Original Article

Prevalence of Metabolic syndrome among school children in Majmaah city, Kingdom of Saudi Arabia

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Abstract:

Background: Metabolic Syndrome (Met S) is a collection of concurring risk factors associated with cardiovascular conditions mainly insulin resistance, dyslipidemia, obesity and hypertension. The current study was designed to observe the prevalence of Met S in school going children and assess the association between various components of Met S. **Materials and Method:** This analytical cross-sectional study was conducted on 72 school children who visited the outpatient department at King Khaled University Hospital from March 2016 to February 2017. Blood samples were collected from the participant enrolled in the study for hematological assay. Anthropometric study was done by calculating the Body Mass Index (BMI) and Waist Circumference (WC). Biochemical parameters such as glycemia, total cholesterol, LDLc, HDLc, and triglycerides were estimated to recognize the existence of Met S. The National Cholesterol Education Program (NCEP) consensus was used for defining Met S in children and adolescent. **Results:** Our results showed the

الملخص

الخلفية: متلازمة التمثيل الغذائي هي مجموعة من عوامل الخطر التآزرية القلبية الوعائية التي تتكون من مقاومة الانسولين، اضطراب شحوم الدم، السمنة، وارتفاع ضغط الدم. الهدف من هذه الدراسة هو العثور على انتشار متلازمة التمثيل الغذائي في الأطفال الذين يذهبون إلى المدرسة وتقييم العلاقة بين المكونات المختلفة لها.

المواد والطريقة: أجريت دراسة تحليلية مقطعية على ٧٢ من أطفال المدارس الذين زاروا قسم العيادات الخارجية في مستشفى الملك خالد الجامعي في الفترة من مارس ٢٠١٦ إلى فبراير ٢٠١٧. كما تم تقييم الشخصية الدموية لكل مشارك في الدراسة. تم تقييم الأنثروبومترية (مؤشر كتلة الجسم ومحيط الخصر) والمؤشرات البيو كيميائية (جليسميا، الكوليسترول الكلي، الدهون منخفضة الكثافة - الدهون عالية الكثافة والدهون الثلاثية) لتحديد وجود متلازمة التمثيل الغذائي.

تم تعريف متلازمة التمثيل الغذائي وفقا لبرنامج تعليم الكوليسترول الوطني في الأطفال والمراهقين.

النتائج: أظهرت نتائجنا انتشار المتلازمة في ١٦,٧٪ من الأطفال. محيط الخصر والدهون منخفضة الكثافة كانت من أبرز عوامل الخطر لمتلازمة التمثيل الغذائي بينما يبدو ضغط الدم الانبساطي أقل عامل خطر بارز. كان تركيز السكر في الدم عند الصيام أعلى بكثير عند مقارنة تراكيزه في حالات التمثيل الغذائي وغير متلازمة الأيض. وقد لوحظ وجود ارتباط معنوي بين مستويات الصيام في الدم ومستويات الدهون الثلاثية عند مقارنتها بين حالات الذكور والإناث من مرضي متلازمة التمثيل الغذائي.

الخلاصة: إن الانتشار المرتفع لمتلازمة التمثيل الغذائي

prevalence of Met S in 16.7% of the children. Waist circumference and LDLc were the most prominent risk factors for Met S and Diastolic blood pressure appeared to be the least prominent risk factor. Fasting blood sugar (FBS) was significantly higher on the comparison between metabolic and non-metabolic syndrome cases. A significant association was observed between fasting blood glucose (FBS) and Triglyceride levels when compared among males and females' cases of Met S. **Conclusion:** The high prevalence of Met S in children is a worrying panorama and a multifaceted approach concerning parents, educators, health professionals and this problem should be addressed more essentially through the media. We suggest more studies focusing on identification, intervention and prevention programs to reduce the risk factors of this syndrome in childhood and to reduce future diabetes and cardiovascular disease. Previous studies present with inconsistent findings in terms of both prevalence of Met S and using different criteria for defining Met S that needs formulating a universal definition of the metabolic syndrome for children.

Keywords: Metabolic syndrome (Met S), obesity, prevalence, school children

لدى الأطفال من السناريوهات المقلقة وذات نهج متعدد التخصصات يشمل الآباء والمعلمين. هناك حاجة إلى المهنيين الصحيين ووسائل الإعلام لمعالجة هذه المشكلة. نقترح المزيد من الدراسات التي تركز على التحديد، التدخل وبرامج وقائية للحد من عوامل الخطر من هذه المتلازمة في مرحلة الطفولة والحد من مرض السكري وأمراض القلب والأوعية الدموية في المستقبل.

الاختلافات في معايير الانتشار وعدم الاتساق لمتلازمة التمثيل الغذائي للأطفال تشير للحوجة إلى تعريف عالمي لها.

Background Introduction:

The prevalence of overweight and obesity is becoming a global threat both among elderly and children. Overweight prevalence tripled in U.S. among children and teenagers in the past 2 decades[1]. As per the recent evaluations, 17.1% of children under age 2-19-years are overweight[1]. Data from Kingdom of Saudi Arabia (KSA) and other countries in the region shows the prevalence of Met S is 18-40% which solely depends on criteria of defining Met S, the population group studied and other sociodemographic profiles.[2-5] There has been

continuing increase in prevalence of obesity and which is expected to rise further due to economic and social transformations in Saudi Arabia that leads to sedentary lifestyle.[6] The critical consequences of this tendency holds huge impact on morbidity, mortality and health services expenditure.

Metabolic Syndrome (Met S) is a multisystem disorder characterized by a cluster of metabolic abnormalities that increases the risk of developing cardiovascular and diabetes dieases[7]. These abnormalities include Diabetes, Hypertension, Obesity and Dyslipidemia (elevated triglyceride, low high-density lipoprotein (HDL-C), raised low-density lipoprotein cholesterol (LDL-C)[7]. Central and abdominal obesity remain the cardinal clinical feature of this syndrome[8]. The specific mechanism and pathophysiology of Met S is not fully understood. Several groups have suggested different criteria for diagnosing this condition[9,10]. Contributing factors to developing this condition include weight gain, aging, inheritance, endocrine maladies like polycystic ovary syndrome in females in reproductive age and with sedentary lifestyle.[12] Changes in blood lipids associated with Met S are raised Triglycerides, high LDL, and a reduced HDL[11]. It has been estimated that a quarter of the world's population is affected by Met S[11]. In western countries, the major cause of deaths seems to be cardiovascular disorders.[12]

Despite of rising metabolic syndrome prevalence rate, there is no consistent criteria available for diagnosing the metabolic syndrome in pediatric age group in terms of components and cutoff points. In children and adolescents, the cutoff points for the metabolic syndrome is based on percentiles and adjusted values adolescents[13,14]. There is lot of lacunae in literature worldwide in terms of metabolic syndrome prevalence in this group of children. Among Arab populations, metabolic syndrome has not been extensively studied, but the available data suggest that it is an increasingly common problem.[1] One of the possible reason for variation in prevalence could be the different age groups and definitions used in the study.

This study was primarily designed to estimate the prevalence of metabolic syndrome using the definition suggested by the National Cholesterol Education Program (NCEP) III among school children attending outpatient department in King Khaled Hospital, Majmaah, Saudi Arabia.

METHODS

Ethical Principles:

Ethics committee approval was provided by the Majmaah University scientific committee. After getting a written informed consent from parents/guardians of all respondents, the self-designed questionnaire was completed. Additionally, all children gave their verbal consent.

Group of children

We have included in this study,72 children

[42% female (n = 30) and 58% male (n= 42)], aged 6–13 years, visiting Outpatient Department of King Khaled Hospital. This was based on a cross-sectional study, with quantitative variables. To be included in the study, children should have parental consent. As a preliminary analysis showed that the gender was not a determining factor in the studied variables, we performed the study with male and female in the same sample.

Anthropometric parameters

Waist circumference (WC) was performed from the midpoint between the lateral iliac crest and the lowest rib using a flexible tape and it was evaluated according to percentile data.[15,16] All the measurements were taken by the same individual to reduce any subjective error.

Biochemical parameters

Blood was collected for the evaluation of the biochemical variables such as glycemia and lipid profile [total cholesterol (TC), triglycerides (TG), high-density lipoprotein (HDL), and low-density lipoprotein (LDL)]. Qualified professionals managed the collection of the blood.

Criteria for diagnosing Metabolic syndrome

NCEP III approach[10] was utilized for valid cross-study comparisons. Subjects who possessed 3 or more characteristics of metabolic syndrome components were considered as having Met S: 1) central obesity (waist circumference ≥ 90th percentile as per the cut-offs recognized by Li et al[17] and modified version by Cook et al[18] for children and adolescent; 2) raised blood pressure (≥ 90th percentile, systolic and/or diastolic; 3) low HDL-C (high-density-lipoprotein-cholesterol) level (≤1.03 mmol/L); 4) elevated serum triglycerides (TGs; ≥1.24 mmol/L); and 5) elevated FBS (≥6.1 mmol/L)[10]

Subjects were selected in the study based on some exclusion criteria like: 1) children with known medical illness; 2) children receiving any cholesterol lowering or sugar reducing medication; and 3) children who were not fasting.

Statistical methods

Statistical analysis was performed using Statistical Package for Social Sciences (SPSS) 20.0 and MS Excel. Data was represented as Mean ± standard deviation for quantitative variables and as percentage for qualitative variables. Comparison within the group was performed using two independent Student's t-test. The fisher exact test was also applied to observe the association between qualitative variable. Result was found to be statistically significant when the corresponding P-value was ≤0.05.

RESULTS

No significant difference was observed between baseline characteristics and gender ($p>0.05$) respectively (Table 1). As per the classification of NCEP III for metabolic syn-

drome, the cases with 3 or more components were classified as Met S. It was observed that 10 cases presented with 3 components of metabolic syndrome while 2 cases presented with 4 components. Based on this, Met S was prevalent in 12 (16.7%) cases (Table 2).

Waist circumference and LDL were the most prominent risk factors for Met S (67%) respectively, followed by FBS and cholesterol (50%) and Diastolic blood pressure (17%) appeared to be least prominent risk factor (Figure 1). A significant difference was observed between fasting blood sugar (FBS) when compared among the metabolic and non-metabolic syndrome cases ($p<0.05$), showing that FBS was significantly raised in Met S cases. Table 3 shows that the other parameters were not statistically significant with $p>0.05$).

Figure 2 shows that there was one component of Met S more prevalent in females (n = 12) as compared to males (n = 6). Moreover, 2 females and 6 males presented with 2 components of Met S. In addition, more female (n =6) presented with 3 components as compared to males (n = 4). Furthermore, 4 components were presented in only 2 males. A significant association was observed between fasting blood glucose (FBS) and Triglyceride levels when compared among males and females' cases of Met S. Result showed that FBS and TG were significantly raised in females' cases ($p<0.05$) respectively. Whereas, WC, HDL, DBP and Met. S appeared nonsignificant between males and females ($p>0.05$) respectively.

DISCUSSION

This is a unique study describing the prevalence of the Met S among adolescents in Majmaah region, Kingdom of Saudi Arabia. This study, carried out in 6–13-year age group of school children, presented the Met S as a widespread challenge in this community. In the current study, the NCEP III consensus definition was used for the diagnosis of Met S in children and adolescent. Our results show that almost fifth of the children studied in this work presented Met S. Brufani et al studied the presence of Met S in Italian children and found a prevalence of 12%.[19] Similar results were obtained in Brazilian schoolchildren (6-10 years) where the prevalence of Met S was found to be 10.2%.[20] Previous study presents with limited data regarding Met S among children or adolescents group in KSA. Another cross-sectional study for the prevalence of Met S was conducted by Al-Daghri[3] on large sample of 1,231 healthy children aged 10–18-year-olds using NCEP III definition. This study documented the Met S prevalence rate of Met S as 9.4% which is quite similar to the present study which considered the identical age group and definition[3].

The waist circumference was the main altered component of Met S and hyperglycemia was the component with the least frequency.[21] In contrast to this, in our study, we found that waist circumference and LDL-c was the most prominent altered component and the least prominent component was diastolic blood

pressure (DBP).

Another study[16] evaluated the prevalence of Met S and its components in children aged 5–9 years in Colombia (using the criteria for the definition of Met S for adolescents) and studied the relationship with overweight and socio-demographic determinants. These authors found a prevalence of Met S of 8.7% and associated overweight with Met S, while HDL-c, triglycerides, and glucose levels were not significantly associated with this syndrome.[16] Our study showed that all another component except fasting blood sugar was significantly associated with Met S.

Prevalence of Met S ranging from 0.3% to 11.0% was found in another study[22] comprising of 675 children and 1247 adolescents from public schools in Bogota. The main prevalent components were altered levels of HDL-c, triglyceride levels, and the least prevalent were altered glycemia and waist circumference.[22]

In this study, the main concern is focused on high levels of fasting blood sugar (glycemia). Insulin resistance and type 2 diabetes is a critical growing health problem in adolescents and adults. Increased glycemia is associated with inflammatory processes due to the production of advanced glycation end products that may lead to the release of Tumor Necrosis Factor a, Interleukin-6, and may lead to activation of macrophages and to oxidative stress that is associated with cardiovascular events.[23,24]

Many studies have been conducted in the past depicting relationship between the occurrence of Met S in childhood and its perseverance into adulthood. A longitudinal study for tracking Met S from childhood to adulthood was done on 174 Swedish and 460 Estonian children[25] that included 9 years old children at the beginning and later followed them for 6 years[25].

Extensive studies have been carried out regarding the prevalence[26,27] and the risk factors associated with Met S[28-29] in adults, however less importance was given to the same in children and adolescent mainly due to lack of clear definition for Met S in this group of age. It is unfortunate to find that the risk factors associated with Met S in pediatric and adolescent population is not trailing far behind. Obesity may be a reason for this as this is major risk for all age group at any stage of their life

Conclusion:

The result of the current study depict a high prevalence rate of metabolic syndrome in school children (16.7%) with further increasing alarming scenario as they grow up. At this juncture, we should start our study directed towards identification, intervention and prevention programs so as to alleviate the risk factors of this syndrome in the early stage of childhood. Also, it is indispensable at this moment to establish an appropriate definition of metabolic syndrome for children below age 15 years.

Limitations of the study:

A potential limitation which may affect the generalization of the findings is that the study was conducted in a single center. Small sample size was another limitation although the study was conducted for a period of one year as it was very difficult to get the consent from the parents for the blood sample.

Conflict of interests

Authors declare no conflict of interest.

Table 1. Baseline Characteristics of the Study Subjects by Sex

Parameters	Male (n =42) Mean±SD	Female (n = 30) Mean±SD	P value
Age (years)	9.0±2.21	9.53±1.89	0.442
Weight (kg)	30.89±9.77	32.80±15.84	0.682
Height (cm)	132.19±13.42	130.20±15.24	0.688
BMI (kg/m2)	17.31±3.41	19.19±9.56	0.476
WC (cm)	60.76±13.73	61.47±14.76	0.885
FBS (mmol/L)	4.87±0.67	5.12±0.97	0.401
HDL-C (mmol/L)	1.33±0.36	1.36±0.31	0.790
TG (mmol/L)	1.11±0.43	1.33±0.54	0.207
SBP (mm Hg)	108.76±5.79	112.80±8.57	0.127
DBP (mm Hg)	64.0±6.81	66.93±13.92	0.460

Abbreviations: BMI, body mass index; WC, Waist circumference; FBS, Fasting blood sugar; HDL-C, high-density-lipoprotein-cholesterol; TG, triglyceride; SBP, systolic blood pressure; DBP, diastolic blood pressure.

Table 2: Classification of Met S based on NCEP III criteria

Met S Component	No. of Male	No. of Female	Total
0	24	10	34
1	6	12	18
2	6	2	8
3	4	6	10
4	2	0	2

Table 3: Metabolic parameters of the children according to the presence of Metabolic Syndrome.

Parameter	Metabolic Syndrome (16.7%)	Non-Metabolic syndrome (83.3%)
FBS	5.20±0.31*	4.93±0.15
TG	1.39±0.25	1.16±0.08
Total cholesterol	163.05±13.55	171.44±5.02
HDL	1.41±0.16	1.33±0.06
WC	63.50±8.39	60.57±2.32
SBP	115.83±2.71	109.37±1.27
DBP	72.33± 8.57	63.80±1.15

* indicate a significant difference at a level of 5%.Abbreviations: BMI, body mass index; WC, Waist circumference; FBS, Fasting blood sugar; HDL-C, high-density-lipoprotein-cholesterol; TG, triglyceride; SBP, systolic blood pressure; DBP, diastolic blood pressure.

Table 4: NCEP III criteria for metabolic syndrome among the studied school children (n = 36)

Parameter	Male		Female		Total		P value
	n	%	n	%	n	%	
WC	6	14.3	2	6.7	8	11.1	0.764
FBS (≥110 mg/dL)	4	9.5	12	40	16	22.2	0.021*
HDL (≤1.03 mmol/L)	4	9.5	6	20	10	13.9	0.825
TG (≥1.7 mmol/L)	4	9.5	8	26.7	12	16.7	0.003*
DBP (≥85 mmHg)	0	0.0	2	6.7	2	2.8	0.917
Metabolic syndrome	6	14.3	6	20	12	16.7	0.442

* denotes the level of significance as p<0.05. Abbreviations: BMI, body mass index; WC, Waist circumference; FBS, Fasting blood sugar; HDL-C, high-density-lipoprotein-cholesterol; TG, triglyceride; SBP, systolic blood pressure; DBP, diastolic blood pressure.

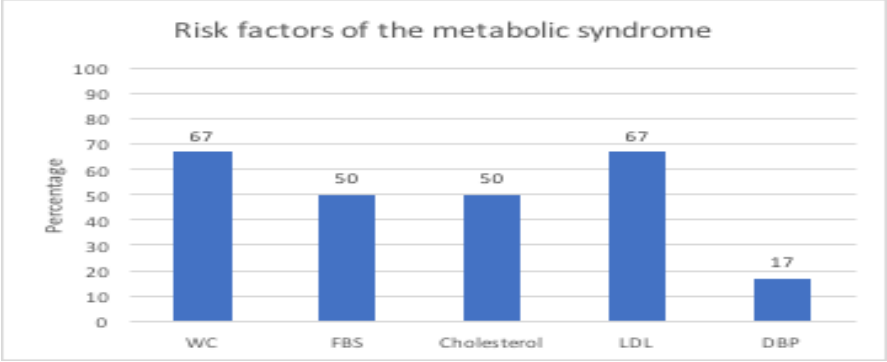


Figure 1: Clustering of risk factors for the Metabolic syndrome. Abbreviations: Waist circumference; FBS, Fasting blood sugar; LDL, low-density lipoprotein; DBP, diastolic blood pressure.

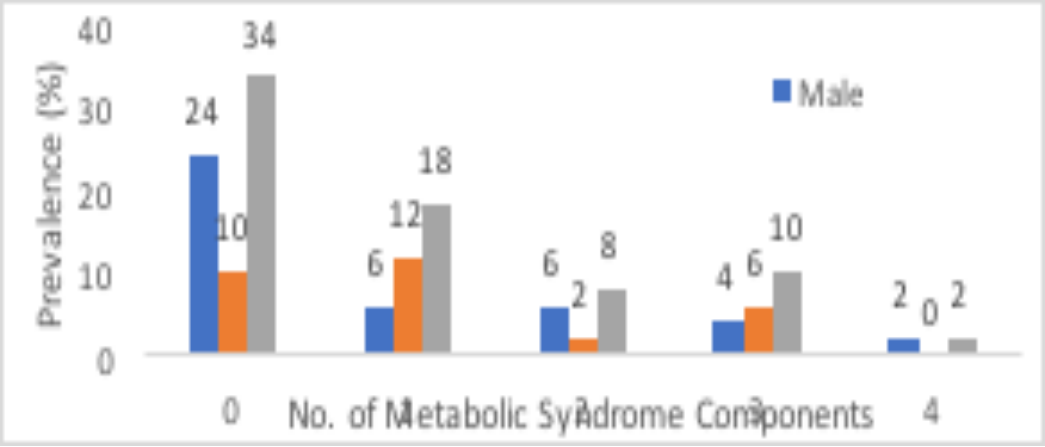


Figure 2: Subjects grouped in male and female according to the number of components of the metabolic syndrome they present with.

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