Original Article

Prevalence of metabolic syndrome among Filipino adults aged 20 years and over

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This study sought to determine the prevalence of metabolic syndrome, using data collected from 4,541 adults aged 20 years and over covered in the Fifth National Nutrition Survey conducted in 1998. The metabolic variables analyzed were: total cholesterol, LDL-c, HDL-c, triglycerides and fasting blood glucose. In addition, measurements of obesity such as body mass index (BMI), waist-to-hip ratio (WHR) and waist circumference (WC) as well as blood pressure were taken. Comparing the mean metabolic characteristics of the non-obese, total obese and the android obese, results showed significant differences in almost all the variables except for the HDL-c. By gender, non-significant differences were observed between males and females in the non-obese group in terms of the BMI and glucose levels and in the android group, in terms of total cholesterol. In all three groups, the biggest difference was observed in the mean triglycerides, where males had significantly higher mean than the females. Comparing adults with >125 mg/dl fasting blood sugar (FBS) there were higher rates of hypertension, high waist-to-hip ratio (WHR), high cholesterol, high triglycerides, high LDL-c, low HDL-c, among the overweight and obese than among those with normal BMI. In general, the proportion of subjects with co-morbid factors increased with higher levels of FBS, except for high cholesterol wherein no pattern was established. The highest prevalence of high FBS was found in both males (35.8%) and females (14.5%) with the following combined characteristics: high BMI, high WHR and high WC. Males with co-existing high BMI, high WHR, and high WC were observed to have the highest prevalence rate of hypertension (66.5%). Among females, the highest prevalence rate of hypertension (37.9%) was seen among those with high fasting blood sugar. The proportion of subjects with hypertension generally increased with age irrespective of the BMI status. One of the significant correlates of high FBS is waist-hip ratio. Males with WHR of equal or greater than 1 have almost six times the risk of having high FBS, while females with WHR of equal or greater than 0.85 have five times the risk of having high FBS compared to those with normal WHR. Among females with triglyceride levels of equal or greater than 200 mg/dL, the risk of having high FBS is five times compared to those with triglyceride levels below 200 mg/dL. Univariate analysis to see the effect of the type of obesity to dyslipidaemia and hypertension revealed that females with high waist circumference generally provided greater risk compared to those who were overweight and obese as well as those with android obesity. For males, high waist circumference had greater risk of developing high triglyceride and high LDL-c. Android obese males had greater risk to high FBS. The results showed that the prevalence rate of metabolic syndrome is 0.28%, based on the number of individuals with the following characteristics: high FBS, hypertensive, android obese, with body mass index (BMI) of $\geq$ 25.0 and high WC. Females had a higher rate than males – almost twice. Considering that metabolic syndrome, with its co-morbidity factors is prevalent among some Filipino adults aged 20 years and over, it is recommended that health programs geared towards minimizing the morbid risk factors be properly developed, promoted and fully implemented.

Key Words: obesity, abdominal fat, blood pressure, blood glucose, blood lipids, hyperlipidaemia, physical activity, Philippines, National Nutrition Survey, metabolic syndrome.

Introduction

The term metabolic syndrome based on the WHO criteria[1] describes a condition characterized by insulin resistance and diabetes mellitus or impaired glucose intolerance with any two of the following: visceral obesity, hypertension, dyslipidaemia, microalbuminuria. This condition has conventionally been known to result from insulin resistance and is associated with diabetes mellitus, ischemic heart disease, and hypertension both independently and as part of the metabolic syndrome.[2] Visceral or android obesity is probably the most common condition associated with insulin resistance. Weight loss by itself improves insulin resistance. It is not rare to find diabetes, hypertension, obesity and hyperlipidaemia in a single patient, and their coexistence is known to synergistically increase the incidence of coronary artery diseases.[3] In recent years, much attention has been focused on this pathological condition which is also called "deadly quartet" by Kaplan[4] or "visceral syndrome". Since the metabolic

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syndrome is closely correlated with cardiovascular disease, which has become a leading cause of mortality in the Philippines, this study sought to determine the prevalence of this condition on a nationwide scale among Filipino adults 20 years and over. This study was done to determine the prevalence of metabolic syndrome among some Filipino adults aged 20 years and over covered in the 5th National Nutrition Survey of 1998.

Specifically, the study aimed to compare:

1. the metabolic characteristics of obese and non-obese subjects
2. the prevalence of high fasting blood glucose in combination with selected risk factors of males and females
3. the prevalence of co-morbid conditions by BMI status and age groups of both males and females
4. the prevalence of hypertension in combination with selected risk factors among males and females
5. prevalence of metabolic syndrome by different combinations of co-morbid factors among males and females
6. to determine effects of obesity on specific risk factors, adjusted for age and gender
7. to determine significant correlates of high FBS among Filipino adults

Subjects and methods

A total of 4,541 individuals, 20 years old and over covered in the Fifth National Nutrition Survey comprised the study population. The BMI was computed from their weight and height data. BMI data were further assessed using the cut-off points suggested by the International Dietary Consultation Group (IDCG).[5] The data on waist-to-hip ratio (WHR) was used to assess visceral obesity or android obesity. A WHR of equal or greater than 1 for males and equal or greater than 0.85 for females were used as assessment criteria for android obesity.[6] WHR is also a strong predictor of insulin resistance, hyperinsulinaemia and glucose intolerance.[7] Waist circumferences (WC) of equal to or greater than 102 cm or 40 inches for males and 88 cm or 35 inches for females were considered high or at risk of metabolic syndrome and cardiovascular complications.[6] Blood levels of cholesterol, total cholesterol, HDL-c, LDL-c, triglycerides and fasting blood glucose were examined using the cholestech L-D-X System and were classified[8] as described in Table 1.

Blood pressure was taken using a conventional mercury sphygmomanometer. Subjects with blood pressure of equal or greater than 140 (systolic)/90 (diastolic) mm/Hg were considered hypertensive.[9] Anthropometric and biochemical data were disaggregated by age, gender, BMI, fasting blood glucose and blood pressure status. The stata version 6 was used in processing and generating results of anthropometric and biochemical data. Descriptive statistics were used to characterize the subjects' anthropometric and biochemical data. Test of proportions was carried out to determine statistical significance in the proportions of risk factors between males and females. Multiple logistic regression analysis was used to estimate odds ratio for significant correlates of high fasting blood sugar while univariate analysis was employed to determine effects of obesity on specific risk factors.

Results

A total of 4,541 Filipino adults covered in the Fifth National Nutrition Survey were subjects of the study. Overall, there was almost the same proportion of males and females. There was a slightly greater number of females compared with males aged 20-59 years, but

Table 1. Classification of blood cholesterol, triglycerides and fasting blood glucose

Classification	Total cholesterol mg/dL	LDL- cholesterol mg/dL	HDL-cholesterol mg/dL	Triglyceride mg/dL	Fasting blood glucose mg/dL
Desirable	< 200	< 130	≥ 60	< 200	< 110
Borderline	200 – 239	130 – 159	30 – 59	200 – 399	110 – 125
High	≥ 240	> 160		≥ 400	> 125
Low			< 35		

Table 2. Prevalence of risk factors, by gender

Risk Factor	Males		Females		Total
	total number of subjects	%	total number of subjects	%	%
BMI ≥ 25.0	4652	17.0	4647	23.3	20.2
High WHR (Male ≥ 1.0 Female ≥ 0.85)	2239	7.9	2300	39.5	
High WC (Male ≥ 102 cm Female ≥ 88 cm)	2239	2.7	2300	10.7	
Total cholesterol ≥ 240 mg/dL	2239	4.0	2302	4.0	4.0
LDL cholesterol ≥ 160 mg/dL	2236	7.2	2299	9.1	2.0
HDL cholesterol < 35 mg/dL	2237	1.9	2299	9.1	2.6
Triglycerides > 200 mg/dL	2239	12.3	2302	5.2	8.6
FBS >125 mg/dL	2239	4.1	2302	3.7	3.9

males out-numbered females aged 60 years and over. Table 2 shows the prevalence of risk factors by gender. Females showed a greater proportion of all indicators of obesity such as BMI, WHR and WC, compared to males. Likewise, the same trend was seen in the proportion of dyslipidaemia as manifested by high LDL-c and low HDL-c. However, there were more males who showed high triglyceride level (12.3%) and high FBS (4.1%) compared to females (5.2% and 3.7%, respectively). There were almost equal number of males and females who had hypercholesterolaemia. Table 3 compares the metabolic characteristics of obese and non-obese Filipino adults aged 20 years and over, by gender.

the androids. The prevalence rates of high fasting blood sugar among subjects with anthropometric risk factors by gender are shown in Table 3. In both sexes, the highest prevalence of high fasting blood sugar was found among those with three risk factors - high BMI, high WHR and high WC, (35.8% and 14.5% for males and females, respectively), followed by those with high waist circumference (20.2% and 11.4% for males and females, respectively). One of the significant correlates of high fasting blood sugar was waist-hip ratio (WHR) as shown in Table 5. Males with WHR of ≥1.0 have almost six times the risk of having high FBS while females with

Table 3. Metabolic characteristics of obese and non-obese adults aged 20 years & over, Philippines, 1998

Characteristics	Non-Obese mean ± SD		Obese Total Obese mean ± SD		Obese Android Obese mean ± SD	
	M (N=1536)	F (N=1325)	M (N=385)	F (N=561)	M (N=180)	F (N=940)
BMI (kg/m^2)	21.5 (±1.8) NS	21.5 (±1.8) NS	27.5 (±2.5)	28.1 (±3.1)	26.5 (±3.9)	24.4 (±4.4)
WHR	0.89(±0.06)	0.82 (±0.05)	0.96 (±0.05)	0.86 (±0.05)	1.02 (±0.02)	0.88 (±0.04)
WC (cm)	76.4 (±6.6)	71.3 (±6.0)	91.9 (±8.4)	85.0 (±7.9)	93.1 (±9.8)	80.1 (±9.4)
Glucose (mg/dL)	86.1 (±21.5)	86.2 (±21.7) NS	98.2 (±39.5)	93.6 (±29.6)	100.2 (±36.3)	92.2 (±31.9)
Total chol (mg/dL)	150.8 (±39.7)	158.9 (±37.9)	177.5 (±44.1)	175.8 (±39.0)	170.1 (±38.9)	169.5 (±42.7) NS
HDL-c (mg/dL)	29.2 (±12.3)	31.6 (±13.8) NS	28.3 (±11.0)	28.2 (±12.8) NS	29.5 (±10.8)	29.8 (±13.4) NS
LDL-c (mg/dL)	98.7 (±36.7)	108.0 (±34.7)	114.1 (±42.0)	121.6 (±33.7)	109.1 (±38.0)	115.8 (±37.5)
Triglyceride (mg/dL)	117.4 (±61.0)	97.3 (±45.8)	177.2 (±96.1)	126.6 (±63.4)	161.1 (±86.6)	118.7 (±60.0)
SBP (mm Hg)	120.9 (±18.5)	112.8 (±18.9)	127.0 (±19.1)	122.4 (±21.0)	126.6 (±19.9)	118.3 (±21.9)
DBP (mm Hg)	78.7 (±10.8)	74.0 (±11.0)	86.3 (±12.0)	81.0 (±11.0)	85.8 (±13.0)	77.7 (±11.7)

NS not significant

In all three groups (non-obese, total obese and android obese), significant differences between males and females were observed for almost all the variables except for HDL-c. However, in the non-obese group, the BMI and glucose levels of the males and females similarly did not differ significantly. In all three groups, the biggest difference was observed in the mean triglycerides, where males had significantly higher mean than the females. In the android obese, no significant difference was noted in the mean total cholesterol level of males and females. Overall, those who were obese as assessed by BMI (total obese) or waist-hip-ratio (android obese) had higher mean values of the metabolic characteristics compared to non-obese except for HDL-c. Total obese had lower HDL-c compared with non-obese while the reverse was true for

Table 4. Prevalence of high fasting blood sugar levels amongst Filipino adults with anthropometric risk factors, by gender, Philippines, 1998

Anthropometric risk Factors	% with high fasting blood glucose Males (N=2213)	Females (N=2272)
High BMI	9.0	6.9
High WHR	15.1	6.4
High waist circumference	20.2	11.4
High BMI, high WHR	16.2	8.7
High BMI, high WHR, high WC	35.8	14.5

Table 5. Estimated odds ratio for significant correlates of high fasting blood sugar among adults, aged 20 years and over determined by multiple logistic regression analyses

Covariates	Odds Ratio	95% CI
Males		
Age		
40-59 years	2.7	1.40 - 5.04
60 years & over	2.5	1.29 - 4.81
Waist circumference (cm)		
≥ 102.0	2.8	1.08 – 8.62
Waist-hip ratio		
0.90. – 0.99	2.9	1.58 – 5.38
≥ 1.00	5.8	2.52 – 13.74
Triglyceride (mg/L)		
≥ 200	2.2	1.26 – 3.94
Females		
Age		
40-59 years	2.2	1.12 – 4.38
60 years & over	3.2	1.62 – 6.16
Waist-hip ratio		
0.90. – 0.99	3.6	1.57 – 8.24
≥ 1.00	5.3	2.37 – 12.0
Triglyceride (mg/L)		
≥ 200	4.2	2.49 – 7.06
Total cholesterol (mg/dL)		
200 – 239	2.2	1.36 – 3.60
≥ 240	3.0	1.64 – 5.80
Physical activity		
Sedentary	2.3	1.12 – 4.80

WHR of ≥ 0.85 had five times the risk of having high FBS compared to those with normal WHR. Among females with triglyceride levels of ≥200 mg/dL the risk of having high FBS was more than four times compared to those with triglyceride levels below 200 mg/dL. Table 6 shows the prevalence of co-morbidity conditions by BMI category by age group among males and females. Overall, the prevalence of co-morbid conditions among subjects by BMI categories increased with increasing BMI. The proportion of subjects with hypertension generally increased with age, irrespective of BMI level.

The effect of types of obesity on specific risk factors, adjusted for age and sex, is shown in Table 7. Males with a high waist circumference had six times the risk of having high cholesterol and high triglyceride levels compared to those who were overweight and obese, and android obese. Among females with high waist circumference the risk of having high cholesterol and high triglyceride levels were five times and six times, respectively, compared to the overweight and obese females and android obese females.

Table 6. Prevalence of co-morbidity conditions by BMI category, by age group among males and females , Philippines, 1998

Age Group	N		Hypertensive (≥140/90 mmHg)		High FBS (>125 mg/dL)		High cholesterol (≥240 mg/dL)		High triglyceride (>400 mg/ dL)		Low HDL-c (<35 mg/dL)		High LDL-c (>160 mg/dL)	
						Normal BMI								
	M	F	M	F	M	F	M	F	M	F	M	F	M	F
20-39	528	497	1.3	4.3	4.6	0.6	-	3.8	-	0.7	62.5	50.1	12.5	7.2
40-59	502	430	23.7	12.0	5.1	0.5	0.5	0.5	2.4	3.3	68.6	62.4	2.0	6.8
60+	506	397	27.8	33.6	3.3	1.8	1.0	1.0	3.1	0.3	55.4	48.9	3.3	4.3
Overall	1536	1324	16.1	12.7	4.3	0.9	0.4	2.4	1.6	0.9	62.1	52.9	6.5	6.4
						Overweight								
	M	F	M	F	M	F	M	F	M	F	M	F	M	F
20-39	121	140	32.0	12.2	8.5	4.8	4.0	0.4	31.9	-	69.2	61.5	11.2	0.8
40-59	136	198	51.0	33.3	8.0	5.7	11.0	11.6	26.6	14.3	55.2	66.4	13.9	21.7
60+	86	118	71.5	43.6	3.9	13.1	3.5	14.3	16.2	15.6	80.5	58.1	9.1	33.0
Overall	343	456	41.8	23.5	7.9	5.9	6..3	6.2	28.8	13.0	65.4	63.2	11.9	12.1
						Obese								
	M	F	M	F	M	F	M	F	M	F	M	F	M	F
20-39	11	31	20.5	13.6	4.5	2.2	14.5	3.1	61.2	5.5	100.0	80.5	15.6	8.3
40-59	25	44	67.9	47.8	29.6	26.6	7.2	13.3	14.9	14.9	68.8	61.2	13.0	21.2
60+	6	30	100.0	79.9	3.7	19.7	-	1.7	-	4.5	100.0	87.4	22.0	40.4
Overall	42	105	44.8	28.3	15.4	105	10.7	0.6	38.3	8.1	86.5	75.4	14.8	14.3

Table 7. Effect of obesity on specific risk factors (adjusted for age and sex)

Risk Factors	Type of Obesity		
	Overweight & Obese	Android obese	High waist circumference
Males			
High Cholesterol	2.8	2.4	6.0
High Triglyceride	3.4	2.8	5.9
High LDL-c	2.6	2.6	3.6
High FBS	1.8	4.6	2.8
Hypertension	2.6	2.2	2.2
Females			
High Cholesterol	1.9	2.5	4.6
High Triglyceride	3.8	3.0	6.2
High LDL-c	1.8	1.6	3.0
High FBS	2.4	2.6	4.0
Hypertension	2.0	1.5	2.0

Table 8 shows the prevalence of hypertension among Filipino adults with selected risk factors. The highest prevalence of hypertension was found among males with three risk factors (high BMI, high WHR, and high WC) followed by those with two (high BMI and high WHR). Among females, the highest prevalence of hypertension was seen among those with high fasting blood sugar. This was closely followed by those with three risk factors (high BMI, high WHR, high WC), then by those with high WC. Overall, males had higher prevalence rates of hypertension in combination with other risk factors than females.

The prevalence of subjects with multiple risk factors of metabolic syndrome is shown in Table 9. Considering the definition of metabolic syndrome as the co-existence of HPN, high blood glucose, visceral obesity, dyslipidaemia (low HDL-cholesterol), the prevalence of the syndrome was 0.36% and 0.21% among adult Filipino males and females, respectively. However, Table 9 also shows the proportion of subjects with at least three multiple risk factors; between gender, the females have about twice as much as males in terms of multiple risk factors.

Table 8. Prevalence of hypertension among Filipino adults by selected risk factors and gender, Philippines, 1998

Selected Risk Factors	% Hypertensive	
	Males (N= 2213)	Females (N=2272)
High BMI	42.2	24.6
High WHR	45.4	21.1
High waist circumference	45.0	33.8
High fasting blood sugar	42.0	37.9
High BMI, high WHR	50.5	29.3
High BMI, high WHR, high WC	66.5	37.0

Table 9. Prevalence of various combination of co-morbid factors of metabolic syndrome among Filipino adults aged 20 years and over, Philippines, 1998

Co-morbid factors	Males N=2239	Females N=2302	Combined sexes N=4541
High FBS, hypertensive, overweight, android, high WC	0.36	0.21	0.28
Hypertensive, BMI > 25.0, android obese, high waist circumference	0.9	1.9	1.4
Hypertensive, BMI ≥25.0, android obese	2.6	4.9	3.8
Hypertensive, android obese, high waist circumference	1.2	2.2	1.7

Discussion

Metabolic syndrome is the combination of medical abnormalities that occur in the same individual, making them at risk for CAD. It is characterized by dyslipidaemia with high triglycerides, low HDL-c, insulin resistance, glucose intolerance or Type 2 diabetes mellitus and hypertension.[1,6,8] The common feature of the syndrome is insulin resistance, and all other changes are likely to be secondary to this basic abnormality.[1] It is suspected that insulin resistance may be genetically induced and/or may be exacerbated by obesity, particularly central or android obesity and inactivity.[1,3]

Although insulin resistance is the common feature of the syndrome, the diagnosis of such may be difficult, and complicated by issues of feasibility more so in a field survey approach. Nonetheless, the other consequences of insulin resistance such as glucose intolerance as manifested by high FBS, dyslipidaemia and hypertension may be assessed in a field setting such as the 5th National Nutrition Survey. These factors have been shown to increase, in a synergistic manner,[3] the risk of coronary artery disease, one of the leading causes of death in the Philippines.[10] The fact that all risk factors may not necessarily be seen in the same individual should not minimize their importance. It is based on these considerations that the study was undertaken. The present study revealed significant differences in all variables measured except HDL-c (Table 3) among non-obese, total obese and android obese adult Filipinos. The study further showed that a risk factor for CHD may occur in combination with other risk factors.

Several studies[11-13] have failed to show a gender difference in CHD morbidity in Type 1 diabetes. The evidence is split in the case of Type 2 diabetes.[14] Although we did not classify subjects with FBS >125mg/dL by type of diabetes mellitus, we found higher prevalence rates of anthropometric risk factors among males with high FBS than among their female counterparts (Table 4).

Excess weight correlates closely with increased blood pressure. Mc Carron and Reusser also reported a positive association between waist-hip ratio as an indicator of android obesity and hypertension.[15] In this study, we found that a high BMI in combination with high WHR and/or high WC increased the risk of hypertension more than high BMI or high WHR alone (Table 8).

The association between adiposity and blood pressure is attributed by Saruta[16] to disturbed glucose or lipid metabolism and insulin resistance often seen in obese patients. Recent studies show that visceral fat has increased angiotensin II. This is what may cause increase in blood pressure. Another possibility is that obesity is associated with hyperinsulinaemia (a consequence of insulin resistance) and consequently with enhanced renal retention of sodium, resulting in increased blood pressure. Results of this study is similar to other studies which have shown that glucose intolerance and hyperinsulinism are common among patients with insulin-stimulated glucose uptake.[17-19]

The present study suggests that waist circumference is the best predictor of metabolic risks. This is in agreement

with the findings of a cohort study of 721 Mexican Americans aged 25-64 years, wherein the predictive power of a single measurement of waist circumference was at least equal to that of WHR and BMI combined. In multivariate analysis, waist circumference was the predictor of NIDDM in models that included other anthropometric variables either separately or simultaneously. WHR and BMI were the independent predictors of NIDDM after adjustment for each other, however, their predictive abilities appeared after adjustment for WC. This indicates that waist circumference is the best obesity-related predictor of NIDDM.[20]

It appears that the co-morbidities of metabolic syndrome in this study are interrelated, such that subjects with high blood pressure tend to be hypertriglyceridaemic or those with hypertension showed glucose intolerance and those with impaired glucose intolerance also have dyslipidaemia and central obesity. It is hoped that this study is sufficient to show that these variances are closely related and have been identified as increasing the risk to CHD. CHD is recognized as a major cause of morbidity and mortality in patients with Type 2 diabetes mellitus, and that impaired glucose tolerance is also associated with an increased risk of CHD. Considering that both chronic degenerative diseases are shown to be on the rise, it is expedient that various aspects of metabolic syndrome should be studied and that health programs geared toward minimizing the morbid risk factors be properly developed, promoted and fully implemented.

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