Metabolic syndrome in Tunisian obese children and adolescents

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Le syndrome métabolique chez l'enfant et l'adolescent obèses Tunisiens

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RÉSUMÉ

But : Déterminer la fréquence des facteurs de risque cardiovasculaire et la prévalence du syndrome métabolique dans une population d'enfants et d'adolescents obèses.

Méthodes : Cette étude transversale a concerné 186 enfants et adolescents obèses (137 filles and 49 garçons), âgés de 6 à 18 ans, recrutés à l'unité de recherche sur l'obésité humaine à l'INNTA entre décembre 2007 et octobre 2008. Le syndrome métabolique est défini selon les critères établis par la Fédération Internationale du Diabète (FID).

Résultats : La fréquence du syndrome métabolique est estimée à 34,4%. Il est plus fréquent chez les garçons (40,8%) que chez les filles obèses (32,1%), mais la différence n'est pas statistiquement significative (p=0.27). L'indice de masse corporelle et le tour de taille moyens sont significativement plus élevés chez les jeunes obèses ayant le syndrome métabolique comparés à ceux ne présentant pas ce syndrome. La fréquence du syndrome métabolique augmente avec l'âge. L'hérédité familiale de l'obésité, le poids de naissance et l'allaitement maternel ne constituent pas des facteurs de risque du syndrome métabolique. L'hyperglycémie modérée à jeun est le composant du syndrome métabolique le plus fréquemment associé à l'obésité abdominale ; elle est retrouvée chez 51% des jeunes obèses. Les deux tiers (65,6%) des patients ayant le syndrome métabolique réunissent trois critères parmi les cinq proposés par la FID.

Conclusion : La prévalence élevée du syndrome métabolique chez nos jeunes obèses justifie l'identification précoce de ce syndrome dans cette population à risque cardio-métabolique élevé et l'instauration de mesures thérapeutiques adaptées.

Mots-clés

Obésité, enfant, adolescent, syndrome métabolique

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SUMMARY

Aim: To determine the frequency of cardiovascular risk factors and the prevalence of metabolic syndrome (MS) in obese children and adolescents.

Methods: This cross-sectional study concerned 186 obese children and adolescents (137 girls and 49 boys), between the ages of 6 and 18 years, recruited in the research unit on human obesity of the National Institute of Nutrition between December 2007 and October 2008. Metabolic syndrome was defined with the International Diabetes Federation (IDF) criteria.

Results: The frequency of MS was 34.4%. It was higher in males (40.8%) than in females (32.1%) but without statistical significance (p=0.27). Body mass index and waist circumference were significantly higher in subjects with metabolic syndrome than that of subjects without metabolic syndrome. The frequency of MS increases with age. Family history of obesity, birth weight and breastfeeding did not influence the prevalence of MS. The most common component, associated with abdominal obesity, was Glucose tolerance abnormalities observed in 51 % of the sample. 65.6% of subjects with MS had 3 criteria of the five proposed by the IDF.

Conclusion: Metabolic syndrome is prevalent in our young obese population. Early identification of young at risk is crucial to the prevention of early cardiovascular diseases.

Key-words

Obesity, children, adolescent, metabolic syndrome

Metabolic syndrome (MS) is a cluster of risk factors for coronary heart diseases and type 2 diabetes including abdominal obesity, impaired glucose tolerance, high triglyceride level, low HDL-Cholesterol, hypertension, inflammation and vascular dysfunction. Despite the lack of a uniform definition, various investigators (1,2) have convincingly shown that MS, typically regarded as a middle-to late-adulthood disorder, develops early and is highly prevalent during childhood and adolescence, particularly in obese children. Several studies (3, 4) have shown the persistence of the cardiovascular risk factors from childhood into young adulthood. As a major risk factor for chronic diseases, paediatric metabolic syndrome has rapidly increased in prevalence worldwide during the past tow decades due to the dramatic rise in childhood obesity and sedentary lifestyles. In Tunisia (5), the prevalence of overweight and obesity reached 19% in adolescents. Therefore, we must focus our attention on the young population at risk to reduce childhood obesity and subsequent cardiovascular diseases.
This study was performed to determine the prevalence and risk factors of MS in obese children and adolescents.

PATIENTS AND METHODS

This cross sectional study was conducted in the research unit on human obesity of the National Institute of Nutrition. A total of 186 overweight and obese children and adolescents (137 girls and 49 boys) were recruited between December 2007 and October 2008. Subjects were eligible if they were between the ages of 6 and 18 years and had a Body Mass Index (BMI) above or equal to the value that predicted overweight or obesity in adulthood according to the definition of the International Obesity Task Force (IOTF)[6]. BMI cut-offs were defined by sex and age of the children in order to classify them as either overweight or obese.
Patients with obesity secondary to endocrinological and genetic diseases and pharmacological agents, as well as those on medication, were excluded from the study. Informed consent was obtained from all children and adolescents and their families during enrollement. Information about birth weight, breast feeding, age at onset of obesity and family history of obesity and metabolic diseases were recorded from interviews with the parents. Body weight was measured with a portable scale and height with a wall-mounted stadiometer. The BMI was calculated as body weight (Kg) divided by height squared (m^2). Waist circumference was measured at the midpoint between the lowest rib and iliac crest along the mid-axillary line at the end of expiration. Pubertal development was assessed by physical examination according to Tanner staging. Blood pressure (BP) was measured using a mercury sphygmomanometer after 5 minutes of rest in the sitting position. Plasma glucose, HDL-cholesterol and triglyceride concentrations were measured by enzymatic methods. Blood samples were collected in the morning and after overnight fasting, and were then examined at the biochemistry laboratory of the National Institute of Nutrition.

Metabolic syndrome was defined according to the International Diabetes Federation (IDF) criteria (7) Abdominal obesity is required as essential criteria. It is defined as waist circumference ≥ 90th percentile for age and gender, using the cut-off points established for American children and adolescents (8). For children less than 16 years of age, MS diagnosis requires the abdominal obesity with two of the following criteria: Triglycerides ≥ 1.7 mmol/l or 1.5 g/l, HDL-Cholesterol < 1.3 mmol/l or 0.40 g/l, systolic/diastolic blood pressure ≥ 130/85 mmHg, and fasting glucose ≥ 5.6 mmol/l T2DM or known type 2 diabetes. For children older than 16 years, we used the IDF adult criteria with the waist circumference cut- off points recommended for European and sub Saharan African populations (94 cm for boys and 80 cm for girls).

Statistical analysis:
Data were analysed using SPSS version 13. Continuous variables are presented as mean ± SD and were compared by unpaired 2-tailed Student t test between the 2 groups. Categorical variables are presented as percent frequencies. Comparison between categorical groups was performed using ¯ 2 test. All tests were 2-tailed, and P< 0.05 was accepted as significant. Univariate analysis was performed to determine differences among subjects with and without metabolic syndrome.

RESULTS

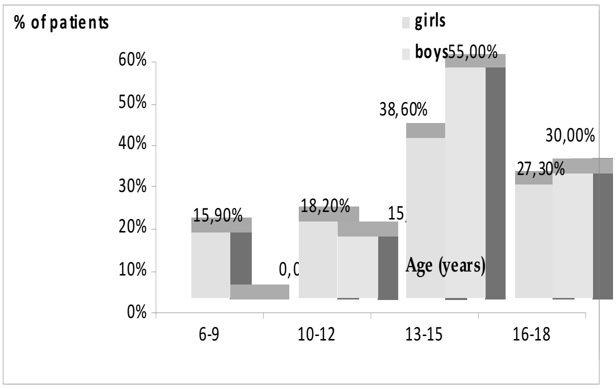
We examined 186 children and adolescents (57 children and 129 adolescents). Anthropometric data, birth weight and breast feeding are shown in table 1. Family history of obesity and diabetes was present in 86% and 75% of the sample, respectively.

Table 1 : Demographic and clinical data of the population study

Characteristics	Girls (n=137)	Boys (n=49)	Total
Age (years)	13,60±3,30	13,22±2,82	13,50±3,17
BMI (Kg/m²)	33,06±6,11	33,43±6,26	33,16±6,14
Waist circumference (cm)	100,55±13,84	107,91±14,35	102,49±14,31
Birth weight (gr)	3319,27±685,24	3521,02±731,44	3372,41±701,38
Breastfeeding (%)	67,90	63,30	66,70
Tanner stage (%)			
I	69,3	46,9	30,7
II to V	30,7	53, 1	69,4
Family history of obesity (%)	85,40	87,80	86,00
Family history of type 2 diabetes (%	78,80	67,30	75,80

The overall prevalence of metabolic syndrome (MS), according to the IDF definition, was 34.4%. MS was more prevalent in boys (40.8%) than in girls (32.1%) without statistical difference. 31.3% of obese children and 43.5% of adolescents met diagnostic criteria for the MS. In both sexes, the prevalence of MS was higher among the 13-15 years old age group (43.8%). Among children less than 10 years of age, 15.9% of girls have MS, while no case was found in boys (Figure 1).

Figure 1 : Prevalence of the MS according to sex and age class



MS was more prevalent in obese subjects (35%) than in those overweight (25%) but without significant difference. Mean birth weight did not differ between the two groups. Low birth weight (<2500g) and macrosomia (> 4000g) were comparable in the two groups (table 2).

Table 2 : Comparison of clinical characteristics between subjects with and without metabolic syndrome

Parameters	MS+ (n=64)	MS- (n=122)	P
Age (years)	13,68 ± 2,89	13,41 ± 3,32	NS
sex (girls/boys)	44/20	93/29	NS
BMI (Kg/m²)	34,12 ± 6,14	32,65 ± 6,08	0.05
Waist circumference (cm)	105,23±14,4	101,05 ± 14,25	0.02
Obesity degree (%)			
Overweight	25	75	
Obesity	35	65	0.47
Breast feeding (%)	70,30%	64,80%	NS
Birth weight(g)	3427,03 ± 689,15	3343,77 ± 708,84	NS
Low birth weight (%)	7,6	10	NS
Macrosomia (%)	26	18	NS
Obesity Duration (years)	6,56 ± 2,0	6,68 ± 3,4	NS
Age at onset of obesity (years)	7,5 ± 2,3	8,0 ± 3,1	NS
Pubertal/ Prepubertal	46 / 18	83 /39	NS

Family history, age at onset and duration of obesity and breast feeding did not influence the prevalence of MS. The distribution of the individual components of MS is shown in table 3.

Table 3 : Prevalence of individual risk factors for the metabolic syndrome

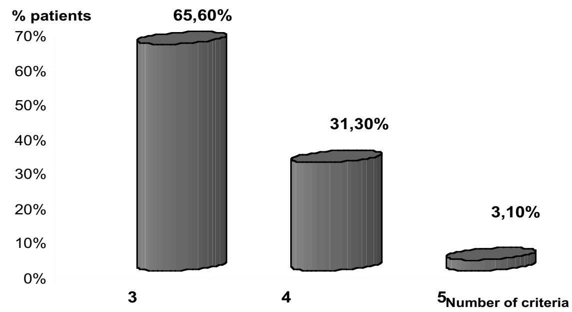
Parameters	Total	Girls	Boys	p
Abdominal obesity (%)	100	100	100	NS
Elevated fasting glycemia (%)	51	49	53	NS
High Blood pressure (%)	28	28	27	NS
LowHDL-CT (%)	27	28	27	NS
Hypertriglyceridemia (%)	15	12	20	NS

High fasting glucose was the most common component in obese subjects identified in 51% of the sample. High blood pressure and low HDL-C were found in 28% and 27% of the sample, respectively. The most frequent associations of different components are shown in table 4. Association of abdominal obesity with two components of metabolic syndrome was observed in 65.6% of cases. All MS components were observed in only 3.1% of cases (Figure 2).

Table 4 : Phenotype of metabolic syndrome in studied population

Associations	Number	Frequency(%)
Central obesity+High blood pressure+ Elevated fasting glucose	16	25
Central obesity +LowHDL-CT+ Elevated fasting glucose	9	14,40
Central obesity +Hypertriglyceridemia+ Elevated fasting glucose	9	14,40

Figure 2 : Distribution of patients according to the number of components of metabolic syndrome



DISCUSSION

Childhood obesity is a major risk factor for insulin resistance and metabolic syndrome (9, 10). Prevalence of metabolic syndrome in children and adolescents has been reported in various populations using a variety of age and gender specific cut-off points for the different components (waist circumference, blood pressure and lipid levels). The prevalence varies widely according to different criteria used by the investigators. Thus, comparison between reported values is difficult. The lack of a unified definition to assess the risk for cardiovascular disease and type 2 diabetes in children and adolescents prompted the International Diabetes Federation (7) to develop a new, simple definition with the aim of providing an accessible diagnostic tool to identify MS in young people worldwide.

In our study, the overall prevalence of MS, according to the international federation of diabetes definition was 34.4%. Similar frequencies were reported in obese adolescents in the United States (11) (31.2%) and China (12) (38.1 %). Lower frequencies, assessed with the modified National Cholesterol Education Program (NCEP), Adult Treatment Panel III (ATP III) criteria, were reported in Iranian (13) (26.6 %), Japanese (14) (17.7 %) and French (15) adolescents (15.9 %). MS is more prevalent in Turkish (16) (41.8 %), Mexican (17) (52.8%) and Israeli (18) (70 %) children and adolescents. The genetic and environmental factors may contribute to ethnic differences in insulin resistance and the other components of MS (19). A number of studies (1, 20) have shown that Black and Hispanic children are more insulin resistant than White children.

In the present study**,** there was no gender difference in the distribution of MS that is in accordance with the majority of authors (15-17).

The prevalence of the syndrome was higher among the 13-15 years-old age group in both sexes. This pubertal period is characterized by a reduction in insulin sensitivity and hyperinsulinemia (1). Among children below 10 years old, 15.9 % of girls and none of boys have MS. The IDF suggests that MS should not be diagnosed between 6 and 9 years unless there is a family history of the syndrome, type 2 diabetes, dyslipidemia, cardiovascular disease, hypertension, and/or obesity. The prevalence of MS increases with the severity of obesity. Weiss et al (21) reported a prevalence of 38.7 % in the moderately obese subjects and 49.7 % in the severely obese group.

The positive family history of obesity and/or diabetes type 2 is present in the majority of our obese subjects, but it did not increase the risk of metabolic syndrome. Different studies (2, 10) have shown that a family history of chronic diseases is related to the metabolic syndrome.

In our study, birth weight was not associated with an increased risk of developing MS. While some studies (22, 23) showed that lower birth weight increased the risk for having MS in adulthood, a longitudinal study (24) showed that large for gestational age newborns were at higher risk of developing MS in childhood. CASPIAN study (25) including 4811 Iranian students 6-18 years of age showed that a birth weight over 4000 g in boys and less than 2500 g in girls increased the risk of having MS. Birth weight reflects the pattern of intrauterine growth which involves a complex interaction between parental genes and intrauterine environment. The Barker's hypothesis (26) of the association of low birth weight and insulin resistance and the development of metabolic syndrome in later life has been confirmed by some epidemiological studies.

In addition, we did not find a protective effect of breastfeeding against metabolic syndrome. Although, some studies (27) have shown the association of breast feeding with some components of MS such as obesity, hypertension and diabetes, but not with their cluster.

In our study, high fasting glucose was the most frequent criteria of MS. In studies conducted among children in Iran (13, 16) and Turkey, the most frequent components of MS were high triglyceride and low HDL-C levels. We suggest that this may be explained by the high rate of family history of diabetes in our sample. Frequency of hypertension was similar to those reported by other authors (12, 16).

Our study had some limitations: it did not include a non-obese subject-group, the sample is not representative of the Tunisian youth population and its cross-sectional nature doesn't allow us to make inferences.

CONCLUSION

In Tunisia, metabolic syndrome is prevalent in obese children and adolescents (34.4 %). The modern "obesogenic" environment is a major contributor of the increase in cardiovascular risk factors and their clustering in our young population. For this reason, it is important to identify young population which is at risk of developing MS, type 2 diabetes and cardiovascular diseases later in life. Hence, early identification may help to target interventions to improve future cardiovascular health of the affected population. Health professionals should focus on primary prevention of childhood obesity by promoting a healthy lifestyle from birth to adulthood.

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