Original Article

Prevalence of cardiovascular disease risk factors in a rural community in West Bengal, India

Abstract

Background: In rural India, only a few studies have been undertaken to investigate the prevalence of cardiovascular disease (CVD). Most of the studies carried out on the urban population. **Objectives:** To investigate the prevalence of CVD risk factors in a rural community in West Bengal, India. **Materials and Methods:** A total of 1007 (645 males and 362 females) participants aged 20 years and above took part in the present study. Various anthropometric measures were undertaken using standard techniques. Metabolic profiles were measured using an auto-analyzer. Blood pressure (BP) was recorded according to standard protocol. Insulin was also measured, and homeostasis model assessment of insulin resistance was calculated accordingly. **Results:** The anthropometric measures are almost equal in male and female except SF4 and percentage of body fat, which are more in the female. It is observed that 52.53% population have high BP, 45.58% have high triglyceride (TG), 23.14% have high fasting blood glucose (FBG), 11.22% have high total cholesterol (TC), and 11.62% have low high-density lipoprotein (HDL). High TC is found more in female, but high TG, high FBG, and high BP are more in male, and low HDL is found almost equal in male and female. The prevalence of three CVD risk factors clustering is also significant in male and female. **Conclusion:** The present study showed that prevalence of CVD risk factors is considerably high in the study population and warranted early intervention to check progressive increase of CVD risk factors in the rural folk.

Key words: Asian Indians, cardiovascular disease, diabetes, metabolic syndrome, obesity

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INTRODUCTION

The prevalence of cardiovascular disease (CVD) is rising worldwide, and it accounts for 17% of the total mortality.[1] It is presumed that not only developed countries will be affected by CVD, the developing countries will also equally, even more, will be affected.[2] Although the prevalence of some CVD risk factors has decreased in economically developed countries, the corresponding prevalence has increased in economically developing countries.[3,4] It was reported[5] that mortality from CVD was projected to decline in developed countries from 1970 to 2015, whereas it was projected to almost double in the developing countries. According to the World Health Organization (WHO), CVD will be the number one cause of morbidity and mortality in the world by the year 2015 (WHO 2000); and it is assumed that Indians would be the most affected amongst all ethnic populations.[4] As per the report of the global burden of disease study, in the year 1990, there were 5.2 million deaths from CVD in economically developed countries and 9.1 million deaths from the same cause in developing

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countries.[6] An estimated 17.3 million people died from CVDs in 2008, representing about 30% of all global deaths. It has been predicted that by the year 2020, there will be an increase by almost 75% in global CVD prevalence, and almost all of this increase will occur in developing countries.[7] By 2030, almost 23.6 million people will die from CVDs, mainly from heart disease and stroke.

CVD is the leading cause of death in India,[8] and its contribution to mortality is rising; deaths due to CVD are expected to double between 1985 and 2015.[5,9,10] According to the World Health Report of 2002, deaths due to coronary heart disease (CHD) in India rose from 1.17 million in 1991 to 1.59 million in 2000 and 2.03 million in 2010.[11] A total of nearly 64 million cases of CVD are likely in the year 2015, of which nearly 61 million would be CHD cases (the remaining would include stroke, rheumatic heart disease, and congenital heart diseases). Deaths from this group of diseases are likely to amount to be a staggering 3.4 million.[12] Cardiovascular mortality in Asian Indian population is likely to climb up 103% in men and 90% in women by 2015.[9] It has been estimated that by 2020, CVD will be the largest cause of disability and death in India, with 2.6 million Indians predicted to die due to CVD.[13,14] It has been predicted that by the year 2020 there will be a 111% increase in cardiovascular deaths in India. It has also been predicted that India would be the heart disease capital in the world by 2020.[15] By 2020, 2.6 million Indians are predicted to die due to CHD, which constitutes 54.1% of all CVD death.[16,17] It was shown that people with changing lifestyles due to growing urbanization are associated with adverse CVD risk factors irrespective of their habitat (rural vs. urban).[18] Several surveys conducted across the country have shown a rising prevalence of major risk factors for CVD in urban as well as rural population.[19-21] There are various factors involved for rapid increasing of the CVD. However, its complete etiology and mechanisms are yet to be understood.

It is seen in a survey conducted in 45 rural villages in India, 32% of all deaths were due to CVD. On the other hand, infectious diseases were responsible for 13%. It proves that the epidemic has reached its advanced stage even in rural India.[22] CHD is more prevalent in Indian urban populations, and there is a clear declining gradient in its prevalence from semi-urban to rural populations. In 2003, the prevalence of CHD in India was estimated to be 3-4% in rural areas (two-fold higher compared with 40 years ago), and 8-10% in urban areas (six-fold higher compared with 40 years ago), with a total of 29.8 million affected (14.1 million in urban areas and 15.7 million in rural areas) according to population-based cross-sectional surveys.[7,23] The Indian Council of Medical Research estimates that the prevalence of diabetes is 3.8% in rural areas, compared with 11.8% in urban areas.[24] Hypertension is even more prevalent among urban (20-40%) than rural adults (12-17%),[25] and was affecting an estimated 118 million inhabitants in India in 2000; this number is projected to almost double to 214 million in 2025.[26]

Therefore, it is found that the prevalence of CVD risk factors is greater in urban population of India and also increasing rapidly. There is a lack of adequate data on the prevalence of CVD risk factors in rural India. The present community-based cross-sectional study was carried out to investigate the prevalence of CVD risk factors in a rural community in West Bengal, India.

MATERIALS AND METHODS

Study population

A total of 1007 (645 males and 362 females) participants (20 years and above) took part in the study. The number of females is comparatively less as because the awareness among them is less and many of them did not want to spend time for giving personal data. The present community-based cross-sectional study was conducted in between July 2012 and February 2014. All subjects were inhabitants of Santiniketan-Bolpur area, West Bengal, India. All the participants were explained the purpose of the study and were assured to keep the information strictly confidential. Written consent was taken from each and every participant before the actual commencement of the work. Only one subject was chosen from each household to avoid intra-household clustering of CVD risk factors. The subjects are divided into five categories, namely, Group I (20-29 years, n = 79), Group II (30-39 years, n = 140), Group III (40-49 years, n = 272), Group IV (50-59 years, n = 347), and Group V (60 years and above, n = 169) to study the prevalence of CVD risk factors according to age groups and sex. The Institutional Ethics Committee of the "Human Genetic Engineering Research Centre," Kolkata, India, had approved the study.

Anthropometric measures

Height, weight, circumferences of mid-upper arm circumference, minimum waist circumference, and maximum hip circumference as well as skinfold thickness at biceps, triceps, subscapular, and suprailiac were taken using standard techniques.[27] Height and weight were measured to the nearest 0.1 cm and 0.5 kg, respectively, with subjects wearing light clothes and without shoes. Mid-upper arm, waist, and hip circumferences were measured with an inelastic tape to the nearest 0.1 cm, in the standing position. Waist circumference was taken at the narrowest part of the torso region as seen from the anterior aspect. Waist-hip ratio (WHR) was computed accordingly. Skinfolds thicknesses were measured on the left side of the body to the nearest 0.2 mm using a Holtain skinfold caliper (Holtain Corporation, UK). Sum of four skinfold thickness, that is, biceps + triceps + subscapular + suprailiac (SF_4) was calculated subsequently. Percentage of body fat (% BF), body mass index (BMI), basal metabolic rate, and visceral fat level were measured using an Omron body fat analyzer (Omron Corporation, Tokyo, Japan). The accuracy of the body fat analyzer was checked periodically by calculating BMI manually (weight in kg/height in m^2).

Socioeconomic characteristics

A schedule was used as a data collection tool. This predesigned questionnaire contained questions relating to sociodemographic information of the participants. The demographic information such as name, age, sex, marital status, etc., as well as socioeconomic

characteristics, such as, monthly family income and expenditure, occupation and education, etc., were obtained from participants through an open-ended schedule. The information on materialistic possessions (e.g., television, washing machine, refrigerator, personal computer, air-conditioner, two wheeler, and four wheeler, etc.) and the health-related behaviors, such as, drinking status, smoking status, family history, dietary lifestyle, physical activity, and etc.,[28] were also recorded.

Blood pressure

Left arm systolic blood pressure (SBP) and diastolic blood pressure (DBP) were taken from each participant in a sitting position using a standard mercury sphygmomanometer according to a standard protocol. The 1st and 5th Korotkoff sounds were recorded as SBP and DBP, respectively. Two BP measurements were taken and averaged for analysis. A third measurement was taken when the difference between the two measurements was ≥5 mmHg, and a subsequent mean was calculated. A 5 min relaxation period between measurements was given for all participants. Mean arterial pressure (MAP) was calculated subsequently using the standard formula: MAP = DBP + 1/3 (SBP-DBP).

Metabolic profiles

A fasting blood sample (7 ml) was collected from each subject for the determination of fasting blood glucose (FBG), total cholesterol (TC), triglyceride (TG), and high density lipoprotein (HDL). An overnight fast of 10–12 h was maintained before collecting blood from the participants. The plasma was separated by centrifugation at 1000 rpm for 20 min at room temperature within 2 h of collection. TC, TG, FBG, and HDL were estimated on separated plasma using auto-analyzer. Low-density lipoprotein (LDL) and very LDL (VLDL) were then estimated using the standard formula:[29] VLDL = TG/5 and LDL = TC – (HDL + VLDL). All metabolic variables were measured in mg/dl (mg %) unit. Serum insulin was estimated for the subjects (n = 101) whose fasting glucose was got ≥100 mg %. Homeostasis model assessment of insulin resistance (HOMA-IR) was then calculated by the following formula:[30]

$$\text{HOMA} - \text{IR} = \frac{\text{fasting insulin}\,(\mu\text{U/mL}) \times \text{fasting glucose (mg \%)}}{22.5}$$

Statistical analyses

Percentage of various socioeconomic characteristics, such as education, occupation, monthly income and expenditure, materialistic possession, and food habit of the population was studied. Descriptive statistics, such as mean, standard deviation (SD) and range of variables were undertaken by sex. The prevalence of CVD risk factors, such as high TC, TG, FBG, and BP, and low HDL was undertaken in respect of the age groups and sex. The prevalence of CVD risk factors clustering by sex was also compared. All statistical analyses were carried out using the SPSS Inc., Chicago, IL, USA (PC + version 14.0).

RESULTS

Percentage of socioeconomic characteristics of the study population is presented in Table 1. It is found that 38.10% population are up to X standard and 29.50% are postgraduate and above. 96.60%, 75.50%, and 46.70% population possess television, refrigerator, and computer, respectively. 93.60% population are found nonvegetarian.

Mean, SD and range of anthropometric measures, lipid profiles, blood glucose, and BP are presented according to sex in Table 2. Mean of lipid profiles, insulin, HOMA-IR, blood glucose, and BP is not significantly different in male and female except mean of TG, which is less in female. The anthropometric measures are almost equal in male and female except SF_4 and % BF, which are more in females.

The prevalence of CVD risk factors by age groups and sex is presented in Table 3. It is observed that 52.53% population have high BP, 45.58% have high TG, 23.14% have high FBG, 11.22% have high TC, and 11.62% have low HDL. High TC is found more in female, but high TG, FBG, and BP are more in male and low HDL is found almost equal in male and female.

The prevalence of three CVD risk factors clustering is shown according to sex in Figure 1. It is found that the prevalence of some clustering of three CVD risk factors is higher in men in comparison to women (high TG, FBG, and BP; high TG and BP and low HDL;

Table 1: Socioeconomic characteristics of the study population (n = 1007)

Variables	Percentage
Education	
Up to X standard	38.10
XII Standard	11.00
Graduation	21.40
Postgraduation and above	29.50
Occupation	
Service	56.50
Others*	40.90
Monthly income	
Up to Rs. 20,000/-**	30.60
Rs. 20,001 to Rs. 40,000/-	38.00
Rs. 40,001 and above	31.40
Monthly expenditure	
Up to Rs. 10,000/-	23.70
Rs. 10,001 to Rs. 20,000/-	45.70
Rs. 20,001 and above	30.60
Materialistic possession	
Television	96.60
Washing machine	16.90
Refrigerator	75.50
Computer	46.70
Air-conditioner	13.10
Two wheeler	70.30
Four wheeler	16.00
Food habit	
Nonvegetarian	93.60

*Farmer, housewife, labor, student, etc., **1 US$ = 61 Indian rupees

Table 2: Descriptive statistics of the study population

Variables	Male (*n* = 645)			Female (*n* = 362)		
	Mean	SD	Range	Mean	SD	Range
Age (years)	49.06	11.93	60.00	47.59	12.58	60.00
Height (cm)	165.12	6.29	42.00	151.31	5.52	37.00
Weight (kg)	66.93	11.59	73.60	59.81	11.24	59.80
MWC (cm)	82.68	8.09	50.00	79.55	8.98	46.00
MHC (cm)	91.74	7.01	50.00	94.38	8.89	49.00
WHR	0.89	0.04	0.26	0.83	0.05	0.31
MUAC (cm)	28.46	3.12	21.50	28.16	3.56	28.00
SF4 (mm)	47.55	16.13	104.20	67.76	19.53	98.60
BMI (kg/m^2)	24.50	3.65	23.80	26.05	4.31	26.40
% BF	27.27	4.91	34.10	37.34	4.56	25.30
FM (kg)	18.46	5.42	32.93	22.58	6.03	32.45
FFM (kg)	48.46	7.58	52.07	37.22	6.05	33.85
BMR (kcal)	1426.07	150.95	1083.00	1178.59	125.94	710.00
VFL	10.92	4.77	26.00	9.16	4.56	29.00
IVF (cm^2)	109.20	47.74	260.00	91.62	45.69	290.00
TC (mg %)	162.65	28.56	183.00	167.03	30.00	181.00
TG (mg %)	157.43	65.17	671.00	143.27	46.72	315.00
HDL (mg %)	45.53	7.51	41.00	49.04	6.38	36.00
LDL (mg %)	85.87	23.58	166.40	89.33	24.84	137.00
VLDL (mg %)	31.24	11.55	67.80	28.65	9.34	63.00
FBG (mg %)	93.39	30.04	287.00	91.09	26.12	232.00
SBP (mmHg)	128.24	17.54	140.00	125.46	19.47	120.00
DBP (mmHg)	82.44	8.33	70.00	79.41	8.87	40.00
MAP (mmHg)	97.70	10.29	83.34	94.75	11.42	66.67
Insulin (μU/mL)*	11.79	6.92	33.05	14.97	11.30	54.32
HOMA-IR*	63.30	38.90	183.53	80.85	63.74	273.78

*Insulin and HOMA-IR (*n* = 101). MWC = Minimum waist circumference, MHC = Maximum hip circumference, WHR = Waist-hip ratio, MUAC = Mid-upper arm circumference, SF_4 = Sum of four skinfolds, BMI = Body mass index, % BF = Percentage of body fat, FM = Fat mass, FFM = Fat free mass, BMR = Basal metabolic rate, VFL = Visceral fat level, IVF = Intra-abdominal visceral fat, TC = Total cholesterol, TG = Triglyceride, HDL = High density lipoprotein, LDL = Low density lipoprotein, VLDL = Very low density lipoprotein, FBG = Fasting blood glucose, SBP = Systolic blood pressure, DBP = Diastolic blood pressure, MAP = Mean arterial pressure, SD = Standard deviation, HOMA-IR = Homeostasis model assessment insulin resistance

high TG and FBG and low HDL). On the other hand, the prevalence of some clustering of three CVD risk factors is found higher in women (high FBG and BP and low HDL; high TC, FBG, and BP; high TC, TG, and FBG). The prevalence of high TC, TG, and BP clustering is almost equal in men and women.

DISCUSSION

In our study, it was seen that most of the population are nonvegetarian (93.60%) which may be a reason for the greater prevalence of CVD. It was reported earlier that nonvegetarian had a higher prevalence of CVD as compared to vegetarian.[31,32]

It was revealed from several studies that South Asians (e.g., Indians) have a more centralized distribution of body fat and markedly higher mean WHR for a given level of BMI compared with Europeans or Americans.[33,34] It was found in our study also that population have greater waist circumference and WHRs with a greater degree of central obesity.

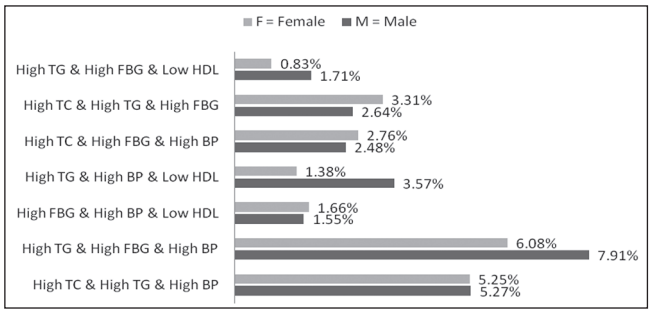

Figure 1: Clustering of at least three cardiovascular disease risk factors in a subject in the study

The prevalence of CVD risk factors, such as high TC, TG, FBG, and BP and low HDL according to age was evident in our study. It was found that the prevalence of CVD risk factors increased in male and female with age which may lead them to increasing risk of CVD. It was reported that CVD in Indian population occurs at least a decade earlier than that in Europeans and Americans.[35,36]

In our study, the prevalence of CVD risk factors was found higher in male than in the female. This finding is consistent with the previous study wherein it was reported that males are more prone to develop CVD as compared to female in rural India.[31] The greater indulgence of males in smoking (38.4%), taking of alcohol (17.4%) along with stress and strain in day to day life, compared to females, may explain their greater proneness to CVD. It was reported that CVDs were more prevalent in individuals addicted to smoking and alcohol.[31,37-39] In our study it was also observed that 40.33% females are in premenopausal stage, considering the mean age of menopause around 45 years,[40] might also be a factor of lower prevalence (CVD risk factors) among female than male since it was already reported that CVD risk factors become prevalent after menopause.[40] The higher prevalence of ischemic heart disease in males was also reported in other studies.[37,41] It was reported that although the prevalence of CHD was low in the rural population of Himachal Pradesh, however, males are more prevalent than females.[42] It was also shown that the incidence of CHD in males was 3 times higher than in females in a rural population of Kheda district, Gujarat, India.[43]

It was also observed in our study that the prevalence of CVD risk factor clustering among the population was evident. We may argue that the risk of CVD among the rural population of West Bengal, India, is high since more than one risk factor is present among many of them. This finding is consistent with the previous study wherein it was reported that CVD risk is high in the presence of one of the risk factors, presence of two doubles it and with three, the risk becomes eight-fold.[44]

It was reported in earlier studies[21,45,46] that the prevalence of CVD risk factors is gradually increasing in the rural population of India and represents a public health concern. In the present study, it is also found that the CVD risk factors are significantly prevalent in the rural population of India. So, it seems reasonable to argue that habitat is irrespective for increasing the CVD risk factors. Since majority of the

Table 3: Prevalence of cardiovascular disease risk factors by age groups and sex

Age groups	Sex	Prevalence of cardiovascular disease risk factors				
		High TC (%)	High TG (%)	High FBG (%)	High BP (%)	Low HDL (%)
Group I	Male	02 (3.92)	13 (25.49)	02 (3.92)	18 (35.29)	12 (23.52)
	Female	00 (0.00)	08 (28.57)	01 (3.57)	03 (10.71)	03 (10.71)
Group II	Male	08 (10.96)	39 (53.42)	18 (24.66)	25 (34.25)	07 (9.59)
	Female	04 (5.97)	30 (44.78)	07 (10.45)	15 (22.39)	08 (11.94)
Group III	Male	23 (13.53)	93 (54.71)	31 (18.24)	95 (55.88)	21 (12.35)
	Female	17 (16.67)	53 (51.96)	21 (20.59)	54 (52.94)	15 (14.71)
Group IV	Male	25 (10.25)	116 (47.54)	66 (27.05)	138 (56.56)	26 (10.66)
	Female	11 (10.68)	38 (36.89)	28 (27.18)	53 (51.46)	12 (11.65)
Group V	Male	10 (9.35)	46 (42.99)	40 (37.38)	80 (74.77)	09 (8.41)
	Female	13 (20.97)	23 (37.10)	19 (30.65)	48 (77.42)	04 (6.45)
Total	Male	68 (10.54)	307 (47.60)	157 (24.34)	356 (55.19)	75 (11.63)
	Female	45 (12.43)	152 (41.99)	76 (20.99)	173 (47.79)	42 (11.60)
Grand total	Male + female	113 (11.22)	459 (45.58)	233 (23.14)	529 (52.53)	117 (11.62)

Group I (20-29 years, n = 79, M = 51, F = 28), Group II (30-39 years, n = 140, M = 73, F = 67), Group III (40-49 years, n = 272, M = 170, F = 102), Group IV (50-59 years, n = 347, M = 244, F = 103), Group V (60 years and above, n = 169, M = 107, F = 62).
[High TC when TC ≥ 200 mg %; high TG when TG ≥ 150 mg %; high FBG when FBG ≥ 100 mg %; high BP when SBP ≥ 130 or DBP ≥ 85 mmHg; low HDL when HDL ≤ 35 in male and ≤ 40 in female][46]

Indians live in rural area, CVD may lead to epidemic proportions.[20] Hence, it is essential to find out the reasons for increasing trend of increasing prevalence of CVD risk factors among the rural population of India so that effective national health promotion and intervention program could be formulated to reduce CVD.

However, some limitations are associated with the present study, including the small sample size. Hence, it is not the representative of the entire Indian rural population. Further studies are required in other parts of the rural population of India to assess whether similar trends exist among them.

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Conflicts of interest

There are no conflicts of interest.

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