Prevalence of hypertension, diabetes and obesity: baseline findings of a population based survey in four provinces in Sri Lanka

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Abstract

Objective To determine the prevalence of selected cardiovascular risk factors in adult Sri Lankan population in four provinces.

Design Cross-sectional, based on a stratified cluster sampling method.

Settings Four provinces, namely the Western, North Central, Southern and Uva.

Patients Six thousand and forty seven participants (2692 men) between the age of 30 and 65 years were surveyed.

Measurements Risk factors measured included height, weight, waist and hip circumference. Waist to hip ratio and body mass index were calculated, and overweight (23 kg/m^2) and obesity (≥25 kg/m^2) determined. Hypertension (systolic blood pressure ≥ 140 mmHg or diastolic blood pressure ≥ 90 mmHg or use of anti-hypertensive medications), and diabetes mellitus (fasting serum plasma glucose level ≥ 7 mmol/L or use of anti-diabetic medications) and impaired fasting glycaemia (≥ 6.1 to < 7 mmol/L) were also determined.

Results The prevalence of hypertension as defined was 18.8% (CI 14.5–23.1) for men and 19.3% (CI 12.2–26.4) for women. The prevalence of diabetes was 14.2% (CI 11.9–16.5) for men and 13.5% (CI 6.9–20.1) for women while impaired fasting glycaemia was 14.2% for men and 14.1% for women. The mean body mass index was 21.5 kg/m^2 (SD = 3.7) in men. It was lower than that in women, 23.3 kg/m^2 (SD = 4.5). The prevalence of obesity was 20.3% in men and 36.5 % in women.

Regional differences were seen in the mean fasting blood glucose and prevalence of diabetes, and mean BMI and prevalence of obesity were highest in Western province. Mean blood pressure and prevalence of hypertension were highest in the Uva Province. Southern Province had the lowest prevalence of hypertension and diabetes, and North Central Province had lowest anthropometric measures of obesity.

Conclusions The prevalence of the selected cardiovascular risk factors is common in the adult Sri Lankan population surveyed. Regional differences exist in the prevalence of these risk factors. The prevalence of high level of risk factors requires urgent public health action.

Introduction

Cardiovascular disease and its risk factors such as hypertension and diabetes represent an increasing proportion of morbidity and mortality in developing countries [1]. Hospital based information suggests that these diseases are the leading causes of morbidity and mortality in Sri Lanka [2]. With the changing demography in Sri Lanka, due to greater proportion of older people and successful intervention in individuals at high risk, the total number of persons with cardiovascular diseases, hypertension and diabetes will show an increase in the future.

Existing health data in Sri Lanka is inadequate and inaccurate. Hospital in-patient and out-patient records are not comprehensive enough to assess the prevalence of most of the common diseases, and one third of the patients seek treatment from other sources such as Ayurveda or private western medical practitioners.

Relatively little reliable information is available on the prevalence of risk factors for hypertension, diabetes and cardiovascular diseases [3, 4–6]. Data available is limited to certain population groups and regions and not representative enough for general applicability. Such information is crucial for developing strategies and projecting health needs to deal with the emerging epidemic of these diseases and as a baseline for assessing future trends. Hence, a prevalence survey of cardiovascular diseases and selected risk factors was undertaken in four provinces to characterise their prevalence along with that of hypertension and diabetes.

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Methodology

Sri Lanka has population of about 19 million and is divided for purposes of administration into nine provinces and 25 districts. The survey was restricted to Western, North-Central, Uva and Southern Provinces because of security and logistic reasons. The Western Province has the highest population density and is the most urbanised province. The other three provinces are agriculture based. The North Central Province, is in the dry zone. People in this area are mainly involved in paddy and vegetable cultivation. Uva, is in the wet zone where people grow mainly tea and vegetables. The Southern Province, is lined by a beachfront on one side with fishing and agriculture as the main income-generating activities.

Sample size

A stratified cluster sampling method was used. Sample size was targeted for a 5% diabetes prevalence rate within a 95% confidence interval and was estimated at 7 800. Allowance was made for cluster effect. To reduce the large sampling error that might occur from clustering, a large number of small clusters were selected. There was no marked difference in the population structure of 30–65 years in the selected provinces.

Sample selection

The number of clusters to be selected from each province and district depended on the population size. The number of clusters required from each district was randomly selected from the list of Gramasevaka Divisions in it. From each cluster, 60 individuals were selected by systematic random sampling. The selection of individuals for the study was done by visiting homes. Subsequently, the houses were selected by systematic random sampling. The interval of houses to be skipped was calculated by dividing the number of households in each division by 60. This varied for the study from 2 to 9. From each household, one individual belonging to the age group of 30–65 years was selected randomly.

Inclusion criterion

All individuals in the age group of 30–65 years were taken into the study. Pregnant women and those who were physically disabled were excluded.

Training of data collectors

All data collectors underwent training for the specific tasks required in the survey. They were trained to ensure standardisation of measurement techniques, interviewing, sample collection and labelling.

Questionnaire

The questionnaires used had two sections; one for individual identification and sociodemographic factors, and the other to ascertain risk factors. The data gathering form also included a section for recording anthropometric measurements, and clinical and biochemical examination findings. Questionnaires used in the survey were validated for local use from standard questionnaires recommended for international use. To standardise the blood glucose measures, subjects were invited to attend the survey early in the morning after an overnight fast of 12 hours.

Anthropometry

Height was measured using a stadiometer and recorded to the nearest 10th of a centimeter with the subject looking straight ahead and with the back against the vertical support of the instrument. Weight was measured without shoes on a digital scale, standardised against a known weight every day. Waist was measured by positioning the measuring tape midway between the lower rib margin and the iliac crest, at the end of a normal expiration. The hip circumference was taken at the maximum circumference over the buttocks, which were the posterior landmark, and the anterior one being the pubic symphysis. The measurements were made without outer garments and the recording was made to the nearest 0.5 cm.

For all the aforementioned measurements and blood pressure recording; the mean of two measurements were taken for each individual.

Blood pressure

Blood pressure was measured in the seated position after the participants had rested for at least 5 minutes. The measurement was taken using the supported left arm at the heart level, using OMRON 705CP device, whose measuring accuracy had been validated and it met the criteria of the British Hypertension Society. Two recordings were taken and the mean was used for analysis. In the event of variation of over 20 mmHg between recordings, a third reading was done and the mean of the last two recordings was used. All OMRON devices were tested against the mercury column sphygmomanometer for accuracy.

Transport of specimens

From all individuals 2 mL of venous blood were drawn to assess the fasting blood glucose. All specimens of blood, were transported within 6 hours of collection in ice packs and cold boxes. When this was not possible, blood was centrifuged and the separated serum was stored in a freezer and transferred within 5 days. All biochemical tests were conducted at the Medical Research Institute, Colombo. The methods were regularly standardised, and random double checking of the specimens was done; quality assurance tests were within acceptable limits.

The study was approved by the Ethical Committee of the Faculty of Medical Sciences, University of Sri Jayewardenepura. Patients detected with disease and abnormal findings were referred for treatment to local or

specialised hospitals. Informed consent was obtained from all individuals selected for the study before interviewing, examining and collecting blood samples.

Results

Sociodemographic variables

The total number invited for the study was 7800 but the survey was done in 6047 individuals, with a non-response rate of 14.6%. The non-response rate was highest in the Southern Province (21.1%) and lowest in the Uva (12.1%). Non-responders were slightly more among men than women.

There were 3 355 women in the sample and the men:women ratio was 1:1.2. The mean age of men was 46.1 years (SD 9.4) and that of women 46.8 (SD 8.9). The mean ages for each province were similar (Table 1).

Nearly 50% belonged to the age group 30–45 years. In the population structure of Sri Lanka too, the proportion of people in this age group is the highest when compared to the other groups in our sample.

Findings of the socioeconomic characteristics are shown in Table 2. In the total sample, more than 85% of the population was married. Nearly 40% of the participants indicated that they receive a monthly income of less than Rs 3 000/- (approx. US$ 30), after all sources of income were taken into account including that from cultivation, cottage industries and self-employment. Nearly 90% of the participants had received school education, and the majority had gone beyond Grade 5. There were more men

Table 1. **Age distribution of participants in provinces (number in each age group, mean age and median)**

	Western		*North Central*		*Southern*		*Uva*		*Total*	
Age group	*M*	*F*	*M*	*F*	*M*	*F*	*M*	*F*	*M*	*F*
30–35	285	285	45	49	21	16	70	61	456	441
36–40	334	359	55	56	25	33	60	78	518	573
41–45	313	425	60	64	24	32	78	99	527	687
46–50	284	399	46	55	26	40	62	77	468	636
51–55	278	436	24	35	21	32	35	74	391	651
56–60	222	345	28	21	12	23	52	42	347	462
61–65	175	161	17	16	10	16	30	26	257	249
Total	**1891**	**2410**	**275**	**296**	**139**	**192**	**387**	**457**	**2692**	**3355**
Mean age	46.4	47.2	44.7	44.6	45.4	46.3	45.6	45.8	46.1	46.8
SD	9.4	8.9	9.0	8.5	8.9	8.6	9.4	8.5	9.4	8.9
Median	46.0	47.0	43.0	44.0	45.0	47.0	44.0	45.0	45.0	47.0

F–female, M–male

Table 2. **Socioeconomic distribution of participants in provinces (percentages)**

	Western		*North Central*		*Southern*		*Uva*		*Total*	
	M	*F*	*M*	*F*	*M*	*F*	*M*	*F*	*M*	*F*
Marital status										
Married (%)	93.1	87.5	95.4	80.7	87.3	84.6	92.4	80.5	92.6	85.8
Single (%)	6.6	4.8	3.9	4.4	10.7	5.5	5.8	7.9	6.4	5.2
Widowed (%)	0.3	7.7	0.7	14.9	2.0	9.9	1.8	11.6	1.1	9.1
Monthly income										
< Rs 3000	32.3	25.1	61.1	66.7	59.3	65.2	61.4	66.9	37.5	43.8
>Rs 3000	67.7	74.9	38.9	33.3	40.7	34.8	38.6	33.1	62.5	56.2
Occupation										
Professional	2.7	1.8	1.9	2.4	0.5	2.1	3.5	1.7	2.5	1.9
Semi professional	34.6	4.1	10.2	1.4	23.3	2.1	18.3	4.4	28.9	3.7
Skilled worker	34.0	5.1	71.4	32.7	41.7	6.0	50.4	14.2	40.7	8.7
Unskilled worker*	28.7	89.0	16.5	63.5	34.5	89.8	27.8	79.7	28	85.7
Education										
None	0.6	2.2	3.4	7.5	1.4	7.5	4.6	11.8	1.5	4. 6
Grade 1 to 5	11.9	15.5	29.3	30.9	27.1	25.7	27.5	25.9	17.7	19.4
Grade 6 to 10	74.9	70.7	60.0	53.7	56.4	55.6	54.2	54.5	68.48	65.25
Advanced level/ Technical education	12.6	11.6	5.3	7.9	15.1	11.2	13.7	7.8	12.33	10.76

* Includes people not regularly employed and unemployed, F–female, M–male

than women attending school and pursuing advanced level or technical education.

The Western Province participants were relatively more affluent and had more professional and semiprofessional workers compared to those in the other provinces. Those in the North Central Province and the Uva Province were the least affluent and a high proportion of the workforce was semi- or unskilled workers. A high percentage of women were involved in income generating activity in the North Central Province compared to other provinces.

The anthropometric measurements, blood pressure recordings and blood glucose levels are summarised in Table 3.

The BMI was categorised according to the proposed classification of the World Health Organisation (WHO) for the Asian and Pacific countries based on risk factor and morbidities. The cut-off points for overweight (≥ 23 kg/m^2) and obesity (≥ 25 kg/m^2) are lower than for WHO classification for adult Europoids. Overall, 46.4% had a BMI of over 23 kg/m^2, of whom 23.6% had moderately severe and 6% had severe obesity (Table 4). In all categories of overweight, the prevalence was greater in women than in men in all provinces. In all the four provinces, women had a higher mean BMI than men, with the highest values seen in men and women in the Western Province. The lightest men and women were in the North Central Province. The men had larger waists and smaller hips compared to women. Overall and in all provinces the waist-to-hip ratio was greater in men than women. The highest waist-to-hip ratios were seen in men and women of the Western Province.

Table 3. **Anthropometric characteristics, blood pressure recordings and blood glucose levels of participants in provinces**

	Western		*North Central*		*Southern*		*Uva*		*Total*	
	M	*F*	*M*	*F*	*M*	*F*	*M*	*F*	*M*	*F*
Weight (Kg)										
Mean	58.9	54.4	54.9	49.5	56.4	51.5	55.3	50.8	57.9	53.4
SD	10.3	11.0	9.1	9.4	11.5	9.9	9.8	9.5	11.0	10.8
IQR	15.6	14.7	12.4	12.8	16.9	14.0	12.4	13.3	15.4	14.8
Height (cm)										
Mean	164.1	151.2	165.2	151.8	164.2	150.6	163.3	150.7	164.1	151.1
SD	6.6	6.0	6.8	6.1	6.1	5.5	6.5	6.1	6.6	6.0
IQR	8.7	8.0	8.6	8.3	7.9	7.6	8.4	8.7	8.3	8.0
BMI (Kg/m^2)										
Mean	21.9	23.8	20.2	21.4	20.7	22.6	20.7	22.4	21.5	23.3
SD	3.8	4.6	3.0	4.0	3.6	4.0	3.3	3.9	3.7	4.5
IQR	5.0	6.0	4.0	6.0	5.0	5.0	5.0	6.0	5.0	6.0
Waist (cm)										
Mean	78.6	76.1	73.5	70.5	75.0	72.7	75.0	71.8	77.4	74.9
SD	10.6	10.7	9.5	9.4	10.3	10.0	9.3	9.0	10.5	10.6
IQR	15.0	14.4	12.9	14.2	16.0	13.8	14.0	12.5	16.0	14.6
Hip (cm)										
Mean	84.3	91.2	81.3	87.0	83.1	88.0	82.4	88.6	83.7	90.3
SD	7.4	9.4	6.2	7.6	6.5	10.0	6.4	7.6	7.1	9.1
IQR	10.0	12.7	8.2	10.7	10.5	10.6	8.1	10.9	10.0	12.0
Waist/hip ratio										
Mean	0.93	0.83	0.90	0.81	0.90	0.82	0.91	0.81	0.93	0.83
SD	0.07	0.09	0.06	0.06	0.06	0.06	0.06	0.07	0.07	0.09
IQR	0.09	0.09	0.08	0.08	0.09	0.08	0.09	0.08	0.09	0.09
SBP (mmHg)										
Mean	120.1	117.1	118.6	117.3	115.9	115.6	122.2	122.1	120.0	117.7
SD	20.4	21.1	19.1	19.6	20.1	23.2	20.7	22.7	20.3	21.4
IQR	24.0	25.5	22.0	28.5	21.5	29.4	23.5	27.9	24.0	26.5
DBP (mmHg)										
Mean	75.4	73.1	73.2	73.2	72.3	72.6	75.3	75.2	75.0	73.8
SD	11.7	11.2	11.3	10.9	12.1	11.8	11.1	11.8	11.6	11.3
IQR	15.0	14.5	15.0	14.5	16.0	14.8	16.5	16.0	15.5	14.5
FBS (mmol/L)										
Mean	6.2	6.2	5.6	5.5	5.1	5.1	5.3	5.4	6.0	5.9
SD	2.6	2.6	1.2	1.2	1.1	1.1	1.7	2.0	2.3	2.4
IQR	1.4	1.4	1.0	0.9	0.5	0.3	1.0	1.0	1.3	1.3

F–female, M–male, SD–standard deviation, IQR–inter-quartile range

Table 4. **Prevalence of obesity according to proposed WHO criteria for adult Asians**

Province	*Males*					*Females*				
	Under-weight	*Normal*	*Over-weight*	*Moderate obesity*	*Severe obesity*	*Under-weight*	*Normal*	*Over-weight*	*Moderate obesity*	*Severe obesity*
North Central Province										
30–35	35.6	44.4	13.3	6.7	0	36.7	34.7	12.2	16.3	0
36–45	30.4	47.8	9.6	12.2	0	35.6	40.2	17.9	11.1	5.1
46–55	30.0	47.1	12.9	8.6	1.4	27.0	31.5	15.7	21.3	4.5
56–65	42.2	42.2	8.9	6.7	0	20.0	40.0	5.7	31.4	2.9
Total	**91**	**127**	**30**	**26**	**1**	**79**	**112**	**43**	**51**	**11**
(%)	(33.1)	(46.2)	(10.9)	(9.4)	(0.4)	(26.7)	(37.8)	(14.5)	(17.2)	(3.7)
Southern Province										
30–35	33.3	38.1	9.5	19.0	0	25.0	37.5	25.0	6.3	6.3
36–45	25.0	37.5	14.6	18.8	4.2	14.1	37.5	14.1	26.6	7.8
46–55	27.7	42.6	14.9	12.8	2.1	11.3	45.1	16.9	19.7	7.0
56–65	40.9	40.9	13.6	4.5	0	22.2	36.1	11.1	30.6	0
Total	**42**	**55**	**19**	**20**	**3**	**29**	**80**	**29**	**43**	**11**
(%)	(30.2)	(39.6)	(13.7)	(14.4)	(2.1)	(15.1)	(41.7)	(15.1)	(22.4)	(5.7)
Uva Province										
30–35	18.6	52.9	11.4	15.7	1.4	29.5	27.9	13.1	27.9	1.6
36–45	31.2	45.7	11.6	10.9	0.7	15.3	39.2	13.6	25.6	6.3
46–55	19.6	52.6	13.4	13.4	1.0	13.3	34.7	18.0	29.3	4.7
56–65	28.0	47.6	9.8	13.4	1.2	17.6	39.7	26.5	16.2	0
Total	**98**	**190**	**45**	**50**	**4**	**79**	**165**	**77**	**117**	**19**
(%)	(25.3)	(49.1)	(11.6)	(12.9)	(1.0)	(17.3)	(36.1)	(16.9)	(25.6)	(4.2)
Western Province										
30–35	16.8	42.8	13.3	23.2	3.9	13.7	28.4	18.3	30.6	9.0
36–45	19.3	33.2	20.1	23.5	3.9	10.2	25.7	20.4	32.5	11.2
46–55	21.2	38.0	18.4	19.8	2.7	13.1	27.2	16.8	31.7	11.2
56–65	26.4	43.4	14.2	14.2	1.8	15.7	30.3	17.9	25.7	10.4
Total	**396**	**721**	**331**	**385**	**58**	**300**	**706**	**432**	**719**	**253**
(%)	(21.0)	(38.2)	(17.3)	(20.4)	(3.1)	(12.8)	(27.5)	(18.4)	(30.6)	(10.8)
Overall Total	**627 (23.3)**	**1093 (40.6)**	**425 (15.8)**	**481 (17.9)**	**66 (2.4)**	**527 (15.7)**	**1023 (30.5)**	**581 (17.3)**	**930 (27.7)**	**294 (8.8)**

Underweight: < 18.5 kg/m^2, Normal: 18.5–22.9 kg/m^2, Overweight: 23–24.9 kg/m^2, Moderate obesity: 25–29.9 kg/m^2, Severe obesity: ≥ 30 kg/m^2

Blood pressure recordings of those receiving antihypertensive treatment were excluded from the analysis. The mean systolic and diastolic blood pressure were higher in men than in women except in the Southern Province. The participants in the Uva Province and those in the Southern Province, respectively, recorded the highest and the lowest systolic and diastolic blood pressure compared to other provinces. There was, however, no significant difference in the blood pressure values between the provinces. Table 5 shows the mean systolic and diastolic blood pressure in different provinces. The mean systolic and diastolic blood pressure show a gradual increase with age in all provinces and in both sexes.

The mean fasting blood glucose was similar in men and women, overall and in all provinces. The highest values for both sexes were found in those in the Western Province and the lowest in the Southern Province.

The age standardised prevalence rate for hypertension (≥ 140/90 mmHg) was 18.8% and 19.3% for men and women, respectively (Table 7). The corresponding crude prevalence rate for the total population was 19.4% and 20.6% in men and women, according to the current cut-off point of 140/90 mmHg and over. Based on a cut-off of 160/90 mmHg and over, the prevalence was 10.5% and 12.4% for men and women. The prevalence of hypertension too shows an increase with age with either definition. Except for the Western Province, the prevalence of hypertension was greater in women than in men.

The overall age standardised prevalence rate of diabetes mellitus according to the WHO/American Diabetic Association definition (fasting blood glucose 7 mmol/L and over) is high with 14.2% in men and 13.5% in women (Table 7). The crude prevalence rate was 14.9% and 13.9 % for males and females, respectively. There was wide variation in the prevalence of diabetes in the provinces. The highest prevalence of diabetes in both men and women was seen in Western Province, which was more than three times that of the Southern Province,

Table 5. **Mean (SD) and systolic and diastolic blood pressure in provinces**

Province	*M*	*F*	*M*	*F*	*M*	*F*	*M*	*F*
age groups:	*30–35*		*36–45*		*46–55*		*56–65*	
North Central								
SBP	111.8	105.9	116.2	113.1	117.3	123.2	133.8	131.6
	(12.1)	(11.5)	(16.7)	(15.4)	(15.8)	(22.2)	(26.6)	(21.5)
DBP	68.9	68.6	72.2	71.9	73.8	76.5	78.9	75.1
	(8.3)	(7.9)	(10.7)	(10.0)	(11.3)	(11.9)	(12.6)	(11.1)
Southern								
SBP	107.3	100.6	112.6	108.2	119.4	116.3	123.7	132.7
	(10.6)	(13.6)	(13.7)	(18.9)	(24.1)	(21.9)	(25.6)	(25.3)
DBP	68.9	65.8	71.5	70.4	75.2	73.3	74.1	77.3
	(7.9)	(6.3)	(8.7)	(12.0)	(15.7)	(12.1)	(10.8)	(10.8)
Uva								
SBP	114.9	110.0	117.5	114.5	121.5	129.7	137.2	135.8
	(14.7)	(13.8)	(17.3)	(16.2)	(17.0)	(23.9)	(26.1)	(27.4)
DBP	71.0	69.5	74.2	72.0	75.0	78.9	80.9	80.5
	(10.7)	(8.9)	(11.1)	(9.7)	(10.3)	(12.3)	(10.1)	(13.2)
Western								
SBP	113.0	106.1	115.1	109.4	122.3	120.0	130.4	130.2
	(14.3)	(12.1)	(14.6)	(15.5)	(21.6)	(20.6)	(25.1)	(24.9)
DBP	70.7	69.4	73.5	70.9	77.3	75.2	79.2	77.6
	(10.1)	(8.9)	(10.2)	(9.8)	(12.2)	(11.3)	(12.7)	(12.2)
Total								
SBP	**112.9**	**106.5**	**115.4**	**110.5**	**121.6**	**121.3**	**131.5**	**131.0**
	(14.0)	**(12.4)**	**(15.3)**	**(15.9)**	**(20.8)**	**(21.5)**	**(25.4)**	**(25.0)**
DBP	**70.3**	**69.2**	**73.4**	**71.2**	**76.6**	**75.7**	**79.2**	**77.7**
	(9.9)	**(8.7)**	**(10.3)**	**(9.9)**	**(12.2)**	**(11.6)**	**(12.3)**	**(12.1)**

DBP–diastolic blood pressure, SBP–systolic blood pressure, F–female, M–male

Table 6. **Prevalence per 100 population of diabetes and impaired fasting glycaemia**

Province	*M*	*F*	*M*	*F*	*M*	*F*	*M*	*F*	*M*	*F*
age groups:	*30–35*		*36–45*		*46–55*		*56–65*		*Total*	
North Central										
Diabetes	2.2	2.0	7.8	5.8	8.6	5.6	8.9	17.9	7.3	6.7
IFG	17.8	10.2	15.7	9.9	8.6	7.9	15.6	25.6	14.2	11.4
Southern										
Diabetes	0.0	0.0	8.2	4.6	6.4	2.8	0.0	10.0	5.0	4.7
IFG	4.8	0.0	8.2	9.2	6.4	2.8	4.5	5.0	6.5	5.2
Uva										
Diabetes	4.5	1.7	5.7	7.4	10.4	5.9	7.3	14.5	7.0	7.2
IFG	7.5	3.4	4.3	8.5	13.5	7.2	11.0	10.1	8.6	7.7
Western										
Diabetes	12.0	10.1	16.6	13.5	21.6	17.8	21.1	23.8	18.3	16.8
IFG	17.3	14.3	12.9	14.0	16.8	17.0	18.8	19.8	16.0	16.3
Total–Diabetes	**9.1**	**7.6**	**13.5**	**11.2**	**18.1**	**14.3**	**17.2**	**21.6**	**14.9**	**13.9**
Total–IFG	**15.1**	**11.7**	**11.7**	**12.5**	**15.0**	**14.1**	**16.8**	**18.3**	**14.2**	**14.1**

F–female, M–male, IFG – impaired fasting glycaemia

which had the lowest prevalence among both sexes. Except in the Uva Province, the prevalence of diabetes was higher in men compared to women. The prevalence increased with age in all regions and in both sexes. The highest prevalence in both men and women was seen in the 46–65 year age group.

Impaired fasting glycaemia (IFG, fasting blood glucose ≥ 6.1 to < 7.0 mmol/L) is also reported in Table 6. The overall prevalence of IFG was similar to the prevalence of diabetes with 14.2% in men and 14.1% in women. Similar to diabetes, the prevalence of IFG is highest in men than women except in the Western Province.

Table 7. **Age standardised prevalence of hypertension, diabetes and obesity per 100 population**

Province	*Diabetes*		*Hypertension*		*Obesity*	
	M	*F*	*M*	*F*	*M*	*F*
Western	17.5	15.7	19.3	18.6	22.5	40.8
CI	13.6–21.4	9.7–21.7	11.2–27.4	10.4–26.8	14.7–30.3	30.7–50.9
North Central	6.7	5.9	13.1	17.9	7.9	19.9
CI	4.7–8.7	3.3–8.5	7–19.2	12.1–23.7	3.7–14.1	11.5–28.3
Uva	6.3	6.8	21.2	24.6	11.8	27.1
CI	3.2–9.4	3.5–10.1	15.7–26.7	21.4–27.8	4.2–19.4	18.1–36.1
Southern	4.2	3.9	12.7	19.5	14.6	27.2
CI	1.2–9.2	1.2–6.6	5.3–20.1	11.9–27.1	9.5–19.7	19.1–35.3
Total	**14.2**	**13.5**	**18.8**	**19.3**	**19.7**	**36.9**
CI	**11.9–16.5**	**6.9–20.1**	**14.5–23.1**	**12.2–26.4**	**12–27.4**	**27.5–46.3**

CI–confidence intervals, F–female, M–male

Discussion

This is the largest cardiovascular risk factor survey carried out in Sri Lanka. Previous studies on cardiovascular risk factors done in Sri Lanka were confined to certain regions of the country and in selected populations. Many of the surveys were limited to individual risk factors, and only a few involved the examination of multiple risk factors. Our study also allows for the first time to make comparisons on the prevalence of risk factors between provinces.

The survey shows a moderately high overall prevalence of hypertension of 19.4% and 20.6% in men and women as defined by either a systolic blood pressure of 140 mmHg or diastolic blood pressure of 90 mmHg. Previous surveys in Sri Lanka have used the earlier WHO criteria of either systolic blood pressure of 160 mmHg and/or diastolic blood pressure of 90 mmHg. A study conducted in the Matale district in the age group of 25–64 years found a hypertension prevalence of 8% [3].

A low prevalence of hypertension of 10% has been reported in rural Southern Province of Sri Lanka and another study in an indigenous Veddah community where the rates have been 5.7% in men and 1% in women [4, 5]. In previous surveys, however, the rates have varied from 10.9% to 19.5% in men and 9.9% to 12.7% in women [6, 7]. The high prevalence of hypertension seen in the present survey signifies a major health problem which requires urgent steps to be taken for its prevention and control.

The higher prevalence of hypertension in the Uva Province compared to other provinces remains unexplained on the differences in age, sex distribution and body mass index. The proportion of previously known hypertensives and those on treatment is also the highest in this province and indicates a true high prevalence.

In the International Clinical Epidemiology Network study, done in 12 centres in seven developing countries in Asia and South America, the prevalence of hypertension in men between 35–65 years based on the previous WHO criteria was over 20% in six countries with the lowest in rural Thailand (3%) and highest in Indonesia (23%) [8]. In a South Indian study using the new blood pressure criteria, the overall prevalence was similar to our study at 21% [9].

The prevalence of diabetes in this study was high in both men and women, and increased steadily with age. The highest prevalence and the highest mean fasting blood glucose level was seen in the predominantly urban Western Province. The 46–65 year age group showed the highest prevalence.

Large variations occur in the prevalence of diabetes in populations around the world, ranging from less than 1% among the Bantu in Africa to as high as 50% in the Pima Indians in the USA. Within Sri Lanka too, previous reports have shown a lower prevalence, ranging from 1% for a rural community to 5–7% in urban areas, but these studies used the earlier WHO criteria and were confined to certain regions of the country [10–12]. The lowering of the cut-off value of the fasting blood glucose to 7mmol/L explains some of the high rates seen in our study but a recent increase of prevalence is a more likely explanation. Over a period of 10 years, the prevalence of diabetes in a static rural population in the Central Province of Sri Lanka has doubled from 1% to 2.1%, which indicates that there is a rise in this condition [11, 12].

The present findings indicate that diabetes affects a significant proportion of the Sri Lankan population and together with a recent study highlighting the unsatisfactory status of diabetes control in six centres in Sri Lanka based on glycosylated haemoglobin estimation makes diabetes a substantial burden to the current and future health of the country [13]. Based on these current findings there are an estimated 2.8 million cases of diabetes.

Several cross-sectional studies and prospective studies have shown that central distribution of adipose tissue, as determined by waist or waist-to-hip ratio, is associated with metabolic complications and is a risk factor for coronary heart disease, similar to the major risk factors [14].

Data on the prevalence of obesity in the Sri Lankan population is confined to a few studies. A mean BMI of 20.5 kg/m^2 for men and 20.9 kg/m^2 for women has been

reported among 30–65 year old healthy adults in the 1997 study [15]. Our study showing a higher mean of 21.5 kg/m^2 in men and 23.3 kg/m^2 in women in a comparable age group may reflect a trend of increasing obesity, as seen in many countries. A 18.2% prevalence of obesity (> 24 kg/m^2) was reported in men between 35–59 years in a population in central Sri Lanka [4].

There is increasing evidence suggesting that the cut-off values for defining obesity used for Caucasians may not be appropriate for Asians, who have smaller body frames than Caucasians. Support for a lower cut-off point comes from the data suggesting that risk for diabetes and hypertension occurs at a level over 23 kg/m^2, which is considered average by western definitions of obesity [16].

A high prevalence of obesity shown in this study is of particular concern as over half of the women and over one third of men are above the cut-off point of 23 kg/m^2. The prevalence of severe obesity of 9.0% in women, though below those reported in the Pacific Ocean populations where the prevalence may reach 74% in certain groups [17], are similar to those reported for Malaysian women (7.7%)[18], but greater than that for Japanese (2.9%) [19] and Hong Kong Chinese women (4.8%) [20]. A low figure of 1.1% of severe obesity for men in our study is consistent with other reported figures in the region. Japanese (1.9%) [19], Hong Kong Chinese (2.2%) [20] and Malaysian men (4.7%) [18] have relatively lower prevalence of obesity compared to women.

In recent years, obesity has reached epidemic proportions globally [21]. Currently, nearly one-quarter of the USA population is considered overweight (defined as BMI, 25.0 –29.9 kg/m^2), and an additional one-quarter is obese (defined as BMI, 30 kg/m^2) [22]. The rising rates of prevalence of diabetes and obesity are not coincidental as both these factors coexist.

Cross-sectional and prospective studies have shown that central distribution of adipose tissue as measured by the waist-to-hip ratio is associated with cardiovascular risk factors. As in other reported studies, the waist and waist-to-hip ratio were higher in men than women. Two studies previously reported in semi-urban localities of Sri Lanka show a similar pattern, where the mean waist-to-hip ratio ranged from 0.93 to 0.9 in men and 0.83 to 0.88 in women [23, 7].

Populations differ in the level of risk associated with a particular waist circumference. Based on western data, the risk of cardiovascular diseases rises steeply in men when the ratio rises above 1.0, and in women when it is above 0.8 [24]. As there are important ethnic and racial differences in the distribution of fat, it is unclear if the above cut-off values would imply the same health risks in Sri Lanka as well. South Asians compared to whites and those of African origin have higher waist-to-hip ratios mainly due to a smaller hip circumference [25].

A waist circumference of less than 94 cm in men and 80 cm in women is considered appropriate in Europoids; these cut-offs may not be suitable for the Asians [26]. Recent report suggests the waist circumference, 90 cm for men and 80 cm for women be used as interim lower values for the Asians [27].

An elevated ratio can be due to either an increased abdominal circumference or a decreased hip circumference, a point that favours more the individual measurement rather than the ratio.

Conclusions

The baseline data reported in this survey provides a new data on the prevalence of some of the major risk factors for cardiovascular diseases. High rates of hypertension, diabetes and obesity should be a major concern to health planners. Some of these factors appear to have increased from previous available data. Based on a high prevalence of diabetes, hypertension and abdominal obesity, it may be postulated that insulin resistance exists in a significant proportion of the population as seen among other South East Asian populations. The factors responsible for such high rates of risk factors should be further explored and monitored in the future. The focus of policy makers should be on the primary and the secondary health care based intervention, improving public awareness and promoting health education.

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References

1. World Health Organisation. The World Health Report 2002. *Reducing risks, promoting healthy life*. Geneva: World Health Organisation, 2002.
2. Ministry of Health. Sri Lanka Annual Health Bulletin 1997.
3. Dhanapala S. *Prevalence, Risk Factors, Awareness, Treatment Status of Hypertension in the District of Matale.* MD Community Medicine Thesis. Postgraduate Institute of Medicine, 1997.
4. Mendis S. Coronary heart disease and coronary risk profile in a primitive population. *Tropical and Geographical Medicine* 1991; **43**: 199–202.

5. Mohideen MR, Hettiarachchi J. Utilization of family health workers in screening for hypertension in a rural community in Sri Lanka. *Ceylon Medical Journal* 1985; **30**: 97–101.

6. Mendis S, Ekanayake EM. Prevalence of coronary heart disease and cardiovascular risk factors in middle aged males in a defined population in central Sri Lanka. *International Journal of Cardiology* 1994; **46**: 135–42.

7. Fernando DJS, Siribaddana SH, de Silva DR, Perera SD. The prevalence of obesity and other coronary risk factors in a suburban Sri Lankan community. *Asia Pacific Journal of Clinical Nutrition* 1994; **1**: 155–9.

8. INCLEN Multicentre Collaborative Group. Risk factors for cardiovascular disease in the developing world. A multicentre collaborative study in the International Clinical Epidemiology Network (INCLEN). *Journal of Clinical Epidemiology* 1992; **45**: 841–7.

9. Shanthirani CS, Pradeepa R, Deepa R, Premalatha G, Saroja R, et al. Prevalence and risk factors of hypertension in a selected South Indian population—the Chennai Urban Population Study. *Journal of the Association of Physicians of India* 2003; **51**: 20–7.

10. Fernando DJ, Siribaddana S, de Silva D. Impaired glucose tolerance and diabetes mellitus in a suburban Sri Lankan community. *Postgraduate Medical Journal* 1994; **70**: 347–9.

11. Illangasekera U, Nugegoda DB, Perera LS. Prevalence of diabetes mellitus and impaired glucose tolerance in a rural Sri Lankan community. *Ceylon Medical Journal* 1993; **38**: 123–6.

12. Illangasekera U, Rambadagalla S, Tennekoon S. Increasing prevalence of diabetes mellitus in a rural Sri Lankan community. *Journal of the Ceylon College of Physicians*, 2002; **33**: 54–5.

13. Chuang LM, Tsai ST, Huang BY, Tai TY; Diabcare-Asia 1998 Study Group. The status of diabetes control in Asia—a cross-sectional survey of 24 317 patients with diabetes mellitus in 1998. *Diabetes Medicine* 2002; **19**: 978–85.

14. Larsson B. Regional obesity as a health hazard in men-prospective studies. *Acta Medica Scandinavica*. 1988; **723**: 45–51

15. Nasser MACKA, Mendis S. *The prevalence of obesity in a Sri Lankan community.* Proceedings of the Sri Lanka Association for the Advancement of Science, 1997; p 41.

16. Singh RB, Mori H, Chen J, Mendis S, Moshiri M, et al. Recommendations for the prevention of coronary artery disease in Asians: a scientific statement of the International College of Nutrition. *Journal of Cardiovascular Risk* 1996; **3**: 489–94.

17. Hodge AM, Dowse GK, Zimmet PZ, Collins VR. Prevalence and secular trends in obesity in Pacific and Indian Ocean island populations. *Obesity Research* 1995; **3**: 77s–87s

18. Ismail MN, Zawiah H, Chee SS, Ng KK. Prevalence of obesity and chronic energy deficiency (CED) in adult Malaysians. *Malaysian Journal of Nutrition* 1995; **1**: 1–9.

19. Yoshiike N, Matsumura Y, Zaman MM, Yamaguchi M. Descriptive epidemiology of body mass index in Japanese adults in a representative sample from the National Nutrition Survey 1990-94. *International Journal of Obesity* 1998; **22**: 684–87.

20. Ko GTC, Chan JCN, Woo J, Lau E, Yeung VTF, et al. Simple anthropometric indexes and cardiovascular risk factors in Chinese. *International Journal of Obesity* 1997; **21**: 995–1001.

21. Seidell JC, Flegal KM. Assessing obesity: classification and epidemiology. *British Medical Bulletin* 1997; **53**: 238–52.

22. World Health Organisation. *Diet, nutrition, and the prevention of chronic disease*. Report of a WHO Study Group. WHO Technical Report Series No. 797. Geneva: World Health Organisation, 1990.

23. Mohideen MR, De Silva L, Kodituwakku S. *Anthropometric measurements of central adiposity in relation to risk factors of coronary heart disease: Findings of a cross sectional study in a semi-urban population in Galle*. Abstracts of the 107th Anniversary Academic Sessions of the Sri Lanka Medical Association. 1994; p 24.

24. Ducimetiere P, Avons P, Cambien F, Richard JL. Corpulence history and fat distribution in coronary heart disease aetiology : the Paris Prospective Study. *European Heart Journal*. 1983; **4**: 8–18.

25. Cappuccio FP, Cook DG, Atkinson RW, Wicks PD. The Wandsworth Heart and Stroke Study. A population based survey of cardiovascular risk factors in different ethnic groups. Method and baseline findings. *Nutrition and Metabolic Cardiovascular Disease* 1988; **8**: 371–85.

26. World Health Organisation. *Obesity: preventing and managing the global epidemic*. Report of a WHO Consultation. WHO Technical Report Series, No. 894. Geneva: World Health Organisation, 2000.

27. WHO Regional Office for the Western Pacific/International Association for the Study of Obesity/International Obesity Task Force. *The Asia-Pacific Perspective: Redefining Obesity and its Treatment*. Sydney: Health Communications Australia, 2000.