Socioeconomic Status and Metabolic Syndrome in Southwest Iran: Results from Hoveyzeh Cohort Study(HCS)

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Abstract

Background: Socioeconomic status (*SES*) strongly predicts morbidity and premature mortality, especially for non-communicable diseases (*NCDs*). However, the effect of these factors on Metabolic Syndrome (*MetS*) is not clear yet. This study was conducted to assess the relationship between socioeconomic indicators and MetS.

Methods: In this prospective cohort study, 10009 people aged 35-70 years enrolled from May 2016 to August 2018. The MetS was defined according to The Standard National Cholesterol Education Program (*NCEP*) - adult treatment panel III (*ATP III*) or *NCEP-ATP III* criteria. Demographics and socioeconomic data were gathered face to face by trained interviews. Also, lab, anthropometrics, and blood pressure measurements were assayed for participants. Logistic regression was used to estimate the association between SES and *MetS*, adjusted for the potential confounding factors.

Results: The overall prevalence of *MetS* in the participants was 39.1%. The crude odds ratios were statistically significant for all the assessed variables (p<0.05). After adjustment for age, sex, physical activity, smoking, and alcohol use as potential confounders, the results indicated significant direct independent associations between skill level (p=0.006) and Townsend index (p=0.002) with *MetS*. In contrast, no significant associations were seen between educational level and wealth status with *MetS*.

Conclusion: The results of our study showed that SES is related to *MetS*. Among four assessed SES indicators, skilled levels and Townsend score had a stronger association with *MetS*. We recommend considering people's SES when interventional programs are planned and conducted on *MetS* in similar communities.

Background

Non-communicable diseases are the leading global reason for death and excessively afflict those living in low-income and lower-middle-income countries (*LLMICs*) (1). Almost three-quarters of deaths and 82% of premature deaths occur within *LLMICs* due to non-communicable diseases (*NCD*s) (2). Generally, morbidity and mortality rates of diseases are higher among people with lower socioeconomic status (*SES*) (3). The primary aim of social epidemiology is to study the relationship between SES and health outcomes in populations. Today, it is well known that in almost all countries, more people of lower *SES* have experienced poorer health than those of higher *SES* (4).

Metabolic syndrome (*MetS*) combines abdominal obesity, glucose intolerance, dyslipidemia, and hypertension. These disorders are a well-known risk factor for cardiovascular disease and type 2 diabetes (5). The prevalence of MetS has been estimated at around 20–25% of the world's adult population (6). It has increased rapidly in both developed and developing countries during recent years (7–9). The socioeconomic factors are actively involved in the development of MetS. Some studies conducted in the United States (10), Netherlands, Poland (11), Tunis (12), Suriname (13), Iran (14, 15), Brazil (16–18), and Mesoamerican countries (19) showed that MetS prevalence decreases with better education (20–22), occupational class (23), income (24, 25), and wealth status (26). On the other hand, reverse patterns were observed in Nigeria, Saudi Arabia, and India, i.e., there was more likelihood for individuals with high socioeconomic status for having *MetS* (27–29).

Due to the higher prevalence rate of *MetS* in Hoveyzeh (30), compared to the rates of other regions of Khuzestan province rates (31) and Iran (32), and also, the important role of *SES* in *NCDs*, we designed a study to investigate the relationship between metabolic syndrome and socioeconomic factors, including education, wealth index, skill level, and Townsend deprivation index in the context of a well-designed population-based cohort study.

Methods

Study Design and Sampling Method

The Hoveyzeh Cohort Study (HCS) is a population-based cohort study designed to assess NCDs in the southwest of Iran(33). This is one of the sites of the Prospective Epidemiological Research Studies in IrAN (the PERSIAN Cohort Study) (34) and recruited 10009 adults (age 35-70 years) from May 2016 to August 2018. Based on the 2016 door-to-door census, 12103 eligible individuals were living in the Hoveyzeh district. Invitations to the cohort site were given by trained inviters one week before the referral day. A phone call was made to remind the invitees the day before the visit. Out of 12103 eligible individuals invited, 8792 were enrolled in the study for the first stage, 982 for the second stage, and 235 for the third stage of invitation. Finally, 10009 individuals entered the study. The overall response proportion was 85.16%.

Inclusion/exclusion criteria of the study participants

Inclusion criteria consisted of: (1) age of 35–70 years old, (2) residence in Hoveyzeh, (3) lack of severe mental disorder and ability to answer the questionnaires without help (4) Not to be deaf and dumb. We excluded participants without data on SES or missing data for MetS.

Definition of the MetS

The criteria for MetS diagnosis were: 1) abdominal obesity (waist circumstance ≥ 102 in men and ≥88 in women), 2) high serum triglycerides (≥150 mg/dL) or take hypertriglyceridemia medications, 3) abnormal serum high-density lipoprotein (HDL) cholesterol (≥40 mg/dL in men and NCDs 50 in women), or take drug treatment for low HDL cholesterol,4) high blood pressure ≥130/85 mmHg, or take hypertension drugs, 5) high fasting plasma glucose (FPG) ≥100 mg/dL, or take hyperglycemia drugs. The presence of at least 3 out of the 5 mentioned criteria used in the case definition constituted a diagnosis of MetS (30).

Components of MetS measurements and quality control of laboratory

Individuals attending the study had been fasting for about 10 to 12 hours on the day of enrollment. Tubes without anticoagulant (clot) were placed at room temperature 30 to 40 minutes before centrifugation under a Class II laminate laboratory hood. During this time, the serum was separated from the rest of the blood. Then, the clot tubes were located into the centrifuge(Sigma, Germany) at 3000 rpm for 10 to 15 minutes. The required serum levels were measured by BT 1500 autoanalyzer (Biotecnica Instruments, Italy). Normal and pathogen control serum samples were defined and RUN for BT 1500 device. Finally, control serum results were evaluated in Westgard and Levy Jennings quality control chart. From these data, mean and SD were calculated. Levy Jennings chart was constructed with x + 2SD as warning limits and x + 3 SD as control limits. The percent coefficient of variation (CV), was defined as SD times 100 divided by the mean value of the results in a set of replicate measurements. Therefore, a smaller CV indicates higher precision. Table 1 represented mean and CV% MetS components.

Table 1 shows precision data obtained for routine biochemical analytes by BT 1500 autoanalyzer.

Analyte	Mean	CV%
HDL	30.8	2.75
Chol	152	2.70
TG	110	2.28
FBS	94.4	2.71

Anthropometric measurements

Anthropometric measurements were taken by trained staff. Height(cm) was measured by a Stadiometer (Seca 206) in a standing position without shoes, shoulders relaxed, facing forward with head and back facing the wall. Weight (kg) was measured with minimal clothing on, by a standing scale (Seca 755). Also, a locked tape meter (Seca) was used for measuring the waist, wrist, and hip circumference (cm).

Blood pressure measurements

At least half an hour before blood pressure measurement, participants should not exercise and have heavy physical activity, have not consumed heavy food, coffee, alcohol, drugs, and stimulant drinks, and have not smoked. Before measuring the first blood pressure, the participant must rest for 1-2 minutes sitting. A Richter sphygmomanometer with a suitable cuff size was used. The blood pressure cuff was neither tight nor too tight on the bare arm. Blood pressure was measured from the right and left arms of the person twice at a ten minutes interval, and when measuring blood pressure, the person's hand was placed on a flat surface such as a table.

SES indicators

We used four indicators to assess SES in this analysis: The Townsend deprivation index, as an area-level indicator of *SES*, the wealth index, as a household level indicator of *SES*, and educational level and skill level, as individual-level socio-economic indicators.

The wealth index was calculated according to the information on households' assets, including freezer, TV, motorbike, cell phone, car, vacuum cleaner, internet access, washing machine, computer, and household utilities consisting of house ownership, number of rooms per capita. A principal component analysis (*PCA*) was conducted to assign a coefficient to each asset. The sum of the first component scores constructed the wealth scores. Eventually, the scores were converted to 5-ordered categories including poorest, poor, moderate, rich, and richest based on the quintiles (35).

Townsend deprivation index was calculated in four steps: 1) To calculate the percentage of households of non-car ownership, non-house ownership, having unemployed adults and overcrowding, 2) To calculate logged unemployed and logged overcrowds, 3) To calculate Z score of no car, non-homeowners, unemployed, and overcrowd, 4) To calculate Z score of no car + Z score of the non-homeowner + Z score of unemployed + Z score of overcrowding = *TDS.* Finally, the calculated scores were categorized into five ordinal categories Based on the quintiles including most affluent, affluent, moderate, deprived, most deprived(36).

In our study, occupational classification was done according to the International Standard Classification of Occupations (*ISCO-8*). Skill level is considered a function of the complexity and range of performing tasks and duties related to an occupation. Four broad and ordered skill levels are used in *ISCO-08*. Skill Level 1 typically involves performing simple and routine physical or manual tasks. The people categorized in Skill Level 1 may require physical strength and/or endurance. In skill level 2, reading information and performing simple arithmetical calculations are usually essential. Skill level 3 generally requires a high level of literacy, numeracy, and well-developed interpersonal communication skills. Finally, Skill level 4 requires extended levels of literacy and numeracy, sometimes at a very high level, and excellent interpersonal communication skills (37).

Lifestyle measurements

We used International Physical Activity Questionnaire (IPAQ) to measure the physical activity level for the participants. The metabolic equivalent of the task (*MET* Index) was calculated from this questionnaire. That is the ratio of a person's working metabolic rate relative to his/her resting metabolic rate. One *MET* is defined as the energy cost of sitting quietly and is equivalent to a caloric consumption of one kcal/kg/hour. A person who has smoked no less than 100 cigarettes during his or her lifetime is defined as a smoker. To determine alcohol abuse among participants, we asked whether they have continually used them in their lifetime. The amount of consumption and its type has also been asked (1).

Statistical analysis

Descriptive statistics measures were performed using mean and standard deviation for quantitative variables, while frequency and percentage were used for categorical variables. Chi-square test, chi-square test for trend, and crude odds ratio used to assess univariate analysis associations. In multivariable analysis, adjusted odds ratios from the unconditional logistic regression model were to measure the association between the study variables. All reported p-values were based on two-tailed tests and compared to a significance level of 0.05. IBM® SPSS® Statistics 26.0 was used for the statistical analysis.

Results

Among 10009 participants, 59.8% (n=5983) were female. The mean ± SD of the participants' age was 48.8 ± 9.2 years. The overall prevalence of MetS in participants was 39.1% (95% CI 38.1 – 40.1). In general, the prevalence of MetS was higher in women (45.7%) compared to men (29.3%) ($p<0.001$). The prevalence rates, in total, were raised by increasing the age of the participants, although, in males, the rates slightly decreased over the age of 60 years (**Table S**1).

Bivariate analysis in Table 2 showed that the prevalence of *MetS*was associated with age, sex, educational level, *MET*, wealth status, job, Townsend index, smoking, and alcohol use ($P<0.05$). The prevalence of *MetS* was higher among females, smokers, and non-alcoholic people than the others ($P<0.05$). Also, the prevalence of *MetS* was significantly higher among older than younger people. The result of trend analyses indicates an upward pattern significantly for age group ($P<0.001$) and wealth status ($P=0.041$), while this pattern was downward for educational level, area deprivation status (Townsend Index), and physical activity ($P<0.001$). Besides, the lowest prevalence of *MetS* was seen among participants in Skill Level IV (mainly manual workers), although the trend was not significant (P for trend=0.48)

Table2 Prevalence of *MetS* by demographic, socio-economic, and lifestyle characteristics of study participants

Characteristic		Total	MetS cases	Prevalence % (CI 95%)	P-value *	P-value for trend **
Overall prevalence		10009	3913	39.1 (38.1 – 40.1)		
Age Group	35-39	1912	475	24.8 (22.9 – 26.8)	<0.001	<0.001
	40-44	2025	646	31.9 (29.9 – 34.0)		
	45-49	1797	716	39.8 (37.6 – 42.2)		
	50-54	1482	672	45.3 (42.8 – 47.9)		
	55-59	1281	641	50.0 (47.3 – 52.8)		
	60-64	798	391	49.0 (45.5 – 52.5)		
	≥65	714	372	52.1 (48.4 – 55.8)		
Sex	Male	4026	1180	29.3 (27.9 – 30.7)	<0.001	
	Female	5983	2733	45.7 (44.4 – 47.0)		
Educational level	Illiterate	6209	2654	42.7 (41.5 – 44.0)	<0.001	<0.001
	Primary school	1665	599	36.0 (33.7 – 38.3)		
	Secondary school	673	225	33.4 (29.9 – 37.1)		
	High school	741	232	31.3 (28.0 – 34.8)		
	University	721	203	28.2 (24.9 – 31.6)		
Physical activity (*MET* Score)	Q1	2503	1201	48.0 (46.0 – 50.0)	<0.001	<0.001
	Q2	2505	1053	42.0 (40.1 – 44.0)		
	Q3	2508	913	36.4(34.5 – 38.3)		

	Q4	2493	746	29.9(28.1 – 31.8)		
Wealth Status	Poorest	2012	748	37.2 (35.1 – 39.3)	0.003	0.041
	Poor	2057	750	36.5 (34.4 – 38.6)		
	Moderate	2087	846	40.5 (39.7 – 44.0)		
	Rich	2023	838	41.4 (39.3–43.6)		
	Richest	1830	731	39.9 (37.7 – 42.2)		
Job	Skill Level I	290	50	17.2 (13.1 – 22.1)	<0.001	0.48
	Skill Level II	2561	761	29.7 (27.9 – 31.5)		
	Skill Level III	84	28	33.3 (23.4 – 44.5)		
	Skill Level IV	345	88	25.5 (21.0 – 30.5)		
Area deprivation status (Townsend Index)	Most Affluent	2390	1190	49.8 (47.8 – 51.8)	<0.001	<0.001
	Affluent	1856	728	39.2 (37.0 – 41.5)		
	moderate	1890	781	41.3 (39. 1 – 41.6)		
	Deprived	1293	425	32.9 (30.3 – 35.5)		
	Most Deprived	2580	789	30.6 (28. 8 – 32.4)		
Smoking	Yes	7920	3191	40.3(39. 2 – 41.4)	<0.001	
	No	2089	722	34.7(32. 5 – 36.6)		
Alcohol use	Yes	197	61	31.0(24. 6 – 37.9)	0.019	
	No	9812	3852	39.3 (38. 3 – 40.2)		

Multivariable Analysis

The crude and adjusted odds ratios using the logistic regression model are presented in Table 3. For all the assessed variables, the crude odds ratios were statistically significant ($p<0.05$), therefore, we included all of them into the multiple logistic regression model. According to the results of the Hosmer-Lemeshow test, the goodness of fit of the model was acceptable (Chi-square= 9.67, df=8, P=0.29). After adjusting for age, sex, physical activity, smoking, and alcohol use as potential confounders, the results indicated independent, direct significant associations between skill level and Townsend index with MetS. In contrast, no significant associations were seen between educational level and wealth status with the condition.

Table3. The crude and adjusted odds ratios of the assessed factors for MetS and their 95% confidence interval using the logistic regression model

Variable		Crude Odds Ratio (95% CI)	*Adjusted Odds Ratio (95% CI)	P-value
Age Group	35-39	1	1	<0.001
	40-44	1.42 (1.23-1.63)	1.33 (1.04. – 1.68)	
	45-49	2.00 (1.74 – 2.31)	1.79 (1.40 – 2.30)	
	50-54	2.51 (2.17 – 2.90)	1.99 (1.51 – 2.61)	
	55-59	3.03 (2.61 – 3.52)	1.78 (1.31 – 2.43)	
	60-64	2.91 (2.44 – 3.46)	1.74 (1.16 – 2.60)	
	≥65	3.29 (2.75 – 3.94)	2.02 (1.24 – 3.27)	
Sex	Male	1	1	<0.001
	Female	2.028 (1.86– 2.21)	1.87 (1.43 – 2.44)	
Educational level	Illiterate	1	1	0.065
	Primary school	0.75 (0.67 – 0.84)	1.24 (0.99 – 1.54)	
	Middle school	0.67 (0.57 – 0.80)	1.36 (1.04 – 1.78)	
	High school	0.61 (0.52– 0.72)	0.96 (0.73 – 1.27)	
	University	0.53 (0.44 – 0.62)	1.04 (0.75 – 1.44)	
Current Smoking	No Smoker	1	1	0.81
	Smoker	1.28 (1.15 – 1.41)	0.98 (0.82 – 1.017)	
Alcohol use	No	1		0.42
	Yes	.69 (.51-.94)	1.17 (0.81 – 1.69)	
MET	Q1	2.16 (1.92-2.43)	1.57 (1.26-1.96)	<0.001
	Q2	1.70 (1.51-1.91)	1.31 (1.05-1.64)	
	Q3	1.34 (1.19-1.51)	1.08 (0.87-1.35)	
	Q4	1	1	
Wealth Status	Poorest	1	1	0.30
	Poor	0.97 (0.85 – 1.10)	1.13 (0.83 – 1.54)	
	Moderate	1.15 (1.02 – 1.31)	1.25 (0.92 – 1.69)	
	Rich	1.19 (1.05 – 1.36)	1.21 (0.89 – 1.65)	

	Richest	1.12 (0.99-1.28)	1.40 (1.01-1.93)	
Job	Skill Level I	1	1	0.006
	Skill Level II	2.03 (1.48 – 2.78)	1.57 (1.13 – 2.18)	
	Skill Level III	2.40 (1.39 – 4.14)	1.89 (1.07 – 3.35)	
	Skill Level IV	1.64 (1.11-2.43)	1.09 (0.70 – 1.76)	
Townsend Index	Most Affluent	2.25 (2.01-2.53)	1.71 (1.26 – 2.31)	0.002
	Affluent	1.46 (1.29 – 1.66)	1.23 (1.01 – 1.51)	
	Moderate	1.60 (1.41 – 1.81)	1.49 (0.72 – 2.47)	
	Deprived	1.11 (0.96 – 1.28)	1.29 (1.02 – 1.63)	
	Most Deprived	1		

The adjusted odds ratios for *SES* indicators are shown in Figures 1 to 4. People with skill level 3 had significantly higher odds than participants with skill level 1 [*OR* = 1.89 (95% *CI*, 1.07 to 3.35)]. Participants living in the most affluent areas had 71% more odds of MetS compared to those living in the most deprived areas [*OR* = 1.71 (95% *CI*, 1.26 to 2.31)]. Besides, age, sex, and physical activity were independently associated with the condition, while no association was seen between cigarette and alcohol use with the disease. The odds ratio of MetS for the age group of ≥65 was two times higher than the age group of 35-39 as the reference group [*OR* = 2.02 (95% *CI*, 1.24 to 3.27)]. The odds of having *MetS* in females was 87% higher than males [*OR* = 1.87 (95% *CI*, 1.43 to 2.44)]. Also, the odds ratio of *MetS* was 57% higher among participants with low physical activity compared to participants with high physical activity [*OR* = 1.57 (95% *CI*, 1.26 to 1.96)].

Discussion

The results showed significant associations between skill level and Townsend index with MetS, so that, the people with skill level 3 had significantly higher odds of MetS compared to the participant with skill level 1. Also, the participants living in the most affluent areas had more odds of MetS compared to those living in the most deprived areas. Besides, the results demonstrated no significant associations between educational level and wealth status with the condition after adjustment for potential confounders.

Our findings showed a considerably high prevalence of MetS in the studied population (39.1%). It was higher than the average rates for countries in the Middle East (25%) (38). The prevalence of MetS was higher in women than men. The odds of having MetS was 87% higher in women. This was concordant with the results of most studies (14, 39). The observed difference can mainly be due to the higher prevalence of important disorders like obesity and diabetes in women compared to men. According to the results, the prevalence of MetS increased with increasing the participants` age. This finding was consistent with the results of most studies conducted in Iran and other countries (14, 18, 40-45).

The prevalence of MetS was significantly higher in smokers compared to non-smokers. In some previous studies, this association was observed (46), while in some other studies, it was not (39, 47). Also, the prevalence of MetS in alcohol consumers was lower than in non-alcohol consumers (31% vs. 39.3%), but these associations were not significant after controlling for the confounder factors. The effect of alcohol consumption on MetS is inconsistent in the results of various studies. Some studies similar to our results found no relationship between alcohol use and MetS (45, 48). On the other hand, some studies have shown a positive association between MetS and alcohol consumption (49) while some others demonstrated a negative association (50).

According to our results, a significant and inverse association was seen between physical activity and MetS. This finding follows other studies (7, 51, 52). Several explanations are regarding the beneficial effects of physical activity and *Mets*, including increased insulin sensitivity (53), better glycemic control via pancreatic *β-cell* insulin secretory compensation (54), improved lipoprotein lipids, such as decreased *TG* and increased high-density lipoprotein cholesterol (*HDLC*) (55).

Studies on the association between socioeconomic status and diseases are prevalent. In this study, we examined four important indicators that determine economic status. Education is a good indicator of social position in epidemiological studies and is often seen as the easier way of measuring present socioeconomic status because it precedes other indicators, such as income or occupational-based social position. The univariate results showed a significant inverse relationship between education level and *MetS*. The highest prevalence was observed in the illiterate group, but this relationship was not significant after controlling the confounders in multivariable regression analysis. This finding is consistent with some results from the other studies (46, 56).

Household wealth includes income, savings, and all marketable assets because it captures all household members' personal and intergenerational capital and assets over time. Continuing material security associated with wealth can benefit health by a sense of protection, autonomy, and prestige (57). In our study, participants in higher wealth quintiles had more MetS than the poorest groups. However, the relationship between the wealth index and MetS was not statistically significant. Conversely, in a similar study, the relationship between the wealth index and MetS was statistically significant. They reported that the prevalence of MetS in the poorest group was higher than in the other groups (58).

After adjusting for confounder factors, our study results showed a statistically significant relationship between skill level and *MetS*. The results indicated that the odds of having MetS were lower in skill levels one and four. These can be due to higher physical activity and less obesity in participants with skill level one, namely manual workers, and greater awareness about risk factors and a more proper lifestyle in managers belonging to skill level four. In a similar study, in the occupational subgroups, equipment, machine operation, and assembling workers group showed the highest prevalence of the *MetS*, same our finding but unlike our results, "managers" had a high rate of *MetS*. Also, similar to our study, they demonstrated that manual workers were significantly less likely to have the MetS than non-manual workers (59).

In this study, the inverse relationship between the Townsend deprivation index and MetS was statistically significant in multiple logistic regression analyses. In contrast to our findings, Yanan Qiao (60) showed that the Townsend deprivation index was strongly associated with a *MetS* so that in the residences of the most deprived area, the prevalence of MetS was higher concerning the most affluent area.

First, the large sample size in the context of a population-based cohort study was one of the strengths of our study. This leads to providing more precise estimates by reducing the probability of random error. Second, the use of the well-trained questioners and the presence of several levels of supervisors in this study can be from its strengths. Third, we included several indicators of SES in the individual, household, and area levels in this analysis that can assess different aspects of this complex issue. Fourth, we used valid measures for the diagnosis of *MetS*. This can reduce the probability of the outcome misclassification. Fifth, our study was conducted on the Arab population, ethnicity, and lifestyle of Iranian Arabs is almost the same as people of neighboring countries, especially south of Iraq and Kuwait. So, the findings from the HCS can be generalized to a wide geographical area covering millions of people. On the other hand, there were some limitations in our study. First, the observed associations are not proving causality because the study design was a cross-sectional survey, and reverse causality bias could occur. Another limitation was recruiting prevalent cases instead of incident cases in our study. It can induce selection bias because the assessed patients were only the cases who survived did not include all the patients. Therefore, the findings of this study may be only generalized to this group of patients and not to fatal cases of the disease.

Conclusion

In summary, this study showed that SES is related to *MetS*. Among the four assessed SES indicators, skilled levels and Townsend score strongly associated with *MetS*. Also, older age group, female gender, and low physical activity were other risk factors for *MetS*. We recommend considering people's SES when interventional programs are planned and conducted on *MetS* in similar communities.

Abbreviations

MetS
Metabolic syndrome
SES
Socioeconomic status
HICs-high income countries
LMICs
low-and middle-income countries
ORs

Odds ratios
95%CI
95% confidence interval.

Declarations

Ethics approval and consent to participate

The study protocol was approved by the ethics committee of Ahvaz Jundishapur University of Medical Sciences (*IR.AJUMS.REC.1398.276*). On the day of registration, informed written consent was received from the study participants.

Consent to publish

Not applicable.

Availability of data and materials

Upon request, the data analyzed at Ahvaz Jundishapur University of Medical Sciences, Ahvaz, Iran, will be made access onsite to external researchers, for this reason, Dr. Cheraghian should be contacted.

Competing interests

The authors declare that they have no conflict of interest.

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Authors' Contributions

BCh and *NS* contributed to the conception and design, data interpretation, and writing of the manuscript. *BCh* contributed to the statistical analyses of this investigation. *ZR* contributed to the data collection and preformation of this investigation. *SAH*, *FR*, *SJH*, and *ZR* contributed to the data interpretation, preparation of the manuscript, and data collection. All authors have read and agreed to the published version of the manuscript.

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Figures

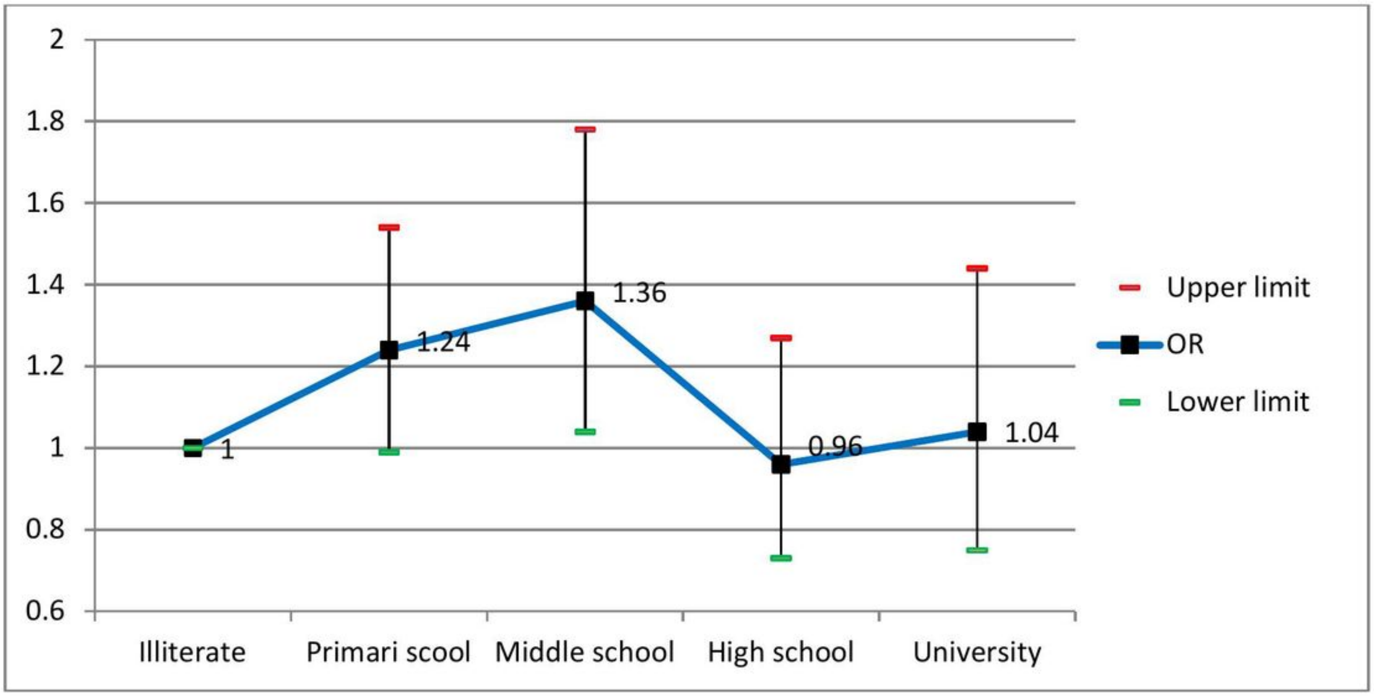

Figure 1

Adjusted ORs (95% CI) of *MetS* related to levels of education

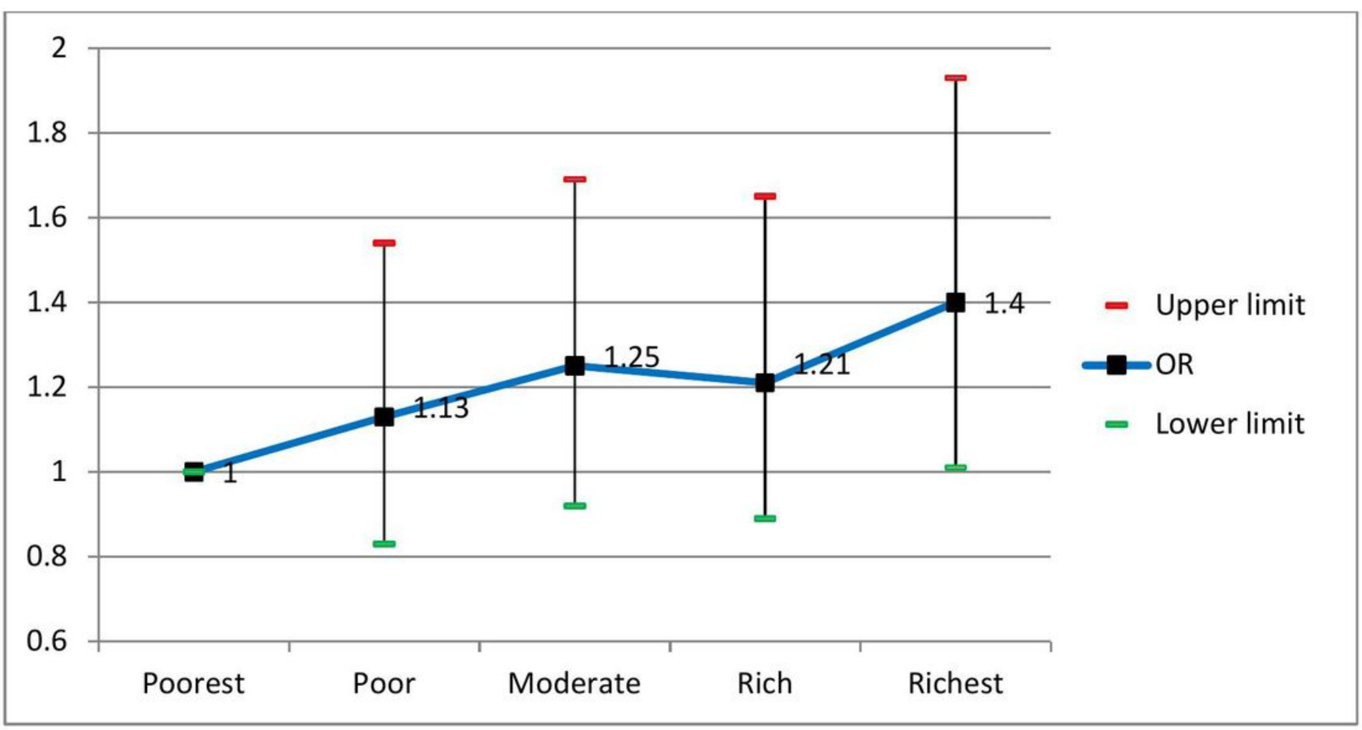

Figure 2

Adjusted ORs (95% CI) of *MetS* related to wealth status

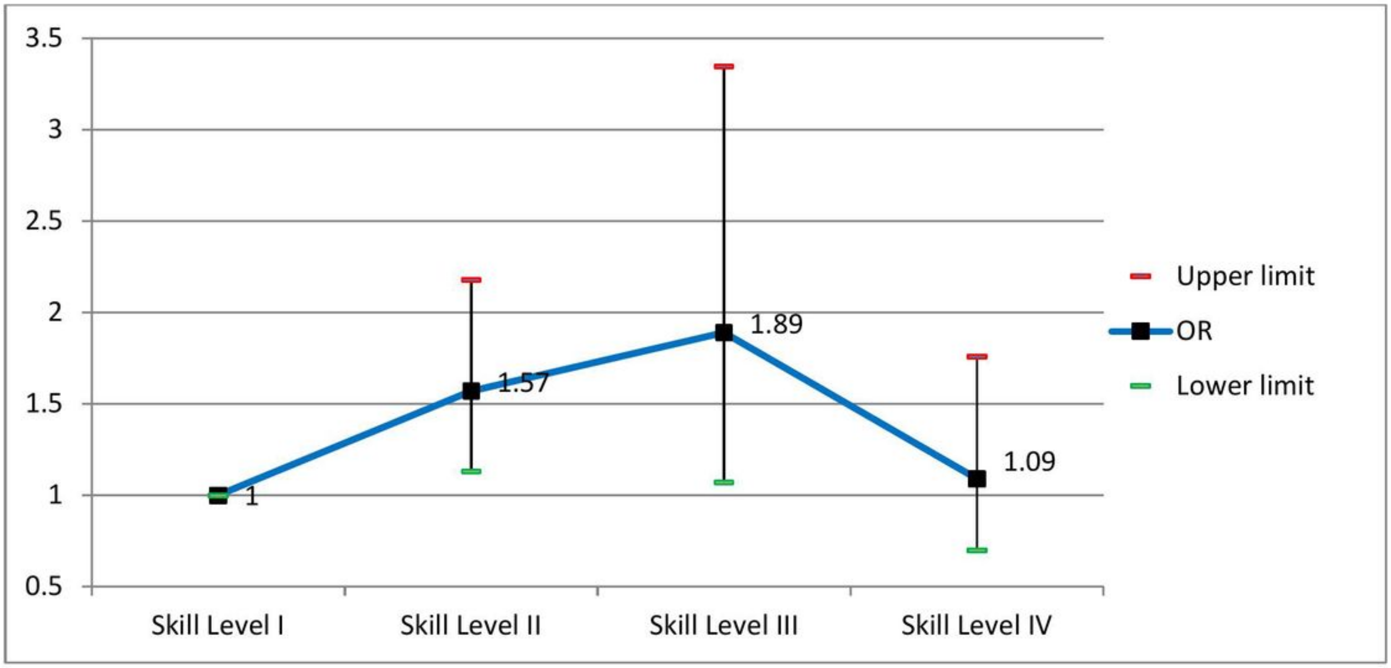

Figure 3

Adjusted ORs (95% CI) of *MetS* related to skill levels

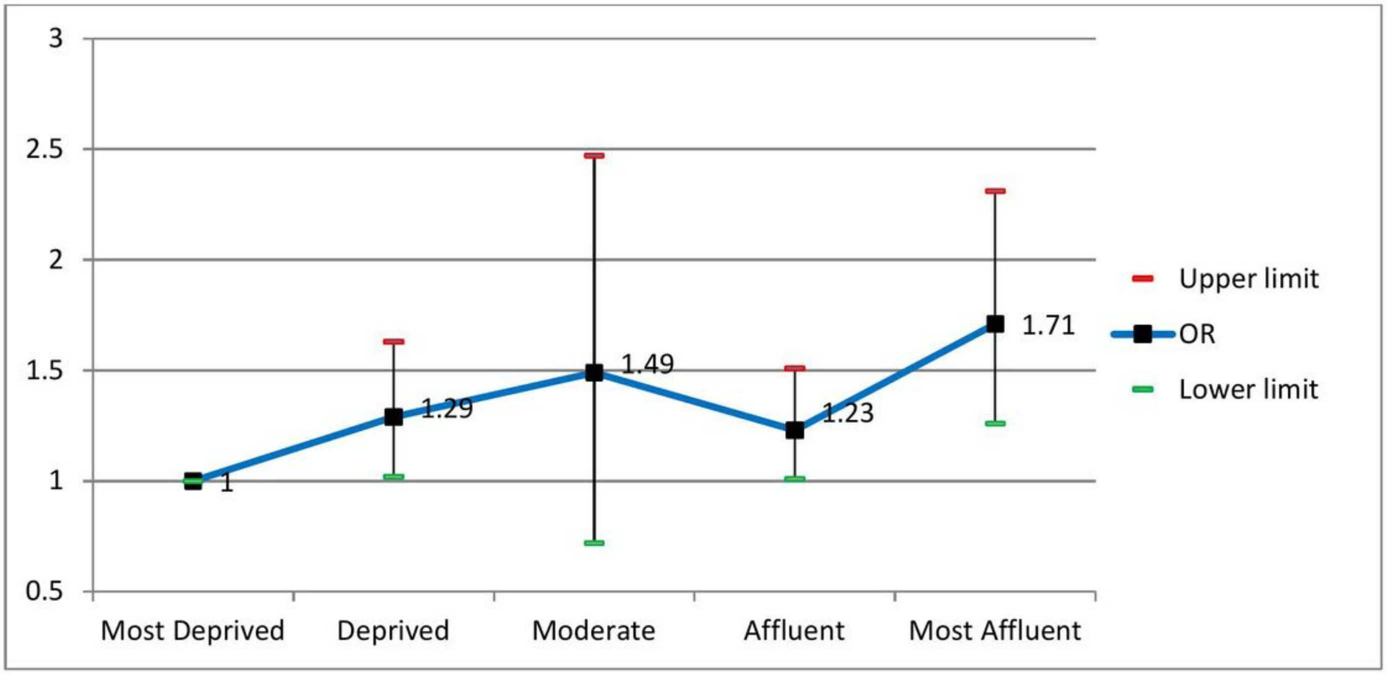

Figure 4

Adjusted ORs (95% CI) of *MetS* related to Townsend index

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