Adverse Cardiometabolic Phenotypes among Meena Tribal Population: A Cross-Section Study from Delhi

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ABSTRACT: Non-communicable diseases (NCDs) have become a major concern for global health. Cardiovascular diseases (CVDs) contribute 48% of the total deaths due to NCDs in India. Though several studies have been conducted in urban and rural areas, there is limited evidence on tribal communities. Therefore, the aim of the present study is to examine cardiometabolic risk factors with respect to obesity, hypertension and dyslipidemia among Meena tribal population residing in Delhi. The present cross-sectional study was conducted among 90 Meena tribal individuals of either sex, aged between 20 and 65 years, from New Delhi district, India. From the recruited participants, detailed socio-demographic information was collected. Fasting blood samples were collected to determine serum lipid estimated using spectrophotometry technique. Anthropometric and physiological data were also collected to determine obesity and hypertension status, respectively. The observed high prevalence of cardiometabolic risk factors among a single tribal community demonstrates rising public health concern which needs an immediate health intervention. These findings have been discussed presently in this paper.

INTRODUCTION

Cardiovascular diseases (CVDs) are the leading cause of disease burden and deaths globally (Prabhakaran *et al*., 2018). In 2019, WHO reported around 17.9 million (32% of total deaths) people died on account of CVDs globally (WHO, 2009). The United Nations, alarmed by the increasing burden of non-communicable diseases (NCDs) and high disease severity and case-fatality in low socio-economic and middle socio-economic countries compared with high socio-economic countries, recognized in 2012 that the rising burden of NCDs was one of the major intimidation to sustainable development in the 21st century (Clark, 2013; Joshi *et al*., 2007; Ralston *et al*., 2016; Yusuf *et al*., 2014). Currently in India, about 63% of the total deaths are due to non-communicable diseases (NCDs), of which 27% are attributed to CVDs (WHO Health Topics, 2019). Several previous studies reported the increasing burden of cardiovascular diseases and their risk factors over time in India (WHO. G, 2011). Further other studies reported that most of the risk factor attributed to CVDs in India include poor dietary intake with increasing prevalence

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of obesity, hypertension and dyslipidemia (Dandona *et al*., 2017; Mensah *et al*., 2019; Prabhakaran *et al*., 2018). In India, Luhar *et al.* (2018) observed that the prevalence of overweight and obesity is increasing faster than worldwide average and on the basis of this observation they predicted a doubling in overweight and obesity by 2040 (Luhar *et al*., 2018). Moreover, lipid abnormalities are correlated with an increasing risk of adverse cardiovascular disease including coronary heart disease, stroke and myocardial infarction (Ciffone *et al*., 2019; Pol *et al*., 2018). Thus, reporting of these risk factors may help in policy intervention and treatments to reduce early death due to CVDs.

India with 1.3 billion people having cultural, demographic and lifestyle diversities, huge variations in the prevalence of obesity, hypertension and dyslipidemia have been observed in different population as well as rural-urban variation (Anchala *et al*., 2014; Gupta *et al*., 2016; Kumar *et al*., 2013; Prabhakaran *et al*., 2016). A further aspect accounting for diversity in the country is the tribal populations, which is more than 8.6% of the total population (Government of India, 2013). Some studies reported that chronic diseases have been described to the wealthy societies because of changing lifestyles in expression of dietary habits and sedentary lifestyle (Popkin *et al*., 1995; Sobal *et al*., 1989). However, rising number of studies has shown a developing trend in lifestyle diseases like obesity, hypertension, dyslipidemia and other CVDs among tribal populations in different states of India (Meshram *et al*., 2014; Rengma *et al*., 2015). On the other hand, remaining to differential ethnic backgrounds, dietary habits and geographic areas etc, tribal populations may have community-specific risk factors (Mishra *et al*., 2021). However, it is essential that lifestyle determinants relating treatment and management of CVD risk factor should be an important component of a national strategy to reduce the increasing burden of CVD in India.

Meena is a tribal community inhabiting the Indian states of Rajasthan, Gujarat, Maharashtra, Madhya Pradesh, Delhi, Karnataka and Chhattisgarh (Government of India, 2013). Because of migration from rural to urban areas and both nutritional and epidemiological transitions, Meena tribal population is expected to be burdened with lifestyle disorders. Thus, the aim of the present study was to examine cardiometabolic related risk factors with respect to obesity, hypertension and dyslipidemia, among the individuals of Meena tribe from Delhi who migrated from Rajasthan.

MATERIALS & METHODS

The present cross-sectional study was conducted among 90 Meena tribal individuals of either sex, aged between 20 and 65 years, from New Delhi district, New Delhi, India. The study was approved by the Ethical Committee, Department of Anthropology (University of Delhi). Pre-informed written consent transcribed in local language was obtained from each individual prior to recruitment and data collection. Detailed data on socio-demographic (name, sex, age, migration history, household composition, education, occupation, income) variables were collected using pretested interview schedules. Kuppuswamy scale was used for categorization of the socioeconomic status (Saleem *et al*., 2021). Anthropometric variables, i.e., height vertex, body weight, waist circumference (WC), and hip circumference, were measured following standard protocol established by the International Society for the Advancement of Kinanthropometry (ISAK) (Silva *et al*., 2020). Blood pressure was measured in the left arm of the participant in sitting position using digital Blood Pressure machine (OMRON-8719) and total three measurements were taken to minimize the error.

Overweight was defined as body mass index (BMI) $\geq$23.0kg/m^2 but<25.0 kg/m^2 while generalized obesity was defined as BMI $\geq$25.0kg/m^2 and underweight as BMI <18.5 kg/m^2 based on World Health Organization and Asia Pacific Guidelines (WHO, Expert Consultation, 2004).

Hypertension was categorized according to the American College of Cardiology/American Heart Association (ACC/AHA) guideline on the basis of systolic blood pressure (SBP) and diastolic blood pressure (DBP) into normal (SBP<120mmHg and DBP<80 mmHg), elevated (SBP 120-129 mmHg and DBP <80mmHg), Hypertension Stage-1(SBP 130-139mmHg and DBP 80-89mmHg) and Hypertension stage-2 (SBP $\geq$140 mm Hg and/or DBP $\geq$90 mm Hg) (Whelton *et al*., 2018).

Abdominal obesity was defined as WC ≥90cm for male and ≥80 for female (WHO Expert Consultation, 2008). High waist-hip ratio (WHR) was categorized as ≥0.90 for male and ≥0.80 for female and measured as WC (in cm) divided by hip circumference (in cm) (WHO Expert Consultation, Geneva, 2008). High waist-height ratio (WHtR) was categorized as ≥0.5 and measured as WC (in cm) divided by height (in cm) (Ashwell et al., 2016). Cluster sampling method was used to select participants. Cluster sampling method is the whole population is subdivided into clusters or groups and random samples are then collected from each group (Lohr, 2019). For clustering analysis, the cluster of 0 to ≥9 cardiometabolic risk factors were determined inthe overall study population. Next, the percentage of the study population with 0 to ≥9 CVD risk factors was determined by age in years with range.

Biochemical Analysis

Overnight fasting intravenous blood (2.5ml) was collected into non-Ethylenediamine tetraacetic acid (non-EDTA) coated vacutainers by trained personnel. Serum was separated from each sample. Serum total cholesterol (TC), triglyceride (TG), and high-density lipoprotein cholesterol (HDL-C) were assayed with the help of spectrophotometer (Dialab instrument) using commercial kits (Randox, USA). Low-density lipoprotein cholesterol (LDL-C) was calculated using Friedewald equation and very low-density lipoprotein (VLDL)was calculated as TG/5 using Friedewald equation (Friedewald *et al*., 1972).

Dyslipidemia was classified according to National Cholesterol Education Program-Adult Treatment Panel III (NCEP-ATPIII) guidelines as (Mishra *et al*., 2005).

- Hypercholesterolemia–serum cholesterol levels ≥ 200 mg/dl (≥ 5.2 mmol/l).
- Hypertriglyceridemia–serum triglyceride levels ≥ 150 mg/dl (≥ 1.7mmol/l).
- Low HDL-C–serum HDL-C < 40 mg/dl (< 1.04 mmol/l)for men and < 50 mg/dl (< 1.3 mmol/l) for women.
- High VLDL-C- serum VLDL-C ≥30 mg/dl (<0.77 mmol/l)
- High LDL-C–LDL-C levels ≥ 130 mg/dl (≥ 3.4 mmol/l)

Statistical Analysis

Statistical analysis was performed using IBM SPSS Statistics v22.0 (SPSS Inc. Chicago, IL, USA). Prevalence was reported as number with percent and values for male and female have been analyzed separately. Chi-square test as used to perform test for difference in categorical variables. As the data of the present study were found to be normally distributed, hence the data were expressed in terms of Mean ± SD. We calculated correlation analysis and calculated Pearson's correlation coefficient. A p-value ≤0.05 was considered statistically significant for all tests.

RESULTS

A total sample of ninety (90) individuals were included in the present study, 62 females (68.9% of the studied population) and 28 males (31.1% of the studied population).Mean age of the studied population was 36.55 (±9.10) years. 93.7 % individuals in the studied population were migrated from different villages of Rajasthan to Delhi, out of which 72.4% individuals have migrated 10-20 years and above 20 years ago and 27.6% individuals have migrated recently or ≤5 years ago. Literate individuals were higher (71.1%) as compared non-literate (28.8%). On the basis of socioeconomic status, upper lower class (47.8%) individuals were higher as compared to upper middle class (23.3%), lower middle class (6.7%) and lower class (22.2%). (Table 1)

Individuals in studied population with generalized obesity (overweight + obese BMI) were found to be around 37.8%. Prevalence of abdominal obesity was much higher with 53.3% of studied population having high WC; more than three fourth of the studied population had high WHR (82.2%) and more than half of the population had high WHtR (58.9%). Hypertension (Stage 1+Stage 2) among the study population was found to be 18.9%. Dyslipidemia in the present studied population varied especially with lowest prevalence consisting of high LDL-C and high TC (23.3% and 17.8% respectively), while the highest prevalence of abnormal lipid variable was found to be abnormal TG (32.2%) and low HDL-C (32.2%). Moreover, abnormal VLDL was 31.1%, respectively in the present studied population (see Table 2).

TABLE 1

General characteristics of socio-demographic variables of the studied population

Generalcharacteristics		Meena population
Age (years)	Mean ± S.D	36.55 ± 9.10
Sex n (%)	Male	28(31.1)
	Female	62(68.9)
Marital status n (%)	Unmarried	3(3.3)
	Married	87(96.7)
Migration n (%)	Yes	62(93.1)
	No	4(6.1)
Total year of migration n (%)	Recent or ≤5 years	16(27.6)
	10-20 years and above	42(72.4)
Cause of migration n (%)	Job	19(28.8)
	Marriage	42(63.6)
	Both	1(1.5)
	No	4(6.1)
Education n (%)	Non-literate	26(28.9)
	Literate	64(71.1)
Occupation n (%)	Housewife	56(63.6)
	Employed	29(32.9)
	Dependent	3(3.5)
Socioeconomic status n (%)	Upper middle	21(23.3)
	Lower middle	6(6.7)
	Upper lower	43(47.8)
	Lower	20(22.2)

TABLE 2

Overall and sex-wisedistribution of cardiovascular variables among the study population

Variables		Total (%)	Female (%)	Male (%)	P-value
BMI	Underweight	13(14.4)	9(14.5)	4(14.3)	0.831[a]
	Normal	43(47.8)	30(48.4)	13(46.4)	
	Overweight	15(16.7)	7(11.3)	8(28.6)	
	Obese	19(21.1)	16(25.8)	3(10.7)	
WC	Normal	42(46.7)	24(38.7)	18(64.3)	0.02[a]*
	At risk	48(53.3)	38(61.3)	10(35.7)	
WHR	Normal	16(17.8)	6(9.7)	10(35.7)	0.003[a]*
	At risk	74(82.2)	56(90.3)	17(64.3)	
WhtR	Normal	37(41.1)	24(38.7)	13(46.4)	0.491[a]
	At risk	53(58.9)	38(61.3)	15(53.6)	
BP	Normal	62(68.9)	48(77.4)	14(50)	0.115[a]
	Elevated	11(12.2)	5(8.1)	6(21.4)	
	Stage-1	9(10.0)	4(6.5)	5(17.9)	
	Stage-2	8(8.9)	5(8.1)	3(10.7)	
TC	Normal	74(82.2)	52(83.9)	22(78.6)	0.543[a]
	At risk	16(17.8)	10(16.1)	6(21.4)	
TG	Normal	61(67.8)	46(74.2)	15(53.6)	0.05[a]*
	At risk	29(32.2)	16(25.8)	13(46.4)	
HDL-C	Normal	61(67.8)	50(80.6)	11(39.3)	<0.001[a]*
	At risk	29(32.2)	12(19.4)	17(60.7)	
VLDL-C	Normal	62(68.9)	46(74.2)	16(57.1)	0.106[a]
	At risk	27(31.1)	16(25.8)	12(42.9)	
LDL-C	Normal	66(76.7)	45(72.6)	24(85.7)	0.173[a]
	At risk	21(23.3)	17(27.4)	4(14.3)	

The sex-wise prevalence of cardiometabolic risk factors was considered (Table 2), females were found to be significantly more obese in form of abdominal obesity (WC=61.3%, WHR= 90.3% and WHtR= 61.3%) as compared to that of males (WC=35.7%, WHR= 64.3% and WHtR= 53.6%). However, the prevalence of generalized obesity was found to be quite higher in males (39.3%) as compared to that of females (37.1%). Hypertensive is more common among males (28.6%) as compared to that of females (14.6%). Low HDL-C, high TG and high VLDL which were found to be the most prevalent form of dyslipidemia in the present population and were significantly higher among males (low HDL-C= 60.7%, TG= 46.4% and VLDL= 42.9%) as compared to females (low HDL-C= 19.4%, TG= 25.8% and VLDL=25.8%). Intriguing, females had higher prevalence of high LDL (27.4%) as compared to males (14.3%). The clustering of cardio vascular risk factors in the study population showed that individuals with $\geq$3 cluster (17.8%, 22-50 years) and $\geq$4 cluster (16.7%, 24-62 years) were highest among studied population and the cluster of risk decreases after $\geq$4 cluster (Figure 1).

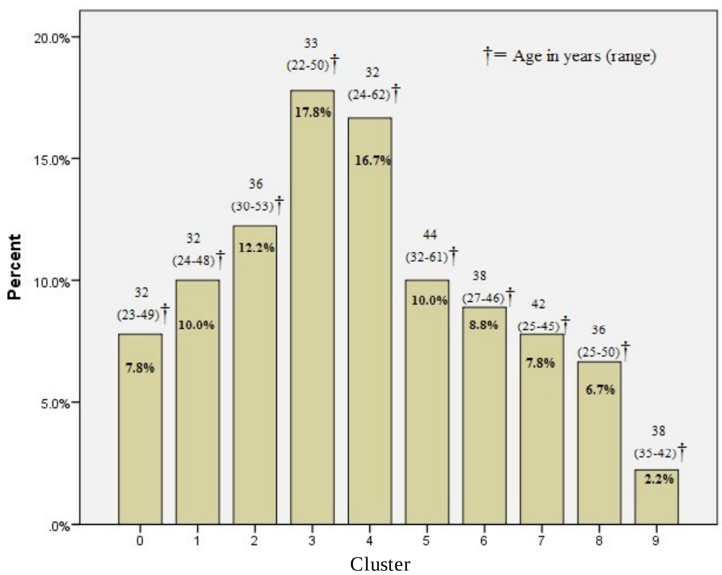

Figure 1: Age-wise clustering of cardio vascular risk factors among the study population

In Table 3, Pearson's correlation analysis revealed that the BMI was positively correlated with WC (r=0.591, P<0.001), WHR (r=0.302, P<0.01) and WHtR (r=0.511, P<0.001). Whereas, the WC was positively correlated with WHR (r=0.489, P<0.001), WHtR (r=0.803, P<0.001) and LDL-C (r=0.253, P<0.05).WHR was significantly negative correlated with HDL-C (r= -0.239, P<0.05) and positively correlated with WHtR (r=0.438, P<0.001), TC (r=0.216, P<0.05) and LDL-C (r=0.257, P<0.05). Further, WHtR was showed that positive correlation with TC (r=0.270, P<0.05) and LDL-C (r=0.301, P<0.05)respectively. TC was positively correlated with LDL-C (r=0.705, P<0.001) respectively. TG was positively correlated with HDL-C (r= 0.389, P<0.001) and VLDL-C (r=0.975, P<0.001). However, HDL-C was positively correlated VLDL-C (r=0.410, P<0.001) and BP (r=0.275, P<0.01).

TABLE 3

Correlation between BMI, WC, WHR, WHtR, BP, Cholesterol, TG, HDL, VLDL and LDL in the study population

Variables	BMI	BP	WC	WHR	WHtR	TC	TG	HDL-C	VLDL-C
BP	.034								
WC	.591**	.110							
WHR	.302**	.150	.439**						
WHtR	.511**	.057	.803**	.438**					
TC	.117	-.002	.144	.216*	.270**				
TG	.051	.092	.168	.010	.141	.177			
HDL-C	-.047	.275**	-.118	-.239*	-.149	-.072	.389**		

VLDL-C	.070	.105	.196	-.001	.122	.127	.975**	.410**	
LDL-C	.112	-.065	.253*	.257*	.301**	.705**	.069	-.156	.026

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

DISCUSSION

There is extensive heterogeneity in the prevalence of cardiovascular risk factors in different areas of India; while CVD has emerged as the leading cause of death in all parts of country (Mishra *et al*., 2021). Therefore, recognizing community- specific risk factors and their underlying mechanisms can help in targeted disease intervention and prevention. The findings in this study provide CVD related risk factors with respect to obesity and dyslipidemia among the individuals of Meena tribal population from New Delhi district, Delhi, India. Alarmingly high prevalence of general obesity was observed in conjunction with high prevalence of abdominal obesity and low HDL-C. A study reported that migration impacts on CVD and its risk factor in developing countries like India (Jeemon *et al*., 2009). Many people are migrating from rural to urban areas due to employment and demographic pressure, due to which their environment, dietary patterns and lifestyle are getting affected, so their CVD risk factor can increase due to this affect (Jeemon *et al*., 2009). In expeditiously growing economics like India, the notion that overweight and obesity usually exhibit among higher socioeconomic position (SEP) has become more of a fallacy, as growing body of evidence shows a rise in overweight and obesity among lower SEP (Luhar *et al*., 2018 and 2019). Comparative analysis of the National Family Health Surveys (NFHS) 2, 3, and 4 from 1998 to 2016, assessing the prevalence of overweight and obesity, showed an increasing trend, irrespective of SEP (Luhar *et al*., 2018). Although these national representative studies exhibit an increasing burden of overweight/obesity in rural populations, unfortunately, there is no such data on tribal populations in India, except for one conducted by the National Nutrition Monitoring Bureau which reported an overweight prevalence of 2–3% among Indian tribes (Mishra *et al*., 2021).

The present study demonstrated high prevalence of generalized obesity (overweight and obese) around35.8% and even higher abdominal obesity with respect to WC, WHR and WHtR as 53.3%, 81.1% and 58.9% respectively, among Meena/Mina tribal population. In 2016, one study reported a cumulative 12.8% prevalence of overweight and obesity among nine tribal population of India (Kshatriya *et al*., 2016). Various other studies on tribal population reported similar high prevalence of obesity (Chhungi *et al*., 2019; Kandpal *et al*., 2016; Rengma *et al*., 2015). Further, the present study found sex-wise variation in the prevalence of abdominal obesity, whereby females (WC=64.5%, WHR=90.3% and WHtR=61.3%) were found to be significantly higher as compared to males (WC=35.7%, WHR=60.7% and WHtR=46.4%). Some postulated that women are at a higher risk of developing abdominal obesity during post-menopausal period because of hormonal changes (Lumsden *et al*., 2015). Thus, this aspect could be attributed to the high prevalence of abdominal obesity among females in this population. However, generalized obesity was quite high in males (39.3%) as compared to females (37.1%). Further, the present study also reported the prevalence of hypertension (Stage 1+Stage 2) was found to be higher in males (29.6%) as compared to females (14.6%). One study observed that the prevalence of hypertension was higher in males (28%) as compared to female (19%) (Meshram *et al*., 2014). In India, the pattern of dyslipidemia tends to have lower hypercholesterolemia with high low HDL-C and triglyceride, more among tribal population (Gupta *et al*., 2016; Ismail *et al*., 2016). The present study reported high prevalence of low HDL-C (33.3%). Several previous studies have also found higher prevalence of low HDL-C among Indian tribes (Bhardwaj *et al*., 2013; Ismail *et al*., 2016). One study observed an exception among Mizo tribal population from North-East India with greater occurrence of hypercholesterolemia as compared to other lipid abnormalities (Chhungi *et al*., 2019). A study on Bhils tribal population also observed high prevalence of low HDL-C as compared to other lipid abnormality (Mishra *et al*., 2021). Present study has significantly high prevalence of low HDL-C in males (65.4%) as compared to females (19.7%). The high prevalence of low HDL-C in study population showed that dietary micronutrient deficiency and under nutrition may be high in males as compared to females which can otherwise be attributed to occupation related lifestyle change (Delisle *et al*., 2013).

Particularly, in the present study 32.2% of population found to be hypertriglyceridemia, whereas males (50.0%) were found to have higher prevalence of hypertriglyceride as compared to females (24.6%). Hypertriglyceridemiais commonly high in South Asians including Indian population because of consumption of carbohydrates highly in their diet (Misra *et al*., 2005). Some studies on Bhil tribal population reported high consume from food items rich in carbohydrates including wheat and rice (Devi *et al*., 2018). The high prevalence of triglyceride found in present study could be because of consumption of carbohydrate-rich diet. Furthermore, present study revealed that abdominal obesity was significantly related with LDL-C, although general obesity could not find any correlation with hypertriglyceridemia and other lipid abnormalities indicating that independent mechanism could affect their triglyceride level. However, WC, WHR and WHtR were found to be significant relation with LDL-C similar with other study (Mishra *et al*., 2021). Even so, abdominal and general obesity seems to be major contributing factor to abnormal lipid levels among Meena population. Consequently, the need to improved awareness on controlling obesity should be the most important and promotion of healthy lifestyles to decrease obesity is significant. Taking into account, the high prevalence of low HDL-C and hypertriglyceridemia in the present tribal population with obesity and other demographic including socio-economic status, migration and their dietary habits as major causal factors and weight management with healthy dietary modification should be of predominant importance.

The clustering of cardiometabolic risk factors in present study showed that about 7.8% of participants in the study population have no cardiometabolic risk factor whereas 17.8% and 16.7% of the participants have 3 and 4 risk factors and after 3 and 4 cluster of risk factors, with increase in clustering of risk factors the percentage of individuals in each cluster declined progressively to about 2.2% whom had at least 9 risk factors (Figure 1). The abdominal obesity-hypertension-dyslipidemia and general and abdominal obesity-hypertension-dyslipidemia cluster were associated with the highest in young adult, mid-adult and older with three or four risk factors. However, declining trend of higher clustering of cardiometabolic risk factor in the present study may also suggest that among participants who had more than 4 cardio-metabolic risk factor they might have higher probability of early mortality, thus not capturing during the cross-sectional study. A study by Gu et.al, 2005 among Chinese adults population from the International Collaborative Study of Cardiovascular Disease in Asia (Inter-Asia) during 2000 to 2001 and compared these data with those of US adults from the National Health and Nutrition Examination Survey of 1999 to 2000. Overall, this study examined to 80.5%, 45.9%, and 17.2% of Chinese adults had $\geq$1, $\geq$2, and $\geq$3 modifiable CVD risk factors (dyslipidemia, hypertension, diabetes, cigarette smoking and overweight), respectively. By comparison, 93.1%, 73.0%, and 35.9% of US adults had $\geq$1, $\geq$2, and $\geq$3 of these risk factors, respectively (Gu *et al*., 2005).

Major limitation of the present study is the smaller sample size. Therefore, the results of the present study need to be validated with a larger sample size.

CONCLUSION

The current study demonstrated high prevalence of obesity and dyslipidemia, especially low HDL and hypertriglyceridemia among a tribal population. Obesity and unbalanced dietary intake may raise dyslipidemia in Meena tribal population. There is clustering of cardiometabolic risk factors among the study population in which only about 7.8% were free from these riskfactors but there is higher number of individuals in the age group 22-62 years with 3 and 4 risk factors, higher clustering of cardiometabolic risk factor in the present study may also suggest that among participants who had more than 4 cardio-metabolic risk factor they might have higher probability of early mortality. Whereas lifestyle disorders can take the form of serious complications in allpopulation, but the main cause may be differentin different populations, especially India, in which found diverse ethnicity, culture and lifestyle. The observed high prevalence of cardiometabolic disease risk factors is a major public health concern which needs an immediate health intervention. Treatment and management of CVD risk factors should be an important component of a national strategy to reduce the increasing burden of CVDs in India.

Abbreviations: NCDs–non-communicable diseases; CVD–cardiovascular diseases; WHO–World Health Organization; ISAK–International Society for the Advancement of Kinanthropometry; WC–waist circumference; BMI–body mass index; WHR–waist-hip ratio; WHtR, waist-height ratio; EDTA–ethylenediaminetetraacetic acid; TC–total cholesterol; TG–triglyceride; HDL-C–high-density lipoprotein cholesterol; LDL-C–lowdensity lipoprotein cholesterol; ACC/AHA–American College of Cardiology/American Heart Association; BP–Blood Pressure; SBP–Systolic Blood Pressure; DBP–Diastolic Blood Pressure; NCEP-ATP III–National Cholesterol Education Program-Adult Treatment Panel III; SPSS–Statistical Package for Social Sciences; SEP–socio-economic position; NFHS–National Family Health Survey.

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