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Association Between Socio-Economic Status (SES) and the Traditional Risk Factors of Cardiovascular Diseases (CVD): A Cross-Sectional MASHAD Cohort Study Results

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ABSTRACT

Background and Aims: Socio-economic status (SES) has been shown to be associated with cardiovascular disease. We aimed to investigate the relationship between SES and traditional risk factors for cardiovascular diseases in 35 to 65 adults of the MASHAD cohort study drawn from the second biggest city in Iran, Mashhad with a population of almost 3 million.

Methods: In this cross-sectional study, subjects were divided into three categories of SES status based on their education level, employment status, and monthly income using latent class analysis (LCA). The three SES of low, medium, and high classes were compared in terms of cardiovascular disease risk factors including diabetes mellitus, metabolic syndrome, obesity, dyslipidemia, and hypertension. p value less than 0.05 was considered as significant.

Results: A total number of 9704 participants were included in the study. According to goodness-of-fit measures and entropy the three-class model is the most optimal and suitable model here. Participants with a low SES had significantly lower means of age, physical activity level, waist circumference, systolic blood pressure and LDL-C, and higher means of weight, and hip circumferences. Also, the prevalence of smoking, hypertension and metabolic syndrome were lower in low SES group than the two other groups. Logistic regression showed that the odds of obesity in the high SES class was 1.3-fold higher than for the middle SES class. Moreover, the chance of metabolic syndrome and hypertension in the low SES class was respectively 0.81 and 0.83 of the middle SES class.

Conclusion: Lower socio-economic was associated with metabolic syndrome and hypertension and obesity was associated with higher SES; it may therefore be necessary to develop more specific and personalized preventive policies for populations in each socio-economic class.

Fatemeh Sadabadi and Nasrin Talkhi are equally contributed to this study.

Summary

- The odds of obesity in the high socio-economic status (SES) class was 1.3-fold higher than for the middle SES class.
- The odds of metabolic syndrome and hypertension in the low SES class was respectively 0.81 and 0.83 of the middle SES class.

1 | Introduction

Socio-economic status (SES) is defined as an individual or group's position in a social environment and is assessed by different variables such as education level, income, job status, and residential location [1, 2]. SES, especially educational attainment, is associated with overall health; however, the underlying mechanism for how low SES leads to poor health is not fully understood [3]. Multiple studies have illustrated the association between SES and mental health, oral health, diabetes, obesity, and cardiovascular diseases (CVDs) [4–8], which have showed the necessity of setting new health policies to curtail the increasing prevalence of chronic diseases and provide better health care [9].

CVD is the leading cause of death in the world and its burden is rising among low-income and middle-income countries (LMICs), mostly affecting younger people [10]. Several studies have indicated that low education level and low income were related to a higher rate of cardiovascular events and mortality [11, 12]. Traditional cardiovascular risk factors such as hypertension, diabetes mellitus, smoking, and dyslipidemia strongly correlate with CVD and overall mortality [13], and some studies have addressed the correlation between SES and these traditional risk factors [14–16]. While most of the CVD burden (almost 80%) is imposed on LMICs [17], most of the studies have been carried out in HICs, and those studies in LMICs had limitations such as small sample sizes, along with inconsistent findings [11, 18, 19]. In addition, findings from HICs may not be extensible to LMICs [20] and the majority of previous research evaluated only one parameter of SES (mostly income or education level) [21]. Therefore, more studies are needed to be carried out in LMICs to give a better overview of the association between SES and CVD traditional risk factors, as how SES contributes to these risk factors has not been fully understood [22], and findings from developing countries seem to be inconsistent with what has been reported in industrialized countries [23].

2 | Objective

In the current study, we aimed to assess the relationship between SES and traditional risk factors of CVD such as smoking, blood pressure, physical activity, body mass index, metabolic syndrome and lipid profile among a large population in northeast Iran, which is a developing country with high CVD rates and mortality [24]. For categorizing SES we used latent class analysis (LCA) which is a complex statistical methodology based on probability modeling and allows respondents to be allocated in a category, that they have the highest probability of belonging to [25].

3 | Methods

Data for this study were obtained from the Mashhad Stroke and Heart Atherosclerosis Disorder cohort study (MASHAD study) [26]. From 9704 participants of the first phase of the cohort conducted in 2007-2008, selected by stratified cluster sampling from urban population of Mashhad, and after excluding subjects with incomplete data related to traditional cardiovascular risk factors or SES parameters, a total number of 8733 remaining subjects were included in the study. We categorized our participants into three socio-economic classes (low, middle, and high SES) based on parameters including occupation, income, and education level. The study protocol was approved by the Ethics Committee of Mashhad University of Medical Sciences (MUMS) (Ethical code: IR. MUMS. MEDICAL. REC.1399.794), and all participants gave written informed consent.

Basic characteristics including age, gender, occupation, education level, monthly income, and lifestyle variables such as smoking and physical activity (hours per week) were obtained from participants through a face-to-face interview which was done by two professional health care workers (ML and MMS) and a nurse (SI). Anthropometric variables were also measured, including height, weight, body mass index (BMI), blood pressure, waist circumference, and hip circumference. After a fasting time of 12 h, venous blood samples were collected and serums were separated according to standard protocol. Serum lipid profile (total cholesterol (TC), Triglyceride (TG), high-density lipoprotein cholesterol (HDL-C), low-density lipoprotein cholesterol (LDL-C), and blood glucose level were measured using standard commercial kits and auto analyzer BT3000 (Biotechnics, Italy) [27–29].

Based on occupation status, monthly income, and education level, we allocated our participants to one of three SES categories (low, middle, and high). For SES classification, we used LCA, which has been proven to assess variables that cannot be directly observed and involve complex relations [30]. The latent class model, as one of the advanced methods based on clustering, is a statistical method in which subjects are clustered based on their response patterns to observed variables, and the clusters are defined as latent variables. This method categorizes subjects according to the underlying mathematical patterns present in the data structure. Subjects within each class are completely similar and differ from subjects in other classes. So, subjects with similar patterns in the observed variables tend to be classified into similar latent classes [31, 32].

Here we used goodness-of-fit measures including Bayesian information criterion (BIC), Akaike information criterion (AIC), AIC3 and consistent Akaike information criterion (CAIC), log-likelihood, and entropy to determine the optimal number of latent classes and evaluate the model [33]. Accordingly, a model that has minimum values for fit indices and an entropy close to one is considered a more suitable model.

Hypertension was defined as systolic blood pressure (SBP) above 140 mmHg and/or diastolic blood pressure (DBP) above 90 mmHg, or taking anti-hypertensive medications by participants [34].

Dyslipidemia was specified as total cholesterol (TC) ≥ 200 mg/dl (5.18 mmol/L), low-density lipoprotein (LDL-C) ≥ 130 mg/dl (3.36 mmol/L), triglyceride (TG) ≥ 150 mg/dl (1.69 mmol/dl) or high density lipoprotein (HDL-C) ≤ 40 mg/dl (1.03 mmol/dl) in men and HDL-C ≤ 50 mg/dl (1.30 mmol/dl) in women [35].

Diabetes was defined as FBG ≥ 126 mg/dl, or taking anti-diabetes drugs [36].

Metabolic syndrome was determined according to the international diabetes federation (IDF) criteria [37].

All data were analyzed using SPSS software version 20 (SPSS Inc., Chicago, IL, USA). The normality of data was assessed using one-sample Kolmogorov-Smirnov test. Normal quantitative data were presented as mean ± standard deviation, not-normal data were presented as median and inter quartile range (IQR) and qualitative data were presented as N (percent %). One-way ANOVA and Kruskal-Wallis test were used to assess normal quantitative data and not-normal quantitative data, respectively. Association between categorical variables were assessed by chi-square test. Univariate logistic regression models were applied to assess the odds ratio of CVD risk factors among different SES groups. *p*-value less than 0.05 was considered statistically significant.

4 | Results

A total number of 8733 participants were included in the final data analysis. The values of the fit indices for different numbers of latent classes are shown in Table 1. For models with more than four classes, no significant improvement in the index values is observed. In deciding between three-class and four-class models, the four-class model has better index values; however, considering four classes makes it difficult to provide a suitable interpretation for the data. In contrast, the three-class model effectively represents the latent patterns in the data and practically allows for feasible interpretation. Consequently, the three-class latent class model is recognized as the optimal and suitable model for the available data.

Based on socio-economic parameters including education level, monthly income, and occupation status, we categorized our participants into low SES ($N = 3874$), middle SES ($N = 4366$) and high SES ($N = 493$) groups. Mean age for low, middle and high SES groups were 48.2 ± 7.63, 48.68 ± 8.01, and 49.73 ± 8.07 years, respectively ($p < 0.001$) The majority of the intermediate SES group were female (59.3%) and on the other hand, 48.7% of low SES participants were women ($p < 0.001$).

As seen in Table 2, physical activity level (PAL) was significantly lower in low and high SES group in compare with intermediate SES group (1.54 ± 0.29, 1.58 ± 0.29, 1.61 ± 0.28 in low, high, and intermediate SES respectively, $p < 0.001$). The mean weight was significantly higher in low SES group in compare with middle and high SES groups (73.75 ± 12.77, 71.11 ± 13.69, 70.83 ± 12.64 in low, high, and intermediate SES respectively, $p < 0.001$). The mean waist circumference showed significant lower levels in low SES participants (94.72 ± 11.44, 95.68 ± 12.05, 95.83 ± 12.52 in low, intermediate, and high SES respectively, $p = 0.001$), while the mean hip circumference was not different in SES groups (103.57 ± 9.15, 103.56 ± 9.20, 102.81 ± 9.02 in low, intermediate, and high SES respectively, $p = 0.229$). Additionally, the prevalence of positive smoking habit was significantly higher in high SES group (25.6%, 24.8%, and 18% in high, intermediate, and low SES respectively, $p < 0.001$).

The prevalence of traditional CVD risk factors including diabetes, hypertension, metabolic syndrome and dyslipidemia among different SES groups is illustrated in Table 3 in details. Hypertension (22.3%, 25.6%, 25.1% in low, intermediate, and high SES respectively, $p = 0.003$) and metabolic syndrome (35.8%, 40.8%, 37.9% in low, intermediate, and high SES respectively, $p < 0.001$) were less prevalent among low SES group than two other groups. Furthermore, obesity (73.1% vs 71.2%, $p = 0.085$) and diabetes (15.4% vs 14% $p = 0.544$) were more common in high SES individuals compared with low SES and dyslipidemia was more common in low SES group compared to high SES (85.8% vs 84.9% $p = 0.817$), although, the differences between groups were not statistically remarkable.

Systolic blood pressure was significantly lower in low SES in compare with intermediate and high SES groups (121.1 ± 17.71, 122.86 ± 18.58, 122.77 ± 18.70 in low, intermediate, and high SES respectively, $p < 0.001$), while, there was no significant difference was evident between groups in case of diastolic blood pressure (79.37 ± 10.81, 79.37 ± 11.40, 79.21 ± 11.29 in low, intermediate, and high SES respectively, $p = 0.956$).

Regarding the fasting lipid profile, the mean HDL-C level in high SES group was significantly higher than low SES group (43.18 ± 10.19 vs 42.19 ± 9.94, $p = 0.032$). Furthermore, LDL-C was significantly higher in high SES group in compare with two other SES groups (120.32 ± 36.17, 116.83 ± 34.88, 115.74 ± 35.77 in high, intermediate, and high SES respectively, $p = 0.023$),

TABLE 1 | Performance of different numbers of latent classes.

Indexes	Log-likelihood	BIC	AIC	AIC3	CAIC	Entropy	R^2
2 classes	−38,366.91	76,958.84	76,767.82	76,794.82	76,985.84	0.58	0.63
3 classes	−38,084.87	76,514.59	76,245.74	76,283.74	76,552.59	0.55	0.55
4 classes	−34,158.20	68,761.07	68,414.40	68,463.40	68,810.06	0.75	0.73
5 classes	−33,752.85	68,050.19	67,625.70	67,685.70	68,110.19	0.81	0.78
6 classes	−32,594.28	65,832.88	65,330.56	65,401.56	65,903.88	0.83	0.81

Abbreviations: AIC, akaike information criterion; BIC, Bayesian information criterion; CAIC, consistent akaike information criterion; Log, logarithm.

TABLE 2 | Baseline characteristics of study population based on social level.

Variable name		Low ($N = 3874$)	Intermediate ($N = 4366$)	High ($N = 493$)	p value
Age		48.02 ± 7.63	48.68 ± 8.01	49.73 ± 8.07	< 0.001[a,b,c]
Female *N*%		1798 (48.7)	2448 (59.3)	263 (56.6)	< 0.001
PAL		1.54 ± 0.29	1.61 ± 0.28	1.58 ± 0.29	< 0.001[a,b,c]
Weight		73.76 ± 12.77	70.83 ± 12.64	71.11 ± 13.69	< 0.001[a,b]
BMI (kg/m^2)		27.87 ± 4.54	27.76 ± 4.85	27.56 ± 4.78	0.325
WC (cm)		94.72 ± 11.44	95.68 ± 12.05	95.83 ± 12.52	0.001[a]
HC (cm)		103.57 ± 9.15	103.56 ± 9.20	102.81 ± 9.02	0.229
Smoking *N*%	Nonsmoker	2644 (71.6)	2680 (64.9)	298 (64.1)	< 0.001
	Ex-smoker	384 (10.4)	425 (10.3)	48 (10.3)	
	Current smoker	664 (18)	1026 (24.8)	119 (25.6)	

Note: Data presented as *N* (%), mean ± standard deviations or median (interquartile range). Chi square, analysis of variance (ANOVA) and Kruskal-Wallis test were used where appropriate.
Abbreviations: BMI, body mass index; HC, hip circumference; PAL, physical activity level; WC, waist circumference.
[a]Comparison between low and intermediate SES.
[b]Comparison between low and high SES.
[c]Comparison between intermediate and high SES.

TABLE 3 | Traditional risk factors based on social levels.

	Social-economic level			
Variable name	**Low ($N = 3874$)**	**Intermediate ($N = 4366$)**	**High ($N = 493$)**	***p*-value**
Diabetes	509 (14)	599 (14.8)	79 (15.4)	0.544
Metabolic syndrome	1319 (35.8)	1684 (40.8)	176 (37.9)	< 0.001
Obesity	2625 (71.2)	2858 (69.3)	339 (73.1)	0.085
Dyslipidemia	3146 (85.8)	3507 (85.4)	393 (84.9)	0.817
Hypertension	822 (22.3)	1056 (25.6)	116 (25.1)	0.003
SBP (mmHg)	121.1 ± 17.71	122.86 ± 18.58	122.77 ± 18.70	< 0.001[a]
DBP (mmHg)	79.37 ± 10.81	79.37 ± 11.40	79.21 ± 11.29	0.956
HDL-C (mg/dl)	42.19 ± 9.94	42.66 ± 9.73	43.18 ± 10.19	0.032[a]
LDL-C (mg/dl)	115.74 ± 35.37	116.83 ± 34.88	120.32 ± 36.17	0.023[b]
Cholesterol (mg/dl)	190.67 ± 37.81	191.06 ± 39.45	194.31 ± 41.72	0.165
TG (mg/dl)	123 (86, 175)	120 (85, 172)	119 (83, 168)	0.399

Note: Data presented as *N* (%), mean ± standard deviations or median (interquartile range). analysis of variance (ANOVA) and Kruskal-Wallis test were used where appropriate.
Abbreviations: DBP, diastolic blood pressure; HDL-C, high-density lipoprotein cholesterol; LDL-C, low density lipoprotein cholesterol; SBP, systolic blood pressure; TG, triglyceride.
[a]Comparison between low and intermediate SES.
[b]Comparison between low and high SES.
[c]Comparison between intermediate and high SES.

while no remarkable difference was found between SES groups and cholesterol (194.31 ± 41.72, 191.06 ± 39.45, 190.67 ± 37.81 in high, intermediate, and low SES respectively, $p = 0.165$) and TG (119 (83,168), 120 (85,172), 123 (86,175) in high, intermediate, and low SES respectively, $p = 0.399$).

The logistic regression model was applied to assess the odds ratio of risk factors among different SES groups and the middle SES class was considered as a reference for analysis. After adjusting for age, sex, smoking status, BMI (was not considered for obesity variable) and PAL, the odds of Metabolic Syndrome and hypertension in low SES group was respectively 0.811 and 0.825 times lower than intermediate group ($p < 0.001$ and 0.001). Moreover, the odds of obesity in the high SES group were 1.3fold higher than intermediate SES group ($p = 0.031$) (Table 4).

5 | Discussion

Few studies are addressing the relationship between SES and risk factors of CVD in LMICs, so in the current study, we investigated this in a representative population sample from northeast Iran. A total number of 8733 participants with an average age of 49.67 ± 7.61 years were included and were classified based on education level, income, and occupation status

TABLE 4 | Assess the odds ratio of CVD risk factors among different SES groups by multivariate logistic regression model among the study population.

	Social-economic status			
	High		Low	
Variable name	**OR (CI 95%)***	***p*-value**	**OR (CI 95%)***	***p*-value**
Diabetes	0.982 (0.745, 1.294)	0.896	0.978 (0.856, 1.117)	0.746
Metabolic syndrome	0.835 (0.671, 1.039)	0.106	0.811 (0.732, 0.898)	< 0.001
Obesity	1.299 (1.024, 1.649)	0.031	1.096 (0.981, 1.225)	0.107
Dyslipidemia	0.924 (0.700, 1.221)	0.580	1.026 (0.898, 1.172)	0.704
Hypertension	0.894 (0.708, 1.130)	0.349	0.825 (0.738, 0.922)	0.001

Note: OR was adjusted for sex, age, smoking status (nonsmoker, ex-smoker, and current smoker), BMI, and PAL. In obesity analysis, OR was adjusted for sex, age, smoking status (nonsmoker, ex-smoker and current smoker), and PAL.
*OR: Odd ratio.

into three classes of low, middle, and high SES with frequencies of 44.4%, 50.0%, and 6.6%, respectively.

The highest prevalence of metabolic syndrome was seen in intermediate SES followed by high and low SES respectively. Lower SES was associated with lower odds of metabolic syndrome, In contrast to the previous studies [38–40]. The explanation for this contradiction might be the reason that, in our study, the reference category for odds ratio was intermediate SES and both low and high SES were compared with the intermediate class not each other. In addition, we calculated the SES category by social items like income, occupation status, and education and did not choose only one social determinant to present the whole SES. Cardel et al. have reported that Metabolic Syndrome severity was associated with both subjective social status (SSS) and objective social status among the African American population and a one-point increment in SSS score was related to a 0.04 decrease in Metabolic Syndrome severity score [41]. Both education and income were shown to be associated with the presence of Metabolic Syndrome [42]. This finding highlights the important effect of public awareness in the prevention of chronic diseases. Education increases the knowledge to acquire a healthy lifestyle and prefer healthy foods over unhealthy foods [43], and occupation could help in an individual's psychosocial stress improvement and lead to metabolic syndrome prevention [44]. Many studies have addressed gender-dependent associations, that low SES had more influence in developing metabolic syndrome in females rather than males [43, 45–48]. Although the underlying mechanism for the gender-dependent association between SES and metabolic syndrome is unclear, some factors have been suggested, including parity, obesity-related effects on social mobility, and greater psychosocial risks in low SES women than low SES men [49]. Similarly, Matthews et al. study indicated that low SES is associated with an elevated risk of mortality and morbidity from diverse causes in female [50].

Dyslipidemia was very common among all of our SES classifications. The lower SES group had slightly more participants with dyslipidemia, however, the differences between SES groups in terms of dyslipidemia prevalence were not remarkable. Li et al. showed that low SES (based on income, education, and occupation) is associated with higher rates of dyslipidemia and stated that people with low SES adopt unhealthy lifestyles such as inactivity, smoking, and alcohol consumption and therefore they are at higher risk for dyslipidemia [51]. On the other hand, Nam et al. also reported that men who have higher levels of educational attainment and higher income are at more risk for dyslipidemia, however, educated women and women with higher income were at lower risk for dyslipidemia [52]. In our population, high SES individuals had lower physical activity, which is known to be associated with dyslipidemia [53], and unhealthy behaviors may be a link between SES and dyslipidemia or other chronic diseases and effects as an intermediate mediator [54]. This could be an explanation for why the lower SES group in our study had a slightly higher prevalence of dyslipidemia. Findings regarding the correlation between SES and dyslipidemia are inconsistent especially in low and middle-income countries [52]. One possible mechanism that may explain this inconsistency could be that people in different regions and social environments may behave differently in specific SES. For instance, high SES people in Iran tend to have more sedentary jobs and eat out more frequently, especially fast foods and junky foods. On the other hand, low SES people prefer to have homemade dishes (because of lower cost compared to fast foods), have more active jobs are more predisposed to psychosocial stress, and smoke more cigarettes, and these associations might be completely different in high-income countries.

In our study hypertension was associated with higher SES and this was consistent with studies from Bangladesh and Uganda, indicating that people with higher education levels and higher incomes were at more risk for developing hypertension [55, 56]. However, a meta-analysis by Leng et al. showed that higher blood pressure was associated with low SES, especially low education levels. This association was significant in high-income countries, but not in some developing countries like India, Nigeria, Thailand, and Jordan [57]. The difference between HICs and LMICs in case of SES effects on hypertension could be explained as follows: in developed countries, fast foods are usually the cheapest meals and are more affordable for low SES people, while in developing countries, high SES groups adopting western lifestyles, consume more fast foods and are at higher risk of hypertension.

Corsi et al. surveyed 758978 Indian participants and indicated a strong correlation between high income and higher prevalence of hypertension, diabetes, and obesity [14], which is similar to our findings in terms of obesity, hypertension, and diabetes. Other studies from India, Bangladesh, and China also reported that diabetes was more prevalent in high SES people [55, 58, 59]. However, studies by Kim SR et al.(among the Korean population) and Jaffiol C. et al. (among the French population) showed that people with low SES were at greater risk for diabetes [56, 57]. Diabetes complications like retinopathy, were more common in low SES people [60]. As it is concluded, like hypertension, findings about the relationship between SES and diabetes vary from developing to developed countries and this inconsistency also has been reported in a systematic review by Zhiye Xu et al. that diabetes prevalence is increasing in developing countries and decreasing in developed countries [61].

We found an inverse gradient between SES and smoking. Concordant with Yiqian Zhan's study, it is implied that people with higher education levels and income tend to smoke less frequently [62], some other studies also determined the same findings [63, 64]. Low SES smokers tend to have a higher risk of hypertension [65] and chronic diseases [66], hence more social support and attention are needed for them. In our study intermediate and high SES classifications had higher rates of smokers compared with low SES, however, former smokers did not differ among different SES categories. In a study carried out in the Kingdom of Saudi Arabia, also individuals with higher education and higher income were more likely to be smokers [67]. However, other studies from China and India showed that the smoking rate is higher among people with lower education and income [62, 68]. In another study carried out by Ashleigh Guillaumier, demonstrated that majority of smokers were individuals with moderate education level rather than non-educated or tertiary education [69]. The study also showed that majority of smokers income is within $ 200 to 400 $ rather than lower or above this amount [69]. This is almost consistent with our findings since the median income of MASHAD study participants was $ 300 which was equivalent to 3 million Rials in Iran. Economical, regional and cultural factors and national's policies towards tobacco use contribute to conflict results towards smoking status. It is also important to consider that smokers who are within lower SES group are at higher risk for chronic disease [66], therefore additional care should be provided for these disadvantaged people.

In this study higher SES increased the odds of being obese. However, studies have shown inconsistent findings [70–73]. In our study, we did not assess education level and income as an indicator of SES separately, this makes it difficult to compare our findings with other studies because in some studies, education and income displayed opposed interaction with obesity [74, 75]. Hua Zhang indicated that higher monthly income reduces the odds of being obese and higher education leads to being overweight; However, Mosli reported that in Saudi Arabia adults with lower education and higher income are more prone to obesity [74, 75]. Physical activity decreases obesity and inflammation, while improves the endocrine system and energy expenditure [7]. In our study, high SES individuals had lower physical activity, which could be an explanation for why higher SES leads to being overweight in our study and physical activity could be a link between SES and obesity as discussed thoroughly in the Pan et al. study [7].

5.1 | Limitation and Strengths

We did not explore the association between cardiovascular risk factors and SES indicators such as education, income, and occupation separately. Based on previous studies, these SES indicators displayed independent and diverse actions in the manner of SES. Although we could consider this as a strength of our study because the SES of a person is a combination and interaction of all indicators and they all have cumulative effects on overall SES. In this study we assessed the most important cardiovascular risk factors in a large population, this would give us a better outlook on the effect of SES on CVDs and health care policies. By using more variables such geographic data maybe more accurate SES stratification could be developed which remains for future studies.

6 | Conclusion

Individuals with a low SES had higher rates of metabolic syndrome and hypertension and obesity was associated with higher SES. These findings may help to set more specific and personalized health policies and screening programs to reduce the prevalence of CVD.

Author Contributions

Fatemeh Sadabadi: writing—review and editing, writing—original draft, investigation. **Nasrin Talkhi:** writing—review and editing, formal analysis. **Mahyaar Omouri-Kharashtomi:** writing—original draft, writing—review and editing. **Mohammad Mirzaei:** writing—original draft, writing—review and editing. **Sara Saffar Soflaei:** writing—original draft, writing—review and editing, supervision. **Zahra Rahimi:** software, formal analysis, writing—review and editing, data curation. **Niloofar Shabani:** software, formal analysis, writing—review and editing, data curation. **MohammadReza Latifi:** investigation, writing—review and editing. **Mohammadreza Mohammadtaghizadeh Sarabi:** investigation, writing—review and editing. **Sarina Iri:** investigation, writing—review and editing, methodology. **Elham Moghaddas:** methodology, conceptualization, writing—review and editing, supervision. **Gordon A Ferns:** writing—review and editing. **Habibollah Esmaily:** conceptualization; methodology, writing—review and editing, supervision. **Majid Ghayour-Mobarhan:** conceptualization, methodology, supervision, project administration, writing—review and editing.

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Ethics Statement

The study protocol was given approval by the Ethics Committee of Mashhad University of Medical Sciences and written informed consent was obtained from participants.

Consent

The authors have nothing to report.

Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

The data that support the findings of this study are available from (Mashhad University of medical sciences), but restrictions apply to the availability of these data, which were used under license for the current study, and so are not publicly available. Data are however available from the authors upon reasonable request and with permission of (Mashhad University of medical sciences).

Transparency Statement

The lead author Habibollah Esmaily, Majid Ghayour-Mobarhan affirms that this manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned (and, if relevant, registered) have been explained.

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