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Original Article

Prevalence of cardiovascular disease risk factors: A community-based cross-sectional study in a peri-urban community of Kathmandu, Nepal

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ABSTRACT

Background: As a low-income country, Nepal is experiencing cardiovascular diseases as an emerging health problem. However, studies are lacking on the risk factors of cardiovascular diseases in peri-urban communities; where the socio-demographical transition is in progress. Therefore, this study aimed to identify the prevalence and socio-demographic distribution of cardiovascular disease risk factors in one of the peri-urban communities in Kathmandu, Nepal.

Methods: We conducted a cross-sectional study in Sitapaila Village Development Committee, Kathmandu from February 2014 to February 2015. Altogether, 347 adults from 18 to 70 years of age were selected randomly. Data were collected through modified WHO STEPS questionnaire for non-communicable disease (NCD) risk factors survey and analyzed in SPSS V.16.0 software.

Results: Mean age of the participant was 42.5 ± 13.2 years. Majority of them were female (n = 206; 59.4%), one-third (34%) represented Brahman and Chetri, and over a quarter (29.1%) did not attend school. Cardiovascular disease risk factors included smoking (17.6%), alcohol consumption (29.4%), insufficient fruit and vegetables intake (98%), insufficient physical activity (21.0%), obesity (15.3%), hypertension (34.4%), diabetes (10.5%), and high triglyceride levels (10.8%). They were significantly associated with different socio-demographic characteristics: smoking with gender, age groups and education level; alcohol consumption was with gender, age groups, ethnicity and occupation; insufficient physical activity with gender, age groups and occupation; hypertension with gender, age groups, ethnicity, education level and occupation.

Conclusion: A high prevalence of cardiovascular disease risk factors and their disproportional distribution among the study population indicated an inevitable risk of cardiovascular events in near future.

1. Background

Globally, cardiovascular diseases (CVDs) are the leading cause of death,[1] mainly due to cardiac arrest and stroke. It has been projected that the death rate would reach 23 million by 2030.[2] In Nepal, non-communicable diseases (NCDs) are estimated to cause 60% of total deaths, with CVDs contributing to 22% of the deaths.[3] Here, heart disease contributed to 38% of NCDs, according to a hospital-based study (n = 400).[4]

Smoking, harmful use of alcohol, physical inactivity, unhealthy diets, obesity, hypertension, diabetes and hyperlipidemia are the established risk factors of CVDs. Smoking is estimated to cause nearly 10% of all CVDs followed by physical inactivity (6%), and overweight and obesity (5%).[5] Increase in blood pressure levels also accelerates the risk of stroke and coronary heart disease.[6] Additionally, people with diabetes also carry a two-fold risk of vascular disease.[7] Raised cholesterol and triglyceride levels have been found to be independent risk factors for coronary heart disease.[8] Similarly, CVD risk profile and incident of cardiovascular diseases could significantly be varied by age, sex, race and occupation.[9,10]

Peri-urban community acts as the rural-urban transition zone. It carries both rural and urban characteristics such as poverty, poor

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health literacy, peri-urbanization and environmental pollution. Constellation of urban and rural predisposing factors may increase the cardiovascular health vulnerability of the peri-urban communities. Findings from the similar settings in Kathmandu showed that nearly half of the study population had poor knowledge on cardiovascular health, and majority had "Red or unhealthy food" preference over "Green or healthy foods and were indulged in sedentary activities".[11,12] Studies elsewhere[13–18] have also demonstrated a high prevalence of CVD risk factors both in urbanizing and rural communities. Nepal NCD risk factors surveys (STEPS survey) 2007 and 2013, and other studies have also assessed some of the CVD risk factors in Nepalese urban or rural population[19–21]. However, there is limited literature on CVD risk factor profile in Nepalese peri-urban population. This study, therefore, aimed to estimate the prevalence of CVD risk factors in a selected peri-urban community of Kathmandu, Nepal.

2. Methods

2.1. Study design and setting

This was a community-based, cross-sectional study carried out in Sitapaila Village Development Committee (VDC) from February 2014 to February 2015. Study site represents one of the rapidly urbanizing places near Kathmandu with a soaring in-migration.[22]

2.2. Study population, sample size and sampling strategy

Study participants included adult (>18 years), of any sex and residing as a permanent resident of the study site at least from previous six months at the time of the study. However, adults with self-reported CVDs and pregnant women were excluded from the study.

Sample size was calculated using formula for estimating single group population proportion ($N = Z^2\,pq/d^2$) with specified absolute precision,[23] where the estimated prevalence of hypertension was 25.7%[21]; allowable error- 5%; level of significance- 5%; and non-response rate-15%. That gave out a sample size of 345.

This study randomly selected 347 participants from the same number of households. Sampling strategy has been described elsewhere.[24] In short, the households were chosen by systematic random sampling method. In the case of more than one eligible participants in a household, a single individual was enrolled into the study by applying the Kish method.[25]

2.3. Data collection tool and technique

Data were collected through face to face interview, and taking anthropometric, clinical and biochemical measurements. We used WHO STEPwise questionnaires to collect the information on tobacco use, alcohol consumption, fruit and vegetable consumption, physical activity and dietary salt consumption.[26] Tools were pre-tested and data enumerators were trained in the research protocol, interviewing and measuring of the variables using WHO STEPS manual[25] before sending them for data collection.

2.3.1. Tobacco use

Data particularly related to the pattern of smoked and smokeless tobacco use including the age of initiation and frequency of use were collected from current, past, and daily users. Current users were those who had smoked or used smokeless tobacco products in the last 30 days.[20] Participants who reported smoking at least 100 cigarettes in their lifetime and who, at the time of the survey, did not smoke were defined as past smoker.[20]

2.3.2. Alcohol consumption

Standard drinks and frequency of drinking in the last 30 days were obtained from current alcohol users.[20] Pictorial cards featuring different kinds of glasses and bowls that weremost commonly used in Nepal were shown to the participants to help themrecall the amount of drinking. The self-reported amount was then used to determine the number of standard drinkof alcohol consumed (one standard drink is equal to 10 g of ethanol).[20] In the same way, current episodic heavy drinking was considered as five or more drinks on any day in the past 30 days.[27]

2.3.3. Diet

Dietary recall method was used to collect information on types, amount and servings of vegetables and fruit consumed in the last three days. Measurement of the amount of fruit and vegetables was aided by pictorial show cards and measuring cups (one standard serving of fruit or vegetables is equal to 80 g). Less than 400 g of fruit and vegetables intake in three days was considered insufficient intake. Information regarding types and amount of cooking oil and salt was also collected. Average salt intake per person per day was then calculated from the amount of salt consumed by a family in a month.

2.3.4. Physical activity

Sufficient physical activity was defined as ≥600 MET minute of moderate and vigorous activity in a week.[28,29] For that, physical activity in the last seven days was recorded. Activities related to work, transport, and recreational activities were categorized into vigorous, moderate, and low level.[28] Vigorous physical activity was defined as any activity with a metabolic equivalent (MET) value of over six. Moderate physical activity was an activity with a MET value between three and six. Finally, physical activities with a value of lower than three such as coffee or tea chats and travelling in a car were considered as low or sedentary physical activity level. The references for METs of each activity were taken from 2011 Compendium of Physical Activities.[30]

2.3.5. Anthropometric measurement

Height was measured in centimeter with a portable standard stature scale with foot and head-wear off, and hair untied. Weight was recorded in kilograms with a portable digital scale (Microlife Corp) by placing on a firm, flat surface. Body Mass Index (BMI) was calculated and categorized below normal (<18.5 kg/m^2), normal (18.5–25.0 kg/m^2), overweight (25.0–<30.0 kg/m^2), or obese (≥30.0 kg/m^2).[25,31]

To determine the waist-hip ratio (WHR), waist and hip circumferences were measured by a constant tension tape. Waist circumference was taken at the end of a normal expiration with arms relaxed at the sides at the midpoint between the lower margin of the last palpable rib and the top of the iliac crest (hip bone). Hip circumference was taken at the maximum circumference over the buttocks. Reading was taken at the level of tape to the nearest 0.1 cm, while ensuring the tape measure was snug.[25] Based on the World Health Organization (WHO) criteria, WHR scores of ≥0.90 cm for male; and ≥0.85 cm for female were considered as obesity.[32]

2.3.6. Clinical examination

A total of three readings of the systolic and diastolic blood pressure were taken using Doctor's Aneroid Sphygmomanometer. Participants took a rest for three minutes between each reading. Average of the second and third readings was used as the final measurement for the analysis. Hypertension was defined as having a systolic blood pressure level ≥140 mm Hg and/or diastolic blood pressure ≥90 mm Hg, or taking any anti-hypertensive medication.[33]

2.3.7. Biochemical measurements

For the collection of biochemical samples for fasting blood sugar (FBS) and lipid, we requested the participants to fast overnight for 12 h. Firstly, venous blood samples (4 mL of blood) were collected, kept in an ice pack carrier, and brought to the hospital laboratory within one hour. A laboratory technician collected the samples and analyzed them. Biochemical measurements of blood glucose and lipids were taken using semi-automated procedures and commercially available kits (from Accurex Biomedical Pvt. Ltd). Low Density Lipoprotein (LDL-C) was calculated using Friedwald equation.[34] Diabetes was defined as having fasting blood sugar level of 126 mg/dL or higher or currently taking any anti-diabetic medications.[35] Similarly, a cholesterol level of $\geq$240 mg/dL, LDL-C $\geq$ 160 mg/dL and triglycerides $\geq$ 200 mg/dL were defined as high, whereas High Density Lipoprotein (HDL-C) values below 40 mg/dL for male or lower, and 50 mg/dL or lower for female were considered to be low.[36]

2.4. Data management and analysis

Data were compiled, edited, and checked for consistency, and processed through Epidata V.2.1 and SPSS V.16.0 for further analysis.

Frequency and percentage were presented in tables to show the distribution of risk factors among socio-demographic characteristics. Chi-square test was used to a) determine whether socio-demographic characteristics were distributed homogenously by gender, and b) examine their association with CVD risk factors. All tests were two-tailed and $p < 0.05$ was considered statistically significant.

2.5. Ethical consideration

The study protocol was approved by an independent Ethical Review Board (ERB) of the Nepal Health Research Council (NHRC). We clearly explained the research purpose and assured to protect their privacy and confidentiality in the study and then we obtained written consent from the participants. Participants who had critically uncontrolled blood pressure and high blood sugar level were referred to the nearby treatment facilities.

3. Results

3.1. Demographics

Of the 347 participants, 141 (40.6%) were males and 206 (59.4%) were females. Mean age was 42.55 $\pm$ 13.26 years with a median of 40 years. The majority of the participants (60.5%) were from Brahmin and Chetri and were married (83%) (Table 1). One third had never attended school and 36.6% were homemakers (Table 1). Mean and median of household income per month were 23584 $\pm$ 18862 and 20,000 Nepalese rupees respectively.

There was no statistical difference in the demographics and ethnicity of the participants. However, a significant statistical difference was found in the educational level by gender: more males had higher education level as compared to females, who tended to have no formal education.

3.2. Prevalence of cardiovascular risk factors

3.2.1. Smoking

Out of the total, 61 (17.6%) participants were currently smoking (Table 2). Half of the current smokers initiated smoking before 17 years of age and 20% had been smoking continuously from the last 40 years. Almost all (57 of 61) smokers smoked manufactured (branded) cigarettes of an average of 10 sticks per day. Thirty-eight (11%) respondents were using smokeless tobacco products (Table 2). Gender, age groups and education level were significantly associated with smoking (Table 5).

3.2.2. Alcohol consumption

Over a quarter of the participants (29.4%) had consumed alcohol at least once in past 30 days (Table 2). Among them, 16.7% (17 of 102) reported drinking alcohol daily. The average number of standard drinks in the last 30 days was 8.9, with a maximum of 30. Current episodic heavy drinking (five or more than standard drinks

Table 1
Distribution of socio-demographic characteristics by gender.

Socio-demographic characteristics		Gender		Total No (%)	P Value
		Male No. (%)	Female No. (%)		
Age group (in years)	<30 years	26(18.4)	39(18.9)	65(18.7)	0.508
	30–39 years	31(22.0)	54(26.2)	85(24.5)	
	49–49 years	40(28.4)	47(22.8)	87(25.1)	
	50–59 years	24(17.0)	44(21.4)	68(19.6)	
	≥60 years	20(14.2)	22(10.7)	42(12.1)	
Caste/Ethnic groups	Brahman	54(38.3)	64(31.1)	118(34.0)	0.536
	Chetri	34(24.1)	58(28.2)	92(26.5)	
	Newar	35(24.8)	49(23.8)	84(24.2)	
	Janajati	12(8.5)	26(12.6)	38(11)	
	Dalit and others	6(4.3)	9(4.4)	15(4.3)	
Marital status	Unmarried	24(17.0)	16(7.8)	40(11.5)	<0.001
	Married	117(83.0)	171(83.0)	288(83)	
	Separated and widow	0 (0)	19(9.2)	19(5.5)	
Education level	No formal education	16(11.3)	85(41.3)	101(29.1)	<0.001
	Primary	18(12.8)	32(15.5)	50(14.4)	
	Secondary	31(22.0)	33(16.0)	64(18.4)	
	Higher secondary	30(21.3)	31(15.0)	61(17.6)	
	Bachelor and Higher	46(32.6)	25(12.1)	71(20.5)	
Occupation	Government job	14(9.9)	6(2.9)	20(5.8)	<0.001
	Non-governmental job	27(19.1)	24(11.7)	51(14.7)	
	Self-employed	52(36.9)	42(20.4)	94(27.1)	
	Students	11(7.8)	12(5.8)	23(6.6)	
	Homemaker	12(8.5)	115(55.8)	127(36.6)	
	Others(Retired, unemployed)	25(17.7)	7(3.4)	32(9.2)	

Table 2
Description of behavioral CVD risk factors (N = 347).

Characteristics		N (%)
Smoking (current)	Yes	61 (17.6)
	No	286 (82.4)
Smoking daily	Yes	52 (15.0)
	No	295 (85.0)
Smoking (past)	Yes	56 (16.1)
	No	230 (66.3)
Smoking in the past (daily)	Yes	39 (11.2)
	No	18 (5.2)
Smokeless tobacco use (ever)	Yes	38 (11.0)
	No	309 (89.0)
Smokeless tobacco use (daily)	Yes	28 (8.1)
	No	10 (2.9)
Alcohol consumption (current)	Yes	102 (17.6)
	No	235 (82.4)
Current episodic heavy drinking (≥5 standard drinks)	Yes	20 (5.8)
	No	82 (23.6)
Fruit and vegetable intake (in total)	Sufficient (≥400 g/day)	7 (2.0)
	Insufficient (<400 g/day)	340 (98.0)
Fruit and vegetable intake (in day one)	Sufficient (≥400 g/day)	51 (14.7)
	Insufficient (<400 g/day)	296 (85.3)
Fruit and vegetable intake (in day two)	Sufficient (≥400 g/day)	33 (9.5)
	Insufficient (<400 g/day)	314 (90.5)
Fruit and vegetable intake (in day three)	Sufficient (≥400 g/day)	29 (8.4)
	Insufficient (<400 g/day)	318 (91.6)
Extra[1] salt intake	Daily	4 (1.2)
	Most often	10 (2.9)
	Occasionally	49 (14.2)
	Rarely	13 (3.9)
	Never	270 (78.0)
Physical activity	Sufficient (≥600 MET minute/week)	274 (79.0)
	Insufficient (<600 METminute/week)	73 (21.0)

Abbreviations: MET = Metabolic Equivalent.
Notes: 1 'Extra' refers to adding salt during food preparation etc.

at any day during the last month) remained limited to 19.6% of total alcohol users. Male, of 40–49 years of age, and from the Newar ethnic group were significantly more likely to drink (Table 5).

3.2.3. Fruit and vegetable consumption

Only 2% of the participants consumed sufficient fruit and vegetables (≥400 g/day). An average of fruit and vegetables intake per person per day was 150 g. Seasonal vegetables, cauliflowers, and guava were the most common.

Participants who had an inadequate intake of fruit and vegetables consumption were female, those who had no formal education, and were from Brahmin and Chetri (Table 5). However, the difference was not statistically significant.

Nearly all households (99.4%) used vegetable oil (mustard, soybean, sunflower oil) for cooking. The average amount of cooking oil used per household was 3.9 L per month. Similarly, the average daily salt intake per person was 9.57 g ± 5.49 g. Very few (4 out of 347) participants were using extra salt to meal at the table (Table 2).

3.2.4. Physical activity

Seventy three participants (21.0%) were insufficiently (<600 METs) involved in moderate and vigorous physical activities (Table 2). Median of MET values of moderate and vigorous activities per week was 1800. Married, male, participants over 50 years and government job holder were significantly less likely to be physically active (Table 5). Although participants from Brahmin and Chetri, and with higher educational level were observed to be less physically active, the difference was not statistically significant.

3.2.5. Obesity

The mean body mass index of total participants was 26.2 kg/m2 ± 5.1 kg/m2 (Table 3). Obesity was observed in 15.3% of the participants (Table 4). In approximately half of the participants, WHR was above the normal cut-off point (≥0.90 cm for male; ≥0.85 cm for women). Obesity, though statistically non-significant, was moderately high in 30–39 age group, female, self-employed, and in those without formal education (Table 5).

Table 3
Distribution of anthropometric, clinical and biochemical characteristics.

Characteristics	N	Total Mean(SD)	Male Mean(SD)	Female Mean(SD)	P* value
BMI (kg/m^2)	347	26.2(5.1)	25.4(5.3)	26.6(5.1)	0.03
Waist-C (cm)	347	85(11)	85.2(10.6)	84.9(11.2)	0.77
Hip-C (cm)	347	91.3(8.6)	89.5(7.3)	92.4(9.2)	0.002
WHR	347	0.93(0.08)	0.95(0.085)	0.92(0.07)	<0.001
SBP (mmHg)	347	122.6(16.9)	124.5(16.1)	121.2(17.4)	0.07
DBP(mmHg)	347	81.1(9.9)	82.6(10.3)	80 (19.5)	0.017
FBS (mg/dl)	296	92(24.5)	92.4(19)	91.7(27.3)	0.819
TG (mg/dl)	296	136.9(67.3)	150.8(75.2)	127(60)	0.004
Cholesterol (mg/dl)	296	167.9(31.5)	170.5(31.1)	166.2(31.8)	0.26
HDL (mg/dl)	296	42.5(6.5)	41.8(6.4)	43(6.5)	0.11
LDL (mg/dl)	296	98(26.4)	98.5(27)	97.6(26)	0.78

Note: BMI, Body Mass Index; Waist-C, Waist Circumference; Hip-C, Hip Circumference; WHR, Waist Hip Ratio; SBP, Systolic Blood Pressure; DBP, Diastolic Blood Pressure; FBS, Fasting Blood Sugar; TG, Triglycerides; HDL, High Density Lipoprotein; LDL, Low Density Lipoprotein. *P value from Student's t test.

3.2.6. Hypertension

Prevalence of hypertension was 34.6% (29.6–39.6). Almost half of them (51 of 120) were unaware of their raised blood pressure level. Of those who were aware (n = 69), 23.2% were not taking any antihypertensive medications. Of those who were taking hypertensive medications (n = 53), nearly half (47.2%) had controlled blood pressure level. Hypertension significantly varied with age groups. It occurred relatively high in elderly, participants without

Table 4
Description of metabolic CVD risk factors.

Characteristics		N (%)
Body Mass Index (kg/m^2)	Below normal (<18.5)	18 (5.2)
	Normal (18.5 and <25)	121(34.9)
	Overweight (25 and <30)	155 (44.7)
	Obesity I (30 and <35)	42 (12.1)
	Obesity II (35 and <40)	5 (1.4)
	Obesity III (≥40)	6 (1.7)
Waist-hip ratio	Normal	160 (46.1)
	Substantially increased (male: ≥0.90 cm; female: ≥0.85 cm)	187 (53.9)
Hypertension	Yes (SBP ≥ 140 mmHg or DBP ≥ 90 mmHg or medication)	120 (34.6)
	No	227 (65.4)
Fasting blood glucose	Normal (<110 mg/dl)	239 (78.3)
	Impaired fasting glucose (110–125 mg/dl)	34 (11.1)
	Diabetes (>126 mg/dl or medication)	32 (10.5)
Triglycerides	Normal (<150 mg/dl)	194 (65.5)
	Borderline (150–199 mg/dl)	70 (23.6)
	High (200–499 mg/dl)	32 (10.8)
Cholesterol level	Normal (<200 mg/dl)	251 (84.8)
	Borderline (200–239 mg/dl)	40 (13.5)
	High (≥240 mg/dl)	5 (1.7)
LDL level	Normal (<100 mg/dl)	147 (49.7)
	Near Ideal (100–129 mg/dl)	121 (40.9)
	Borderline high (130–159 mg/dl)	23 (7.8)
	High (160–189 mg/dl)	5 (1.7)
HDL	Poor (male:<40 mg/dl; female: <50 mg/dl)	202 (68.2)
	Better	94 (31.8)

any formal education, married, Newar, and homemakers than others (Table 5).

3.2.7. Diabetes

Only 296 of the 347 (85.3%) participants provided blood samples for biochemical measurements. Nine participants who were absent during sample collection confirmed that they had diabetes. Diabetes was present in 10.5% (32 of 305) of the participants. Among the person with diabetes, 19 were taking anti-diabetic medicines. Mean fasting glucose was 91.9 mg/dl ± 25 mg/dL. Impaired fasting glucose was seen in 11.1% (34 of 305). Diabetes was significantly varied with age groups and occupation.

3.2.8. Lipid levels

Triglyceride (TG) level was above the normal limit (≥150 mg/dL) in 34.4% (102 of 296) of the participants. Among them, borderline high TG levels (150–199 mg/dL) were observed in 23.6% and substantially high (≥200 mg/dL) was noticed in 10.8%. The average triglyceride level was 133.5 mg/dL. Substantially high TG level was significantly associated with age groups, genders, and occupation (Table 5).

Compared to TG, the number of participants with high cholesterol level (≥240 mg/dL) was negligible (1.7%). Borderline cholesterol level (200–239 mg/dL) was noted in 13.5%. The proportion of the participants having high LDL cholesterol was 1.7%. In contrast to other lipids, a high proportion of the participants (68.2%) had poor HDL level.

3.3. Clustering of risk factors

Most of the respondents (93.2%) had at least one risk factor. One third of the participants were presented with three and more risk factors. Similarly, a cluster of five and more risk factors was noted in 4.1% of the participants.

4. Discussion

This study found high prevalence of CVD risk factors among the study population. They were disproportionately distributed by age, gender, education level and ethnicity. This was the first community based study conducted to estimate the prevalence of CVD risk factors in the area. As this study was conducted at a selected site, study findings should, therefore, be generalized cautiously to other peri-urban settings.

Our study found comparatively high prevalence of CVD risk factors than that of the national representative estimate[21,37,38] and the findings from a number of studies from similar settings in Nepal.[16,39–41]

The proportion of current smoker (17.6%) is nearly equal to that estimated in the nationwide NCD risk factors survey 2013 (18.5%).[21] Particularly, male and 41–50 years aged participants had more tendency to be a smoker. Similarly, the presence of smoking habit in a large proportion of participants without formal education suggested an association between smoking and educational level. Several studies evaluated the relationship between low literacy and smoking and found that people with low reading ability were more likely to be smokers.[42] The presence of a large proportion of participants who quitted smoking (16.1%) in the study could possibly suggest the increasing trend of cessation of smoking. That might be because of increasing literacy rate and implementation of tobacco free initiatives thorough out the nation. Recent studies also indicated a decreasing trend in prevalence of smoking in Nepal.[43,44] However, as we concluded in our recent meta-analysis, downward shift in the age of initiation of smoking and high prevalence of tobacco use among adolescents are the major challenges in tobacco free initiatives in Nepal.[45]

Approximately one third of the participants (29.4%) had consumed alcohol in the last 30 days. The proportion is higher than that reported in the NCD risk factors survey (17.4%).[21] In Kathmandu, particularly in Newar ethnic group, alcohol consumption is culturally an integral part of every ritual celebrations. Therefore, proportion of current alcohol users was comparatively high in the study population and other communities of Kathmandu.[39]

This study found that inadequate fruit and vegetables consumption (<400 g/day) was universal (98%). Other national studies also showed similar results.[20,21] Both the findings from the current study and national survey are substantially higher than

Table 5
Socio-demographical distribution of CVD risk factors.

Characteristics	Smoking (%)	Alcohol consumption (%)	Insufficient fruits and vegetables intake (%)	Insufficient physical activity (%)	Obesity (%)	HTN (%)	DM (%)	High TG (%)	Low HDL (%)
Total	17.6	29.4	98	21	15.3	34.6	10.5%	10.8	68.2
(CI)	(13.6–21.6)	(24.6–34.2)	(96.5–99.5)	(16.7–25.3)	(11.5–19.1)	(29.6–39.6)	(7.1–13.9)	(7.3–14.3)	(69.9–73.5)
Age in years									
<30	7.7	23.1	98.5	12.3	4.6	4.6	1.8	3.5	80.7
30–39	11.8	34.1	97.6	17.6	18.8	15.3	1.4	4.2	68.1
40–49	26.4	36.8	98.9	20.7	17.2	54.0	10.1	16.5	58.2
50–59	19.1	25.0	97.1	23.5	20.2	47.1	25.9	21.6	68.6
≥60	23.8	21.4	97.6	38.1	11.9	59.5	17.9	8.1	70.3
P value	0.015*	0.173*	0.941	0.025*	0.071	<0.001*	<0.001*	0.004*	0.099
Gender									
Male	27.7	46.1	96.5	34.0	12.1	41.8	11.5	16.4	41.4
Female	10.7	18.0	99.0	12.1	17.5	29.6	9.8	7.2	85.6
P value	<0.001*	<0.001*	0.198	0.001*	0.168	0.019*	0.647	0.02*	<0.001*
Caste/Ethnic groups									
Brahman	11.9	17.8	96.6	27.1	13.6	27.1	10.5	14.7	70.6
Chetri	21.7	18.5	98.9	19.6	13.0	33.7	7.4	8.9	70.9
Newar	14.3	52.4	98.8	22.6	16.7	41.7	12.0	12.2	67.6
Janajati	26.3	44.7	97.4	5.3	15.8	31.6	9.1	3.0	20.0
Dalit and others	33.3	20.0	100.0	21.0	33.3	66.7	27.3		50.0
P value	0.062	<0.001*	0.699	0.059	0.338	0.019*	0.358	0.277	0.689
Marital status									
Unmarried	12.5	27.5	97.5	22.5	5.0	12.5	2.8	5.6	75.0
Married	18.8	30.9	98.3	19.1	17.0	36.5	10.4	11.2	66.9
Others(separated, Windows)	10.5	10.5	94.7	47.4	10.5	52.6	26.3	16.7	72.2
P value	0.441	0.162	0.556	0.013*	0.118	0.003*	0.025*	0.427	0.583
Educational status									
No education	26.7	23.8	99.0	21.8	15.8	44.6	15.7	15.1	74.4
Primary	24.0	36.0	100.0	16.0	24.0	48.0	16.7	9.8	70.7
Secondary	14.1	28.1	96.9	18.8	10.9	29.7	5.7	5.9	56.9
Higher secondary	11.5	34.4	100.0	23.0	14.8	23.0	1.8	9.3	70.4
Bachelor and above	8.5	29.6	94.4	23.9	12.7	25.4	10.6	10.9	65.6
P value	0.009*	0.495	0.095	0.828	0.369	0.004*	0.04*	0.538	0.288
Occupation									
Government job	15.0	25.0	95.0	40.0	25.0	30.0	17.6	12.5	43.8
Non-governmental job	15.7	33.3	100.0	13.7	15.7	33.3	7.9	13.5	54.1
Self-employed	24.5	39.4	95.7	27.7	19.1	30.9	11.4	19.2	61.5
Students	8,7	30.4	100.0	21.7	4.3	4.3			69.6
Homemaker	13.4	18.9	99.2	15.7	13.4	42.6	12.0	8.0	83.2
Others(Retired, unemployed)	25.0	37.5	96.9	21.9	12.5	40.6	9.7	3.4	58.6
P value	0.199	0.025*	0.309	0.06*	0.389	0.015*	0.513	0.043*	<0.001*

HTN = hypertension; DM = diabetes mellitus.
High TG = Triglyceride level of 200–499 mg/dl.
HDL: High Density Lipoprotein level <40 mg/dl for male and <50 mg/dl for female.
* Association is significant at the 0.05 level (2-tailed).

that of low- and middle-income countries.[46] One of our studies conducted in rural Nepal indicated that dependency over seasonal production, insufficient supply and comparatively high price of fruit and vegetables adversely affected on their intake.[19] This can also be explained as insufficient knowledge on the benefits of fruit and vegetables intake.

Finding on physical activity level suggests that sedentary lifestyle could be a major public health threat in future. The proportion of insufficient physical activity (<600 METs/week) in the study population was nearly six times higher than that of the national level.[21] Evidence suggests that individual factors, such as age, sex, environmental, geopolitical and economic factor can discourage people exercising outdoors.[47]

Likewise, the prevalence of immediate CVD risk factors such as obesity, diabetes and hypertension were considerably high in the study population as compared to other studies in Nepal.[19,21,37–39] They had disproportional distribution among age groups, ethnicity and education which are consistent with other Nepalese studies that showed an inverse association between cardiovascular risk factors including diabetes and hypertension to education and socio-economic status.[19,21,39] This study has limited scope to explain the presence of high prevalence of CVD risk factors in the study population. However, role of the existing predisposing factors such as shifting demographics of a rapidly expanding elderly population, growing socio-economic inequalities, rural-to-peri-urban migration, unplanned urbanization and deteriorating air pollution cannot be refuted.

Overall, the current study demonstrated high prevalence of CVD risk factors in a semi-urban population in Kathmandu, Nepal suggesting Nepalese peri-urban communities may also have the same level of risk of developing the cardiovascular diseases like the urban communities in future. Therefore, as guided by the Urban Health Policy of 2015, provision of Urban Health Promotion Centre (UHPC) should be extended beyond the territory of urban communities for greater cause of serving semi-urban population and ensuring delivery of quality essential health care services and

health promotion activities, with particular focus on prevention and control of NCDs including CVDs among the poor, women, children, and marginalized groups. Similarly, the recently endorsed Multi-sectoral Action Plan for the Prevention and Control of NCDs (2014–2020) should be implemented effectively for health promotion and risk reduction in peri-urban areas as well.

This study had some limitations; first, because of its cross-sectional in nature, we could not take multiple measurements and confirm the diagnosis of diabetes and hypertension. Similarly, there was a risk of recall bias while recording dietary and medication history and assessing seven days physical activities. This study might also have encountered measurement errors while collecting data through anthropometric, clinical and biochemical measurements.

5. Conclusion

Findings on prevalence and distribution of CVD risk profile of a peri-urban community in Kathmandu suggest that study population is at high risk of developing cardiovascular disease in near future. This study has major implications for developing community-centered CVD preventative programs targeting different social strata in Nepal.

Conflict of interest

The authors declare that there are no conflicts of interest.

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Authors' contributions

RRD conceptualized, designed and executed the study, analyzed and interpreted the data, and prepared the first draft of the manuscript. SD, SJM, PCB, AS and LA provided input on the concept, design and interpretation of the study. PT and YG contributed in the execution and interpretation of the study. All the authors read and approved the final manuscript.

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