

Prevalence of Metabolic Syndrome in Healthcare Workers: A Cross-Sectional Study Using Baseline Data of the SUMS Employees Health Cohort Study (SUMS EHCS) in South of Iran

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ABSTRACT

Introduction: Shift work, a characteristic of healthcare workers' jobs, is recognized as a contributing factor to various health conditions, particularly metabolic syndrome. However, the risk of this medical condition is still understudied among shift workers in the healthcare sector. This study investigated metabolic syndrome and its components in the "Shiraz University of Medical Sciences Employees Health Cohort Study" (SUMS EHCS), a branch of the PERSIAN cohort study in the south of Iran.

Methods: This cross-sectional study utilized baseline data from 5,903 participants in the SUMS EHCS. The ATP III criteria were applied to diagnose metabolic syndrome, which requires the elevated triglycerides, low HDL cholesterol, high blood pressure, and elevated fasting plasma glucose. Statistical analyses were conducted using Poisson regression models and STATA software.

Results: The prevalence of metabolic syndrome was 23.50%, with abdominal obesity identified as the most common component (50.5%). The presence of underlying diseases was significantly associated with the diagnosis of metabolic syndrome in both univariable (prevalence ratio (PR) = 1.93 [95% confidence interval (CI): 1.74, 2.14]; $P < 0.001$) and multivariable analyses (adjusted PR (aPR) = 1.94 [95% CI: 1.75, 2.15]; $P < 0.001$). No significant association was found between modifiable lifestyle factors and metabolic syndrome ($P > 0.05$).

Conclusion: The similar prevalence of metabolic syndrome in healthcare workers compared to the general population highlights the need for similar preventive and curative health strategies, particularly focusing on underlying medical conditions to improve the metabolic health of healthcare workers.

Key words: Metabolic syndrome; Occupational health; Healthcare workers; Cohort

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INTRODUCTION

Metabolic syndrome is known as the driver of non-communicable diseases (NCD), which are now major health challenges for humans.¹ It defines as a cluster of risk factors that can directly facilitate the onset of several diseases such as diabetes, arteriosclerotic cardiovascular disease, fatty liver, and certain cancers.² The prevalence of metabolic syndrome has been steadily increasing in both developed and developing countries,^{3,4} impacting approximately one-quarter of the world's population.⁵ In accordance with this global burden, the Iranian population has also seen a rising trend in metabolic syndrome prevalence, with roughly one-third of adults affected⁶ Furthermore, approximately 5% of adults in the capital city develop the syndrome annually.⁷

The increasing global prevalence of metabolic syndrome is attributed to sedentary lifestyles,⁸ unhealthy diet,⁹ inadequate sleep, environmental chemical exposure,^{10, 11} and chronic occupational stress.¹² Shift workers, who represent a significant portion of healthcare professionals, face a heightened risk of metabolic syndrome due to the nature of rotating shifts.¹³ These shifts are known to disrupt biological functions, including circadian rhythms and hormonal balance, leading to various health issues such as type 2 diabetes, obesity, cardiovascular diseases, high blood pressure, and mental health problems.^{11, 14, 15} Studies have shown an increased relative risk of cardiovascular diseases, as well as the cardiovascular deaths, among night shift workers, emphasizing the impact of irregular work schedules on health outcomes.¹⁶ Several studies have indicated that occupational factors such as shift work, excessive sitting time, and sedentary occupations significantly increase the risk of metabolic syndrome and its components,¹⁷⁻²⁰ with a clear dose-response relationship linked to the length of exposure.²¹ However, these studies often involve employees from diverse industries and lack a concentrated focus on healthcare professionals. Healthcare workers are crucial to study because their occupational stressors²² such as extended work hours and night shifts are notably intense compared to other professions. Additionally, their health directly affects their capacity to care for others. Despite the critical importance from both policy and intervention perspectives, there is limited research examining how these occupational factors specifically impact the prevalence of metabolic syndrome among healthcare professionals. Bridging this gap can guide targeted interventions and workplace policies to mitigate these risks.

The present study aimed to determine the prevalence of metabolic syndrome and its components among employees participating in the “Shiraz University of Medical Sciences Employees Health Cohort Study” (SUMS EHCS), a branch of the PERSIAN Cohort Study in southern Iran. Although the current analysis was based on the baseline phase of this cohort and therefore had a cross-sectional nature, the cohort framework enhances methodological strength by using prospectively collected, standardized data, comprehensive exposure and outcome assessments, and rigorous quality control procedures. These features reduce the likelihood of recall bias and measurement error, providing more valid estimates compared with conventional cross-sectional surveys. By focusing specifically on healthcare workers within this well-established cohort, the study offers valuable insights into occupational influences on metabolic health while maintaining conceptual alignment with the broader aims of NCD surveillance in Iran.

METHODS

Participants

This cross-sectional study was based on baseline data from participants aged 20 to 70 years who enrolled in the Shiraz University of Medical Sciences Employees Health Cohort Study (SUMS EHCS) between 2017 and 2022. SUMS EHCS is an ongoing prospective cohort launched in 2017 to investigate various health parameters among the employed population of Shiraz University of Medical Sciences (SUMS), Iran. The study population included employees from administrative, healthcare, and clinical settings, representing a wide range of occupational groups across the university. All permanent, contractual, and temporary employees of SUMS who actively worked during the baseline phase and provided written informed consent were eligible. The study employed census sampling, including participants who had complete data on demographic characteristics, anthropometric measurements, underlying diseases, and biochemical tests. Participants were excluded if they were pregnant or had major physical or psychological disabilities that prevented accurate health assessment. After the application of these criteria, a total of 5,903 participants remained for the final analysis in this study. All procedures were approved by the Research Ethics Committee of Shiraz University of Medical Sciences (ethics code: IR.SUMS.REC.1401.455), and written informed consent was obtained from all participants at enrollment as part of the national PERSIAN Cohort framework.

Measurements

Participants completed a general questionnaire covering demographic factors, occupational status, past medical history (with a focus on non-communicable diseases), and personal habits, including smoking history, opium and hookah use, as well as alcohol consumption. Additionally, physical activity levels were assessed using the International Physical Activity Questionnaire (IPAQ). Anthropometric measurements, including height, weight, and waist circumference, were taken in the morning while participants were in a fasting state using US National Institutes of Health protocol. Blood pressure readings, including Systolic and Diastolic measurements, were recorded using the InBody BPBIO 320 digital device in a fasting state. After a 12-hour fasting period, blood samples were collected using Vacutainers (KANG JIAN, China, (K2EDTA-9ml), Golden Vac, China, (K2EDTA-3ml), AYSET TUBE, Turkey, (Clot Activator-6ml)). The clinical laboratory tests included measurements of fasting blood sugar levels, total cholesterol concentration, high-density lipoprotein cholesterol concentration, low-density lipoprotein cholesterol concentration, and triglyceride levels. We used ATP III criteria for the diagnosis of metabolic syndrome.²³ The diagnosis of metabolic syndrome is established when an individual presents with three or more of the following conditions: a waist circumference of at least 102 cm in men and 88 cm in women, serum triglyceride levels of 150 mg/dL or higher or ongoing drug treatment for elevated triglyceride, HDL cholesterol levels below 40 mg/dL in men and 50 mg/dL in women or ongoing drug treatment for reduced HDL-C, blood pressure readings of 130/85 mmHg or higher or ongoing treatment for hypertension, and fasting plasma glucose levels of 100 mg/dL or higher or ongoing drug treatment for elevated glucose. Data on ongoing drug treatment were collected by trained nurses through standardized interviews and verified using the participants' medical records.

in the SUMS health database.

Statistical Analysis

The study utilized baseline data from the PERSIAN cohort. Descriptive statistics were used to report categorical variables as proportions and continuous variables as mean (with standard deviation). To assess the relationship between metabolic syndrome and background factors, robust Poisson regression was employed. Crude and adjusted prevalence ratios (aPRs) were calculated, adjusting for baseline characteristics. Statistical significance was set at $p < 0.05$. The statistical analysis was performed using STATA software (version 17.0, Stata Corp). Multicollinearity among predictors was assessed using the Variance Inflation Factor (VIF). The goodness of fit for the Poisson model was evaluated using the deviance statistics and the Akaike Information Criterion (AIC). Poisson regression with robust variance was selected because it provides stable convergence and directly estimates prevalence ratios (PRs), which are more interpretable in cross-sectional studies with common outcomes such as metabolic syndrome. Log-binomial models often face convergence issues, and modified Cox models require survival-type data, which were not applicable here.

RESULTS

A total of 5,903 health workers included into the study. Biochemical data were complete for the vast majority of participants, and individuals with missing values were excluded from analyses requiring those variables. Their mean age was 41.17 ± 6.98 years and 56.4 % of them were female. The average physical activity of the participants was 4330.52 MET-min/week and most of them (56.8%) had one or more underlying disease. Table 1 shows the demographic and medical characteristics of EHCS participants.

The prevalence of metabolic syndrome was 23.50% [95% CI: 22.28,24.77]. Abdominal obesity was the most common component of metabolic syndrome (50.5% [95% CI: 47.8, 53.1]) (Table 1).

Table 1. Frequency of metabolic syndrome components in EHCS participants (n = 5,903) according to demographic and medical characteristics

Variable	Total (N = 5,903)	Metabolic syndrome diagnosis (N=1,387)
Metabolic syndrome component		
Low HDL-C Levels	2,852 (48.1[47.0-49.6]) ¹	678 (48.9[46.3-51.5])
Hypertriglyceridemia	1,870 (31.6[30.5-32.9])	445 (32.1[29.6-34.5])
Hyperglycemia	938 (15.8[15.0-16.8])	214 (15.4[13.5-17.3])
Hypertension	688 (11.6[10.8-12.5])	419 (30.2[27.8-32.6])
Abdominal obesity	2,912 (49.3[48.1-50.6])	700 (50.5[47.8-53.1])
Sex		
Male	2,571 (43.6) ²	590 (42.5)
Female	3,332 (56.4)	797 (57.5)
Age group		
21-30	224 (3.8)	46 (3.3)
31-40	2,748 (46.4)	689 (49.7)

Table 1 (continued).

Variable	Total (N = 5,903)	Metabolic syndrome diag-nosis (N=1,387)
41-50	2,296 (38.8)	510 (36.8)
51-60	619 (10.5)	133 (9.6)
> 60	33 (.6)	7 (0.5)
Education		
Elementary School	237 (.4)	48 (3.5)
Middle School	302 (5.1)	75 (5.4)
High School diploma	1,104 (18.6)	257 (18.5)
Associate degree	600 (10.1)	144 (10.4)
College education	3,681 (62.1)	863 (62.2)
Marital Status		
Single	870 (14.7)	222 (16.0)
Married	4,736 (80.2)	1,102 (79.5)
Widowed	66 (1.1)	12 (0.9)
Divorced	230 (3.9)	51 (3.7)
Other	1 (.01)	0 (0)
Underlying disease		
Yes	3,350 (56.8)	995 (71.7)
No	2,553 (43.2)	392 (28.3)
Employment Status		
Official	2,674 (45.4)	622 (44.8)
Treaty	330 (5.6)	88 (6.3)
Contractual	2,741 (46.5)	645 (46.5)
Corporate	146 (2.5)	32 (2.3)
High-risk behaviors		
Opium use	860 (1.5)	19 (1.4)
Hookah use	785 (13.3)	168 (12.1)
Alcohol use	303 (5.1)	65 (4.7)
Ex-smoker	195 (3.3)	41 (3.0)
Current smoker	399 (6.8)	92 (6.6)
Occupational group		
Administrative	1,958 (33.2)	482 (34.8)
Clinical therapeutic	2,098 (35.6)	482 (34.8)
Public Service	819 (13.9)	185 (13.3)
Technical and maintenance	223 (3.8)	64 (4.6)
Laboratory staff	323 (5.5)	46 (3.3)
Guarding	245 (4.2)	77 (5.6)
Other	67 (1.1)	51 (3.7)
Work Experience, year 3	16.94 (6.49)	16.70 (6.46)
MET Levels, MET-min/week 3		
Vigorous activities	487.42 (1649.14)	521.53 (1805.53)
Moderate activities	1174.13 (2406.63)	1125.25 (2363.27)
Walk	2668.97 (2848.84)	2656.65 (2913.19)
Met Total	4330.52 (5293.83)	4303.43 (5448.58)

HDL-C, High-Density Lipoprotein Cholesterol; Met, Metabolic Equivalent of Task; Underlying disease include: Renal disease, Less serious liver diseases, Psychiatric disease, Thyroid disease, Chronic headache Cardiovascular disease, COPD, Rheumatologic disease, Neurologic disease, Cancer and Serious liver disease

1 N (% [95% CI]); 2 N (%); 3 Mean (SD)

The prevalence of metabolic syndrome was evaluated by age, sex, education, marital status, underlying disease, employment status, work experience, occupational groups, and high-risk behaviors (such as smoking) and physical activity. Multicollinearity diagnostics showed a mean VIF of 1.68, confirming the absence of multicollinearity among independent variables. The results show that there is a statistically significant association between the presence of underlying disease and the prevalence of metabolic syndrome (PR = 1.93 [95% CI: 1.74, 2.14]; $P < .001$). This association remained significant even after adjusting for other variables (aPR = 1.94 [95% CI: 1.75, 2.15]; $P < .001$) (Table 2). In the univariable Poisson regression analysis, none of the demographic or lifestyle factors, including age, sex, education, marital status, smoking, alcohol, or opium use, showed a significant association with metabolic syndrome. In both univariable and multivariable models, only the presence of underlying disease remained significantly associated with metabolic syndrome.

Table 2. Crude and adjusted Associations between Metabolic syndrome and baseline characteristics in EHCS cohort study

Variable	Univariable Poisson regression models			Multivariable Poisson regression model		
	PR	95% CI	P	aPR	95% CI	P
Age	0.99	0.98–0.99	0.03	0.99	0.98–1	0.21
Sex						
Male	Ref					
Female	1.04	0.94–1.14	0.38			
Education						
College education	Ref					
Elementary School	0.86	0.66–1.11	0.27			
Middle School	1.05	0.85–1.29	0.60			
High School diploma	0.99	0.88–1.12	0.93			
Associate degree	1.02	0.87–1.19	0.78			
Marital Status						
Single	ref			ref		
Married	0.91	0.80–1.03	0.14	0.90	0.79–1.02	0.11
Widowed	0.71	0.42–1.20	0.20	0.74	0.44–1.24	0.25
Divorced	0.86	0.66–1.13	0.30	0.87	0.67–1.14	0.34
Underlying disease						
No	ref			ref		
Yes	1.93	1.74–2.14	<.001	1.94	1.75–2.15	<.001
Employment Status						
Official	ref			ref		
Treaty	1.14	0.94–1.38	0.16	1.11	0.91–1.35	0.29
Contractual	1.01	0.91–1.11	0.81	0.93	0.82–1.05	0.29
Corporate	0.94	0.68–1.28	0.71	0.82	0.58–1.17	0.28
Work Experience	0.99	0.98–1	0.09	0.99	0.98–1.01	0.80
Occupational group						
Administrative	ref			ref		
Clinical therapeutic	0.93	0.83–1.04	0.20	.89	0.80–1	0.07
Public Service	0.91	0.79–1.06	0.25	.95	0.78–1.16	0.73
Technical and maintenance	1.16	0.93–1.45	0.17	1.17	0.92–1.48	0.13
Laboratory staff	0.83	0.63–1.08	0.17	.78	0.60–1.02	0.07

Table 2 (continued).

Variable	Total (N = 5,903)			Metabolic syndrome diagnosis (N=1,387)		
Guarding	0.96	0.78 –1.19	0.76	.98	0.79 –0.22	0.96
Other	0.84	0.65 – .09	0.20	.84	0.65 –0.08	0.16
Opium use						
No	ref					
Yes	1.06	0.71 –1.58	0.76			
Hookah use						
No	ref			ref		
Yes	1.11	0.96 –1.28	0.14	1.11	0.97 –1.28	0.12
Alcohol use						
No	ref					
Yes	1.09	0.88 –1.37	0.39			
Smoking						
Never smoker	ref					
Ex-smoker	0.89	0.67 –1.17	0.40			
Current smoker	0.97	0.81 – .17	0.80			
MET Total	0.99	0.99 – 1	0.85			

Deviance goodness-of-fit =3859.47

Akaike Information Criterion (AIC)=6663.47

Mean VIF:1.63

DISCUSSION

Metabolic syndrome is a significant concern for healthcare workers, affecting both their health and professional performance. In this study, we aimed to evaluate the prevalence of metabolic syndrome among healthcare workers in south of Iran using baseline data from the PERSIAN Cohort of Healthcare Workers.

The prevalence of metabolic syndrome in our study was 23.50% [95% CI: 22.28,24.77]. This rate is consistent with previous studies conducted among healthcare workers globally^{18, 19} and close to the prevalence reported in the general population of Iran.^{21, 24} This finding suggests that healthcare workers have a similar risk of developing metabolic syndrome compared to individuals in the general population.

The most prevalent component of metabolic syndrome in our study was abdominal obesity, closely followed by low HDL-C levels. This finding is in line with previous studies that have consistently recognized abdominal obesity as a key contributor to the development of metabolic syndrome.^{23, 25} Abdominal obesity is strongly related to insulin resistance and dyslipidemia, which are central features of metabolic syndrome.²⁶ Therefore, there is a need for addressing abdominal obesity through lifestyle modifications to reduce the prevalence of metabolic syndrome.

Regarding the association between metabolic syndrome and baseline characteristics of healthcare workers, the multivariable Poisson regression model showed that only the presence of underlying

disease remained independently associated with metabolic syndrome after adjustment for potential confounders. Healthcare workers with one or more underlying conditions had nearly a two fold higher prevalence of metabolic syndrome compared with those without such diseases. Underlying comorbidities—including renal, hepatic, psychiatric, cardiovascular, neurologic, rheumatologic, pulmonary, and thyroid disorders—were strongly linked to a higher prevalence of metabolic syndrome, consistent with findings from previous studies.²⁷⁻³¹

While physical activity has been consistently linked to improved insulin sensitivity, better lipid profiles, and reduced blood pressure—key factors in metabolic syndrome—our findings challenge this association.³¹⁻³⁴ One possible explanation for this unexpected result could be the self-reported nature of physical activity data. Future research utilizing more objective measurements of physical activity may provide more reliable and precise data regarding this matter. This unexpected lack of association between physical activity and metabolic syndrome warrants closer examination. Beyond the self-reported nature of our physical activity data, several factors may explain this discrepancy. First, healthcare workers often report high levels of physical activity due to their occupational requirements, yet this activity may be insufficient in intensity or duration to confer metabolic benefits. Second, the cross-sectional design of our study may not capture the long-term effects of consistent exercise on metabolic parameters. Third, the potential "compensation effect," where individuals who exercise may subsequently increase caloric intake or reduce other forms of physical activity throughout the day, could negate the metabolic benefits of planned exercise sessions.^{35, 36} Finally, the timing of physical activity relative to work shifts, particularly among night shift workers, may impact its metabolic effects, as exercise during biologically inappropriate times may not provide the same benefits.³⁷

In this study, we did not find significant associations between lifestyle factors such as smoking, alcohol consumption, and opium use and metabolic syndrome. Although this finding contradicts some previous reports,³⁸⁻⁴⁰ several factors may explain these non-significant results. Underreporting of these behaviors due to social desirability bias among healthcare professionals,⁴¹ their low prevalence in our sample, and the possible "healthy worker effect"—where individuals with severe substance-related conditions may have exited the workforce—could collectively contribute to this outcome.^{42, 43} From a biostatistical perspective, the limited variability and small cell counts for these exposures likely resulted in wide confidence intervals and reduced statistical power, which may have hindered the detection of true associations. Nevertheless, these behaviors carry well-established health risks beyond metabolic syndrome, and promoting healthier habits remains essential.⁴⁴

The findings of this study should be interpreted in light of certain limitations. Firstly, the cross-sectional design restricts our ability to establish causal relationships between the variables; future longitudinal investigations would provide more robust evidence regarding temporal associations. Secondly, self-reported information on lifestyle behaviors may have introduced recall bias. Moreover, potential selection bias could have arisen from the voluntary participation of healthcare workers, which may limit the generalizability of our findings. Residual confounding from unmeasured occupational factors—such as shift length, workload, and psychosocial stress—might also have affected the observed associations. Additionally, model fit indices were not reported due to the descriptive purpose of the

Poisson regression model applied. Finally, clustering effects within workplaces were not accounted for, which may have led to an underestimation of standard errors.

CONCLUSION

Our study showed a prevalence of 23.5% for metabolic syndrome among healthcare workers in southern Iran. Among all examined factors, only the presence of underlying diseases was associated with a higher prevalence of metabolic syndrome, while age and other demographic or lifestyle variables were not significantly associated. Additionally, abdominal obesity and low HDL-C levels were the most prevalent components of metabolic syndrome. Although physical activity and lifestyle factors did not show significant associations in this cross-sectional analysis, promoting healthier behaviors may help improve metabolic health among healthcare workers. Workplace wellness initiatives—including balanced dietary programs, regular physical activity promotion, stress-management workshops, and schedule adjustments to mitigate shift work effects—could contribute to better metabolic outcomes in this population. Finally, as this study was conducted among healthcare workers within a regional cohort in southern Iran, the findings may not be fully generalizable to other populations or occupational groups.

Ethical Consideration

All procedures were approved by the Research Ethics Committee of Shiraz University of Medical Sciences (ethics code: IR.SUMS.REC.1401.455), and written informed consent was obtained from all participants at enrollment as part of the national PERSIAN Cohort framework.

Data Availability

The corresponding author can provide the data upon request.

Conflict of Interest

The authors declare that they have no competing interests.

Funding Information

This study was financially supported by Shiraz University of Medical Sciences (code: 26496).

ACKNOWLEDGMENT

All authors listed meet the International Committee of Medical Journal Editors (ICMJE) criteria for authorship. They take full responsibility for the integrity of the work as a whole and have given their

approval for this version to be published.

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