk factors such as diabetes, hypertension, and obesity among Indian police personnel and provides the scientific basis for planning interventional strategies to improve their health.

Keywords: Diabetes, hypertension, obesity, police personnel, risk factors

Introduction

The basic sign of a good governance is efficient law enforcement, and this responsibility lies primarily with the police department. Fulfilling this responsibility requires policemen to carry out a vast range of activities, some of which are physically and mentally intense in nature. The extent of these activities intensifies manifold during events such as festivals, elections, communal and social disturbances, natural calamities and other disasters.[1] These duties can be carried out efficiently only when policemen

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are physically and psychologically fit at all times and in every situation that they encounter.[2]

With an estimated population of over 20 million, Mumbai is the largest and densest city in India.[3] It is the financial capital of the country and is also the capital of Maharashtra, the second largest state of India.[3] The city has been a witness to some of the worst disasters like terrorist attacks, massive flash floods, gang wars, stampedes, and riots causing enormous loss of life and property. Mumbai also has one of the highest crime rates in the country. More than one tenth of all crimes in all 36 districts of the state of Maharashtra are reported from Mumbai.[4] These factors make Mumbai one of the most challenging cities in the world for the police in terms of law enforcement.[1]

The advent of coronavirus disease 2019 (COVID-19) has added a new dimension to policing, wherein the policemen are entrusted with additional responsibilities such as implementing government orders of restraining public movements, enforcing lockdowns, supplying essential supplies to the underprivileged, managing and cremating unclaimed dead bodies, and providing security to the COVID-19 designated hospitals. Presence of pre-existing conditions such as hypertension, diabetes, and obesity have been shown to be associated with a higher risk of complications and poor prognosis in COVID-19 patients,[5-7] which makes screening of policemen for these conditions extremely important.

Several studies have been conducted to assess the health status of police personnel in India and have shown a varied prevalence of lifestyle disorders.[8-17] Prevalence of hypertension has been reported to be 5%[9] to 58.5%,[16] diabetes 2.6%[9] to 34.7%[15] and obesity 37%[9] to 65.6%.[17] Some key limitations of the existing literature are noteworthy. The sample size of the studies ranged from 256[14] to 2160,[12] with only 3 studies[11,12,15] having a sample size in excess of 1000. Many studies[8,10,13,14,16] suffer from selection bias and poor external validity, especially the ones with small sample sizes. Moreover, several studies[8,11,13,15,17] have failed to report their limitations in a transparent way, making it difficult for the reader to interpret the evidence objectively. Consequently, there is a need to evaluate the health status of police personnel using a large sample size that is representative of the underlying population of interest. We therefore conducted this study to evaluate the prevalence of diabetes and hypertension along with their risk factors in a large population-based sample of police personnel in the city of Mumbai, India.

Materials and Methods

Study design and setting

We designed a cross-sectional study to cover all 93 police stations in Mumbai in two phases, with 47 stations to be covered in phase 1 and 46 in phase 2. In this manuscript, we are presenting the results of phase 1 for the first set of 47 police stations that were covered in June and July 2020. In the 47 selected police stations, the total number of police personnel was 7050. All 7050 police personnel were considered eligible for this study irrespective of their age, gender or any other clinical or demographic characteristic. There were no exclusion criteria since the goal of study was to collect data on each police officer. The present study was approved by the Maharashtra Institute of Medical Education and Research (MIMER) Institutional Ethics Committee (Registration No. ECR/607/Inst/MH/2014) on 20th February 2020. The written informed consent was taken from each participant prior to collecting data.

Study tools

A separate predesigned paper-based data collection sheet was used to enter data for each police officer. The police personnel first reported at the designated desks to note their personal details (such as name, age, gender, police station, police identity number, date, and serial number). After the initial personal data were collected, the police personnel were guided to trained nurses to measure their height, weight, body mass index (BMI), random blood sugar, and blood pressure. Plasma glucose was estimated using glucose oxidase method. Blood pressure was recorded on right arm by mercury sphygmomanometer (Rossmax, Serial no: 15C081000057, HSN code: 9018) in a sitting position after 5-minute rest. All blood pressure measurements were taken between 10:30 am and 2:00 pm. The personnel were then guided to the principal investigator (DC) to take medical history related to diabetes mellitus and hypertension.

Statistical analysis

Continuous variables were expressed as mean ± standard deviation or median (minimum–maximum), where applicable, whereas nominal data were expressed as number and percentages. Hypertension was defined as systolic blood pressure (SBP) of > = 140 mmHg and/or diastolic blood pressure (DBP) of > = 90 mmHg.[18] Based on random blood sugar testing, patients were classified into normal (<140 mg/dl), prediabetic (140-199 mg/dl) and diabetic (> = 200 mg/dl) groups.[19] In accordance with the WHO recommendations,[20] BMI was categorized as: <18.5 kg/m^2 = underweight; 18.5 to 24.9 kg/m^2 = normal; 25.0 to 29.9 kg/m^2 = overweight; and > 30.0 kg/m^2 = obesity. Age was categorized as: <25 years, 25-34 years, 35-44 years, 45-54 years and > = 55 years.

Binary logistic regression was used to quantify the relationship between the independent variables (age, gender, and BMI) and the dichotomous dependent variables (diabetes and hypertension). Evaluation of the binary logistic regression model included overall goodness-of-fit (Chi-square omnibus test of model coefficients and Hosmer and Lemeshow Chi-square) tests and a classification table showing the percentage of correct predictions. Multicollinearity was assessed using tolerance and variance inflation factor to ensure that it was not significantly affecting the model coefficients.[21] All data were analyzed using IBM SPSS version 28.0 (IBM, Armonk, NY, USA).

Table 1: Patient characteristics (*n*=3474)

Characteristic	Categories	Number (Percent)
Age (years)		
	<25	55 (1.6)
	25-34	1078 (31)
	35-44	893 (25.7)
	45-54	951 (27.4)
	>=55	497 (14.3)
Gender		
	Males	2999 (86.3)
	Females	475 (13.7)
BMI (kg/m^2)		
	Underweight (<18.5)	41 (1.2)
	Normal (18.5–24.9)	1048 (30.2)
	Overweight (25–29.9)	1692 (48.7)
	Obese (>=30)	693 (19.9)
Diabetes		
	No diabetes	2461 (70.8)
	Prediabetes	666 (19.2)
	Diabetes	347 (10)
Hypertension		
	No	1555 (44.8)
	Yes	1919 (55.2)
Known cases of diabetes		
	No	3103 (89.3)
	Yes	371 (10.7)
Known case of hypertension		
	No	2937 (84.5)
	Yes	537 (15.5)
Characteristic	**Mean (standard deviation)**	**Median (range)**
Age (years)	41.6 (10.1)	40 (17–67)
BMI (kg/m^2)	26.9 (3.9)	26.6 (15.6–40.7)

BMI, body mass index; kg/m^2, kilograms per meter squared

Results

Patient characteristics

A total of 3474 personnel (out of 7050) from 47 police stations in Mumbai were evaluated. The remaining 3576 police personnel were either on the field or on leave on the day of the evaluation. Table 1 shows the characteristics of the study population. Of a total of 3474 police personnel studied, 86.3% were males while 13.7% were females. The mean age was 41.6 years. 48.7% participants were overweight while 19.9% were obese. The mean BMI was 26.9 kg/m^2. With respect to the main study outcomes, 29.2% participants were either pre-diabetic or diabetic and 55.2% were hypertensive.

Of a total of 371 participants with a known history of diabetes, 213 (57.4%) were found to have elevated random blood sugar level (> = 200 mg/dl) at the time of the study, suggesting poorly controlled diabetes. Similarly, of a total of 537 participants with a known history of hypertension, 433 (80.6%) were found to have elevated blood pressure (SBP of > = 140 mmHg and/or DBP of > = 90 mmHg), suggesting poorly controlled hypertension.

Prevalence of diabetes and hypertension stratified by gender, age, and BMI

Male gender was significantly associated with a higher prevalence of diabetes and hypertension, as shown in Table 2. A significantly greater proportion of males (31.1%) were pre-diabetic or diabetic compared to females (17%); $P < 0.001$. Similarly, a significantly greater proportion of males (60.4%) were hypertensive compared to females (22.5%); $P < 0.001$.

Older age was significantly associated with a higher prevalence of diabetes and hypertension, demonstrating a clear exposure-response gradient [Table 2]. The prevalence of prediabetes or diabetes was 1.8%, 13.2%, 22.9%, 40.7% and 56% in <25, 25-34, 35-44, 45-54 and > = 55 age groups respectively; $P < 0.001$. Similarly, the prevalence of hypertension was 20%, 37.5%, 53.5%, 67.9%, and 76.5% in <25, 25-34, 35-44, 45-54 and > = 55 age groups respectively; $P < 0.001$.

Higher BMI was significantly associated with a higher prevalence of diabetes and hypertension, demonstrating a clear exposure-response gradient [Table 2]. The prevalence of prediabetes or diabetes was 0%, 23.3%, 28.9%, and 40.4% in underweight, normal, overweight, and obese categories, respectively; $P < 0.001$. Similarly, the prevalence of hypertension was 9.8%, 40.5%, 58.5%, and 72.3% in underweight, normal, overweight, and obese categories respectively; $P < 0.001$.

Predictors of diabetes and hypertension

Male gender, higher age, and obesity were significantly associated with a greater likelihood of diabetes on univariate analysis, however, upon multivariate analysis, only higher age and obesity retained their statistical significance [Table 3]. In the adjusted analysis, participants with > = 55 years of age were 7.9 times more likely to have diabetes compared to those with < = 34 years of age. Similarly, obese individuals were 1.6 times more likely to have diabetes compared to those with normal BMI.

Male gender, higher age, and obesity were significantly associated with a greater likelihood of hypertension both on univariate as well as multivariate logistic regression analysis [Table 3]. Males were 3.3 times more likely to have hypertension as compared to females in the adjusted analysis. Similarly, participants with > = 55 years of age were 3.7 times more likely to have hypertension compared to those with < = 34 years of age. Finally, overweight and obese individuals were 1.7 and 3.1 times respectively more likely to have hypertension compared to those with normal BMI in the adjusted analysis.

Discussion

There are several key findings of this study. The prevalence of prediabetes/diabetes and hypertension was 29.2% and 55.2%, respectively. In total, 48.7% of police personnel were overweight while 19.9% were obese, which amounts to a staggering ~ 70% prevalence of overweight status/obesity in this population. While

Table 2: Prevalence of diabetes and hypertension stratified by gender, age, and BMI (*n*=3474)

	Gender					*P*
	Males (*n*=2999)			Females (*n*=475)		
Diabetes						
No diabetes	2067 (68.9%)			394 (82.9%)		<0.001
Prediabetes	606 (20.2%)			60 (12.6%)		
Diabetes	326 (10.9%)			21 (4.4%)		
Hypertension						
No	1187 (39.6%)			368 (77.5%)		
Yes	1812 (60.4%)			107 (22.5%)		<0.001
	Age (years)					
	<25 (*n*=55)	25-34 (*n*=1078)	35-44 (*n*=893)	45-54 (*n*=951)	>=55 (*n*=497)	
Diabetes						
No diabetes	54 (98.2%)	936 (86.8%)	688 (77%)	564 (59.3%)	219 (44.1%)	<0.001
Prediabetes	1 (1.8%)	127 (11.8%)	161 (18%)	236 (24.8%)	141 (28.4%)	
Diabetes	0 (0%)	15 (1.4%)	44 (4.9%)	151 (15.9%)	137 (27.6%)	
Hypertension						
No	44 (80%)	674 (62.5%)	415 (46.5%)	305 (32.1%)	117 (23.5%)	
Yes	11 (20%)	404 (37.5%)	478 (53.5%)	646 (67.9%)	380 (76.5%)	<0.001
	BMI (kg/m^2)					
	Underweight (*n*=41)		Normal (*n*=1048)	Overweight (*n*=1692)	Obese (*n*=693)	
Diabetes						
No diabetes	41 (100%)		804 (76.7%)	1203 (71.7%)	413 (59.6%)	<0.001
Prediabetes	0 (0%)		163 (15.6%)	329 (19.4%)	174 (25.1%)	
Diabetes	0 (0%)		81 (7.7%)	160 (9.5%)	106 (15.3%)	
Hypertension						
No	37 (90.2%)		624 (59.5%)	702 (41.5%)	192 (27.7%)	
Yes	4 (9.8%)		424 (40.5%)	990 (58.5%)	501 (72.3%)	<0.001

BMI, body mass index; kg/m^2, kilograms per meter squared. Numbers in parentheses are column percentages and add up to 100

Table 3: Predictors of diabetes and hypertension: logistic regression (*n*=3474)

Variables	Diabetes[1]			Hypertension		
	Unadjusted OR (95% CI)	Adjusted OR (95% CI)	*P*[3]	Unadjusted OR (95% CI)	Adjusted OR (95% CI)	*P*[3]
Gender						
Females (reference)						
Males	2.2 (1.7 – 2.8)	1.01 (0.77 – 1.3)	0.92	5.3 (4.2 – 6.6)	3.3 (2.5 – 4.2)	<0.001
Age (years)[2]						
<=34 (reference)						
35-44	2.1 (1.6 – 2.6)	1.9 (1.5 – 2.4)	<0.001	2.0 (1.7 – 2.4)	1.4 (1.2 – 1.7)	<0.001
45-54	4.8 (3.8 – 5.9)	4.3 (3.4 – 5.4)	<0.001	3.7 (3.1 – 4.4)	2.5 (2.0 – 3.0)	<0.001
>=55	8.8 (6.9 – 11.3)	7.9 (6.2 – 10.4)	<0.001	5.6 (4.4 – 7.1)	3.7 (2.8 – 4.7)	<0.001
BMI (kg/m^2)						
Normal (reference)						
Overweight	1.3 (1.1 – 1.6)	1.1 (0.94 – 1.4)	0.19	2.1 (1.8 – 2.4)	1.7 (1.5 – 2.0)	<0.001
Obese	2.2 (1.8 – 2.8)	1.6 (1.3 – 2.1)	<0.001	3.8 (3.1 – 4.7)	3.1 (2.5 – 3.8)	<0.001

BMI, body mass index; CI, confidence interval; kg/m^2, kilograms per meter squared; OR, odds ratio. [1]Prediabetes and diabetes were combined into one outcome category for the purpose of this analysis. [2]Since there were only 55 participants in <25 category, they were merged with the 25-34 category for the purpose of this analysis. [3]*P* values are reported for the adjusted analyses. Adjusted model included all three variables: age, gender and BMI

prevalence estimates of this study are generally in line with those reported in the previous studies, it is worth noting that there is a wide variation in the estimates reported in the literature. The prevalence of hypertension ranges from 5%[9] to 58.5%,[16] diabetes from 2.6%[9] to 34.7%[15] and overweight status/obesity from 37%[9] to 65.6%.[17] This variation could be accounted, in part, by the differences in methodological parameters such as study population, sample size, cut-offs used to define diabetes and hypertension, study period, and geographic location across studies. Only 3 studies[11,12,15] in the existing literature have a sample size greater than 1000, whereas only 1 study[12] has a sample size greater than 2000. A sample size of approximately 3500 in the current study provides highly reliable prevalence estimates of these lifestyle disorders in the police personnel of India.

Male gender, 55+ age group, and obesity were significantly associated with approximately 3-fold greater likelihood of hypertension independent of each other. With respect to diabetes, 55+ age group and obesity were identified as the key independent risk factors, conferring approximately 8- and 1.5-times greater risk, respectively. While gender and age are non-modifiable risk factors, BMI is one critical factor that can be modified using a combination of healthy dietary habits and an active non-sedentary lifestyle.

The extraordinary health specifications required for recruitment in the police force, and the subsequent intense physical training indicate that at the time of enrolment, the policemen are among the fittest people in the community. The deterioration of their health after several years of service is indicative of the extent of occupational hazards of working as a policeman and warrants immediate attention. The findings of this study emphasize the need for early detection, regular surveillance, and lifestyle modifications in this important occupational group of the society.

Any serious effort to improve the overall health of policemen would require major administrative changes such as increasing the manpower so that a shift duty pattern can be implemented and outsourcing of some of the non-core policing functions. Free workshops on managing stress, meditation, and promoting healthy lifestyles should be conducted on regular basis.[22,23] Exercise programs should be structured according to age and physical condition and should include both aerobic as well as dynamic resistance training. Finally, regular reinforcement of dietary education customized according to the socio-cultural conditions will assist in weight management, better control of blood sugar, and prevention of diabetic complications.[24]

We acknowledge the limitations of this study. First, this is a cross-sectional study which can only provide evidence on associations and not causation. Second, the assessment of random blood sugar and blood pressure on a single occasion can lead to mis-classification bias. Third, due to feasibility constraints, we did not collect data on other risk factors (such as dietary history, presence of other comorbidities, physical inactivity, and current medication use) that could potentially impact the study outcomes. Future large-scale prospective studies are needed to investigate the effect of specific preventive interventions in reducing the burden of diabetes and hypertension in this population.

Despite these limitations, the present study has some unique strengths. The biggest strength is a large sample size of 3474 police personnel from approximately 50% (47 out of 93) of all police stations in Mumbai. These 3474 police personnel account for approximately 25% of the entire police population in the city of Mumbai. Consequently, we believe that prevalence estimates of this study are truly population-based and unlikely to suffer from selection bias, a problem that frequently plagues observational research. That said, the possibility of selection bias cannot be ruled out completely since we do not have comparative baseline demographic data on police personnel who couldn't participate in this study. Another strength of this study is no missing data for the entire study sample. This study provides the much-needed scientific evidence on the health status of policemen in India and can form the basis for planning interventional strategies to improve their health and eventually lead to more efficient policing.

Conclusion

This study demonstrates a high prevalence of cardiovascular risk factors such as diabetes, hypertension, and obesity among the police personnel in Mumbai, India. Future studies should focus on investigating the effectiveness of lifestyle modifications in reducing morbidity in this important and vulnerable occupational group.

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Conflicts of interest

There are no conflicts of interest.

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