Original Article

Relationship of socio-economic inequality and overweight with non-communicable diseases risk factors: A study on underprivileged population

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Abstract

Background: Out of every five deaths in India three are due to Non-Communicable Diseases (NCDs). Two major modifiable risk factors for NCDs are overweight and socioeconomic inequality. This study assesses the burden of various NCDs risk factors and their relationship with socioeconomic inequality and overweight among the underprivileged population. **Aim:** To compare the different Non-Communicable Diseases risk factors with socioeconomic inequality and overweight. To evaluate the relationship between socioeconomic inequality and body weight with NCDs. **Materials and Methods:** A cross-sectional study incorporating 241 random sample of participants was assessed using WHO Stepwise approach to NCD risk factor surveillance. Anthropometric measurements and biochemical analysis of 12 h of fasting venous blood samples were done. Data were analyzed using Stata version 16 and Graph Pad Prism 8, using two-sided significance tests at the 5% significance level. **Results:** The study finds a 10-fold higher risk of tobacco use ($AOR = 10.18,\ C.I = 2.79 - 37.10$) and 5 times higher risk of alcohol use ($AOR = 5.57,\ C.I = 1.25 - 24.65$) among people with poor SES compared to higher SES. A significant correlation was observed between BMI , LDL cholesterol ($r = -16.0;\ P = 0.009$) and HDL cholesterol ($r = 18.0; P = 0.006$) with socioeconomic status. The study finds that for individuals who were overweight the odds of systolic blood pressure (AOR = 2.11, C.I = 1.03—4.31), fasting blood sugar ($AOR = 3.84, C.I = 1.30 - 11.32$) , triglyceride level, ($AOR = 2.20,\ C.I = 1.18 - 4.09$) high-density lipoprotein ($AOR = 2.63,\ C.I = 1.26 - 5.46$) were significantly higher compared to normal BMI individuals. **Conclusion:** The study showed that the socioeconomic patterning of the population is significantly associated with NCD risk factors. Obesity was closely linked with several major NCD risk factors.

Keywords: Alcohol use, NCDs, overweight, risk factors, SES, tobacco use

Introduction

Throughout ages, disease prevention and control has always been a concern and is a challenge to every physician and researcher. Non-communicable diseases (NCDs) are the major public health problem of the 21st century. It is predicted that out of every ten deaths in developing countries seven will be attributed to non-communicable diseases.[1] Worldwide NCDs kills approximately 41 million people each year accounting for

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70% of global deaths with majority of death occurring in low and middle-income countries.[2,3] Cardiovascular diseases, cancer, and diabetes are the top three NCDs in the world that accounts for the majority of all NCD deaths.[1,4,5] According to WHO global status report on NCD in India about 60% of all deaths are accountable to NCDs.[6] Inconsistencies in social patterning of NCD risk factors was observed among countries at different level of epidemiological transition.[7,8] For example, a study based on data of 10 European countries reported that those who live in poor or marginalized communities have higher risk of dying from non-communicable diseases than more economically stable groups or communities. In contrast, studies in India, China, Saudi Arabia, and Bangladesh have reported an increased risk of cardiovascular diseases and cardio-metabolic risk factors among the rich.[9-13] Factors like socioeconomic status have an impact on the various risk factors and outcomes on the NCD. These associations though exits differ in different populations at different stages of the demographic cycle. Thus for effective timely prevention, it's important to understand the impact of socioeconomic and demographic factors on health. One plausible explanation of mixed results on the social patterning of NCDs risk factors in low and middle-income countries can be the varying population composition along with countries socioeconomic development. A major chunk of non-communicable diseases is contributed by the modifiable risk factors called overweight and obesity. Globally more than 1.9 billion adults are overweight and about 650 million are obese.[14] In India, more than 135 million individuals are affected by obesity and abdominal obesity is one of the major risk factors for cardiovascular diseases (CVD) in the country.[15] According to a global report it is estimated that by 2030 India will have 27 million obese children, globally second highest number after China.[16] The present trend indicates the necessity of effective intervention to control obesity trends and related NCDs.

Materials and Methods

This study is a part of the shortlisted ICMR STS project 2019 "A Multilevel Study of Risk factors for Non-Communicable Diseases: Evidence from a Tertiary Care Hospital of Eastern India". The study protocol was approved by the Institutional Ethics Committee (No. 412 (Dean-Joka)/IEC/2014-15/Vol I dated: 10th August, 2019). A written informed consent was also obtained from all the study participants. The study duration was of four months, conducted from 20.05.19 to 19.09.19.

Study design and study population

This is a descriptive, cross-sectional study carried out in ESI-Post Graduate Institute of Medical Sciences and Research, a government tertiary care hospital, Joka, Kolkata. The study is conducted on the insured patient (IP) of ESIC and their family members whose age is more than 18 years. The IP population of ESIC are the beneficiaries of ESIC, an under privilege population whose monthly family household income is less than twenty-one thousand. The study was carried out in the Department of Biochemistry and Community Medicine.

Survey instrument

Based on the WHO STEPS approach a modified questionnaire incorporating socioeconomic inequality based on Kuppuswamy's SES Scale 2019 and modified BMI classification based on the Asia-Pacific classification was used.[17-19] The brief steps of the study tool are discussed below.

Step-1: Questions regarding the demographic information of individuals, i.e., age, sex, and behavioral information questions on tobacco use, alcohol consumption, diet, and physical activity, history of raised blood pressure and history of diabetes were asked.

Step-2: Patient were subjected to several physical measurements such as height, weight, waist-hip circumference. Blood pressure was measured with mercury sphygmomanometer in a seated position. Blood pressure and Heart Rate were measured three times with three minutes' interval and average was taken.

Step-3: Biochemical analysis was done. With all aseptic precaution, 5 ml of fasting blood was drawn from the median antecubital vein after 10-12 hr of fasting which were done based on colorimetric principles. The estimation of serum fasting blood glucose and lipid profile (total cholesterol, triglyceride, and HDL were done using fully automated analyzer –Beckman coulter AU 480 FR and low-density lipoprotein (LDL) and very low-density lipoprotein (VLDL) cholesterol were calculated using Friedwald's formula. Standard protocol was adopted for analyzing biochemical samples.[20-24] Cut-off values recommended by WHO STEPS approach were used for prevalence estimation of NCDs risk factors.[17] The definitions of all the NCD risk factors were based on thorough review of the literature and were based on standard guidelines. (The detailed definitions are published elsewhere).[25]

Sample size and sampling technique

Tobacco use has been identified as the single largest risk factor attributable to NCDs. According to WHO global status report (2014) on NCDs the prevalence of current tobacco use was 23.6% percentage. The sample size for this study was calculated using the following formula:

$$n = \frac{Z_{\alpha/2}^2 * p * (1-p) * D}{E^2}$$

Where

$Z_{\alpha/2}$ is the critical value of the normal distribution at $\alpha/2$ level, Prevalence (p)=23.6 % is the design effect taken as 1.5 and E is the maximum allowable error, chosen as 7 percent.

A sample size of 208 was obtained, assuming a non-response rate of 20 percent a total sample of 250 was to be incorporated. There were 9 dropouts as the participants were not willing to be a part of the study. Therefore, the final sample size was 241. For maintaining anonymity and confidentiality, the participants were given unique identification numbers. An appropriate list

of complete sampling frame was developed. Sample was chosen randomly using simple random sampling technique (SRS). The response rate was 96.4%.

Data collection and analysis

A total of 210 subjects were examined and their data were analyzed in this study. Analyses were conducted in Stata version 16 (StataCorp LP, College Station, TX, USA), using two-sided significance tests at the 5% significance level. Categorical data were compared using the Chi-Square test, whereas ANOVA was used for comparison of means across different groups. Logistic regression was used to calculate adjusted odds ratio with 95% confidence interval. Socio-demographic factors such as age, sex, religion, caste, marital status, work status, type of house, residence place, and education were used as controls for the analysis. To further assess the differences between the middle and low-income groups the four SES classification was reduced into two groups (one comprising of upper and lower-middle categories and second group comprising of upper lower and lower categories) creating a dichotomous variable. The correlation between Socioeconomic Status (SES) with various physical and biochemical NCDs risk factors was assessed using point biserial (r_pb) correlation coefficient.

Results

Table 1 presents the demographic characteristics of the study population. Majority (81%) of the study population were Hindus. Compared to males (42%) a higher proportion of females (58%) was present in the study. The mean age of the participant across different SES groups was in the range of 44–50 years (homogeneous representation of age across SES groups, P=0.075). The lower socioeconomic strata mostly (62.5%) constituted of schedule cast whereas majority (72.2%) of participants belonging to the upper middle class were from general caste. A significant (P = 0.000) association was found between SES and caste. The level of illiteracy was more than 2 fold high in (27.5%) lower SES group compared to upper middle class (12.5%). The percentage of individuals having higher level of education was quite low in (13.9%) upper middle class and it decreases further as one move down to lower SES levels (an inverse relationship was observed, P=0.000). About two-third of the study subjects have rural background. Three fourth of the upper middle-class population resides in paka house while more than half (60.0%) of the lower class have semi-paka houses. Females belonging to lower socioeconomic groups got married (mean age = 15.2 years), before their legal age of marriage. The mean age of marriage among upper middle-class females was above 20 years (variation in mean age of marriage across SES was not uniform, P=0.001). The prevalence of behavioural risk factors was quite high among individuals belonging to lower socioeconomic class. For example, the prevalence of use of smokeless tobacco was 6 times higher (42.5%) in low socioeconomic class compared to lower middle (7.1%) class group, , P=0.000. More than three fourth individual

Table 1: Distribution of the demographic characteristics of the participants included in the study

Demographic Characteristics	Socioeconomic Class				*P*
	Upper Middle N=72 (%)	Lower Middle N=70 (%)	Upper Lower N=59 (%)	Lower N=40 (%)	
Mean age	44.8	46.9	50.2	48.4	0.075*
Religion					
Hindu	63 (87.5)	58 (82.8)	45 (76.3)	28 (70.0)	0.113
Muslim	9 (12.5)	12 (17.2)	14 (23.7)	12 (30.0)	
Caste					
General	52 (72.2)	48 (68.6)	37 (63.8)	5 (12.5)	0.000
OBC	10 (13.9)	5 (7.1)	7 (12.1)	10 (25.0)	
SC	10 (13.9)	17 (24.3)	14 (24.1)	25 (62.5)	
Place of Residence					
Urban	33 (45.8)	28 (40.0)	10 (16.9)	12 (30.0)	0.004
Rural	39 (54.2)	42 (60.0)	49 (83.1)	28 (70.0)	
Type of House					
Kachha	10 (13.9)	28 (40.0)	17 (28.8)	9 (22.5)	0.000
Pakka	54 (75.0)	38 (54.3)	34 (57.6)	7 (17.5)	
Semi-Pakka	8 (11.1)	4 (5.7)	8 (13.6)	24 (60.0)	
Level of Education					
Illiterate	9 (12.5)	12 (17.1)	13 (22.0)	11 (27.5)	0.000
Primary	8 (11.1)	13 (18.6)	7 (11.9)	22 (55.0)	
Middle	20 (27.8)	17 (24.3)	30 (50.8)	4 (10.0)	
High-School	25 (34.7)	18 (25.7)	8 (13.6)	**	
Graduate or above	10 (13.9)	10 (14.3)	1 (1.7)	3 (7.5)	
Occupation					
Working	39 (54.2)	33 (47.1)	35 (59.3)	23 (57.5)	0.533
Non-Working	33 (45.8)	37 (52.9)	24 (40.7)	17 (42.5)	
Mean age of mother at marriage	20.4	18.6	19.9	15.2	0.001*

*P calculated using ANOVA for rest χ^2-test was applied. **No observation

belonging to middle or upper lower class was using refine oil for cooking while among the poor 45% was using palm oil or mustard oil for cooking. Majority of the participants did not take the recommended 5 servings of fruits and vegetables per day but were involved in some form of moderate/heavy physical activity [Table 2]. Mostly 40.3%, $P = 0.020$) the participants of upper middle class have access to safe drinking water.

The mean distribution of physical and biochemical parameters for NCD risk factors revealed that the mean diastolic bold pressure (DBP) was significantly high (mean = 87.2) in upper lower class followed compared to poor group (mean = 82.92,$P = 0.013$). Lipid profile abnormalities like high cholesterol ($P = 0.018$) and LDL levels ($P = 0.003$) tended to be associated with low education but not with wealth [Table 3]. Point biserial correlation coefficient (r_{pb}) correlation coefficient value is used to assess the relationship between socioeconomic status with various physical and biochemical NCDs risk factors [Table 4]. A significant correlation was observed between BMI ($r = -14$; $= 0P.054$), LDL cholesterol ($r = -16.0$; $P = 0.009$) and HDL cholesterol ($r = 18.0$; $P = 0.006$) with socioeconomic status (SES). Figure 1a-f presents the adjusted odds ratios (AORs) derived from logistic regression model with NCD risk factors as dependent variable and SES as independent variable. The SES strata was controlled for demographic and social characteristics variables. The results indicate that the odds of tobacco use (AOR = 10.18,C.I = 2.79-37.10), alcohol consumption (AOR=5.57,C.I = 1.25-24.65), poor fruit consumption (AOR = 4.91,C.I = 1.56 - 15.44) were significantly high among people with poor SES compared to highest SES. On the other hand, no significant differences were observed between poor and non-poor for vegetable consumption, physical activity and overweight/obesity. The prevalence of overweight and obesity as per the modified criteria for the Asian Indians was observed to be 41.41% and respectively. Figure 2 presents the relationship via adjusted odd's ratio between overweight and NCD risk factors. The adjusted odd ratio for systolic blood pressure (AOR=2.11,C.I=1.03-4.31), fasting blood sugar (AOR=3.84,C.I=1.30-11.32), triglyceride level (AOR = 2.20,C.I = 1.18-4.09), high density lipoprotein (AOR = 2.63,C.I = 1.26-5.46) and very low density lipoprotein (zAOR =2.69,C.I = 1.41-5.13) were significantly higher for individuals who were overweight compared to normal.

Table 2: Profile of the study population with respect to behavioural and other risk factors related to NCDs

NCD risk factors	Socioeconomic Class				*P*
	Upper Middle N=72 (%)	Lower Middle N=70 (%)	Upper Lower N=59 (%)	Lower N=40 (%)	
Behavioural risk factors					
Smoker	9 (12.5)	19 (27.1)	9 (15.3)	11 (27.5)	0.071
Smokeless tobacco use	11 (15.3)	5 (7.1)	12 (20.3)	17 (42.5)	0.000
Alcoholic	10 (13.9)	17 (24.3)	10 (17.0)	11 (27.5)	0.236
Life-Style risk factors					
Walk/Cycling (at least 10 mint.)	50 (69.4)	53 (75.7)	44 (74.6)	29 (72.5)	0.849
Daily Vigorous-intensity work (at least 10 min)	14 (19.4)	13 (18.6)	9 (15.3)	12 (30.0)	0.328
Fruit intake <5 servings	67 (93.1)	67 (95.7)	53 (89.8)	40 (100.0)	0.173
Vegetables intake <5 servings	22 (30.6)	38 (54.3)	19 (32.2)	8 (20.0)	0.001
Type of oil use**	23 (31.9)	19 (27.1)	14 (23.7)	18 (45.0)	0.049
Environment and Hygiene					
Separate room for kitchen	60 (83.3)	46 (77.8)	39 (66.1)	32 (80.0)	0.051
Access to safe drinking water	29 (40.3)	16 (22.9)	9 (15.2)	12 (30.0)	0.020
Mean age of Initiation					
Smoking	20.3	23.1	23.4	18.5	0.148*
Smokeless	32.7	35.8	26.1	18.4	0.000*
Alcohol	24.3	23.1	24.3	21.3	0.684*

**Other than-Vanaspati/Pure ghee/butter/refined. *P calculated using ANOVA and for rest χ^2-test was applied

Table 3: Mean distribution of physical and biochemical parameters for NCDs risk factors according to SES classification

NCD Risk Factors (n=241)	Socioeconomic Class				*P*
	Upper Middle N=72	Lower Middle N=70	Upper Lower N=59	Lower N=40	
BMI	25.86	24.98	24.20	24.19	0.133
Waist Hip Ratio	0.95	0.94	0.95	0.94	0.752
Systolic Blood Pressure	135.18	133.18	136.20	127.17	0.103
Diastolic Blood Pressure	87.29	85.98	89.64	82.92	0.013
Fasting Blood Sugar level	94.56	95.40	94.54	92.60	0.982
Total Cholesterol level*	190.81	185.16	187.00	183.77	0.836
Triglyceride level	149.32	154.30	153.93	156.20	0.961
HDL Cholesterol level	46.76	44.28	50.88	51.30	0.037
LDL Cholesterol level**	116.37	113.20	102.77	100.92	0.047

*Significant difference (P=0.018) in mean values observed with participant's level of education. **Significant difference (P=0.003) in mean values observed with participant's level of education

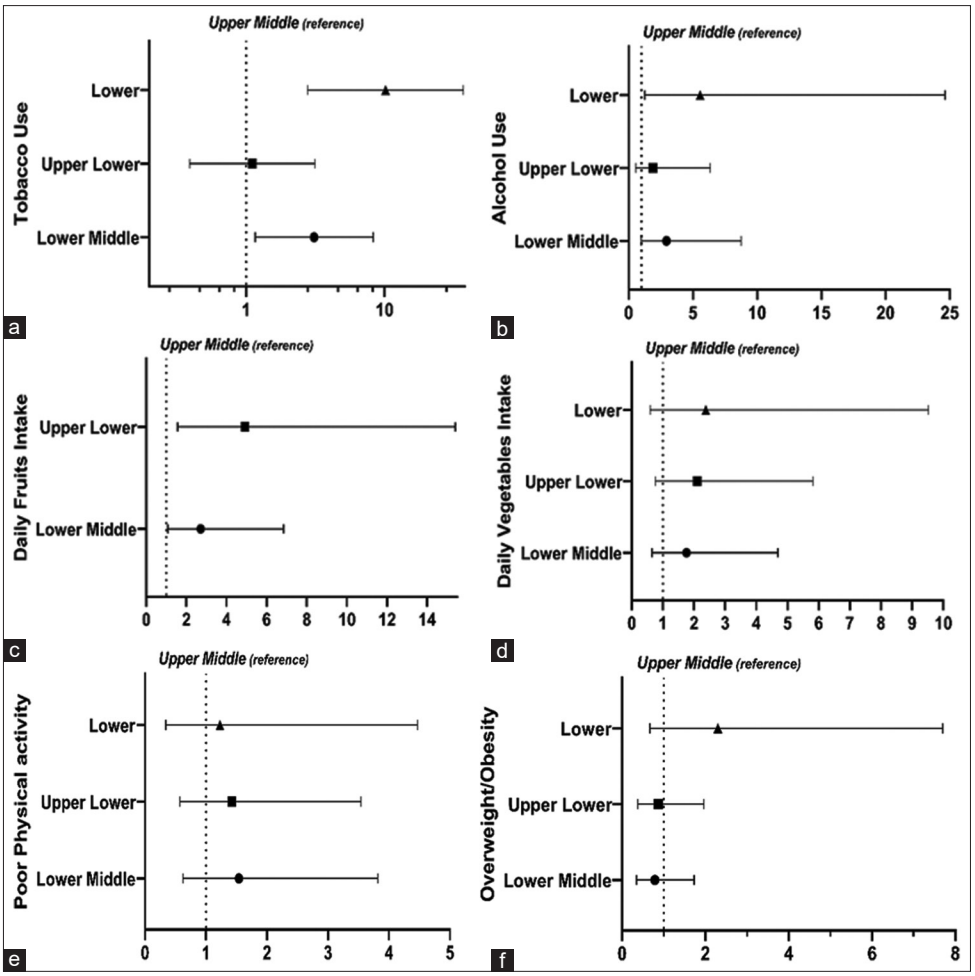

Figure 1: (a) Adjusted Odds ratio (95%C.I) for tobacco use. (b) Adjusted Odds ratio (95%C.I) for Alcohol use. (c) Adjusted Odds ratio (95%C.I) for daily fruits intake. (d) Adjusted Odds ratio (95%C.I) for daily vegetables intake. (e) Adjusted Odds ratio (95%C.I) for poor physical activity. (f) Adjusted Odds ratio (95%C.I) for Overweight/Obesity

Table 4: Correlation between Socioeconomic Status (SES) with various physical and biochemical NCDs risk factors

NCD Risk Factors (n=241)	Correlation Coefficient*	Confidence Interval (95%)	*P*
BMI	-0.14	(0.01,0.25)	0.036
Waist Hip Ratio	0.00	(-0.12,0.12)	0.097
Systolic Blood Pressure	-0.04	(-0.08,0.16)	0.522
Diastolic Blood Pressure	-0.01	(-0.13,0.11)	0.837
Fasting Blood Sugar level	-0.01	(-0.11,0.14)	0.785
Total Cholesterol level	-0.03	(-0.10,0.15)	0.690
Triglyceride level	-0.02	(-0.14,0.16)	0.747
HDL Cholesterol level	0.18	(0.05,0.29)	0.006
LDL Cholesterol level	-0.16	(0.04,-0.28)	0.009

*Point biserial correlation coefficient (r_{pb})

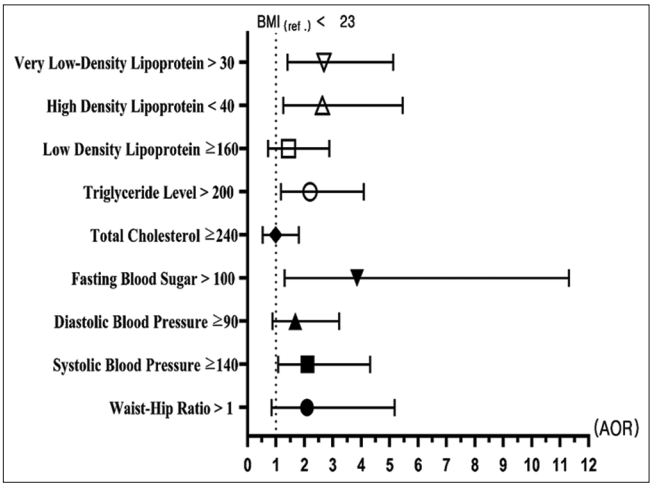

Figure 2: Adjusted Odds ratio (AOR) with 95%C.I for prominent NCD risk factors

Discussion

Understanding variation in NCD risk factors among underprivileged population is particularly relevant as the poor is more exposed to mortality and morbidity due to NCDs. In low and middle income countries very few studies have focused on relationship between socioeconomic patterning with NCD risk factors.[3,13] Socioeconomic differences in health exists globally no matter what measures of social classifications is used.[26-29] It has

been observed in this study that the level of illiteracy, tobacco use, alcohol consumption, and poor fruit intake was more common among the poor while the upper middle class had raised blood pressure, low HDL, and high LDL cholesterol levels. Furthermore, lipid profile abnormalities like high cholesterol and LDL levels tended to be associated with low education but not with wealth. Similar findings have been reported in past as well.[30,31] The age of initiation of smokeless tobacco use was significantly lower among poor compared to individuals belonging to upper or lower middle class strata. The study finds 10-fold higher risk of tobacco use and 5 times higher risk of alcohol use among people with poor SES compared to highest SES. This corroborates results from other studies conducted in both developed and developing countries.[32-35] The issue of disproportionately high use of tobacco among poor has been reported earlier as well.[36,37] Worldwide, tobacco use causes more than 7 million deaths per year and by 2030 this number is expected to touch 8 million figure.[38] Reducing tobacco and alcohol use is one of the best buys for preventing NCDs. The study does not find equatorial distribution of access to safe drinking water by SES classification. The issue of safe drinking supply in similar settings has been highlighted earlier as well.[39] Obesity is a growing public health problem.[14,15] The present study finds higher odd ratio values for blood pressure and for lipid profiles for individuals who were overweight compared to normal. The issue of Obesity was closely linked with an elevated risk of several major non-communicable diseases, including type 2 diabetes, coronary heart disease, stroke, asthma, and several cancers.[7,13,30] Although overweight was less prevalent among participants of lower socio-economic status, but several other risk factors were distributed equally across all socio-economic groups. This indicates that once regarded as diseases of the affluent, NCD risk factors now burden even poorer and puts them at risk of chronic diseases.[30]

The study finds that the majority of the study population have low level of education. The prevalence of behavioural risk factors was quite high among individuals belonging to low socioeconomic class. Most of the participants did not take recommended servings of fruits or vegetables per day. Lipid profile abnormalities tended to be associated with low education but not with wealth. A significant correlation was observed between SES with BMI, LDL and HDL cholesterol. Given the strong linkage between NCD risk factors with socioeconomic inequalities, their management assumes paramount importance. Studies have shown that primary health care providers do not feel competent enough to address healthcare related issues to NCDs prevalent in different SES settings.[40] It is therefore essential to encourage appropriate capacity building with respect to NCD care, right from formative stage of education.

Conclusion

The study showed that the socioeconomic patterning of the population is an important factor while addressing NCDs. The study finds some NCD risk factors were more prevalent among the poor than the non-poor and vice versa. Obesity was closely linked with several major NCD risk factors. The findings of the study indicate the need for stratified approach to address the needs of the poor and non-poor in order to reduce NCDs risk factors inequalities.

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Conflicts of interest

There are no conflicts of interest.

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