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RESEARCH ARTICLE

Prevalence and Predictors of Overweight and Obesity Among Primary School Children in Cairo, Egypt: The Role of Dietary and Lifestyle Factors

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BMI, childhood, dietary, factors, habits, lifestyle, obesity, overweight, physical activity, prevalence, risk, socioeconomic status, soft drinks

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Abstract

Background and Objective: Childhood obesity is a growing global health concern associated with sedentary lifestyles and unhealthy dietary habits, with substantial health consequences during both childhood and adulthood. This study aimed to determine the prevalence of overweight and obesity among primary school children aged 6-12 years and to identify key factors associated with these conditions.

Materials and Methods: A cross-sectional study was conducted among 600 children enrolled in two primary schools, including a public Arabic-language school and a public language school, in East Nasr City, Cairo, Egypt.

Results: The overall prevalence of overweight and obesity was 15.7 and 12.7%, respectively. Girls had higher prevalences of both overweight and obesity than boys. Body mass index (BMI) was positively correlated with age and inversely correlated with meal frequency and physical activity. Consumption of specific foods, including meatballs, shrimp, and burgers, as well as soft drinks, was associated with higher BMI. Logistic regression analysis identified the father's occupation and late dinner consumption as significant predictors of obesity, whereas regular breakfast consumption was associated with a lower likelihood of obesity.

Conclusion: Socioeconomic factors and specific dietary habits are important predictors of childhood obesity. Preventive strategies targeting healthy dietary practices, regular meal patterns, and increased physical activity may help reduce the risk of overweight and obesity among school-age children.

INTRODUCTION

Childhood obesity has emerged as a growing global public health concern, largely attributed to increasingly sedentary lifestyles and unhealthy dietary habits. The prevalence of childhood obesity has risen substantially, contributing to a range of health complications during childhood and later in life[1]. The World Health Organization (WHO) reports that obesity rates among children have increased by up to 40% in some European countries over the past decade, with substantial increases also observed in the Middle East and developing countries[2]. In Egypt, childhood obesity among primary school children represents a significant public health concern. A large cross-sectional study

involving 31,270 schoolchildren aged 6-11 years reported prevalences of 15.02% for overweight and 10.55% for obesity, with obesity being more prevalent among children from higher socioeconomic backgrounds[3].

Childhood obesity is associated with both physical and psychological consequences[4], including an increased risk of hyperlipidemia, hypertension, and cardiovascular disease, as well as psychological disorders such as depression[5]. Therefore, the present study aimed to assess the prevalence of overweight and obesity among primary school children in Cairo and to investigate the associated risk factors.

MATERIALS AND METHODS

Study design: A cross-sectional study was conducted among primary school children aged 6-12 years in Nasr City, Cairo, Egypt, from February to April 2010. The study was designed to assess the prevalence of overweight and obesity and to identify associated risk factors among school-aged children.

Sampling: A convenience sample of 600 children was recruited from two primary schools, Al Tagrebya Al Mowahada and Khalid Ebn El Waleed. The sample size was calculated using a 95% confidence level.

Study tools

Interview questionnaire: Data were collected using a structured interview questionnaire that included information on sociodemographic characteristics, including age, sex, parental education and occupation and family size. The questionnaire also assessed dietary habits, including meal frequency, fruit and vegetable consumption and snacking habits, as well as lifestyle factors, including physical activity and screen time.

Anthropometric measurements: Body weight and height were measured for each child and used to calculate body mass index (BMI) according to the standard formula:

$$\text{BMI} = \frac{\text{Weight (kg)}}{\text{Height (m}^2\text{)}}$$

BMI categories and corresponding percentiles are presented in Table 1. BMI-for-age percentiles were used to classify the children's weight status. Each child's BMI was plotted according to age and sex on the Egyptian BMI-for-age growth charts to determine the corresponding weight-status category (Fig. 1 and 2).

Table 1: BMI categories and the corresponding percentile ranges

Weight groups	Percentile range
Underweight	< the 5th percentile
healthy weight	5th - < the percentile
Overweight	85th - < the 95th percentile
Obese	≥the 95th percentile

Statistical analysis: Data were analyzed using SPSS software, version 15. Descriptive statistics were used to summarize the study variables. The chi-square test was used to assess associations between categorical variables, while correlation analysis was performed to examine relationships between continuous variables. The unpaired t-test was used to compare continuous variables between two independent groups. Logistic regression analysis was performed to identify factors independently associated with overweight and obesity. Statistical significance was considered at $p<0.05$.

Ethical considerations: Ethical approval was obtained from the relevant authorities before commencement of the study. Written informed consent was obtained from the parents or legal guardians of all participating children. Confidentiality of the collected data was maintained throughout the study and the information was used solely for research purposes.

RESULTS AND DISCUSSION

The results of this study are presented in two sections:

- Characteristics of the study sample and the prevalence of overweight and obesity
- Correlations and associations between BMI and selected risk factors for childhood overweight and obesity

There were notable differences in the sociodemographic characteristics of children between the two schools. In the Arabic school, 33.7% of fathers and 44.7% of mothers were illiterate, whereas 99.3% of parents in the language school were university graduates. Regarding parental occupation, 73.0% of fathers in the Arabic school were manual workers and 70.7% of mothers were housewives, compared with 45.6% of fathers who had professional occupations and 59.0% of mothers who were housewives in the language school. The differences between the two groups were statistically significant (Table 2).

These findings may be explained by the association between educational attainment and occupational status, whereby lower levels of education may be associated with lower occupational attainment. Parental educational and occupational levels may also serve as indicators of the family's socioeconomic status[6].

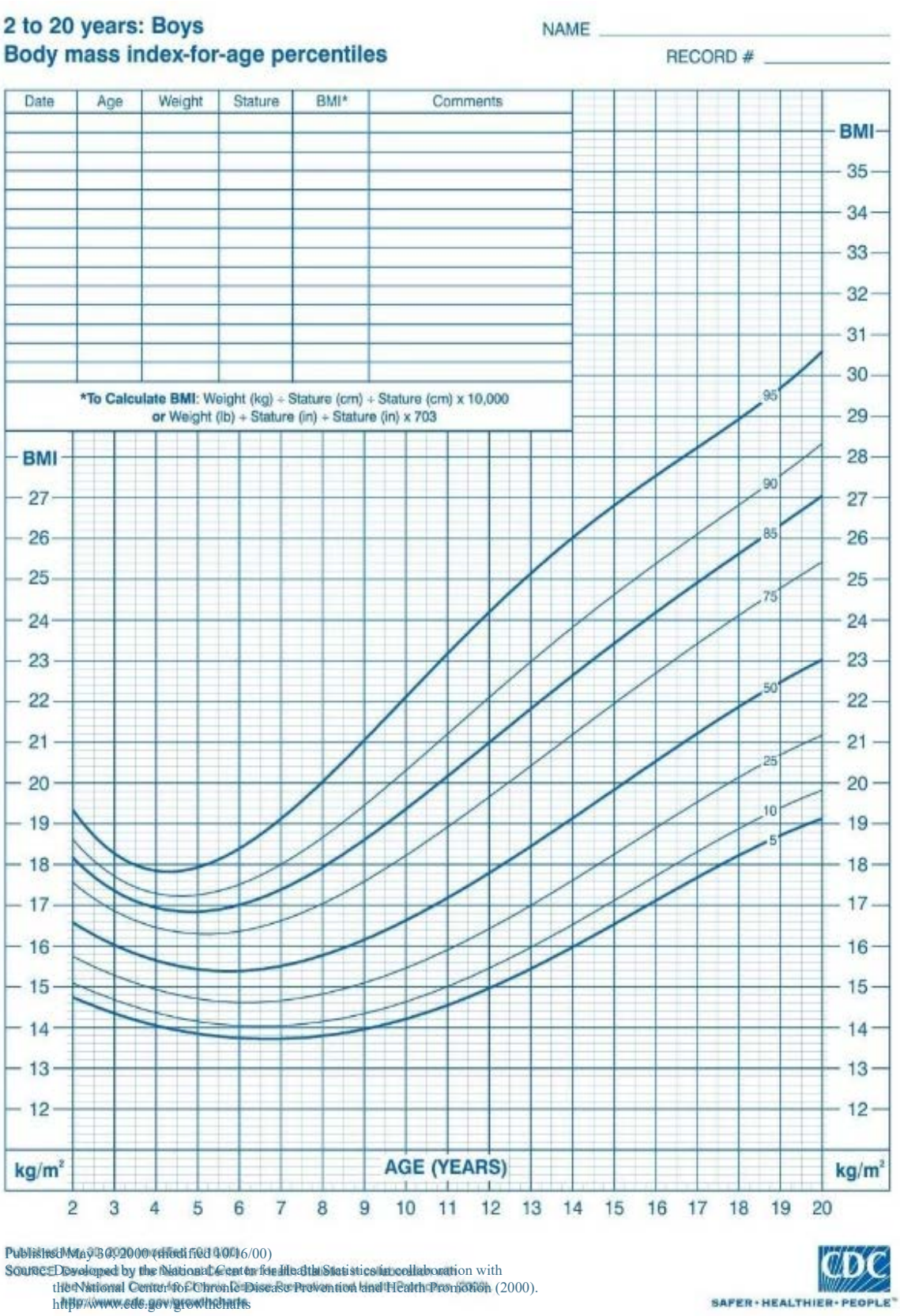

Fig. 1: BMI for age percentiles, Egyptian boys (2-20 years)[27]

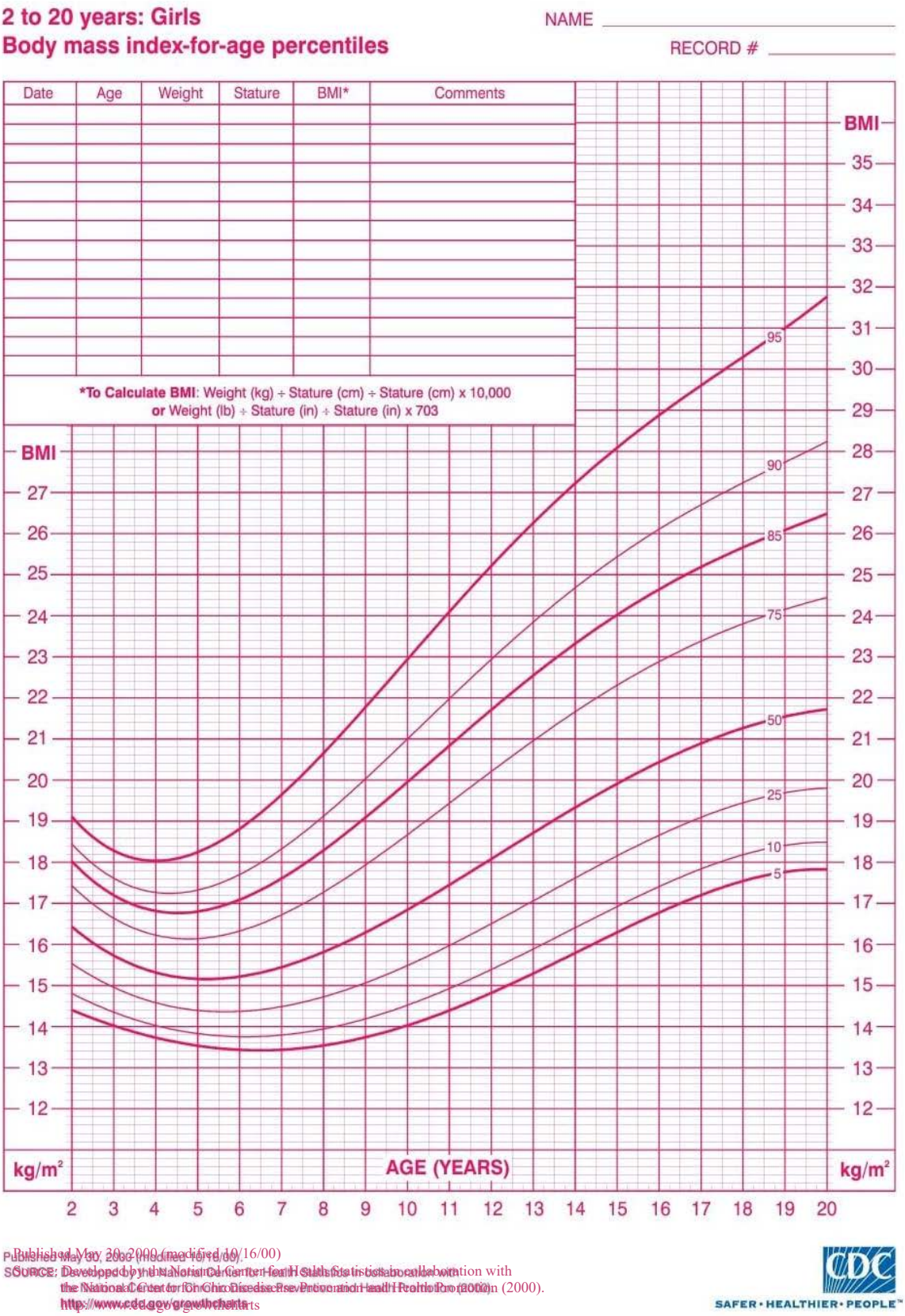

Fig. 2: BMI for age percentiles, Egyptian girls (2-20 years)[27]

Table 2: Comparison of sociodemographic characteristics between children attending arabic and language schools

Variables		Group A (Arabic) N = 300	Group B (Language) N = 300	χ^2	p-value
Age (mean±SD)		9.3±1.7	9.7±1.8	1.9*	0.100
Gender	Boys				
	No. (%)	145(48.3)	128(42.7)	1.9	0.160
	Girls				
	No. (%)	155(51.7)	172(57.3)		
Father education					
	Illiterate				
	No. (%)	101(33.7)	-	398.4	0.000
	Read & write				
	No. (%)	69(23)	-		
	Primary or Intermediate				
	No. (%)	48(16)	-		
	Secondary				
	No. (%)	24(8)	2(0.7)		
	University Or Institute				
	No. (%)	58(19.3)	298(99.3)		
Father occupation					
	Manual				
	No. (%)	219(73)	9(3)	333.2	0.000
	Clerks				
	No. (%)	33(11)	131(43.7)		
	Professionals				
	No. (%)	23(7.7)	137(45.6)		
	Free Job				
	No. (%)	25(8.3)	23(7.7)		
Mother education					
	Illiterate				
	No. (%)	134(44.7)	-	421.4	0.000
	Read and write				
	No. (%)	64(21.3)	-		
	Primary or Intermediate				
	No. (%)	30(10)	-		
	Secondary				
	No. (%)	22(7.3)	2(0.7)		
	University Or Institute				
	No. (%)	50(16.7)	298(99.3)		
Mother occupation					
	Working				
	No. (%)	88(29.3)	123(41)	8.9	0.003
	Not working				
	No. (%)	212(70.7)	177(59)		

N.B., Group A: Students of Al Tagrebya Al Mowahada School (Arabic school), Group B: Students of Khaled Ben El Waleed Language School, No.: Number. - Missing data. SD: Standard deviation and *Test of significance (unpaired t test)

A statistically significant difference was observed between children attending the Arabic and language schools regarding the educational and occupational levels of their parents[7]. Children attending the language school were more likely to have parents with higher levels of education and occupational status. This socioeconomic difference was associated with a higher prevalence of obesity among children attending the language school[8].

Table 3 shows that children attending the Arabic school had significantly lower body weight and height than those attending the language school, as demonstrated by the unpaired *t*-test. However, no statistically significant difference was observed between the two groups with respect to BMI.

The higher proportion of overweight and obese children in the language school may be associated with differences in the educational and occupational characteristics of their parents[9]. Parents of children attending the language school had higher educational and occupational levels than those of children attending the Arabic school. Conversely, the higher proportion of underweight children observed in the language school was unexpected. This finding may be related to differences in dietary habits between the two groups. For example, some underweight children in the language school may have consumed snacks frequently as substitutes for regular meals. Genetic factors may also contribute to differences in body weight and nutritional status[10].

Table 3: Comparison of anthropometric measurements between children attending arabic and language schools

Anthropometric measurements	Group A (Arabic) N = 300	Group B (Language) N = 300	t	p-value
Weight(kg) (Mean±SD)	34.08±12.6	37.1±11.8	3.1	0.002
Height(cm) (Mean±SD)	135.07±12.2	139.7±11.4	4.7	0.000
BMI(kg/m^2) (Mean±SD)	18.09±3.8	18.6±4.1	1.8	0.060

Table 4: Comparison of meal timing and frequency between children attending arabic and language schools

Variables		Group A (Arabic) N = 300	Group B (Language) N = 300	χ^2	p-value
Number of meals per day (Mean±SD)		2.9±0.7	2.9±0.5	0.12*	0.800
Eating breakfast					
	Never	12(4)	6(2)	24.8	0.000
	Rarely	1(0.3)	-		
	Often	13(4.3)	2(0.7)		
	Almost	19(6.3)	3(1)		
	Everyday	255(85)	289(96.3)		
Eating dinner before sleeping					
	Never	189(63)	144(48)	26.2	0.000
	Rarely	5(1.7)	2(0.7)		
	Often	24(8)	13(4.3)		
	Almost	19(6.3)	31(10.3)		
	Everyday	63(21)	110(36.7)		
Time of meals					
	Not fixed	77(25.7)	161(53.7)	49.2	0.000
	Fixed	223(74.3)	139(46.3)		

*Test of significance (unpaired t test)

Table 4 shows that the majority of children in both schools consumed breakfast daily. However, the proportion of children who never consumed breakfast was higher in the Arabic school than in the language school. More than one-quarter of the children in the language school reported consuming dinner immediately before bedtime every day, compared with less than one-quarter of children in the Arabic school. Regarding meal timing, children attending the Arabic school were more likely to consume meals at fixed times than those attending the language school, with a highly significant difference between the two groups according to the chi-square test. No statistically significant difference was observed between the two groups regarding the number of meals consumed per day.

Regarding consumption of dinner before bedtime, Vujović *et al.*[11] suggested that the body may not utilize calories as efficiently at night as during the daytime, contributing to the commonly held belief that nighttime eating promotes fat accumulation.

Table 5 demonstrates significant differences between the two groups in the consumption of snacks, salads, soft drinks, and fruit juices, based on the chi-square test. Children attending the language school consumed more snacks and fruit juices than those attending the Arabic school, except for corn chips. Regarding salad and fruit consumption, children in the Arabic school consumed salads more frequently than those in the language school, whereas fruit consumption was lower among Arabic school children. Soft drink consumption was also higher among children attending the language school than among those attending the Arabic school.

These findings are consistent with those reported by Vereecken *et al.*[12], who found that fruit consumption increased with family wealth and higher parental occupational status. Soft drink consumption was lower among students with higher parental occupational status in Northern, Southern, and Western European regions, although this pattern was not observed in Central and Eastern Europe[13]. In Central and Eastern European regions, higher levels of soft drink consumption were associated with greater family affluence[14].

These findings are consistent with those reported by Phillips *et al.*[15], who found no significant association between snack-food consumption and subsequent changes in BMI *z*-score. Similarly, the present findings are in agreement with a study by Field *et al.*[16], which reported no significant association among girls between the consumption of fruits, fruit juice, or vegetables, either individually or in combination, and subsequent changes in BMI *z*-score.

Table 6 shows that children attending the language school were more likely to eat while watching television than those attending the Arabic school, with a highly significant difference between the two groups according to the chi-square test. No significant differences were observed between the two schools with respect to the other variables assessed. This finding may be related to differences in the amount of time children spent at home. Children attending the language school may have had more opportunities to watch television at home, whereas children attending the Arabic school may have spent more time playing outdoors.

Table 5: Comparison of soft drink consumption and snack, salad, and fruit intake between children attending arabic and language schools

Variables		Group A (Arabic) N = 300	Group B (Language) N = 300	χ^2	p-value
Eating snacks					
	Chips	285(95)	289(96.3)	0.6	0.400
	Molto	263(87.7)	293(97.7)	22.07	0.000
	Chocolate	279(93)	298(99.3)	16.3	0.000
	Biscuits	279(93)	286(95.3)	1.4	0.200
	----------	----------	Others ----------	----------	----------
	Corn chips	35(11.7)	23(7.7)	69.7	0.000
	Ice cream	19(6.3)	59(19.7)		
	Lolli-pop	18(6)	35(11.7)		
	Cake	21(7)	36(12)		
	Juice	20(6.7)	42(14)		
	Crisps	2(0.7)	7(2.3)		
Eating green salad					
	Don't eat	21(7)	53(17.7)	104	0.000
	Everyday	137(45.7)	60(20)		
	3 times weekly	107(35.7)	66(22)		
	2 times weekly	24(8)	59(19.7)		
	Once	11(3.7%)	62(20.7)		
Eating fruits					
	Don't eat	8(2.7)	5(1.7)	5.2	0.200
	Everyday	144(48)	122(40.7)		
	3 times weekly	106(35.3)	117(39)		
	2 times weekly	25(8.3)	36(12)		
	Once	17(5.7)	20(6.7)		
Drinking soft drinks					
	Don't drink	24(8)	13(4.3)	31.2	0.000
	Everyday	85(28.30)	44(14.7)		
	3 times weekly	68(22.7)	64(21.3)		
	2 times weekly	62(20.7)	68(22.7)		
	Once	61(20.3)	111(37)		

Table 6: Comparison of eating behaviors and dietary habits between children attending arabic and language schools

Variables		Group A (Arabic) N = 300	Group B (Language) N = 300	χ^2	p-value
Good chewing					
	Yes	283(94.3)	288(96)	0.9	0.300
	No	17 (5.7)	12(4)		
Eating speed					
	Fast	21(7)	12(4)	2.6	0.200
	Slow	37(12.3)	37(12.3)		
	Normal	242(80.7)	251(83.7)		
Eating while watching TV					
	Yes	251(83.7)	294(98)	43.6	0.000
	No	49(16.3)	6(2)		

Television viewing may reduce the time available for physical activity and has also been associated with increased food consumption, either during television viewing or in response to exposure to food advertisements[17]. Eating slowly and chewing food thoroughly may contribute to appetite regulation and body-weight control by allowing greater time for satiety signals to develop. In contrast, rapid eating may be associated with increased energy intake and overeating[18]. In the present study, however, no significant associations were observed between BMI and television viewing, chewing behavior, or eating speed. This may be explained by the multifactorial nature of childhood obesity, in which dietary behaviors, physical activity, socioeconomic characteristics, genetic factors and other environmental influences may interact[19].

Table 7 shows that children attending the Arabic school were more likely to participate in sports and walk to school than those attending the language school, with highly significant differences between the two groups according to the unpaired *t*-test. However, no significant difference was observed between the two groups regarding the duration of walking to school.

Physical activity has been reported to have beneficial effects on anxiety and depressive symptoms and waist circumference among children and adolescents with overweight or obesity[20]. Furthermore, physical activity combined with other interventions may contribute to improvements in anxiety and depressive symptoms, as well as BMI and BMI *z*-scores[21,22]. These findings suggest that physical

Table 7: Comparison of sports participation between children attending arabic and language schools

Variables		Group A (Arabic) N = 300	Group B (Language) N = 300	t	p-value
Number of days of practicing sports		3.8±2.9	2.2±2.1	7.4	0.000
Number of days of walking to school		3±2.4	0.9±1.9	11.4	0.000
Time of walking to school in minutes					
	10 mins	13(6.8)	8(13.3)		
	10 to19 mins	129(67.2)	39(65)		
	20 to 29 mins	33(17.2)	10(16.7)		
	30 to 39 mins	12(6.3)	3(5)		
	50 to 59 mins	5(2.6)	-	4.08*	0.3

*Test of significance (chi square test)

Table 8: Association between BMI and sociodemographic characteristics among children attending arabic schools

		BMI					
Variables		Under weight	Normal weight	Over weight	Obese	χ^2	p-value
Gender							
	Boys No. (%)	5(55.6)	130(51.2)	4(20)	6 (35.3)	8.6	0.03
	Girls No. (%)	4(44.4)	124(48.8)	16(80)	11(64.7)		
Father education							
	Illiterate No. (%)	2(22.2)	88(34.6)	7(35)	4(23.5)	13.7	0.3
	Read and write No. (%)	3(33.3)	62(24.4)	3(15)	1(5.9)		
	Primary or intermediate No. (%)	2(22.2)	39(15.4)	4(20)	3(17.6)		
	Secondary No. (%)	2(22.2)	18(7.1)	2(10)	2(11.8)		
	University or Institute No. (%)	-	47(18.5)	4(20)	7(41.2)		
Father occupation							
	Manual No. (%)	8(88.9)	190(74.8)	12(60)	9(52.9)	26.5	0.002
	Clerk No. (%)	1(11.1)	31(12.2)	-	1(5.9)		
	Professional No. (%)	-	15(5.9)	3(15)	5(29.4)		
	Free Job No. (%)	-	18(7.1)	5(25)	2(11.8)		
Mother education							
	Illiterate No. (%)	6(66.7)	116(45.7)	10(50)	2(11.8)	19.9	0.06
	Read and write No. (%)	1(11.1)	57(22.4)	2(10)	4(23.5)		
	Primary or inter-mediate No. (%)	1(11.1)	25(9.8)	2(10)	2(11.8)		
	Secondary No. (%)	1(11.1)	19(7.5)	1(5)	1(5.9)		
	University or Institute No. (%)	-	37(14.6)	5(25)	8(47.1)		
Mother occupation							
	Working No. (%)	3(33.3)	76(29.9)	3(15)	6(35.3)	2.3	0.4
	Not working No. (%)	6(66.7)	178(70.1)	17(85)	11(64.7)		

activity may serve as a useful adjunct to existing therapeutic approaches for children and adolescents with overweight or obesity.

Table 8 shows a significant association between BMI and sex, with girls having higher proportions of overweight and obesity than boys. A significant association was also observed between BMI and paternal occupation, with more than half of the children having fathers who were manual workers. However, no significant associations were observed between BMI and the other variables assessed using the chi-square test. In contrast to the present findings, Strauss and Knight[23] reported that children whose parents had nonprofessional occupations were significantly more likely to develop obesity than children whose parents were employed in professional or managerial occupations (relative risk, 1.76; 95% CI, 1.15-2.67, $p<0.01$).

Table 9 also demonstrates a significant association between BMI and paternal occupation according to the chi-square test. Approximately half of the underweight, normal-weight, overweight, and obese children had fathers with professional occupations. No significant associations were observed between BMI and the other variables assessed using the chi-square test. These findings may reflect the multifactorial etiology of childhood obesity, whereby parental

Table 9: Association between BMI and sociodemographic characteristics among children attending language schools

Variables		BMI				χ^2	p-value
		Under weight	Normal weight	Over weight	Obese		
Gender							
	Boys No. (%)	5(22.7)	104(45.2)	12(44.4)	7(33.3)	4.9	0.1
	Girls No. (%)	17(77.3)	126(54.8)	15(55.6)	14(66.7)		
Father education							
	Secondary No. (%)	-	2(0.9)	-	-	0.6	0.8
	University or Institute No. (%)	22(100)	228(99.1)	27(100)	21(100)		
Father Occupation							
	Manual No. (%)	1(4.5)	8(3.5)	-	-	17.8	0.03
	Clerk No. (%) No. (%)	9(40.9)	103(44.8)	13(48.1)	6(28.6)		
	Professional No. (%)	10(45.5)	104(45.2)	14(51.9)	9(42.9)		
	Free Job No. (%)	2(9.1)	15(6.5)	-	6(28.6)		
Mother education							
	Secondary No. (%)	-	2(0.9)	-	-	0.6	0.8
	University or Institute No. (%)	22(100)	228(99.1)	27(100)	21(100)		
Mother occupation							
	Working No. (%)	7(31.8)	97(42.2)	13(48.1)	6(28.6)	2.8	0.4
	Not working No. (%)	15(68.2)	133(57.8)	14(51.9)	15(71.4)		

Table 10: Association between bmi and meal timing among children attending arabic schools

Variables		BMI				χ^2	p-value
		Under weight	Normal weight	Over weight	Obese		
Eating breakfast							
	Never	-	7(2.8)	3(15)	2(11.8)	14.2	0.2
	Rarely	-	1(0.4)	-	-		
	Often	-	10(3.9)	2(10)	1(5.9)		
	Almost	1(11.1)	17(6.7)	-	1(5.9)		
	Everyday	8(88.9)	219(86.2)	15(75)	13(76.5)		
Eating dinner before sleeping							
	Never	3(33.3)	161(63.4)	14(70)	11(64.7)	25.6	0.01
	Rarely	-	5(2)	-	-		
	Often	-	22(8.7)	2(10)	-		
	Almost	-	13(5.1)	4(20)	2(11.8)		
	Everyday	6(66.7)	53(20.9)	-	4(23.5)		
Time of Meals							
	Not fixed	1(11.1)	64(25.2)	7(35)	5(29.4)	2.06	0.5
	Fixed	8(88.9)	190(74.8)	13(65)	12(70.6)		

occupation may be related to educational attainment, socioeconomic status, lifestyle and other environmental factors that can influence children's dietary and physical activity patterns.

Table 10 shows a significant association between BMI and eating dinner before bedtime. More than half of the underweight children and less than one-quarter of the normal-weight and obese children reported eating dinner before bedtime every day. No significant associations were observed between BMI and the other variables assessed using the chi-square test.

A study by Veugelers and Fitzgerald[24] reported that children who purchased lunch at school had an increased risk of overweight (adjusted odds ratio [OR], 1.39; 95% confidence interval [CI], 1.16-1.67), whereas those who ate supper with their family three or more times per week had a lower risk of overweight (OR, 0.68; 95% CI, 0.52-0.88).

A possible association was observed between BMI and breakfast consumption. All underweight children and the majority of normal-weight, overweight and obese children reported consuming breakfast every day. A significant association was also observed between BMI and meal timing. Approximately half of the normal-weight children, more than half of the underweight and overweight children and more than three-quarters of the obese children reported that they did not consume meals at fixed times. No significant

Table 11: Association between bmi and meal timing among children attending language schools

Variables		BMI				χ^2	p-value
		Under weight	Normal weight	Over weight	Obese		
Eating breakfast							
	Never	-	2(0.9)	1(3.7)	3(14.3)	19.9	0.01
	Rarely	-	-	-	-		
	Often	-	2(0.9)	-	-		
	Almost	-	3(1.3)	-	-		
	Everyday	22(100)	223(97)	26(96.3)	18(85.7)		
Eating dinner before sleeping							
	Never	11(50)	111(48.3)	9(33.3)	13(61.9)	13.9	0.3
	Rarely	-	2(0.9)	-	-		
	Often	-	12(5.2)	-	1(4.8)		
	Almost	-	27(11.7)	4(14.8)	-		
	Everyday	11(50)	78(33.9)	14(51.9)	7(33.3)		
Time of meals							
	Not fixed	13(59.1)	115(50)	15(55.6)	18(85.7)	10.2	0.01
	Fixed	9(40.9)	115(50)	12(44.4)	3(14.3)		

association was observed between BMI and eating dinner before bedtime according to the chi-square test (Table 11).

Levitsky and Pacanowski[25] reported that individuals who consume a substantial breakfast may consume less food during the remainder of the day, whereas breakfast skipping may be associated with greater food intake later in the day. Frequent meal consumption has also been proposed to influence energy expenditure through the thermic effect of food, which represents the energy required for digestion, absorption and metabolism of nutrients. However, the evidence regarding whether increased meal frequency independently increases total energy expenditure or promotes weight loss remains inconsistent. Similarly, the potential role of frequent small meals in maintaining more stable blood glucose levels requires consideration of overall dietary composition, meal size and individual metabolic characteristics[26].

CONCLUSION

This study, conducted among 600 primary school children in two schools in Nasr City, Cairo, found that 80.7% of participants had normal weight, whereas 7.8% were overweight, 6.3% were obese and 5.2% were underweight. Girls had a higher prevalence of overweight and obesity than boys. BMI was positively correlated with age and inversely correlated with meal frequency and physical activity. The consumption of certain foods and soft drinks was associated with higher BMI, particularly among children attending the language school. Logistic regression analysis identified paternal occupation and eating dinner before bedtime as significant predictors of obesity, whereas daily breakfast consumption was associated with a lower likelihood of obesity. These findings highlight the importance of addressing dietary, lifestyle and socioeconomic factors in strategies aimed at preventing childhood overweight and obesity.

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