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Research Article

Prevalence and Determinants of Selected Cardiovascular Disease Risk Factors: A cross-sectional study among Adults in Sabaragamuwa Province, Sri Lanka

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Abstract
Introduction: Cardiovascular Disease (CVD) is the leading cause of death and disability worldwide. The objective of this study was to assess the prevalence of selected risk factors of CVDs and their associations with socio-demographics and anthropometrics factors among adults in the Sabaragamuwa Province of Sri Lanka. Methods: A descriptive cross-sectional study was conducted among adults aged between 30-60 years. Participants were selected using a three staged random sampling method. The WHO STEPS wise approach was used to collect data. Results: There were 366 participants with a male to female ratio of 1:2.1. The mean age was 45.2 years (SD=8.8). Approximately two-thirds (63.4%) of the participants were physically inactive. Prevalence of high blood pressure, high blood glucose level, high total cholesterol level, high low-density lipoprotein (LDL) cholesterol level, low high-density lipoprotein (HDL) cholesterol level and high triglycerides were 27.0%, 22.1%, 39.9%, 37.7%, 29.0%, and 37.7% respectively. The mean values of systolic blood pressure (SBP), diastolic blood pressure (DBP) and triglyceride level were significantly higher among men, whereas mean values of HDL, LDL, waist circumference and BMI were higher in women. Mean SBP, DBP and prevalence of blood pressure increased with age. Mean waist circumference, BMI, total cholesterol, and triglyceride level increased with the years of education. Conclusion: The prevalence of CVD risk factors was considerably high in this population. Therefore, it is essential to plan public health interventions considering the population characteristics associated with CVD risk factors.

Keywords: Adults, Cardiovascular disease, Risk factors, Sri Lanka, WHO STEP wise approach

Introduction

At the beginning of the 20th century, cardiovascular diseases (CVDs) were responsible for less than 10% of total deaths worldwide [1]. Currently, CVDs are the number one cause of death globally. The death rates and patterns vary between high-income countries and low and middle income countries [2]. Among all CVD related deaths, more than 80% are from low-income and middle-income countries [3]. Age-adjusted death rates are declining in developed countries compared to developing countries since most of the people who are in high income countries do have well-established preventive interventions for early detection and treatment plans for people with risk factors [4]. The South Asian Region is one of the most densely populated

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regions in the world. This region accounts for over 25% of the worldwide low and middle income countries' CVD related deaths [4]. Moreover, studies conducted in the countries of this region have shown a significantly increasing trend of CVDs over the past few years [5].

According to the latest World Health Organization (WHO) estimates for Sri Lanka, the CVD-related mortality rate is relatively higher than the other countries in the South Asia Region [6]. In 2010, a study conducted in four Provinces of Sri Lanka by Wijewardene et al. [7] found that regional differences exist in the prevalence of CVDs. Therefore, assessing the prevalence of CVD risk factors in each region of the country will be helpful in initiating more specific preventive programmes in each region based on regional statistics rather than country statistics. Since no study has been conducted to estimate the prevalence of CVD risk factors among adults in Sabaragamuwa province, the present study has given an opportunity to identify the status of CVD risk factors among this population. In addition, the results can be used in planning to identify more specific interventions to reduce the prevalence of CVD risk factors among adults in the Sabaragamuwa province, Sri Lanka.

Methods

Study setting

The Sabaragamuwa Province is one of the nine Provinces of Sri Lanka, located in the South-West region of the island and is comprised of two administrative districts, Ratnapura and Kegalle. It has a population of 1,928,655 representing 9% of the national population [8]. Each District is divided into divisional secretariate areas and there are 17 and 11 divisional secretarial divisions respectively in Rathnapura District and Kegalle District. They have been further divided into Grama Niladhari (GN) divisions which are the smallest administrative units. The study was conducted among adults aged 30-60 years in the Sabaragamuwa Province.

Study design, population and sampling methodology

A cross-sectional community-based descriptive study was conducted among adults aged 30-60 years in Sabaragamuwa Province, from June 2019 to February 2020. The sample size was calculated based on the prevalence of low high-density lipoprotein (HDL), which was 53% from a previous study in Sri Lanka [9]. For a prevalence of 53% of low HDL at a 95% confidence level and a precision of 5%, a minimum sample of 384 was required. For contingencies, the sample size was inflated by 10% giving the total number as 420.

The three-stage random sampling method was used to select the sample from the defined population. First, one divisional secretariat division was selected from each District by using a random number generator. Then, 10% of GN divisions were randomly selected from each selected divisional secretariat division. Sampling within the selected GN divisions was done as the third stage. The sampling frame was the electoral lists available at the selected GN divisions. All Sri Lankans above 18 years are registered in the electoral list of the GN division in which the person lives. During the registration, it is mandatory to record the name, national identity card number, address, and sex according to the household. The present study used the electoral register prepared for the year 2018 as the sampling frame.

Each GN division was considered as a subgroup or strata within the population. Since the age of a person was not indicated in the electoral list, the first two numbers of the national identity card number were used to select persons aged between 30-60 years from each selected list. All persons aged between 30-60 years were assigned a number and the required number of participants was selected randomly proportionate to the population size of each GN division using the random numbers generated by the Microsoft Office Excel program. To ensure an acceptable rate of participation, those who have moved out or died but remain in the list were counted as not selected and dropped from the sample list. Critically ill patients, pregnant women, and mentally unfit individuals were excluded.

Data collection and measurements

The WHO STEP wise approach was used to collect data [10] Since the original version of the WHO STEP wise approach questionnaire was in English language, it was translated into Sinhala and Tamil languages. Forward-translations and back-translations were done to produce a locally understandable country-specific instrument, but the original intent of the questions was maintained during the translation. STEP 1 of this approach was used to gather information related to socio-demographic characteristics. Participants were asked about demographic information including age, marital status, education level, occupation and monthly income.

The STEP 2 was used to capture the measurements of weight, height, waist circumference and blood pressure. This was carried out using the same digital weighing scale, stadiometer and digital blood pressure monitor for all participants. Routine calibration was done as soon as the equipment was purchased and then routinely at weekly intervals where all measurements were recorded and checked for accuracy by comparing with previous calibration data each time to ensure the quality of measurement recorded by each equipment. The participants were asked to sit quietly with his/her legs uncrossed. The right arm was kept resting at an angle of 45 degrees on a table with the palm up. The elbow was supported during the measurements. The appropriate size of a cuff was used to wrap firmly around the wrist and both pulse reading and resting blood pressure were taken. Three blood pressure measurements were taken and the mean of the second and third readings was calculated. The participant rested for three minutes between each reading. Hypertension was defined as systolic blood pressure (SBP) ≥140 mmHg and/or diastolic blood pressure (DBP) ≥90 mmHg as per the World Health Organization/ International Society of Hypertension (WHO/ISH) definition and/or currently taking antihypertensive medications [11,12]. To get the weight of the participant, he/she was asked to remove all excess clothing and made to stand upright on the scale on bare feet with face forward, and arms on the sides. To measure the height of the participant he/she was asked to stand with bare feet on the board facing the investigator with feet together, heels against the backboard and knees straight. The Body Mass Index (BMI) of the participant was calculated by dividing the weight in kilograms by squared height in meters. BMI classification was done using the cut-off values for Asians given by the WHO [13]. BMI values; less than 18.5 kg m^{-2} was considered underweight, 18.5–22.9 kg m^{-2} was considered ideal weight, 23–25 kg m^{-2} was considered overweight and above 25 kg m^{-2} was considered as obese [13,14]. Waist circumference measurements were taken to determine central obesity among the participants. They were asked to stand upright with a relaxed abdomen, and a horizontal measurement was taken midway between the lowest rib and iliac crest using a non-stretchable tape. This measurement was taken without clothing directly over the skin in men and with light clothes in females. Central obesity was defined as a waist circumference > 90 cm in men and > 80 cm in women [14].

In STEP 3, drawing of blood samples for laboratory chemical analysis for fasting (12 hours) blood sugar, total cholesterol, low-density lipoprotein (LDL), HDL, very low-density lipoprotein (VLDL) cholesterol, and triglycerides were done. A sample of 5 mL fasting blood was collected from the participant using a sterile 5 mL tube and 18–20-gauge hypodermic needle taking precautions to avoid infection and injury. Blood samples were centrifuged at 1000 rpm for two minutes to separate serum after allowing the blood to clot at the collection center itself and then placed in a vaccine carrier at 0-4 ^{0}C until whole blood samples were collected and transported to the laboratory within four hours of collection. According to the WHO diagnostic criteria for diabetes, fasting blood glucose (FBG) level >126 mg/dL and/or currently taking anti-diabetic drugs was considered as diabetic [15]. National Cholesterol Education Programme-Adult Treatment Panel III (NCEP-ATP III) Guidelines were used to categorize cholesterol levels in this study [16]. High total cholesterol level was defined as values >200 mg/dL and/or taking lipid-lowering medications, low HDL was defined as values <45 mg/dL in men and <55 mg/dL in women, high LDL was defined as values >130 mg/dL and high triglyceride level was defined as values >150 mg/dL [17,18].

Statistical methods

Data were analyzed using Statistical Package for the Social Sciences (SPSS) version 26. Data were analyzed for frequency of distribution, proportion and percentages for categorical variables and mean±SD, for continuous variables. The Kolmogorov-Smirnov test was used to assess the normality of the continuous variables. Significance was assessed using inferential statistical tools such as simple linear regression, and independent sample t-test distribution based on a 95% confidence level (alpha=0.05). Chi-square test was used to assess the association between categorical variables and the ANOVA test was used to compare means across groups. The UNIANOVA method was used to adjust some variables for age.

Ethical considerations

Ethical approval was obtained from the Ethics Review Committee of the Faculty of Medicine, University of Peradeniya (Ref No: 2018/EC/06) Written permission to conduct the study in Sabaragamuwa Province was obtained from the Provincial Director of Health Services in Sabaragamuwa Province and the Medical Officer of Health in each divisional secretary area. Permission was obtained from the Divisional Secretary in each selected divisional secretary area and the Grama Niladhari Officer in each selected GN area before the data collection.

Informed, written consent was a prerequisite to be included in this study. The aims and the processes of the research were fully explained to the participants and their informed written consent was obtained for participation in each of the three components of the STEPS survey – STEP 1, STEP 2, and STEP 3. Participants were informed about the content of the interviews to enable them to understand the procedures and give their full approval. The importance of the study was made known to the participants as well as any possible risk that may be involved. Participation was made voluntarily rather than imposition thus, individuals were given the right to or not to take part in the study. The participants were informed that they can withdraw from the study at any stage, and it does not cause any problems for them.

Results

Socio-demographic characteristics

The study sample consisted of 366 adults aged between 30 to 60 years with a mean age of 45.2 years (SD=8.8). The rate of participation was 87.1%. A total of 116 men and 250 women were included in the study (Table 1).

Prevalence of CVDs risk factors

Approximately two-thirds (63.4%) were physically inactive. Women were significantly more physically inactive than men (p=< 0.001). Prevalence of high blood pressure, high blood glucose level, high total cholesterol level, high LDL cholesterol level, low HDL cholesterol level and high triglycerides were 27.0%, 22.1%, 39.9%, 37.7%, 29.0%, and 37.7% respectively.

Table 1: Socio-demographic characteristics of the study participants (n=366)

Socio-demographic characteristic		Number	Frequency (%)
Age (Years)	30-40	128	35.0
	41-50	114	31.1
	51-60	124	33.9
Sex	Male	116	31.7
	Female	250	68.3
Education Level	No formal education	10	02.7
	Grade 1 to Grade 5	36	09.8
	Grade 5 to Grade 10	121	33.1
	Passed O/L	91	24.9
	Passed A/L	85	23.2
	Graduate/Diploma	23	06.3
Monthly Income (LKR)	<10,000	27	07.4
	10,000-20,000	97	26.5
	20,001-30,000	92	25.1
	30,001-40,000	69	18.9
	>40,000	81	22.1

* Significant at the p value 0.05

The prevalence of individual risk factors for CVDs according to the gender is summarized in Table 2. The prevalence of high blood pressure and central obesity were more significantly higher among women than men (p=0.029 and p<0.001 respectively). Increasing prevalence of high blood pressure with age among both men (p=0.009) and women (p=<0.001) was identified. Among females, the prevalence of high blood cholesterol level (p=0.049), high blood glucose level (p=0.002) and central obesity (p=0.001) were increasing with age. The results also identified a decrease in the prevalence of high blood pressure with years of education (p=0.009) and an increase in the prevalence of general obesity (p=0.038) and central obesity (p=0.004) with monthly income among women.

Associations of CVD risk factors with socio-demographics factors

The CVD risk factors in relation to socio-demographic characteristics are shown in Table 3. When consider the gender of the participants, the mean SBP (p=0.007) and DBP (p=0.01) were significantly different between men and women. There was no significant difference in total cholesterol levels in the two groups (p=0.12). The mean HDL level (p=0.024) and mean LDL level (p=0.007) were significantly higher in women, while the mean triglyceride level (p=0.001) was significantly higher in men. The mean FBG level was higher in men (p=0.09) but not significant. Both mean waist circumference (p=0.025) and BMI (p=0.015) are significantly higher in females than in men.

When considering the association with age, the mean SBP and DBP showed an increase with age among both men (p=0.001 for SBP and p=0.026 for DBP) and women (p=<0.001 for SBP and p=<0.001 for DBP). The mean total cholesterol value was not significantly different across the three age groups of men (p=0.115) but the mean total cholesterol level of women showed an increase with age (P=0.001). The highest prevalence of high total cholesterol levels was

Table 2: Prevalence of individual risk factors for cardiovascular diseases (n=366)

		High blood pressure N (%)	High blood cholesterol N (%)	High blood glucose N (%)	General obesity N (%)	Central obesity N (%)
Sex	Male	40 (34.5)	47 (40.5)	31 (26.7)	63 (54.3)	31 (26.7)
	Female	59 (23.6)	99 (39.6)	56 (22.4)	149 (59.6)	200 (80.0)
	χ2 P	0.029*	0.868	0.366	0.340	<0.001*
Age (Years)	Men					
	30-40	6 (16.7)	17 (47.2)	9 (25.0)	25 (69.4)	11(30.6)
	41-50	11 (33.3)	14 (42.4)	4 (12.1)	16 (48.5)	6 (18.2)
	51-60	23 (48.9)	16 (34.0)	15 (31.9)	22 (46.8)	14 (29.8)
	χ2 P	0.009*	0.463	0.124	0.089	0.422
	Women					
	30-40	3 (3.3)	30 (32.6)	9 (9.8)	46 (50.0)	62 (67.4)
	41-50	25 (30.9)	30 (37.0)	20 (24.7)	53 (65.4)	70 (86.4)
	51-60	31 (40.3)	39 (50.6)	24 (31.2)	50 (64.9)	68 (88.3)
	χ2 P	<0.001*	0.049*	0.002*	0.062	0.001*
Years of education	Men					
	0-8	13 (46.4)	8 (28.6)	9 (32.1)	23 (53.5)	9 (32.1)
	9-12	17 (37.0)	18 (39.1)	10 (21.7)	40 (54.8)	9 (19.6)
	>13	10 (23.8)	21 (50.0)	9 (21.4)	63 (54.3)	13 (31)
	χ2 P	0.135	0.196	0.524	0.892	0.367
	Women					
	0-8	18 (40.9)	20 (45.5)	13 (29.5)	44 (59.5)	36 (81.8)
	9-12	22 (18.2)	49 (40.5)	24 (19.8)	105 (59.7)	92 (76.0)
	>13	19 (22.4)	30 (35.3)	16 (18.8)	149 (59.6)	72 (84.7)
	χ2 P	0.009*	0.514	0.324	0.977	0.293
Monthly income (LKR)	Men					
	<20,000	9 (34.6)	9 (34.6)	7 (26.9)	10 (38.5)	4 (15.4)
	21,000-40,000	21 (34.4)	26 (42.6)	13 (21.3)	35 (57.4)	18 (29.5)
	>41,000	10 (34.5)	12 (41.4)	8 (27.6)	18 (62.1)	9 (31.0)
	χ2 P	1.000	0.780	0.754	0.168	0.329
	Women					
	<20,000	24 (24.5)	38 (38.8)	20 (20.4)	49 (50.0)	69 (70.4)
	21,000-40,000	22 (22.0)	45 (45.0)	22 (22.0)	64 (64.0)	83 (83.0)
	>41,000	13 (25.0)	16 (30.8)	21 (21.2)	36 (69.2)	48 (92.3)
	χ2 P	0.886	0.230	0.963	0.038*	0.004*

* Significant at the p value 0.05

Table 3: Cardiovascular Diseases risk factors by socio-demographic characteristics (n=366)

Variable			SBP (mmHg) Mean (SD)	DBP (mmHg) Mean (SD)	TC (mg/dl) Mean (SD)	HDL (mg/dl) Mean (SD)	LDL (mg/dl) Mean (SD)	TG (mg/dl) Mean (SD)	FBG (mg/dl) Mean (SD)	WC (cm) Mean (SD)	BMI (Kgm^{-2}) Mean (SD)
Sex		Male	132.5 (17.6)	81.7 (10.4)	187.9 (37.3)	44.5 (9.9)	114.5 (32.2)	143.6 (96.8)	103.7 (43.7)	86.7 (10.7)	23.2(3.9)
		Female	127.0 (18.2)	78.8 (10.1)	194.4 (36.5)	47.2 (10.8)	124.5 (33.0)	114.4 (69.6)	97.1 (29.7)	89.3 (9.9)	24.3(4.2)
	t test p		0.007*	0.01*	0.12	0.024*	0.007*	0.001*	0.09	0.025*	0.015*
Age	Men	30 – 40	123.7 (12.2)	77.9 (9.1)	194.9 (31.4)	43.8 (8.2)	121.6 (28.2)	152.2(84.4)	108.1 (54.5)	87.2 (8.8)	24.8(4.3)
		41 – 50	134.6 (16.3)	82.7 (10.1)	191.7 (36.3)	45.1 (9.2)	115.9 (34.6)	144.6(31.7)	95.6 (35.1)	86.4 (14.0)	22.3(3.2)
		51 – 60	137.8 (19.5)	83.9 (10.9)	179.9 (41.2)	44.6 (11.7)	108.2 (32.6)	136.3(76.5)	106.0 (39.8)	86.7 (9.6)	22.5(3.6)
	Trend p		0.001*	0.026*	0.115	0.962	0.127	0.622	0.857	0.865	0.034*
	Women	30 – 40	117.6 (11.1)	74.4 (8.6)	187.2 (32.8)	47.9 (11.6)	118.9 (26.8)	101.8(52.6)	90.9 (28.9)	86.9 (10.2)	23.5(4.1)
		41 – 50	129.4 (18.3)	80.2 (10.1)	193.6 (35.8)	45.5 (10.4)	123.0 (32.2)	125.8(95.5)	99.5 (29.8)	90.1 (9.5)	24.8(4.6)
		51 – 60	135.9 (19.9)	82.5 (9.9)	203.9 (39.8)	47.9 (10.1)	132.5 (38.9)	117.4(51.3)	101.9 (29.9)	91.4 (9.6)	24.7(4.0)
	Trend p		< 0.001*	<0.001*	0.001*	0.698	0.003*	0.031*	0.009*	0.004*	0.099
Years of Education #	Men	0-8	136.5 (3.4)	80.7 (2.1)	178.8 (7.5)	45.2 (2.1)	104.0 (6.4)	119.3 (19.4)	108.1 (9.0)	85.4 (2.2)	22.5 (0.7)
		9-12	132.6 (2.5)	83.2 (1.5)	187.0 (5.5)	44.7 (1.5)	113.1 (4.6)	158.7 (14.4)	102.6 (6.5)	86.5 (1.6)	22.8 (0.5)
		>13	129.8 (2.6)	80.8 (1.6)	195.1(5.8)	43.8 (1.6)	123.1 (4.9)	143.2 (15.2)	101.9 (6.9)	87.9 (1.7)	24.0 (0.5)
	ANOVA p		0.004*	0.093	0.152	0.95	0.053	0.438	0.953	0.833	0.052
	Women	0-8	129.9 (2.5)	79.2 (1.5)	191.9 (5.6)	48.4 (1.7)	123.6 (5.1)	99.2 (10.7)	94.1 (4.5)	88.2 (1.5)	23.6 (0.6)
		9-12	125.5 (1.5)	77.8 (0.8)	194.0 (3.3)	47.1 (0.9)	123.7 (2.9)	116.2 (6.2)	95.7 (2.6)	88.7 (0.8)	24.1 (0.3)
		>13	127.7 (1.8)	79.9 (1.0)	196.4 (3.9)	46.6 (1.2)	125.9 (3.5)	119.7 (7.5)	100.6 (3.2)	90.8 (1.0)	24.8 (0.4)
	ANOVA p		<0.001*	<0.001*	0.008*	0.834	0.031*	0.068	0.037*	0.013*	0.169
Monthly Income # (LKR)	Men	<20,000	133.2 (3.3)	81.6 (2.0)	185.8 (7.3)	43.6 (1.9)	111.7 (6.3)	166.4 (19.2)	104.3 (8.7)	83.3 (2.1)	21.9 (0.7)
		20,000-40,000	131.2 (2.2)	80.8 (1.3)	190.6 (4.7)	45.2 (1.3)	115.5 (4.1)	141.2 (12.4)	102.6 (5.6)	87.8 (1.4)	23.5 (0.5)
		>40,000	133.6 (3.2)	83.8 (1.9)	184.4 (7.1)	43.9 (1.9)	114.9 (6.2)	128.2 (18.6)	105.6 (8.4)	87.6 (2.0)	23.5 (0.7)
	ANOVA p		0.011*	0.9	0.377	0.902	0.464	0.511	0.989	0.326	0.052
	Women	<20,000	124.8 (1.6)	77.5 (0.9)	191.7 (3.6)	47.1 (1.1)	123.7 (3.3)	104.9 (6.9)	92.9 (2.9)	86.2 (0.9)	22.8 (0.4)
		20,000-40,000	128.8 (1.6)	78.7 (0.9)	199.1 (3.5)	47.3 (1.1)	127.4 (3.3)	122.1 (6.9)	97.9 (2.9)	91.2 (0.9)	25.3 (0.4)
		>40,000	128.9 (2.3)	81.1 (1.3)	190.7 (4.9)	46.9 (1.5)	120.3 (4.5)	117.4 (9.6)	103.4 (4.0)	91.6 (1.3)	25.4 (0.6)
	ANOVA p		<0.001*	<0.001*	0.003*	0.978	0.016*	0.05*	0.011*	<0.001*	<0.001*

*Significant at the p-value 0.05   # Age adjusted mean values

SBP: Systolic Blood Pressure   DPB: Diastolic Blood Pressure TC: Total Cholesterol   TG: Triglyceride   WC: Waist Circumference reported among the youngest age group of men and the oldest age group of women. The mean HDL levels showed no significant differences across the age groups in both men (p=0.962) and women (p=0.698). The mean LDL level in men and the proportion of men with high LDL levels decreased with age. Among women, the mean LDL level and proportion of women with high LDL levels increased with age and it showed significant differences across age groups (p=0.003). Although the mean triglyceride level was not significantly different among age groups of men (p=0.622), it was significantly different across age groups of women (p=0.031). The highest mean triglyceride level was reported among the 41-50 years age group of women. The mean FBG level was significantly different among the age groups of women (p=0.009). Mean waist circumference was similar across age groups of men. Among women, mean waist circumference showed a statistically significant increase by age (p=0.004). The mean BMI was significantly higher among women than men (p=0.015).

A statistically significant decrease in SBP was observed in both men (p=0.004) and women (p=<0.001) with increasing years of education. DBP was significantly different only among females with years of education (p=<0.001). Among women, the highest mean DBP was reported among the highest educated women. Mean total cholesterol levels increased with years of education in both men and women but were not significant. The highest mean total cholesterol level and LDL level were reported among the highest educated women and the difference was statistically significant (p=0.008 and p=0.031 respectively). Even though triglyceride showed a positive relationship with increasing years of education in both men and women it was not significant.

Mean SBP (p=<0.001) and mean DBP (p=<0.001) tended to increase significantly with the income of women. Mean total cholesterol tended to decrease from the intermediate income group to the highest income group in both men and women, but the difference was significant only among females (p=0.003). The mean LDL level was decreased from the intermediate income group to the highest income group and the difference was significant only among females (p=0.016). The mean FBG level of women tended to increase significantly with their income (p=0.001).

Discussion

Studies that used similar methodologies with similar cut-off points as used in the present study were considered to compare the findings of this study. The present study found a significant difference in the prevalence of hypertension according to gender, 34.5% and 23.6% among men and women respectively but the STEP survey conducted in Sri Lanka in 2015 has not reported a significant difference by gender (25.4% for men and 26.7 % in women) [19]. Few other studies conducted in Sri Lanka also reported that the prevalence of hypertension was higher among women than men [7,20,21]. However, according to the WHO and a few other studies conducted in countries such as Korea, China, and Ethiopia a higher prevalence of hypertension among men compared to women has been reported [22-25].

Comparison of the studies in relation to lipid levels is difficult since different studies have used different cut-off points to define high cholesterol levels. This might be the reason for the varying prevalence of raised total cholesterol reported in different studies. In the present study, 37.7% had high LDL, 29.0% had low HDL and 21.3% had high triglyceride levels. A study conducted with a nationally representative sample of Sri Lanka in 2005-2006 with the same cut-off points as the present study had reported 46% with high LDL, 49.6% with low HDL, and 23% with high triglyceride levels [26]. Accordingly, in the present study, the prevalence of low HDL levels is markedly low compared to the above-mentioned study (29% vs 49.6%) in Sri Lanka. Another study done in 2010 among adults in Kandy District has reported 23.2% of high total cholesterol, 55.4 % of low HDL and 37.3% of high triglyceride levels [9]. Compared to the findings of this study too, a huge disparity was observed in the prevalence of low HDL (29.0% vs 55.4%). Nevertheless, a study done in 2017 among adults in the Ragama Medical Officer of Health area in Sri Lanka has reported a 20.8% prevalence of low HDL [27]. Therefore, further studies should be needed to explore the factors affecting HDL levels among adults in Sri Lanka. Furthermore, the present study found higher levels of mean HDL, LDL, and VLDL levels in women compared to men. Similar results have been reported by the STEPS survey in 2015 in Sri Lanka [28]. However, the finding of high mean triglyceride level among men than women in the present study was contrary to the above study. Nevertheless, similar to the present study, another study conducted in Sri Lanka also found a higher level of triglycerides among men compared to women [26].

The mean FBG level was not significantly different between men and women in this study. Corresponding to this finding, a study involving four major provinces in Sri Lanka has reported blood glucose values with no significant difference overall and in all provinces [7]. Several other studies conducted in Iran, Bangladesh, North India and Sri Lanka also found similar findings to the present study [29-33]. In contrast, some other local studies conducted in Galle and Jaffna Districts [34,35] and foreign studies conducted in China, Korea and Saudi Arabia [36-38] showed a male predominance of the prevalence of dysglycaemia while some studies done in Ghana and Sri Lanka showed female predominance [39,40].

Older age, being hypertensive, higher BMI and higher triglyceride levels were associated with a higher prevalence of dysglycaemia in this study. A higher prevalence of dysglycaemia was present among participants who were overweight or obese and this finding is consistent with the finding of overweight and obesity being common risk factors of diabetes mellitus [41]. Similar results had been found by other studies in Sri Lanka as well as in other countries [30,35,39,42]. Moreover, in the present study mean high blood glucose level was increased among women by years of education and monthly income, which was reported among adults in Kaluthara District, Sri Lanka as well [43]. Similar trends have been reported among both men and women in studies done in other countries such as Bangladesh and India [30,31].

Strengths and limitations of the study

The biggest strength of this study is the appropriateness of the study design to achieve the objective. It was increased by selecting a well-defined population and conducting the study in a representative sample of Sabaragamuwa Province in Sri Lanka. The three-stage random sampling method used in this study had been given the same chance for each adult aged between 30-60 years in Sabaragamuwa province to be selected for the study. Furthermore, data collection was done using a well-known WHO STEPs vise approach and routine calibration of each instrument ensured accurate results collected in this study. Nevertheless, there are few limitations in this study. Since it took only a snapshot of the population, if another timeframe is chosen differing results may be possible. Furthermore, though the male to female ratio in Sabaragamuwa Province is 1: 1 this study could capture a ratio of 1: 2.1. Because of that, limitations could occur when the findings are projecting to the total population.

Future implications

As the prevalence of CVD risk factors reported in this study is higher than the country statistics, this study emphasizes the need of identifying regional specific prevalence in each region of the country. Thereby the prevention programmes or screening programmes can be organized based on the region-specific data considering the region-specific characteristics. Furthermore, the higher prevalence reported in this study emphasize the urgent need of public health interventions to prevent and control non-communicable diseases in this region. The findings of this study have a major implication for strengthening or developing community centered CVD prevention programmes targeting different regions in Sri Lanka.

Conclusion

The prevalence of high blood pressure, dysglycemia, dyslipidemia, general obesity, and central obesity is higher in this population. Therefore, the findings of this study suggest that the study population in this region is at high risk of developing cardiovascular disease in near future. More men were hypertensive. Mean HDL, LDL, and VLDL levels were higher among females than males while mean triglyceride level was higher among males. Accordingly, the prevalence of CVD risk factors is considerably high in this population. Therefore, it is high time to plan public health interventions considering the population characteristics which are associated with CVD risk factors.

Conflict of Interest

The authors have no conflicts of interest associated with the material presented in this paper

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