ISSN: 0975-8585

Research Journal of Pharmaceutical, Biological and Chemical Sciences

Dietary Pattern of obese children with metabolic syndrome

Radwa G. Helal[1*], Rehab Abdelkader[2], Elsayed Mahmoud Hammad [3], Nehal Salah[4], Sherif Omar[1], Enas Raafat Abdel Hameed[1], and Nebal A. Aboul Ella[3].

[1]Child health department, National Research Center, Cairo, Egypt,
[2]Medical Studies Department, Institute of Postgraduate Childhood Studies, Ain Shams University,
[3]Clinical Nutrition department, National Nutrition Institute, and
[4]clinical pathology, National Research Center, Cairo, Egypt.

ABSTRACT

Childhood obesity is associated with substantial co-morbidity and late sequelae. Exogenous obesity results from chronic caloric imbalance, with more increased calories intake than expended each day. Main Aim of this study was to assess dietary pattern in obese children and investigate relation between dietary pattern and metabolic syndrome markers. Case-control study included 45 obese children compared to 45 lean sex and age matched children. The energy and nutrients computed through complied food composition tables. Nutritional value of foods and beverages consumed was compared to the recommended dietary allowances. Prevalence of Metabolic syndrome among studied obese sample was 53.3%. Obese children had more calories, fibers and carbohydrate consumption than peers. Around one third of obese children had calories consumption over recommendations, while 83.3% had carbohydrate consumption over recommendations. Daily consumption of fruits and vegetables was found to be 6.7%, 11.1% respectively in obese sample, however 71.1%, 64.4% of the obese children don't eat vegetables or fruits at all. Metabolic syndrome is highly prevalent in studied obese children. Dietary pattern of the majority of Egyptian obese children and their families needs significant change to follow international dietary guidelines with special stress on fresh leafy Vegetables, Fruits and Fiber in their daily diet.

Key words: Childhood obesity, dietary pattern, metabolic syndrome, food consumption.

**Corresponding author*

ISSN: 0975-8585

INTRODUCTION

Childhood obesity considered nowadays as one of the most serious public health challenges of the 21st century. Childhood obesity became a global problem steadily affecting high, middle and low-income countries, particularly in urban settings. The rapidly increasing prevalence has become an alarming sign. [1]

Prevalence and severity of childhood obesity has provided great assertion on the wide variety of long and short term consequences and complications of obesity Some of those complications have been thought to be long-term issues occurs only in adulthood however its shown now to occur in childhood and adolescence. These findings raised issues concerning the general health expertise of those who develop obesity early in life and have even raised questions about whether the childhood obesity epidemic might shorten the life span of the current generation of children. [2]

Metabolic syndrome is a cluster of risk factor originates from insulin resistance accompanying abnormal adipose deposition and function. It includes risks of coronary heart disease, as well as for diabetes, fatty liver, and several cancers.

Lifestyles, dietary habits and physical activity are the most important risk factors in the development of insulin resistance and consequently metabolic syndrome even more than genetic factors. Growing evidence from epidemiologic studies and intervention trials support that dietary habits are more relevant for the development of Metabolic syndrome and cardiovascular diseases than physical activity or sedentary lifestyles. [4]

Obesity is secondary to chronic caloric imbalance, with more consumed calories than gained each day. History of obesity is mostly multifactorial which includes hereditary, metabolic, environmental, cultural, behavioral and socioeconomic factors all play a role. Most obese adults were obese adolescents and obese or overweight children. In fact, origin of obesity usually traced to early childhood growth and development. Risk of adulthood obesity increases in children who experience early adiposity rebound before 5 years old; it is associated with increase in mean body mass index (BMI) from age 3 to adolescence, on the other hand children who experience late adiposity rebound has decreases in BMI from age 3 to adolescence. Differences in BMI between those who experience early and late adiposity rebound are maintained into adulthood. Environmental, behavioral and family cultural factors play the most important role in childhood obesity along with genetic factors. It is also important to consider children's choices and availability of healthy nutrition in the process of food consumption and its direct relation to obesity. [5]

In addition to food consumption; energy expenditure is very important to maintain healthy weight. Obesity rates in youth are expected to keep growing. Consequently, it is fundamental to consider psychological and physical health of important correlation and serious consequences of childhood obesity. [6] Consequences of childhood obesity are far reaching. It includes health-related physical outcomes such as high blood pressure, high cholesterol, metabolic syndrome, type 2 diabetes, orthopedic problems, sleep apnea, asthma, and fatty liver disease and furthermore non-physical complications such as psychological, social, and behavioral consequences including body image and self-esteem related problems, social anxiety, depression and reduced quality of life. [6]

The Main purpose of this study was to assess the Dietary Pattern among a sample of Egyptian obese children and Investigate relationship between dietary pattern and metabolic syndrome markers.

SUBJECTS AND METHODS

Sample

This case-control study included 45 simple obese children compared to 45 healthy lean children with age range of 4 – 15 years attending outpatient clinic of the National Nutrition Institute, Cairo, Egypt. Medical ethical committee approved the present study. All children were apparently and clinically healthy, without acute infection, and did not take drugs known to induce weight changes.

Methods:

All children were subjected to the following:

Medical assessment: Full personal, past history for systemic diseases, and family history of chronic non-communicable diseases (obesity, diabetes, cardiovascular diseases and hypertension). Detailed medical history and assessment, physical examination and anthropometric evaluations were performed to all children; including measurement of blood pressure and comparing it to age specific blood pressure percentiles reported by NHANES, 2004. [7]

Anthropometric assessment: All anthropometric assessment has been obtained using standardized equipment, and following the recommendations of the International Biological program [8]. Children were weighed (in kg) using a calibrated Seca scale to the nearest 0.1kg while height (in cm) was measured using a Harpenden Stadiometer to the nearest 0.1 cm. Body mass index for age was recorded according to World Health Organization (WHO) standards. Calculation of BMI according to the following known formula BMI = $\frac{Weight\ (kg)}{height\ (m^2)}$ [9].

Obesity is defined as a BMI at or above the 95th percentile (WHO growth curves) for children of the same age and sex [10]. Waist Circumference was measured to the nearest 0.1 cm. Assessment of waist circumference was done using categories reported by Fernandez et al., [11]

Dietary assessment: Data on nutritional status had been collected using specially designed questionnaire cover required information on: a) Food intake (24 hour recall): detailed food intake at each eating event was obtained for the previous day to the interview day. Beginning with the first eating event (breakfast) and continued with each eating event subsequently till before sleep. Amounts of foods and beverages consumed were determined by using a dietitian kit of utensils of known weights and volumes) Dietary pattern (food frequency method): was used to obtain a profile of food intake. A questionnaire was designed by NNI to cover selected food items on daily, weekly and monthly basis.

The energy and nutrients content of the 24 hour was computed through the complied food composition tables of the NNI, 1996 [12]**.** The nutritional value of foods and beverages consumed was compared to the recommended dietary allowances (RDAs) of WHO. FAO, 2003 [13]

Laboratory assessment:

Blood samples were withdrawn from patients and controls after overnight fasting. Plasma was separated by centrifugation (3000 rpm, 15 min) and stored frozen at - 32° C until further analyses of fasting serum glucose using Stanbio Enzymatic glucose procedure No.1075; a single reagent glucose method based on a technique described by Trinder, [14], fasting serum insulin using The BioSource INS-EASIA. Results of the samples are determined using the standard curves [15], Cholesterol measured using an enzymatic method [16], Triglysrides were measured using an enzymatic method [17], HDL-cholesterol, LDL-cholesterol and HbA1c was measured by quantitative coloriometric determination method [18]. Insulin resistance was estimated by using the Homeostasis Model Assessment (HOMA), which calculated according to the known formula [19].

Metabolic syndrome diagnosis:

Metabolic syndrome diagnosis was done using definition developed by United State National Cholesterol Education program NCEP, 2002 and NCEP, 2004 [20], [21]. Modified cutoff values for children and adolescents were used according to Lambert et al., [22]. It includes abnormalities in any three (at least) of the following components: Presence of overweight (BMI ≥ 85 percentiles) or at risk for central obesity (waist circumference ≥ 75 percentiles), Elevated systolic or diastolic BPs (≥ 90 percentiles) Low HDL- cholesterol levels (< 40 mg/dl)**,** High fasting serum triglyceride levels (> 110 mg/dl), High fasting serum glucose levels (> 100 mg/dl) [23].

Statistical Analysis

Collected data were coded, tabulated, and statistically analyzed using IBM SPSS VS. 22.0, IBM Corp., Chicago, USA, 2013. Descriptive statistics were done for quantitative data as minimum& maximum of range as well as mean±SD (standard deviation) for quantitative parametric data, while number and percentage were done for qualitative data.

Inferential analyses were done for quantitative variables using 95% confidence interval (CI) independent t-test in cases of two independent groups with parametric data. In qualitative data, inferential analyses for independent variables were done using Chi square test for differences between proportions. Correlations were done using Pearson correlation for numerical parametric data, and partial correlation test in cases of controlling certain variables. Level of significance was taken at P value < 0.050 is significant, otherwise is non-significant.

RESULTS

Statistical significant difference was found between obese group versus lean group in weight, body mass index and waist circumference. (p<0.001* in all parameters). Fasting Glucose level, Fasting Insulin level, HOMA, HDL and HbA1c were significantly lower in obese compared to lean (p value <0.001*). On the other hand, Cholesterol and triglycerides and LDL- cholesterol levels, did not show significant difference between the two studied groups **(Table 1).**

Table 1: Anthropometric and laboratory data in two studied groups

	Obese N=45	Lean N=45	P Value
	Mean± SD	Mean± SD	
Weight (Kg)	48.9±16.7	25.8±7.6	<0.001*
Height (cm)	129.0±17.2	124.4±14.5	0.174
BMI (Kg /m^2)	28.3±3.6	16.2±1.2	<0.001*
Waist circumference (cm)	84.0±9.4	58.1±5.5	<0.001*
Fasting glucose (mg/dl)	94.4±9.3	82.5±7.2	<0.001*
Fasting Insulin (mIU/ml)	13.9±7.5	4.5±2.5	<0.001*
HOMA	3.24±1.85	0.92±0.51	<0.001*
Cholesterol (mg/dl)	141.1±24.1	145.6±20.3	0.345
Triglycerides (mg/dl)	89.1±35.2	80.9±17.2	0.160
HDL- Cholesterol (mg/dl)	37.9±8.7	45.5±5.7	<0.001*
LDL- Cholesterol (mg/dl)	84.9±25.5	83.8±19.3	0.807
HbA1c (%)	5.9±0.5	5.5±0.6	0.004*

According to metabolic syndrome components; 93.3% of patients were above the 90th percentile for waist circumference, 64.7% had systolic and diastolic blood pressure above 90th percentile, 24.4% has high serum fasting blood glucose, 4.4% had high serum triglycerides level and 35.6% were below 35 mg/dl as for HDL serum level (**Table 2).**

Table 2: Metabolic syndrome components in obese children

Metabolic Syndrome Component	No.	%
Waist Percentile > 90th percentile	42	93.3
Blood pressure > 90th percentile	21	64.7
Glucose >/= 100	11	24.4
TG >/= 150	2	4.4
HDL-Cholesterol < /=35	16	35.6

As regard diet adequacy from calories, protein, carbohydrates, fat and fibers **(Table 3)** in obese and lean groups; distributing them according to level of consumption where < 50% considered unsafe level of consumption, $\geq$ 50-75% considered needs improvement, $\geq$ 75-120% considered acceptable level of consumption and $\geq$ 120% considered over consumption. Calories and fibers consumption in females and males groups were significantly higher in obese children than their lean peers where p value <0.05.

ISSN: 0975-8585

Table 3: Distribution of diet adequacy in the two studied groups per sex

Nutrient	Level of consumption	Males				P value	Females				P value
		obese		lean			obese		lean		
		No.	%	No.	%		No.	%	No.	%	
Calories	< 50%	5	22.7	4	25	0.5000	1	4.4	8	27.6	0.041*
	≥ 50-75%	8	36.4	9	56.2		7	30.4	10	34.5	
	≥ 75-120%	5	22.7	2	12.5		9	39.1	9	31	
	≥ 120%	4	18.2	1	6.3		6	26.1	2	6.9	
Carb-hydrates	50-75%	1	4.6	0	0	0.300	1	4.4	2	6.9	0.261
	≥ 75-120%	5	22.7	7	43.8		5	21.7	12	41.4	
	≥ 120%	16	72.7	9	56.2		17	73.9	15	51.7	
Proteins	≥ 50-75%	0	0	0	0	0.184	1	4.3	2	6.9	0.849
	≥ 75-120%	2	9.1	4	25		1	4.3	2	6.9	
	≥ 120%	20	90.9	12	75		21	91.4	25	86.2	
Fat	< 50%	0	0	1	6.3	0.611	0	0	1	3.4	0.296
	≥ 50-75%	2	9.1	1	6.3		0	0	3	10.3	
	≥ 75-120%	4	18.2	4	25		5	21.7	4	13.8	
	≥ 120%	16	72.7	10	62.4		18	78.3	21	72.4	
Fibers	< 50%	0	0	0	0	0.031*	20	87	29	100	0.134
	≥ 50-75%	18	81.8	16	100		1	4.3	0	0	
	≥ 75-120%	4	18.2	0	0		2	8.7	0	0	

Table 4: Frequency Consumption of selected food items for 2 studied group

Food item	obese						lean						P Value
	Don't eat		Daily ≥ Once		weekly ≥ 3times		Don't eat		Daily ≥ Once		weekly ≥ 3 times		
	No.	%	No.	%	No	%	No.	%	No.	%	No.	%	
Legumes	6	13.3	19	42.2	5	11.1	9	20	3	6.7	11	24.4	0.031*
Meat	1	2.2	28	62.2	11	24.4	2	4.4	26	57.8	16	35.5	0.645
Dairy	0	0	38	84.4	2	4.4	0	0	41	91.1	4	8.8	0.274
Fatty diet	2	4.4	37	82.2	2	4.4	5	11.1	40	88.9	0	0	<0.001*
Vegetables	32	71.1	8	17.8	0	0	38	84.4	6	13.3	1	2.2	0.090*
Fruits	29	64.4	11	24.5	1	2.2	39	86.7	3	6.7	0	0	0.979
Simple Carb.	0	0	36	80	7	15.6	0	0	34	75.6	10	22.2	0.028*
Complex carb.	0	0	37	82.2	1	2.2	3	6.7	35	77.8	2	4.4	0.997
Junk food	2	4.4	40	88.9	1	2.2	8	17.8	21	46.7	8	17.8	0.476
Carbonated Drinks	4	8.9	30	66.6	6	13.3	7	15.6	28	62.2	3	6.6	0.019*

Table 4 shows food intake frequency of selected food items consumption of fatty diet, legumes, vegetables, simple carbohydrates and soft drinks was significantly higher in obese than lean group where P value was (<0.001*).

Daily consumption of vegetables showed that 71.1% of obese children don't eat vegetables in their diet at all. Most of obese children take dairy products > once daily, while most of lean children didn't take dairy products daily without statistical significant difference between groups.

DISCUSSION

Childhood obesity considered as main risk factor for serious chronic diseases and plays a pivotal role in insulin resistance and consequently metabolic syndrome, which includes hyperinsulinemia, hypertension, hyperlipidemia, type II diabetes and increased risk of cardiovascular disease. Metabolic syndrome (MS) is a cluster of risk factors that raises risk of some chronic diseases such as cardiovascular disease and type 2 diabetes. [24]

The term "metabolic" refers to the biochemical processes involved in the body's normal functioning. Risk factors are traits, conditions, or habits that increase the chance of developing a disease.

The growing worldwide prevalence of type 2 diabetes mellitus in the young has contributed to increase prevalence of childhood obesity and consequently metabolic syndrome [25].

Present study describes the relation between dietary pattern and metabolic syndrome markers in obese children compared to lean group of matched age and sex children.

Metabolic syndrome risk factors are relatively stable characteristics tends to maintain through childhood to adulthood. Research proved that obesity might even originate in fetal stages. Identification of obese children with elevated risk factors is of great interest from both clinical and public health views. Definition of metabolic syndrome used in this study developed by United State National Cholesterol Education program [20], [21] and modified cutoff values for children and adolescents were used according to Lambert et al., [22].

Although direct comparison across studies is obstructed because of the differences in the definition of metabolic syndrome, in the present study prevalence of metabolic syndrome among studied sample of obese children (53.3%) was more than many other studies in which the authors used the same definition of metabolic syndrome was used in this study, Cook et al., De Ferranti et al., and Aboul Ella et al., reported prevalence of metabolic syndrome ranged from 1.7 to 14.3%. [26], [27], [24].

In contrary results of present study; Zimmet et al., Kelishadi et al., and Ford et al., [28], [29], [30] reported a range from 2.2% to 9.5% of metabolic syndrome among their sample of obese children and adolescents; authors of previously mentioned studies used the new IDF criteria [31] to define metabolic syndrome in children.

In current study both 24-hour dietary recall and food frequency questionnaire were used for better assessment and evaluation or the dietary pattern of obese children and its relation to metabolic syndrome and insulin resistance. Accurate dietary intake assessment is critical to link dietary behavior with health outcomes. Although only one 24-hour dietary recall per person shown to exemplify dietary intake for a large group. This method is known to be less successful in ranking individual food and nutrient intakes. Processing and collection of dietary intake record data are also expensive and demanding. That's why food frequency questionnaire (FFQ) is used extensively in studies.

Results of present study showed that Calories consumption was over recommendations for age and sex in of obese boys and girls, with significant difference between cases and control. Fibers consumption was lower in both males and females obese groups in comparison to lean children. Most of obese children had Western dietary pattern i.e. energy dense, high fat and low fiber diet these children are more prone to metabolic and cardiovascular complications, Excess energy intake plays a major role in the development of obesity. These results are concordant with those of Johnson et al., and Ambrosini et al., [32], [33].

In contrary, results reported by the National Egyptian Survey on Diet, Nutrition, and Prevention of chronic non communicable diseases [34] showed that children and adolescents with criteria of Metabolic syndrome showed no significant difference in their calories consumption from other groups, yet their energy from saturated and unsaturated fat was significantly more.

Results of this study proved that increased amount of fast food consumed food away from home by children establish implications for poorer dietary quality. Increased frequency of eating away from home is associated with increased fatty intake in obese children. This fits results of Oellingrath et al., and Poti et al., [35], [36].

Current study proved that carbonated drinks are preferred more than milk with meals taken away from home. This comes in agreement with Zabinski et al., Kim et al., findings [37], [38]. Family culture and household eating rules are positively correlated with children's food and beverage intake. Thus, parents are required to build up encouraging home environment where healthful food and beverages choices for children are always available till children begin to regulate their own food choices.

Results showed no significant difference found in between obese and lean children, as regard milk consumption, which means that milk intake, is not associated with BMI change. Berkey et al. and Cluskey et al., concluded the same [39], [40]. While Barba et al. [41] found that the prevalence of overweight was inversely associated with the consumption of whole milk, yet when whole milk and skimmed milk consumption were pooled, the association is no longer statistically significant.

Current study showed that total fruits and vegetables intake in both obese and lean children is below recommendations. Children's consumption of fruit and vegetable are influenced by frequent exposures to fruits and vegetables, taste preferences, social experiences, and healthy food choices availability. All efforts must be made to increase attention to food environments and eating policies in different settings, including schools, nurseries, preschools, outings and homes which will help to continue the progress and improve fruits and vegetables intake.

In conclusion this study suggests that preventive screening tests and laboratory investigations of metabolic syndrome markers must begin during childhood because it may identify young people at risk of developing premature cardiovascular diseases and metabolic syndrome in the future.

Dietary practice needs improvement first to avoid obesity and its consequences of chronic non-communicable diseases and metabolic syndrome.

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