Prevalence of Metabolic Syndrome and Its Components among Adolescent Students at Two Selected Schools in Yangon

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Due to changes in lifestyle and nutrition conditions, adolescents are at increased risk for developing metabolic syndrome (MetS). In Myanmar, there is limited data about MetS among adolescents. The objective of this study was to determine the prevalence of MetS and its individual components among school adolescents. A cross-sectional descriptive study was conducted at two selected schools in Yangon during October to December 2019. A total of 240 adolescents of both sexes, aged 14-16 years, were recruited. The presence of metabolic syndrome and individual components was ascertained using the National Cholesterol Education Program- Adult Treatment Panel III (NCEP-ATP III) criteria, modified for adolescents. There were 117 males (49%) and 123 females (51%) in the study with their mean age of 14.61±0.7 years. The overall prevalence of MetS was 5% (95% CI: 2.7-8.3) with 7.7% in males and 2.4% in females. The most commonly found abnormality was low high-density lipoprotein cholesterol (35%), followed by hypertension (28.3%). The prevalence of elevated triglycerides, abdominal obesity and high fasting plasma glucose were 16.2%, 8.8% and 8.3% respectively. The prevalence of low HDL cholesterol was significantly higher in boys than in girls (49.6% vs. 21.1%). Metabolic syndrome was significantly more prevalent in obese students (53.8%) than those with normal body weight (0.5%) or overweight (23.5%) ($p<0.001$). In this study, the prevalence of metabolic syndrome and its components were high. As there is strong evidence that clustered risk factors track from childhood to adulthood, proper intervention strategies in the prevention and treatment of adolescent metabolic syndrome are urgently needed.

Keywords: Metabolic syndrome, Adolescent students, Yangon

INTRODUCTION

Metabolic syndrome (MetS) is recognized as the clustering of risk factors of obesity, insulin resistance, dyslipidemia and hypertension with the subsequent development of cardiovascular disease and type 2 diabetes mellitus.[1] MetS is not limited to adults. A previous study suggested each component of the MetS must be identified as early as possible to prevent definitive diseases in adult life.[2] In view of cardiovascular risk factors tend to track from childhood into adult-hood; early identification of MetS and its individual components is valuable in targeting efforts for chronic disease prevention.[3] An association between genetics and the development of MetS has been reported.[4] However, environmental factors can also influence this genetic predisposition.[5]

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Changes in childhood lifestyle, characterized by lack of physical activity and high caloric diet, denote a significant concern in public health and pediatric medicine.[6]

According to the Nationwide Survey of Risk Factors for Non-communicable Diseases in 2014, prevalence of MetS in adults was 24% (95% CI: 23-27) with 18% in the men and 32% in the women.[7] A study among urban adults people in Pyin Oo Lwin Township (2015) reported overall prevalence of MetS as 35.2% with prevalence in men and women 27% and 38%, respectively. Central obesity was the highest component (41%) followed by elevated triglycerides (36%) and hypertension (29%).[8] The high prevalence of MetS among adults suggests that it is important to determine the prevalence of MetS among the adolescents. It was also reported in a previous study that NCD risk factors were very prevalent among school adolescents in Yangon. The most prevalent risks were inappropriate diet (95%), physical inactivity (52%) and high blood pressure (28%).[9] In our country, there is limited data concerned with MetS among adolescents. Due to changes in lifestyle and nutrition conditions, adolescents are at increased risk for developing MetS. Determining the prevalence of MetS among adolescents in Myanmar will provide in supporting prevention of non-communicable disease (NCD) program.

Therefore, in the present study, prevalence of MetS and its individual components among school-going adolescents was assessed.

MATERIALS AND METHODS

A cross-sectional descriptive study was conducted at No. 4 Basic Education High School, Ahlone Township and No. 2 Basic Education High School, North Okkalapa Township in Yangon from October to December 2019. These schools were purposely selected, one each from urban and peri-urban townships. Students with chronic disease, chronic medication use and those who could not fast were excluded. Of all eligible students, 120 students were randomly recruited from each school. A total of 240 adolescent students of both sexes within the age of 14-16 years participated in the study.

After getting informed consent from the parents and assent from the participants, face-to-face interview was conducted to collect data on background characteristics (age, sex, household monthly income) and family history of obesity in their first degree relatives using a structured questionnaire. Body weight, height and waist circumference were measured according to standard procedures. Body weight was recorded to the nearest 0.1 kg and height to the nearest 0.1 cm. Waist circumference (WC) was measured midway between the lower rib margin and iliac crest. Body mass index (BMI) was computed as weight (in kg) by height square (in meter^2). Using WHO (2007) Growth Reference, students with BMI >-2SD but <+1SD, BMI >+1SD, and BMI >+2SD were considered as normal, overweight and obese, respectively.

Blood pressure was measured using a digital blood pressure monitor twice at least 5 mins apart in sitting position. The mean of the two readings was taken as the participant's blood pressure. The fingertip blood sample was taken in the morning after 8 hours fast and triglycerides, high-density lipoprotein cholesterol (HDL-C) and fasting plasma glucose (FPG) were measured on-site using SD Lipido Care Professional Analyzer. The SD Lipido Care cholesterol test systems were certified by the Cholesterol Reference Method Laboratory Network (CRMLN) as meeting the National Cholesterol Education Program's (NCEP) performance criteria for accuracy and precision in capillary whole blood samples. This device was also used in Myanmar National STEPS survey of non-communicable disease (NCD) risk factors in 2014.

Presence of MetS was established using the National Cholesterol Education Program-Adult Treatment Panel III (NCEP-ATP III) criteria, modified for adolescents.[10] According to this definition, MetS was present when the respondent had *three or more* of the following abnormalities:

abdominal obesity (waist circumference ≥90th percentile for age and sex), hypertriglyceridemia (triglycerides ≥ 110 mg/dl), low HDL-C (HDL-C ≤40 mg/dl), hypertension (≥90th percentile for height, age and sex) and high fasting plasma glucose level (FPG ≥110 mg/dl). Data were analyzed using SPSS software version 20. Continuous variables were expressed as mean (±) standard deviation (SD) and categorical data as percentages. The prevalence of MetS and its components were expressed as a percentage with 95% confidence intervals (95% CI). Differences in general characteristics and prevalence rates were tested using Student-t test, chi-square test and Fisher's exact test as appropriate. Statistical significance was set at $p<0.05$.

Ethical consideration

This study was approved by the Institutional Review Board of the Department of Medical Research.

RESULTS

As shown in Table 1, a total of 240 adolescents (48.8% males and 51.2% females) were included in the study. Their mean age was 14.61±0.7 years. Median household monthly income was approximately 400,000 kyats. Presence of family history of obesity was reported by 8.8%. As expected, male subjects had significantly higher mean body weight and height than their female counterparts.

There were also significantly higher fasting plasma glucose and lower HDL level among males. Age, waist circumference, body mass index (BMI) and body weight status were comparable between male and female subjects.

The prevalence of MetS and its individual components among male and female adolescents are shown in Table 2 and Figure 1.

Table 1. Background characteristics of study population

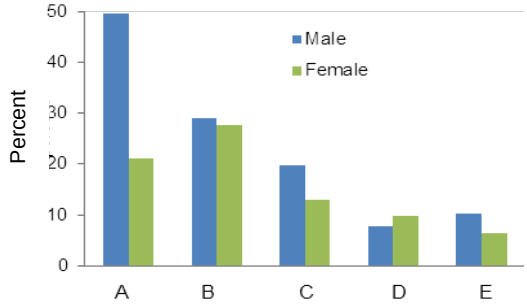
	Male (n=117)	Female (n=123)	Total (n=240)	p Value
Age (years)	14.59± 0.73	14.63± 0.68	14.61±0.7	0.69
Presence of family history of obesity	6(5.1)	15(12.2)	21(8.8)	0.053
Anthropometric measurements				
Body weight (kg)	49.25±10.9	45.75±12.15	47.45±11.7	0.02
Height (cm)	162.49±9.8	153.96±5.44	158.11±8.9	<0.001
Waist circumference (cm)	68.63±9.29	66.87±8.51	67.73±8.93	0.13
BMI (kg/m^2)	18.63±3.84	19.21±4.41	18.93±4.14	0.28
Biochemical Parameters				
Fasting plasma glucose (mg/dl)	103.36±9.26	99.89±10.55	101.36±10.13	0.01
Triglycerides (mg/dl)	81.9±31.23	82.18±27.28	82.05±29.11	0.94
HDL cholesterol (mg/dl)	42.36±10.22	49.8±10.69	46.17±11.1	<0.001
Body weight status				
Normal	105(89.7)	105(85.4)	210(87.5)	0.49
Overweight	6(5.1)	11(8.9)	17(7.1)	
Obese	6(5.1)	7(5.7)	13(5.4)	

Data were presented as n (%) or mean ± SD.

The overall prevalence of MetS was 5% (95% CI: 2.7-8.3). Although the prevalence was higher among males (7.7%) compared to females (2.4%), the difference does not reach the significance level (p=0.06). Low HDL-C level was the most common metabolic abnormality (35%, 95% CI: 29.2-41.2), followed by hypertension (28.3%, 95% CI: 22.9-34.3), hypertriglyceridemia (16.2%, 95% CI: 12-21.3), abdominal obesity (8.8%, 95% CI: 5.6-12.8) and high fasting plasma glucose (8.3%, 95% CI: 5.3-12.4). The prevalence of low HDL cholesterol (49.6% compared with 21.1%) was significantly higher in boys than in girls. No significant differences in the prevalence of hypertension, hypertriglyceridemia, abdominal

Table 2. Prevalence of metabolic syndrome and its components according to sex

	M n=117 n(%)	F n=123 n(%)	Total n=240 n(%)	P value
≥ 3 metabolic abnormalities (MetS)	9 (7.7)	3 (2.4)	12 (5.0)	0.06
Low HDL cholesterol	58 (49.6)	26 (21.1)	84 (35.0)	<0.001
Hypertension	34 (29.1)	34 (27.6)	68 (28.3)	0.81
Hypertriglyceridemia	23 (19.7)	16 (13.0)	39 (16.2)	0.16
Abdominal obesity	9 (7.7)	12 (9.8)	21 (8.8)	0.57
High fasting plasma glucose	12 (10.3)	8 (6.5)	20 (8.3)	0.29



A=low HDL cholesterol, B=Hypertension
C=Hypertriglyceridemia D=Abdominal obesity
E=High fasting plasma glucose

Fig. 1. Comparison of metabolic syndrome components according to sex

obesity or fasting plasma glucose were observed between two sexes. Regarding the prevalence of MetS according to body weight status, it was found to be significantly higher among obese subjects (7/13, 53.8%), compared to overweight (4/17, 23.5%) or normal weight subjects (1/210, 0.5%). (Fisher's exact test, $p<0.001$)

DISCUSSION

The overall prevalence of metabolic syndrome in this study according to modified NCEP-ATP III criteria was 5%. It was higher than the world median of 3.3% and the prevalence reported from Hong Kong (2.4%), India (2.6%) and United States of America (4.2%).[11-13, 10] But it was lower than the previous studies from Iran (6.1%) and Turkey (10.8%).[14, 15] In some studies, pre-valence as high as 13% and 14% were reported from Korea and Kuwait.[16, 17] These discrepancies in pre-valence may partly be due to different age range, ethnicity and diverse criteria for MetS diagnosis, and so direct comparison of prevalence need to be done with caution. In addition, overall prevalence of metabolic syndrome depends on other factors; social status, family income, food habits and environmental factors. [18, 19]

The prevalence of MetS between sexes was comparable in this study. Some studies also reported no gender difference in the prevalence among adolescents.[20, 21] The most common metabolic abnormality was low HDL-C level. Similar findings were seen in other studies from Iran, Jordan and China.[14, 22, 23] It was found that HDL-C level was lower among males than females. This finding is in agreement with previous studies either among Iranian or American adolescents.[14, 24]

In our study, compared with normal-weight subjects, overweight and obese subjects were more likely to develop MetS, which supports previous studies in Iran, China, Malaysia and Jordan.[22, 25-27]A systematic review (2010) also revealed that MetS was present in up to 60% of overweight and obese children and adolescents. In Myanmar, Khin Than Yee, *et al* (2013) reported a high prevalence of MetS (39%) among obese children in Yangon. [28, 29]

Conclusion

In this study, the prevalence of metabolic syndrome and its components were high. Low HDL-C level was the most common abnormality especially among male students, followed by elevated blood pressure. Overweight and obese adolescents showed a high prevalence compared to their normal-weight counterparts. As there is strong evidence that clustered risk factors track from childhood to adulthood, the prevention and early detection of metabolic syndrome in adolescents are urgently needed in our country.

Competing interests

The authors declare that they have no competing interests.

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