Journal of Medicine in Scientific Research

Volume 2 | Issue 1 Article 7

Subject Area:

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Recommended Citation

Marei, Ahmed S.; El-Gazzar, Hany H.; ElKelany, Khaled; Al Soda, Mohamed F.; Khairy, Saher A.; Saleh, Salwa M.; and Al-Mendalawi, Mahmood D. (2019) "Relationship between dietary intake and obesity among a group of primary school-aged children in Cairo Governorate," *Journal of Medicine in Scientific Research*: Vol. 2: Iss. 1, Article 7.
DOI: https://doi.org/10.4103/JMISR.JMISR_19_19

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Original Article

Relationship between dietary intake and obesity among a group of primary school-aged children in Cairo Governorate

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Abstract

Context

Currently, childhood obesity has been growing at an alarming rate, and it is a common nutritional problem among children in developed countries as well as in developing countries. It has become one of the most serious public health challenges of the 21st century.

Aim

This study attempts to determine the relationship between dietary pattern and obesity among primary school children.

Patients and methods

This is a cross-sectional descriptive study involving 842 children (6–12 years old), comprising 389 boys and 453 girls. This study was carried out by using anthropometric data and dietary assessment (24 h recall) and food consumption pattern.

Results

The finding revealed that high-density foods were significantly associated with obesity. Obese children adequately took bodybuilding food. Preventive food was adequately taken, but some of them were within the recommended dietary allowance percentage, and others were less than recommended dietary allowance percentage.

Conclusion

We concluded that there was a positive correlation between the increased intake of high-energy dense food (fat and sugar) and obesity in the studied group.

Keywords: Children, dietary intake, high-density food, obesity

Introduction

Obesity is currently the most common dietary problem; it is one of the most significant public health issues in developing societies [1]. The prevalence and severity of overweight are increasing among children [2]. Childhood obesity is a multifactorial condition that results from an interaction between genetics and environment [3]. However, plenty of factors seem to contribute to overweight and other obesity-related chronic diseases. Inadequate dietary intake is defined as a significant contributor to obesity [4]. Simplistically, obesity results from an imbalance of caloric intake and energy expenditure. The sustained caloric excess results in excess adiposity [3]. Over the past four decades, the food environment has changed dramatically. Nutrition transition, namely, the adoption of a western diet (high amounts of meats, refined grains, snacks, and fast food products) may help explain the increase in adiposity among children [5]. These changes, combined with excessive marketing pressure, have resulted in larger portion size, increased food density, and added variety with a subsequent increase in energy intake [6]. There are different known dietary patterns. These dietary patterns include plant foods, which are

Access this article online

Quick Response Code:

Website: www.jmsr.eg.net

DOI: 10.4103/JMISR.JMISR_19_19

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How to cite this article: El-Gazzar HH, Saleh SM, Khairy SA, Marei AS, ElKelany K, Al Soda MF. Relationship between dietary intake and obesity among a group of primary school-aged children in Cairo Governorate. J Med Sci Res 2019;2:42-53.

highly loaded with fruits, vegetables, legumes, and olive oils, whereas other patterns include fast foods, sugar-sweetened beverages, and pastry. There are other dietary patterns that have a higher factor loading for dairy products (yogurt, milk, and ice cream), and dietary pattern that include higher amounts of crackers and cookies [7]. Using dietary pattern approach, which considers a more comprehensive overview of the diet, could provide more interpretable findings than studying single nutrients or foods, as foods are not consumed separately [8]. Several studies have explored the food patterns throughout the world mainly conducted on adults [9]. However, few studies have explicitly focused on children [10]. Dietary patterns that are loaded with high-energy foods and sugar-sweetened beverages were related to increased obesity prevalence [11]. This study was carried out to assess the dietary intake of primary school children to find the relationship between dietary intake and childhood obesity.

Patients and methods

Patients

Ethical committee approval and consent was taken. This is a cross-sectional descriptive randomized study. Samples were taken from primary school-aged children in Cairo governorate, of age between 6 and 12 years. They were chosen from those who frequently came to the Ahmed Maher Teaching Hospital and the National Nutritional Institute. The total sample included 842 children. Of those, 389 (46.2%) were boys and 453 (53.8%) girls. The children of the study were classified into three nonoverlapping groups according to their weight status as normal, overweight, and obese according to their BMI [12]. Underweight children were excluded from the study. We focused on comparing the normal with the obese children regarding their dietary intake.

Methods

All children were subjected to the following:

(1) Anthropometric measurements:
Weight:

The weight was recorded using the platform scale; the scale was standardized by known weight before the measurement in each studied site twice daily and corrected according to the test. The patient was weighed with light clothes, and the reading was done to the nearest 0.1 kg according to WHO [12].

Regarding the assessment of weight for age, for age from 6 to 12 years old, the percentile BMI was used for boys and girls. The following categories of weight status were determined [12]:

(a) Underweight: less than 5th percentile.
(b) Normal weight: from 5th to 85th percentile.
(c) Overweight: from 85th to 95th percentile.
(d) Obese: greater than the 95th percentile.

(2) Dietary assessment:
Food consumption pattern and dietary intake of the surveyed children were assessed using the following methods:

Dietary pattern (food frequency questionnaire):

This method was used to obtain qualitative descriptive information about particular food items and consumption pattern.

Energy foods:

Such as cereals and its products, fats, tubers, and sweets.

Tissue building foods:

Such as meat, chicken, fish, eggs, legumes, milk, and its products.

Preventive foods:

Such as vegetables and fruits.

Twenty-four-hour recall method:

In this method, every child was asked to recall the exact food intake during the previous 24-h period. Quantities of food consumed were estimated using household measures and were converted to grams. The food composition developed by National Nutrition Institute [13] was used to determine the energy and nutrient intake of each surveyed child. Adequacy of the diet consumed was assessed by comparing the energy and daily nutrient intakes of the child with the recommended dietary allowances (RDA) [14].

Results

The number of primary school-aged children was 842, where 389 were boys and 453 were girls. Obesity represented 47% among the studied primary school-aged children, representing 55% of all studied boys and 40% of all studied girls (Table 1).

We found out that boys were taller than girls, with more waist circumference than girls. Girls had more hip circumference than boys did. Waist and hip circumference increased with increased weight status. Weight/height (*Z* score) was higher among boys than in girls (Table 2).

From our results, we found out that there was high consumption (i.e., more than or equal to three times per week) of certain food items such as bread, starchy foods, fat, oil, legumes, and milk. Other food items such as molasses, meat, poultry, vegetables, and fruits were consumed less frequently (i.e., less than three times per week). However, there was no significant difference among the three categories regarding the consumption of carbohydrates, fats, meat products (fish and liver), and fruits. However, a significant difference was observed regarding the consumption of meat, poultry high, and low carotene. Regarding beverages, high consumption was observed regarding tea and fruit (i.e., more than or equal to three times per week), whereas carbonated beverages were consumed less frequently (i.e., less than three times per week). It was found that carbonated beverage was higher in the obese group, whereas tea and fruit juices were consumed higher in the normal group (Table 3).

Table 1: Percent distribution of children according to sex, age groups, and weight in Cairo governorates

Age groups (years)	Sex	Normal [*n* (%)]	Overweight [*n* (%)]	Obese [*n* (%)]	Total [*n* (%)]
6-12	Boys	86 (22.1)	88 (22.6)	215 (55.2)	389 (100.0)
	Girls	139 (30.6)	132 (29.1)	182 (40.1)	453 (100.0)
Total		225 (26.7)	220 (26.1)	397 (47.1)	842 (100.0)

Table 2: Anthropometric measurements in both sexes according to weight status in Cairo governorate

Sex	Anthropometric measurements	Normal (mean±SD)	Overweight (mean±SD)	Obese (mean±SD)	Total (mean±SD)	*P*
Boys						
	Weight (kg)	37.6±8.50	48.6±8.49	55.4±13.91	49.9±13.77	0.144
	Height (cm)	137.1±8.46	140.56±9.09	140.6±11.03	139.7±10.17	0.045*
	Waist (cm)	64.4±8.9	76.7±6.9	80.2±16.2	75.9±14.6	0.000**
	Hip (cm)	77.8±8.2	87.8±5.9	91.2±17.7	87.4±14.6	0.000**
	Weight/height (*Z* score)	0.67±1.02	2.5±0.31	4.7±1.5	3.33±2.06	0.002*
Girls	Weight (kg)	41.6±8.10	48.6±11.40	53.8±15.13	48.5±13.26	0.144
	Height (cm)	138.1±8.55	139.4±11.72	137.7±12.63	138.3±11.25	0.045*
	Waist (cm)	68.91±10.41	75.4±7.8	80±27.2	75.3±10.99	0.000**
	Hip (cm)	81.70±10.4	88.50±8.7	92.6±17.3	88±14.01	0.000**
	Weight/height (*Z* score)	1.14±0.75	2.5±0.28	4.5±1.3	2.9±1.7	0.002*

*Significant. **Highly significant.

It was observed from the results that there was high consumption (i.e., more than or equal to three times per week) of bread, starchy foods, fat, oil, legumes, fruits, and milk, whereas other food items such as molasses, meat, poultry, liver, vegetables varieties, and fruits were consumed less frequently (i.e., less than three times per week). There were no significant differences among the three categories of the studied groups. Regarding carbohydrates, fats, poultry, and liver, there was a significant difference observed regarding meat and protective foods. Regarding beverages, there was a high consumption of tea and fruit (i.e., more than or equal to three times per week), but carbonated beverages were consumed less frequently (i.e., less than three times per week). It was found that carbonated beverage was higher in the obese group, whereas tea and fruit juices were higher in the normal group (Table 4).

Regarding the intake of energy, carbohydrates, fats, and protein, there was a higher intake of all macronutrients in the obese groups compared with the normal group, but there were no significant differences regarding dietary intake of the macronutrients. Regarding minerals, there was a higher intake of calcium, iron, and zinc among the obese group compared with the normal group. Moreover, it was observed that there was a higher intake of fat-soluble vitamins A and E in the obese group compared with the normal group. Regarding water-soluble vitamins, there was a higher intake in the normal group compared with the obese group. A significant difference was observed in the intake of calcium and vitamin A (Table 5).

Regarding the intake of energy, carbohydrates, fats, and protein, there was a higher intake of all macronutrients in the obese groups compared with the normal group, but there were no significant differences among them. Regarding minerals, there was a higher intake of calcium, iron, and zinc among the obese group compared with the normal group with a significant difference. Regarding fat-soluble vitamins, there was a higher intake of vitamins A and E among obese the group compared with the normal group, with no significant differences. Regarding water-soluble vitamins, there was a higher intake of vitamins C and B among the normal group compared with the obese group, with no significant differences among them (Table 6).

It was observed from the results that 55% of the boys got more than or equal to 100% of their energy RDA%. There was a high intake of energy among overweight and obese, with no significant differences among the three studied groups. Regarding protein, 89.5% of the boys in the three studied groups got more than or equal to 100% of their RDA% of protein. There were no significant differences among the three studied groups. Regarding mineral intake, the majority of the boys got less than 50% of their RDA% from calcium, without significant differences among the three studied groups. As for iron, it was found that 29% of the normal weight, 31.8% of the overweight, and 33.9% the obese girls got less than 50% of their iron RDA%. The majority of boys (88%) in the three studied groups got more than or equal to 100% of their RDA% from zinc, but there were no significant differences (Table 7).

Regarding water-soluble vitamins, the majority of the boys got more than or equal to 100% of their RDA in the three studied groups. Regarding fat-soluble vitamins, 82.6% of the boys got more than or equal to 100% of their RDA% of vitamin A. There were no significant differences observed between them from their intake of vitamin E. Overall, 76.3% of the boys got less than 50% of their RDA of vitamin E. There were no significant differences observed between groups.

Table 3: Frequency of consumption of food and beverage items by boys with different categories of weight

Food and beverage items	The frequency of consumption per week [*n* (%)]					
	Normal (*n*=86)		Overweight (*n*=88)		Obese (*n*=215)	
	< 3	≥3	< 3	≥3	< 3	≥3
Bread	-	86 (100.0)	-	88 (100.0)	-	215 (100.0)
P			0.559 (NS)			
Starchy foods	4 (3.6)	82 (96.4)	6 (3.6)	82 (96.4)	10 (4.66)	205 (95.34)
P			0.954 (NS)			
Sugar	-	86 (100.0)	-	88 (100.0)	8 (3.7)	207 (96.3)
P			0.403 (NS)			
Molasses	44 (51.2)	42 (48.8)	50 (56.8)	38 (43.2)	193 (89.76)	22 (10.24)
P			0.963 (NS)			
Oils and fats						
Ghee	66 (76.7)	20 (23.3)	11 (12.5)	77 (87.5)	116 (54)	99 (46)
P	0.560 (NS)					
Butter	-	-	-	-	-	-
P			-			
Vegetable Oils	5 (5.8)	81 (94.2)	9 (10.2)	79 (89.8)	18 (8.4)	197 (91.6)
P			0.614 (NS)			
Palm oil	41 (47.7)	45 (52.3)	12 (13.6)	76 (86.4)	17 (12.7)	117 (87.3)
P			0.254 (NS)			
Meat	71 (82.6)	15 (17.4)	81 (92)	7 (8)	185 (85.1)	30 (13.9)
P			0.028 (sig)			
Liver	45 (52.3)	41 (47.7)	67 (76.1)	21 (23.9)	117 (54.4)	98 (45.6)
P			0.825 (NS)			
Poultry	74 (86)	12 (14)	78 (91.2)	10 (8.8)	181 (84.2)	34 (15.8)
P			0.009 (sig)			
Fish	78 (90.6)	8 (9.4)	88 (100.0)	-	198 (92.1)	17 (7.9)
P			0.254 (NS)			
Legumes	32 (37.2)	54 (62.8)	22 (25)	66 (75)	53 (24.7)	162 (75.3)
P			0.464 (NS)			
Eggs	38 (44.2)	48 (64.9)	44 (50)	44 (50)	95 (43.9)	120 (56.1)
P			0.236 (NS)			
Milk and its products	10 (11.8)	76 (88.2)	14 (12.9)	74 (84.1)	31 (14.0)	184 (86.0)
P			0.748 (NS)			
Vegetables						
High carotene	76 (89.4)	10 (10.6)	63 (72.9)	25 (27.1)	147 (68.7)	68 (31.3)
P			0.001 (HS)			
Moderate carotene	62 (72.9)	24 (27.1)	56 (65.9)	32 (34.1)	128 (59.8)	87 (40.2)
P			0.095 (NS)			
Low carotene	71 (82.4)	15 (17.6)	62 (72.9)	26 (27.1)	131 (61.2)	84 (38.8)
P			0.001 (HS)			
Fruits						
High calcium	47 (62.2)	28 (37.8)	64 (70.4)	24 (29.6)	136 (63.6)	79 (36.4)
P			0.479 (NS)			
Moderate calcium	48 (62.3)	38 (37.7)	62 (72.9)	26 (27.1)	132 (61.7)	83 (38.3)
P			0.171 (NS)			
Low calcium	51 (63.0)	35 (37.0)	56 (65.9)	32 (34.1)	129 (60.3)	86 (39.7)
P			0.656 (NS)			
Beverages						
Tea	38 (43.9)	48 (56.1)	23 (22.6)	65 (77.4)	70 (32.6)	145 (67.4)
P			0.028 (sig)			
Coffee	10 (83.3)	2 (16.7)	7 (41.2)	10 (58.8)	162 (75.0)	53 (25.0)
P			0.025 (sig)			
Roselle (carcade)	82 (95.6)	4 (4.4)	82 (94.1)	6 (5.9)	200 (92.8)	15 (7.2)

Contd...

Table 3: Contd...

Food and beverage items	The frequency of consumption per week [*n* (%)]					
	Normal (*n*=86)		Overweight (*n*=88)		Obese (*n*=215)	
	< 3	≥3	< 3	≥3	< 3	≥3
P			0.818 (NS)			
Fenugreek	82 (95.6)	4 (4.4)	77 (87.5)	11 (12.5)	197 (91.5)	18 (8.5)
P			0.350 (NS)			
Carbonated drinks	47 (54.8)	39 (45.2)	60 (67.1)	28 (32.9)	136 (62.9)	79 (37.1)
P			0.272 (NS)			
Fruit juice	35 (40.8)	51 (59.2)	38 (41.2)	50 (58.8)	104 (46.6)	111 (53.4)
P			0.556 (NS)			

HS, highly significant.

Table 4: Frequency of consumption of food and beverage items by girls with different categories of weight

Food and beverage items	The frequency of consumption per week [*n* (%)]					
	Normal (139)		Overweight (132)		Obese (182)	
	<3	≥3	<3	≥3	<3	≥3
Bread	-	139 (100.0)	-	132 (100.0)	-	182 (100.0)
P			0.298 (NS)			
Starchy foods	10 (6.9)	129 (93.1)	7 (3.8)	125 (96.2)	8 (3.9)	174 (96.1)
P			0.387 (NS)			
Sugar	7 (4.8)	132 (95.2)	4 (2.3)	128 (97.7)	6 (2.8)	176 (97.2)
P			0.474 (NS)			
Molasses	120 (86.4)	19 (13.6)	123 (92.4)	9 (7.6)	163 (89.6)	19 (10.4)
P			0.525 (NS)			
Oils and fats						
Ghee	66 (16.4)	116 (83.6)	28 (15.5)	154 (84.5)	33 (17.9)	149 (82.1)
P			0.931 (NS)			
Butter	-	-	-	-	-	-
P			0.136 (NS)			
Vegetable oils	14 (9.8)	125 (90.2)	10 (8.9)	122 (91.9)	12 (6.1)	170 (93.9)
P			0.458 (NS)			
Palm oil	14 (9.8)	125 (90.2)	19 (21.5)	103 (78.5)	12 (6.1)	170 (93.9)
P			0.008 (Sig)			
Meat	126 (90.6)	13 (9.4)	115 (87.5)	17 (12.5)	144 (79.4)	38 (20.6)
P			0.021 (Sig)			
Liver	134 (97.1)	5 (2.9)	69 (98.6)	1 (1.4)	173 (94.8)	9 (5.2)
P			0.403 (NS)			
Poultry	127 (91.4)	12 (8.6)	114 (86.4)	18 (13.6)	157 (86.0)	25 (14.0)
P			0.356 (NS)			
Fish	108 (94.7)	6 (5.3)	109 (98.2)	2 (1.8)	175 (95.8)	7 (4.2)
P			0.378 (NS)			
Legumes	38 (27.4)	101 (72.6)	58 (43.6)	74 (56.4)	73 (40.4)	109 (59.6)
P			0.155 (NS)			
Eggs	80 (57.6)	59 (42.4)	65 (49.1)	67 (50.9)	86 (46.9)	96 (53.1)
P			0.182 (NS)			
Milk and its products	27 (19.3)	112 (80.7)	31 (23.6)	101 (76.4)	32 (13.8)	150 (86.2)
P			0.089 (NS)			
Vegetables						
High carotene	114 (81.8)	18 (18.2)	102 (77.6)	30 (22.4)	122 (66.9)	60 (33.0)
P			0.008 (sig)			
Moderate carotene	82 (58.7)	57 (41.3)	92 (69.7)	40 (30.3)	97 (53.6)	85 (46.4)
P			0.019 (sig)			
Low carotene	104 (75.0)	35 (25.0)	87 (65.8)	45 (34.2)	108 (59.3)	74 (40.7)

Contd...

Table 4: Contd...

Food and beverage items	The frequency of consumption per week [*n* (%)]					
	Normal (139)		Overweight (132)		Obese (182)	
	<3	≥3	<3	≥3	<3	≥3
P			0.017 (sig)			
Fruits						
High calcium	101 (73.1)	38 (26.9)	83 (63.0)	49 (37.0)	115 (62.7)	67 (37.3)
P			0.138 (NS)			
Moderate calcium	100 (72.4)	39 (27.6)	83 (63.0)	49 (37.0)	109 (59.6)	73 (40.4)
P			0.076 (NS)			
Low calcium	99 (71.5)	40 (28.5)	89 (67.8)	43 (32.2)	104 (57.1)	78 (42.9)
P			0.024 (sig)			
Beverages						
Tea	54 (39.1)	85 (60.9)	48 (36.1)	84 (63.9)	59 (32.4)	123 (67.6)
P			0.666 (NS)			
Coffee	93 (66.7)	46 (33.3)	117 (88.9)	15 (11.1)	91 (50.0)	91 (50.0)
P			0.174 (NS)			
Roselle (carcade)	128 (92.4)	11 (7.6)	120 (91.2)	12 (8.8)	166 (91.3)	16 (8.7)
P			0.963 (NS)			
Fenugreek	121 (87.1)	18 (12.9)	125 (94.7)	7 (5.3)	166 (91.5)	16 (8.5)
P			0.531 (NS)			
Carbonated drinks	76 (67.3)	37 (32.7)	70 (63.1)	41 (36.9)	104 (57.3)	78 (42.7)
P			0.235 (NS)			
Fruit juice	64 (46.2)	75 (53.8)	60 (44.9)	72 (55.1)	71 (38.8)	111 (61.2)
P			0.374 (NS)			

It was observed from the result that 48% of the girls got more than or equal to 100% of their RDA. There were no significant differences observed between the three studied groups. Regarding protein, the majority of the girls in the three studied groups (about 88%) got more than or equal to 100% of their total protein % RDA. There were no significant differences between them. Regarding mineral intake, it was found that 44.2% of normal group and 37.1% of the overweight girls got less than 50% of their calcium RDA%, whereas 30.9% of the obese group got more than or equal to 100% of their calcium RDA%. Moroever, as for iron, it was found that 43.2% of the normal weight, 35.7% of the overweight, and 40.1% the obese girls got less than 50% of their iron RDA%. There were no significant differences among the three studied groups. The majority of girls in the three studied groups got more than or equal to 100% of their zinc RDA%. There were no significant differences among the three studied groups (Table 8).

Regarding water-soluble vitamins, normal, overweight and obese girls got more than or equal to 100% of their vitamin B1, folic acid, and niacin RDA. There were no significant differences among the three studied groups.

Regarding fat-soluble vitamins, 59.4% of the girls got more than or equal to 100% of their vitamin A RDA%. There were no significant differences observed among them. However, 44.2% of the girls got less than 50% of their vitamin E RDA%. There were significant differences among the three studied groups.

Discussion

Obesity is an important global health problem. The alarming figures from national surveys indicated an increasing prevalence with great effect on morbidity and mortality [15]. It is obviously important to trace certain aspect of lifestyle that predisposes to obesity [16]. The current study attempts to highlight the influence of dietary intake on body weight in a group of primary school-aged children. The total sample number was 842; of them 389 were boys and 453 were girls. We found that obesity represented 47% of primary school-aged children, which was 55% of all studied boys and 40% of all studied girls. In the present study, most of the obese children had higher energy intake compared with nonobese children. The mean energy intake among all boys was 2640 kcal/day. It was lower for those of normal weight 2520 kcal/day and was 2675 kcal/day among obese boys. Similar results were observed in girls. The mean energy intake was 2506 kcal/day for all girls. However, it was lower for the normal group at 2315 kcal/day, and higher mean intake of energy was noticed among those of obese at 2648 kcal/day. In India [17], it was found that the overall prevalence of overweight/obesity among the children was 19.2% in boys and 18.1% in girls. A similar finding was reported in the study by Kovalskys *et al*. [18] in 2013 in which the obesity represented 34.3% and overweight represented 29.9%, and the average calorie intake of the studied group was 2316 kcal/day (±888). Another supportive evidence came from Downs study, which reported that obese children consumed on average of 2004 kJ (479 kcal) more

Table 5: The mean dietary intake±SD for boys in the three categories of the studied groups

Variables	Normal (86)		Overweight (88)		Obese (215)		Total (389)	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Energy (kcal)	2520	903.55	2670.6	945.63	2674.6	997.04	2639.5	965.43
P	0.366 (NS)							
Animal protein (g)	37.4	22.439	41.2	31.911	43.6	22.462	41.7	24.913
Plant protein (g)	46.6	19.77	50.9	20.806	48.3	21.002	48.5	20.691
Total protein (g)	83.9	35.352	92.1	40.451	91.9	35.14	90.2	36.48
P	0.173 (NS)							
Animal fat (g)	41.8	26.752	48	29.825	53.1	31.522	49.4	30.425
Plant fat (g)	52.8	30.866	52.3	30.057	46.1	29.127	49	29.817
Total fat (g)	94.5	38.059	100.3	42.496	99.2	43.224	98.4	41.921
P	0.597 (NS)							
Carbohydrate (g)	304.5	120.82	328.3	121.06	329.5	132.93	323.7	127.86
P	0.231 (NS)							
Calcium (mg)	634.8	339.38	732	439.60	801.1	480.62	749	435.52
P	0.010 (sig)							
Iron (mg)	20.1	8.855	22.7	9.494	21.1	8.745	21.2	8.761
P	0.421 (NS)							
Zinc (mg)	9.1	3.391	9.5	3.736	9.4	3.829	9.3	3.623
P	0.684 (NS)							
Copper (µg)	1.4	0.882	1.5	0.783	1.5	0.792	1.5	0.785
P	0.539 (NS)							
Selenium (mg)	252.8	97.456	273.1	107.37	280.6	108.241	272.8	101.65
P	0.077 (sig)							
Thiamin (mg)	1.2	0.526	1.2	0.795	1.2	0.52	1.2	0.592
P	0.975 (NS)							
Riboflavin	3.4	2.853	2.9	2.489	2.6	2.48	2.8	2.581
P	0.082 (NS)							
Niacin	19	9.686	17.2	8.107	18.1	8.743	18.1	8.824
P	0.426 (NS)							
Folic acid (µg)	775.3	786.40	662	502.15	712.6	537.82	715.3	594.33
P	0.363 (NS)							
Vitamin C (m)	118.21	12.556	117.27	13.485	119.91	12.468	126.77	17.91
P	0.820 (NS)							
Vitamin A retinol equivalent RE	599.4	371.97	613.8	363.51	723.2	432.52	671.6	408.36
P	0.011 (sig)							
Vitamin E	4.9	2.722	5.6	3.677	5.1	3.107	5.2	3.165
P	0.281 (NS)							

energy daily than normal children. Regarding human studies, a population-based survey has reported that the level of fat intake in the diet is strongly and positively related to excess body weight [19]. Increased dietary fat has a higher energy density than other foods [20]. There is evidence that the excess dietary fat has greater efficiency for storage than the excess of carbohydrates and protein. Fat also has a palatability effect that enhances the increased intake of food [6]. This study of Jenning showed that the highest mean intake of carbohydrate was 329.5 g, whereas the mean intake was 304.5 g in normal weight. Moreover, it showed that the highest mean intake of carbohydrate in girls was 323.0 g among obese and overweight and lowest mean intake was 279.7 g among those of normal girls. There were significant differences among the groups

Regarding consumption of oils and fats, we found that the total mean fat intake in boys was 98.4 g among the studied groups; the lowest mean intake was observed among those of normal weight was 94.5 g and the highest mean intake was 100.3 g among obese boys. In girls, we found that the total mean intake was 93.5 g, whereas the highest and lowest mean intake of total fat was 100.3 g and 87.8 g among the obese and normal girls, respectively. There were significant differences among the three studied groups. Langevin *et al*. [21] found that the mean caloric intake was 1723 kcal (SD ± 924) and mean percentage of calories from carbohydrate was 57%. The fat consumption was 32% of the total caloric intake. Regarding food building macronutrients, protein intake was higher in the obese children compared with nonobese in both boys and girls, correspondingly. Our finding was in contrast with Langevin *et al*. [21] who found that protein consumption was 13% of the total caloric intake of obese children, which was lower than normal. Our finding could be explained by

Table 6: The mean±SD dietary intake of girls in the three categories of the studied groups

Variables	Normal (139)		Overweight (132)		Obese (182)		Total (453)	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Energy (kcal)	2314.5	879.328	2509.1	944.436	2648.3	1045.58	2505.4	975.577
P	0.008 (NS)							
Animal protein (g)	36.9	17.76	38.3	19.358	43.5	21.082	39.9	19.788
Plant protein (g)	40.3	17.335	44.9	16.424	46.2	22.233	44	19.34
Total protein (g)	77.2	29.304	83.2	28.037	89.6	33.872	83.9	31.245
P	0.002 (NS)							
Animal fat (g)	46.2	26.076	46.4	30.316	52.8	31.868	48.9	29.85
Plant fat (g)	41.5	29.272	43.7	25.148	47.5	30.931	44.5	28.88
Total fat (g)	87.8	37.643	90.1	35.91	100.3	43.594	93.5	40
P	0.010 (NS)							
Carbohydrate (g)	279.7	114.495	323.4	174.876	323	141.027	309.9	145.773
P	0.231 (NS)							
Calcium (mg)	632.7	363.778	683.1	437.69	818.1	487.71	721.8	444.845
P	0.001 (HS)							
Iron (mg)	17.4	6.232	21.2	8.803	20.4	8.13	19.7	6.629
P	0.1031 (NS)							
Zinc (mg)	7.9	2.92	8.6	3.384	9.8	3.457	8.5	3.3
P	0.020 (sig)							
Thiamin (mg)	0.98	0.464	1.1	0.499	1.1	0.524	1.1	0.501
P	0.065 (sig)							
Riboflavin	2.5	2.024	2.1	1.459	2.3	1.815	2.3	1.789
P	0.306 (NS)							
Niacin	16.1	7.928	17.1	8.6	17.5	8.263	17	8.284
P	0.294 (NS)							
Folic acid (µg)	664.7	640.42	728.3	669.56	686.8	500.79	692.2	596.92
P	0.665 (NS)							
Vitamin C (mg)	104.9	110.992	97.2	97.75	109.4	104.641	104.4	104.581
P	0.601 (NS)							
Vitamin A retinol equivalent RE	641.8	382.14	662.8	435.84	772.6	511.50	700.5	456.04
P	0.022 (Sig)							
Vitamin E	4.2	2.591	5.3	4.501	5.5	4.404	5.1	4.006
P	0.007 (sig)							

the increased total food intake in obese children compared with normal. The adequacy of protective food (vegetables and fruits) was the topic of interest in many studies. In this present study, we found that both vegetables and fruits were consumed adequately by the majority of the three studied groups in both boys and girls. However, our result was in contrast to Kovalskys *et al*. [18] who found that only 2% of children complied with the recommended intake of vegetables and 17% complied with the recommended intake of fruits. Our result was on the opposite side of Bloss *et al*. [22] who recorded reduced intake of fruit and vegetables. The study explained this finding by the consumed food pattern, where grain wheat and maize were the main diets with reduced intake from fruit and diet was based on cereal staples that accounted for 70% of total energy intake. The adequate intake of protective food in our study in the three studied groups reflected the food pattern in our country. Regarding micronutrients intake, the vitamins intake (fat-soluble vitamins) was higher in the obese than in the normal group. In both groups, some vitamin intake was within the RDA, and other was less than the RDA. The increased total fat consumption could explain this. In the current study, there was an increased intake of water-soluble vitamins in normal groups compared with the obese group. In spite of the higher intake among the normal group, there was no significant difference. The mineral intake was assessed in this study, and it was found that calcium, iron, and zinc intake were relatively higher in overweight and obese groups compared with the normal group. Regarding the iron intake, the total mean intake of iron was 21.2 mg in boys and 19.7 mg in girls, but the highest mean intake of those of overweight was 22.7 mg in boys and 21.2 mg in girls. The lowest mean intake were 20.1 mg in boys and 17.4 mg in girls. The three levels of weight status got less than 50% of their RDA of iron. Our result was in contrast to randomized clinical trial done by Khatib and Elmad [23] that investigated the micronutrients intake among school children. The study found out low iron intake and anemia, which were prevalent at rates of, 25.2, 57.3, respectively. In spite of relative adequate iron intake in our study, there is a high prevalence of anemia in Egyptian children. This contradiction could be explained by

Table 7: Percent distribution of boys according to the adequacy of their intake from recommended dietary allowances

% RDA	Normal (86) [*n* (%)]	Overweight (88) [*n* (%)]	Obese (215) [*n* (%)]	Total (389) [*n* (%)]
Energy				
<50	-	5 (5.6)	5 (2.3)	10 (2.6)
50	17 (19.8)	13 (14.8)	34 (15.8)	64 (16.4)
75	29 (33.7)	20 (22.8)	51 (23.8)	100 (25.7)
≥100	40 (46.5)	50 (56.8)	125 (58.1)	215 (55.3)
Protein				
<50	-	1 (1.1)	-	1 (0.3)
50	3 (3.5)	2 (2.3)	2 (0.9)	7 (1.7)
75	10 (11.6)	5 (5.7)	18 (8.4)	33 (8.5)
≥100	73 (84.9)	80 (90.9)	195 (90.7)	348 (89.5)
Calcium				
<50	36 (41.8)	34 (38.6)	68 (31.6)	138 (35.5)
50	22 (25.6)	17 (20)	40 (18.7)	79 (20.3)
75	14 (16.3)	15 (17.6)	49 (22.9)	78 (20)
≥100	14 (16.3)	22 (25.9)	58 (27.1)	94 (24.2)
Iron				
<50	25 (29)	28 (31.8)	73 (33.9)	126 (32.4)
50	33 (38.8)	26 (30.6)	67 (31.3)	126 (32.4)
75	16 (18.8)	12 (14.1)	40 (18.7)	68 (17.5)
≥100	12 (14.1)	22 (25.9)	35 (16.4)	69 (17.7)
Zinc				
<50	-	1 (1.2)	1 (0.5)	2 (0.5)
50	3 (3.5)	3 (3.5)	8 (3.7)	14 (3.6)
75	9 (10.6)	7 (8.2)	14 (6.5)	30 (7.7)
≥100	74 (85.9)	77 (87.1)	192 (89.3)	343 (88.2)
Thiamin				
<50	5 (5.8)	6 (7.1)	14 (6.5)	25 (6.4)
50	18 (21.2)	23 (27.1)	53 (24.8)	94 (24.2)
75	18 (21.2)	16 (18.8)	39 (18.2)	73 (18.8)
≥100	45 (51.8)	43 (47)	109 (50.5)	197 (50.6)
Riboflavin				
<50	2 (2.3)	3 (3.5)	6 (2.8)	11 (2.8)
50	7 (8.1)	8 (9)	12 (5.6)	27 (7)
75	2 (2.3)	3 (3.5)	8 (3.7)	13 (3.3)
≥100	75 (87.3)	74 (84)	189 (87.9)	338 (86.9)
Niacin				
<50	-	-	-	-
50	-	-	-	-
75	-	-	1 (0.5)	1 (0.3)
≥100	86 (100)	88 (100)	214 (99.5)	388 (99.7)
Folic acid				
<50	2 (2.4)	3 (3.5)	6 (2.8)	11 (2.9)
50	2 (2.4)	9 (10.6)	10 (4.7)	21 (5.5)
75	7 (8.1)	9 (10.6)	15 (7)	31 (8.1)
≥100	75 (87.2)	67 (76.1)	184 (85.6)	326 (83.8)
Vitamin C				
<50	6 (7.1)	14 (16.4)	22 (10.3)	42 (10.8)
50	1 (1.1)	5 (5.9)	9 (4.2)	15 (3.9)
75	6 (7.1)	5 (5.9)	24 (11.2)	35 (9)
≥100	73 (84.7)	64 (72.8)	160 (74.4)	297 (76.3)
Vitamin A				
<50	6 (7)	9 (10.2)	6 (2.8)	21 (5.4)
50	2 (2.3)	3 (3.4)	15 (7)	20 (5.1)
75	8 (9.3)	9 (10.2)	10 (4.7)	27 (6.9)

Contd...

Table 7: Contd...

% RDA	Normal (86) [*n* (%)]	Overweight (88) [*n* (%)]	Obese (215) [*n* (%)]	Total (389) [*n* (%)]
≥100	70 (81.4)	67 (76.2)	184 (85.6)	321 (82.6)
Vitamin E				
<50	73 (84.7)	64 (72.8)	160 (74.4)	297 (76.3)
50	6 (7.1)	14 (16.4)	24 (11.2)	35 (9)
75	1 (1.1)	5 (5.9)	9 (4.2)	15 (3.9)
≥100	6 (7.1)	5 (5.9)	22 (10.3)	42 (10.8)

RDA, recommended dietary allowances.

Table 8: Percent distribution of girls according to the adequacy of their intake from recommended dietary allowances

% RDA	Normal (139) [*n* (%)]	Overweight (132) [*n* (%)]	Obese (182) [*n* (%)]	Total (453) [*n* (%)]
Energy				
<50	11 (7.2)	3 (2.3)	5 (2.3)	19 (4.2)
50	23 (16.7)	23 (17.4)	30 (16.6)	76 (16.8)
75	49 (35.5)	39 (29.5)	51 (28.2)	139 (30.7)
≥100	56 (40.6)	67 (50.8)	96 (53)	219 (48.3)
Protein				
<50	3 (1.4)	-	-	3 (0.7)
50	8 (5.8)	7 (5.3)	6 (2.8)	21 (4.6)
75	12 (8.7)	5 (3.8)	12 (6.6)	29 (6.4)
≥100	116 (84.1)	120 (90.9)	164 (90.6)	400 (88.3)
Calcium				
<50	61 (44.2)	49 (37.1)	51 (28.2)	161 (35.5)
50	35 (25.4)	35 (26.5)	49 (27.1)	119 (26.3)
75	18 (13)	27 (20.5)	25 (13.8)	70 (15.5)
≥100	25 (17.4)	21 (15.9)	57 (30.9)	103 (22.7)
Iron				
<50	60 (43.2)	47 (35.7)	73 (40.1)	180 (39.7)
50	47 (33.8)	44 (33.3)	53 (29.1)	144 (31.8)
75	16 (11.5)	25 (18.9)	24 (13.1)	65 (14.3)
≥100	16 (11.5)	16 (12.1)	32 (17.7)	64 (14.2)
Zinc				
<50	2 (1.4)	2 (1.5)	2 (1)	6 (1.3)
50	13 (9.4)	5 (3.8)	4 (2.2)	22 (4.9)
75	17 (12.4)	17 (12.9)	24 (13.2)	58 (12.8)
≥100	107 (77.5)	108 (81.8)	152 (83.6)	367 (81)
Thiamin				
<50	24 (17.3)	7 (5.3)	18 (10.4)	50 (11)
50	38 (27.4)	42 (31.8)	50 (27.5)	130 (28.7)
75	23 (16.5)	29 (22)	33 (18.1)	85 (18.8)
≥100	54 (38.8)	54 (40.9)	80 (44)	188 (41.5)
Riboflavin				
<50	11 (8)	12 (9.1)	9 (5)	32 (7)
50	10 (7.2)	9 (6.8)	8 (4.4)	28 (6.2)
75	6 (3.6)	8 (6.1)	15 (8.2)	28 (6.2)
≥100	112 (81.2)	103 (78)	150 (82.4)	365 (80.6)
Niacin				
<50	1 (0.7)	-	-	1 (0.2)
50	-	-	-	-
75	-	1 (0.8)	-	1 (0.2)
≥100	138 (99.3)	131 (99.2)	182 (100)	451 (99.6)
Folic acid				
<50	4 (2.8)	5 (3.7)	8 (4.4)	17 (3.8)

Contd...

Table 8: Contd...

% RDA	Normal (139) [*n* (%)]	Overweight (132) [*n* (%)]	Obese (182) [*n* (%)]	Total (453) [*n* (%)]
50	11 (7.9)	8 (6.1)	9 (5)	28 (6.2)
75	19 (13.8)	8 (6.1)	13 (7.1)	40 (8.8)
≥100	105 (75.5)	111 (84.1)	152 (83.5)	368 (81.2)
Vitamin A				
<50	11 (8)	17 (12.9)	20 (11)	48 (10.6)
50	25 (18)	24 (18.1)	20 (11)	69 (15.2)
75	23 (16.5)	17 (12.9)	27 (14.9)	67 (14.8)
≥100	80 (57.5)	74 (56.1)	115 (63.1)	269 (59.4)
Vitamin E				
<50	70 (50.4)	53 (40.2)	77 (42.3)	200 (44.2)
50	33 (23.7)	37 (28)	42 (23)	112 (24.7)
75	23 (16.6)	14 (10.6)	26 (14.3)	63 (13.9)
≥100	13 (9.3)	28 (21.2)	37 (20.4)	78 (17.2)

RDA, recommended dietary allowances.

the low intake of animal protein, which may result in reduced bioavailability of iron [24]. The current study reported that the majority of boys and girls got less than 50% of their RDA from calcium without significant differences among the three levels of weight status. Our result was in line with Bloss *et al*. [22] who reported a lower intake of calcium than the RDA. Zinc plays a role in the lifestyle modification and improvement of cardiometabolic risk factor related to obesity [25]. Zinc directly influences immune function, growth hormone, and insulin-like growth factor. It affected bone metabolism and is involved in DNA synthesis [26]. The current study showed that most children in the three levels of weight status got more than or equal to 100% of their RDA of zinc. This finding was in contrast with Hotz [24] who found that the prevalence of inadequate zinc intake was greater than 25% of the studied group. Regarding beverage consumptions, we found out that there was increased consumption of tea and carbonated beverages in overweight and obese children compared with normal children. Our results go in line with the findings of several studies that suggested that carbonated drinks are the major contributor to increased energy intake and obesity [27]. Recently, Kovalskys *et al.* [18] reported that the most frequently consumed high-calorie-density foods were soft drinks, juices, and carbonated beverages. It was associated with increased obesity prevalence. The key finding in the study by Downs *et al.* [28] was that the foods contributing to energy and dietary fat were energy-dense market foods of low nutritional value such as sweetened beverages and snack foods. In Austria, Grimes *et al.* [29] reported that 62% of the studied population was consuming sweetened soft beverage. Older children and those of lower socioeconomic status (SES) were more likely to consume sweetened soft beverages. High-energy dense food is considered as a major contributor to the increased obesity prevalence [30]. Researchers found out that diet quality, not total calories were significantly associated with improved weight status after other adjustments [31]. The nutrient-poor convenience foods and the increased adiposity affected the storage and the availability of certain nutrients [32]. Healthy dietary patterns are characterized mostly by fruits, different kinds of vegetables, low-fat dairy products, fish and poultry, legumes, and nuts [33]. Providing a variety of vegetables or fruit as a snack could help children meeting their recommended intake of vitamin and mineral [34] Western diet pattern is highly loaded with processed meat, pizza, snacks, soft drinks, mayonnaise, and refined grains. This pattern was associated with increased obesity prevalence [33]. Obesity is more than excessive fat deposition. It is associated with adverse metabolic complication as well as short-term and long-term physical and psychological problems [35]. It may also lead to increased risk of cardiovascular disease, diabetes, hyperlipidemia, hypertension, and metabolic syndrome [36]. Obesity control requires successful intervention strategies, which must change in the lifestyle and dietary pattern.

Conclusion

The current study revealed that there is an increased total caloric intake among studied obese primary school children. The higher intake was in the energy-dense foods containing fats and sugars. There was increased consumption of beverages in the obese compared with the nonobese group. The bodybuilding food and protective food were taken adequately by obese children and the nonobese groups. Some micronutrients intake was within the RDA% and others were less than RDA%.

Childhood obesity is a challenging problem. The successful intervention strategies require the cooperation of family, the community, and the government to combat this epidemic. This can be done with the application of the economic instruments to reduce consumption of foods that are high in saturated fats and other energy-dense foods for preventing and treating obesity.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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