

**Relationship between waist-hip ratio and cardiovascular risk factors
among people in South Dagon Township**

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The objective of the study was to determine the frequency of cardiovascular risk factors (high total cholesterol (≥ 250 mg/dl); low HDL-cholesterol (< 35 mg/dl); and high ratio of TC and HDL-C concentrations (≥ 4.5) in people categorized by two waist-hip ratio (WHR) levels. Total of 370 stored sera (185 each for men and women) from 294 men and 329 women of the previous study were randomly selected. In men, the mean and SD of TC and HDL-C concentrations were 206 ± 46 mg/dl and 28 ± 9 mg/dl, respectively, whereas in women, these values were 222 ± 58 mg/dl and 25 ± 9 mg/dl, respectively. The ratios of TC and HDL-C concentrations in men and women were 8.2 ± 3.2 and 10.2 ± 4.5 , respectively. In men, compared to those with $\text{WHR} < 0.95$ (92 samples), age and life style (physical activity, cigarette smoking) adjusted odds ratios for having high TC, low HDL-C concentrations and high ratio of these two parameters were 3.5 (95% CI=1.8 to 7.1), 1.40 (0.7 to 3.0) and 3.6 (0.7 to 18.2), respectively in those with $\text{WHR} \geq 0.95$ (93 samples). In women, compared to those with $\text{WHR} < 0.92$ (99 samples), these odds ratios were 1.00 (0.6 to 1.7), 2.90 (1.0 to 8.1) and 0.50 (0.1 to 3.1), respectively in those with $\text{WHR} \geq 0.92$ (86 samples). In conclusion, $\text{WHR} \geq 0.95$ could significantly identify men aged 40-60 years in South Dagon Township at increased risk of high total cholesterol concentration whereas $\text{WHR} \geq 0.92$ could significantly identify women at increased risk of low HDL-cholesterol concentration.

INTRODUCTION

In Myanmar, ischaemic heart disease (IHD) is an important priority health problem identified in National Health Plan (1996-2001). Among the modifiable risk factors, obesity and elevated blood lipids are the important risk factors in association with IHD. And the patterning of the body's adipose tissue distribution, independent of total body fat, alters the health risks of obesity. More specifically, ratios of waist-to-hip girth that exceed 0.80 for women and 0.95 for men are associated with an increased risk of death from coronary artery disease and other illnesses [1]. In the previous study, we determined some cardiovascular

risk factors in people in South Dagon Township categorized by various levels of waist-hip ratio. Compared with those with lower waist-hip ratio levels, age and life style (physical activity, cigarette smoking) adjusted odds ratios for having hypercholesterolaemia (≥ 250 mg/dl) and hypertension (systolic pressure ≥ 160 mmHg or diastolic pressure ≥ 95 mmHg) were 2.85 and 2.16, respectively in men with a waist-hip ratio of 0.95-1.00 and 1.16 and 1.54, respectively, in women with a waist-hip ratio of 0.92-0.97. These age and life style adjusted odds ratios were 5.77 and 2.43, respectively, in men with a waist-hip ratio of > 1.00 and 1.49 and 3.02, respectively, in women with a waist-hip ratio of > 0.97 [2].

The distribution of cholesterol among the various lipoproteins is a more powerful predictor of heart disease than the total blood cholesterol (TC). Specifically, elevated levels of high density lipoproteins (HDL) (>35mg/dl is desirable) are associated with a lower heart disease risk. An effective way to evaluate lipoprotein status is to divide TC by HDL cholesterol (HDL-C). This ratio is a superior measure of heart disease risk than either TC or low-density lipoprotein (LDL) levels. A ratio greater than 4.5 indicates a high heart disease risk, whereas a ratio of 3.5 or lower is more optimal [3].

General objective

To verify the relationship between waist-hip ratio and cardiovascular risk factors among people in the South Dagon Township

Specific objectives

1. To measure the fasting serum total cholesterol and HDL-cholesterol concentrations and calculate the ratio of these two parameters among people in the South Dagon Township
2. To determine the relationship between waist-hip ratio and these cardiovascular risk factors among these people

MATERIALS AND METHODS

Study design

A cross-sectional descriptive study

Study population

Apparently healthy, aged 40 to 60 years old people living in South Dagon Township

Study samples

Total of 370 stored sera (185 each for men and women) from 294 men and 329 women of the previous study [2] were randomly selected.

Data collection techniques

Waist and hip circumferences were measured by a steel measuring tape. Waist circumference was measured around the waist, over the abdomen where the girth

is the largest while standing relaxed, not pulling in the stomach. Hip circumference was measured around the hip, over the buttocks where the girth is largest [2]. Fasting serum total cholesterol level and serum HDL-cholesterol level were measured by using Cholesterol RTU test kit [2] and HDL-Cholesterol test kit [4], respectively, based on the enzymatic methods. The ratio of TC and HDL-C was calculated by dividing the concentration of TC by HDL-cholesterol concentration.

RESULTS

Physical and metabolic characteristics of 185 men and 185 women are shown in Table 1. In men, the mean and SD of TC and HDL-C concentrations were 206±46 mg/dl and 28±9 mg/dl, respectively, whereas in women, these values were 222±58 mg/dl and 25±9 mg/dl, respectively. The ratios of TC and HDL-C concentrations in men and women were 8.2±3.2 and 10.2± 4.5, respectively.

Table 1. Physical and metabolic characteristics of study participants

Characteristics	Men (n=185)		Women (n=185)	
	Mean	SD	Mean	SD
Age (years)	49.9	6	49.2	5.8
Weight (kg)	58.5	12.7	51.9	12.9
Height (cm)	162.2	5.9	151.5	5.9
Body mass index (kg/m ²)	22.2	4.4	22.5	4.9
Waist circumference (cm)	83.7	12.9	84.4	11.1
Hip circumference (cm)	89.2	8.2	92.6	11.1
Waist-hip ratio	0.9	0.07	0.91	0.05
Total cholesterol (mg/dl)	206.4	45.5	221.8	57.8
HDL-cholesterol (mg/dl)	27.6	8.6	24.5	8.9
TC/HDL-C ratio	8.2	3.2	10.2	4.5

Table 2 shows the mean serum TC concentration, HDL-C concentration and their ratio of men and women in two different waist-hip ratio levels. The mean values of TC concentration were increased significantly with increased WHR in both men and women.

Table 2. Mean serum TC concentration, HDL-C concentration and their ratio in men and women in different categories of waist-hip ratio

Waist-hip ratio	Numbers	Total cholesterol (mg/dl)	HDL-cholesterol (mg/dl)	TC/HDL-C ratio
		Mean (SE)	Mean (SE)	Mean (SE)
<i>Men</i> 185				
<0.95	92	193.5 (4.1)	27.4 (0.9)	8.0 (0.4)
>/=0.95	93	219.2 (4.9)	27.8 (0.9)	8.4 (0.3)
		(p=0.0001)	(p=0.75)	(p=0.39)
<i>Women</i> 185				
<0.92	99	216.3 (5.4)	25.3 (0.8)	9.5 (0.4)
>/=0.92	86	228.1 (6.6)	23.7 (1.0)	11.0 (0.5)
		(p=0.17)	(p=0.22)	(p=0.02)

Table 3. Prevalence, positive and negative predictions, and sensitivity and specificity of high TC concentration (>/=250mg/dl), low HDL-C concentration (<35mg/dl) and their high ratio (>/=4.5) in men by WHR cut-off values

Risk factor	Prevalence*	Percentage (95% confidence interval)			
		Positive prediction	Negative prediction	Sensitivity	Specificity
<i>Waist-hip ratio (>/=0.95) (n=93)</i>					
High total cholesterol	15.14	23.7 (15.7-33.8)	93.5 (85.8-97.3)	78.6 (58.5-91.0)	54.8 (46.7-62.7)
Low HDL-C	81.62	83.9 (74.5-90.4)	20.7 (13.2-30.6)	51.7 (43.4-59.8)	55.9 (38.1-72.4)
High TC/HDL-C ratio	95.14	97.8 (91.7-99.6)	7.6 (3.4-15.6)	51.7 (44.1-59.2)	77.8 (40.2-96.1)
One or more risk factors	95.68	97.8 (91.7-99.6)	6.5 (2.7-14.2)	51.4 (43.8-58.9)	75.0 (35.6-95.5)

*Prevalence of risk factors in total population

Table 3 and Table 4 show prevalence, positive and negative predictions, and sensitivity and specificity of high TC concentration (>/=250 mg/dl), low HDL-C concentration (<35 mg/dl) and their high ratio (>/=4.5) in men and in women, respectively by their WHR cut-off values. All the results for high TC concentration in men and women were comparable to that of previous study [2]. For the other two risk factors, (low HDL-C concentration and ratio of TC and HDL-C concentrations) their prevalence

rates were very high in both men and women. Sensitivity and specificity for identifying risk factors from WHR (>/=0.95 in men and >/=0.92 in women) were between 51% and 75% in men and 47% and 67% in women, respectively with positive prediction varying between 24% and 98% in men and 33% and 97%, respectively in women for individual risk factors. Positive prediction was 98% in men and 99% in women who had one or more risk factors. Negative prediction varied between 8% and 94% in men and 2% and 75% in women for individual risk factors. It was 7% in men and 2% in women who had one or more risk factors.

Table 4. Prevalence, positive and negative predictions, and sensitivity and specificity of high TC concentration (>/=250 mg/dl), low HDL-C concentration (<35 mg/dl) and their high ratio (>/=4.5) in women by WHR cut-off values

Risk factor	Prevalence*	Percentage (95% confidence interval)			
		Positive prediction	Negative prediction	Sensitivity	Specificity
<i>Waist-hip ratio (>/=0.92) (n=86)</i>					
High total cholesterol	28.65	32.6 (23.1-43.6)	74.7 (64.8-82.7)	52.8 (38.8-66.5)	56.1 (47.2-64.6)
Low HDL-C	87.57	93.0 (84.9-97.1)	17.2 (10.6-26.4)	49.4 (41.5-57.3)	73.9 (51.3-88.9)
High TC/HDL-C ratio	97.30	96.5 (89.4-99.1)	2.0 (0.4-7.8)	46.1 (38.7-53.7)	40.0 (7.3-83.0)
One or more risk factors	98.38	98.8 (92.8-99.9)	2.0 (0.4-7.8)	46.7 (39.3-54.2)	66.7 (12.5-98.2)

*Prevalence of risk factors in total population

In Table 5, odds ratio of men and women having high TC concentration, low HDL-C concentration and their ratios in different categories of WHR adjusted for age, cigarette smoking and physical activity by logistic regression are shown. In men, compared to those with WHR<0.95, age and life style adjusted odds ratios for having high TC, low HDL-C concentrations and high ratio of these two parameters were 3.5 (95% CI=1.8 to 7.1), 1.40 (0.7 to 3.0) and 3.6 (0.7 to 18.2), respectively in those with WHR>/=0.95.

In women, compared to those with WHR<0.92, the odds ratios were 1.00 (0.6 to 1.7), 2.90 (1.0 to 8.1) and 0.50 (0.1 to 3.1), respectively in those with WHR>=0.92.

Table 5. Odds ratio of high TC concentration (>=250 mg/dl), low HDL-C concentration (<35 mg/dl) and their high ratio (>=4.5) in different categories of waist-hip ratio adjusted for age, cigarette smoking and physical activity in men and women

Waist-hip ratio	Odds ratio (95% confidence interval)		
	High TC	Low HDL-C	HighTC/HDL-C ratio
<i>Men (n=185)</i>			
<0.95	1	1	1
>=0.95	3.50 (1.8-7.1) P=0.0001	1.40 (0.7-3.0) P=0.39	3.60 (0.7-18.2) P=0.12
<i>Women(n=185)</i>			
<0.92	1	1	1
>=0.92	1.00 (0.6-1.7) P=0.91	2.90 (1.0-8.1) P=0.04	0.50 (0.1-3.1) P=0.43

DISCUSSION

The mean values of total cholesterol concentration (206 mg/dl in men and 222 mg/dl in women) in the present study were much higher than those of the studies carried out during 1990s [5, 6, 7], the values of which varied from 170 to 180 mg/dl. The present values were also higher than the result taken at Hlegu Township [8] in 2001 which was 183 mg/dl. Although it can be assumed that serum total cholesterol level may have the upward trend in recent years, it may be due to variations in the studies such as differences in age, sample size, method of measurements etc. Even so, the present data were lower than the defined unit of hypercholesterolaemia which was 250 mg/dl [9]. According to this definition, the prevalence rates of hypercholesterolaemia were 15% in men and 29% in women in South Dagon Township.

For the determination of serum HDL-Cholesterol concentration, there were more variations among various studies. They showed its range between 18 mg/dl and

64 mg/dl [7, 8, 10]. The mean HDL-C concentrations of the present study were 28 mg/dl in men and 25 mg/dl in women and were lower than the cut-off value (<35 mg/dl) for having the higher heart disease risk. Therefore, the prevalence rates were 82% in men and 88% in women and were very much higher than those for hypercholesterolaemia.

Because of this high prevalence of low HDL-C concentration, the prevalence of TC/HDL-C ratio became high among people in South Dagon Township. Because the cut-off values for high TC concentration and low HDL-C concentration are 250 mg/dl and 35 mg/dl, the cut-off value for their ratio should be 7.2. However, the actual cut-off value was defined as 4.5 so that the mean ratio of present study (8.2 in men and 10.2 in women) were very high and their prevalence rates also became 95% and 97%, respectively. Interestingly, according to the Hlegu study [8], that ratio of the all participants was 2.9 (TC=183 mg/dl and HDL-C=64 mg/dl) and was lower than that of the present study. However, another study done in 1994 [11] in which 20 female students of age about 20 years from Institute of Nursing were included showed that the TC/HDL-C ratio was 4.7. Therefore, further study may be needed to find out the actual values of HDL-C and TC/HDL-C ratio for high heart disease risk in Myanmar population.

In South Dagon Township, WHR>=0.95 in men and >=0.92 in women could identify the cardiovascular risk factors with sensitivity and specificity varying between 47% and 75%. These results were comparable to that of previous study [2] although the confidence interval ranges for specificity was much higher in the present study. Positive predictive values were different for prediction of high TC concentration and other two risk factors. Because of low prevalence rate of hypercholesterolaemia, only one out of four (24%) in men and one out of three (33%) in women could be predicted whereas for low HDL-C concen-

tration and high TC/HDL-C ratio, 8.5 to 9.5 out of ten (84% and 98%) in men and 9 to 9.5 out of ten (93% and 97%) in women could be predicted because of their high prevalence rates. Therefore, the reverse is true for negative prediction of these risk factors i.e. negative prediction for hypercholesterolaemia was very high (94% in men and 75% in women) and it was very low (21% and 8% in men and 17% and 2% in women) for other two risk factors. In the present study, only eight men (4.3%) and three women (1.6%) did not have any risk factors (data not shown).

The present study also showed the closed relationship between WHR and cardiovascular risk factors. In men, hypercholesterolaemia could be significantly identified at 3.5 times the prevalence in the whole population at WHR 0.95. This result further confirmed the previous study [2]. In men having low HDL-C concentration or high TC/HDL-C ratio, these odds ratio were 1.4 and 3.6 times, respectively, although these results were not statistically significant. Moreover, there was no correlation between the two risk factors and WHR in general (data not shown), and no significant difference between two different WHR groups.

Therefore, it can be concluded that relationship between these two risk factors and WHR were not as firm as that for hypercholesterolaemia. In women, low HDL-C concentration (<35mg/dl) could be significantly identified at nearly three (2.9) times the prevalence in the whole population at WHR 0.92. The result for hypercholesterolaemia was comparable to that of previous study [2]. In women having high TC/HDL-C ratio, there was significant difference between two different WHR groups. However, the odds ratio was 0.50 instead of higher than 1.0 (95% CI=0.1-3.1). Therefore, it can be concluded that the relationship between the two risk factors, namely high total cholesterol and high ratio of TC and HDL-C concentrations, and

WHR was not as strong as that for women having low HDL-C concentration.

In conclusion, WHR \geq 0.95 could significantly identify men aged 40-60 years in South Dagon Township at increased risk of high total cholesterol concentration whereas WHR \geq 0.92 could significantly identify women at increased risk of low HDL-cholesterol concentration.

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