DIETARY INTAKE AND BODY COMPOSITION FOR PRIMARY SCHOOL GIRLS IN THE MAKKAH PROVINCE OF SAUDI ARABIA

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ABSTRACT

Background: *Malnutrition can pose a problem for primary schoolchildren that are entering puberty. Inappropriate food intake can be manifested as stunting, wasting, undernourishment, or obesity.*

Objective: *To evaluate body composition and dietary intake for schoolgirls living in the Saudi Arabia.*

Patients: *A cross-sectional. study was conducted on 300 randomly selected primary schoolgirls aged 6-12 years living in Makkah Province. Design The children were divided into two age groups for comparison.*

Settings: *Demographic information was collected through a questionnaire. Main Outcome Measures Dietary assessments were conducted using 24-hr recall. Subjects height, weight, waist circumference, and body composition were measured using anthropometric methods to determine the body mass index (BMI) z-score and body composition values were evaluated by bioelectrical impedance.*

Results: *The ≤ 8-years-old had: i) higher mean body fat%; ii) significantly (P<0.01) lower mean of lean and dry lean body (kg) and body fluid (liter); and iii) significantly smaller (P<0.001) mean waist, hip, and mid-upper arm circumferences. Both groups were mostly overweight (> -1 SD). The majority had normal BMI-for-age Z-score (-2 to 1 SD). Older girls (> 8-years-old) had lower than average intake (AI) for calorie, iron, magnesium, phosphorus, and sodium. As for vitamins, folic acid for both groups was markedly less than the AI. In contrast, all students met AI for vitamins A, B_1, B_2 and B_3.*

Conclusion: *Calories, phosphorous, magnesium, iron, sodium, and folic acid intakes were lower than AI for girls in both groups. Differences in body composition found in the two groups. Limitations Deficit assessment of population Intake of micronutrients at this risk age.*

Keywords: girls; wasting; underweight; obesity; stunting; Makkah

INTRODUCTION

Globally, nutritional status is considered to be the best indicator of the well-being of young children and a parameter for monitoring growth progress. Good nutrition, especially in the

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first years of a child's life, is of particular concern since children make critical gains in growth and development during this period.

Childhood nutrition is increasingly recognized as being crucial for present and future health. Appropriate dietary intake and nutritional status during childhood is important for growth and development, but these factors can also impact health later in life (Tomkins 2001).

Developing healthy dietary and physical activity habits early in life is essential for the continuation of these habits into adulthood and to prevent obesity, type 2 diabetes, and other chronic diseases (LaRowe et al. 2010). Thus, childhood dietary needs must be taken seriously in order to improve health on a nation-wide basis, as well as to ensure that children have healthy and active lifestyles (Tomkins 2001).

The definition of school-age groups corresponds approximately to the period from kindergarten through lower secondary schooling; this phase begins after the preschool years and continues through most of adolescence, when significant growth gains are made and sexual maturation occurs (Kuala et al. 2000). Pre-school children in particular are a nutritionally vulnerable segment of the population, and are also susceptible to morbidity due to infections (Prema and Hema 2009).

Anthropometric measurements of child growth are important indicators for assessing nutritional status at a community level. Such measurements reflect the development of a country and unsatisfactory values can highlight the potential burden of malnutrition in developing nations. Inadequate or inappropriate nutrition can be manifested as wasting, stunting, undernourishment, or obesity. Thus, to improve overall health in Saudi Arabia, measurements of body composition, as well as anthropometric indices and dietary intake of children are needed to provide the basis for future research in nutritional intake.

OBJECTIVES OF RESEARCH

The present study was designed to:

1. Evaluate body composition of 6-12-year-old female children living in the Makkah province of Saudi Arabia.
2. Identify the dietary intake of study subjects divided by age group (≤ 8-years-old and > 8-years-old).
3. Assess socio-economic factors that affect dietary intake among these children.

SUBJECTS AND METHODS

Subjects

A cross-sectional study was conducted during the 2013-2014 academic year. The study included 300 children who were randomly selected from the total population. All study subjects were girls between 6- and 12-years-old and were students at different schools in the Makkah Province of Saudi Arabia.

Study Design

Schools were randomly selected to participate, as were pupils from the selected schools. Twenty students were included from each school. If the school did not have 20 qualifying students, more students from other schools were included. At the initiation of the study, a letter was sent to every school that outlined the research objectives. Written parental consent was obtained for each study participant. Researchers visited every school on separate days and study subjects completed a study questionnaire concerning their health, nutritional, and socioeconomic conditions. Anthropometric data were recorded for each child, as was food intake frequency, and 24-h recall of food intake. The identification of all participant were kept anonymous

Population

The study was conducted in the Holy city of Makkah at different areas/districts and in communities with various socioeconomic and cultural backgrounds. Five primary schools were visited and the school's contribution to the study was discussed with the administration and teaching staff. All schools follow Ministry of Education curricula. Four schools were under the supervision of the governmental free education system and two were part of the private sector.

Methods

Data

Data for both parents and children were collected with a structured interview questionnaire that was divided into two parts: socioeconomic level questionnaire and 24-hour recall sheet. Most of the interviews were conducted at the children's schools in the presence of their parent or guardian. Data from the 24-hour diet recall questionnaires were used to determine energy intake (Parnell et al. 2003).

Anthropometric measurements

For anthropometric measurements, children wore light clothing and no shoes. Measurements were taken at the schools by research assistants. Weight and height measurements were made following standard techniques using a scale and anthropometer rod to determine values to the nearest 0.5 kg and 0.1 cm, respectively (Gordon, Chumlea, and Roche 1988). Triceps (mid-point of a horizontal line between the acromion process and the tip of the olecranon) and subscapular (inferior angle of scapula) skinfold thicknesses were measured with calipers to the nearest 0.1 mm. Two measurements were made at each site. If the measurements differed by more than 0.5 mm, a third measurement was taken and the mean of the closest two measurements was recorded. Similarly, two waist (highest point of the iliac crest during minimal respiration) and arm (mid-point of a horizontal line between the acromion process and the tip of the olecranon) circumferences were measured to the nearest 0.1 cm at each site. If these values differed by more than 0.5 cm, a third measurement was taken and the mean of the closest two measurements was recorded. All anthropometric measurements were made on the right side of the body whenever possible, and the final value was calculated as the mean of the two closest measurements (Hodgkin et al. 2010).

Mid-arm circumference (MAC) was measured with a flexible but non-stretchable measuring tape (steel tape) and was recorded to the nearest 0.1 cm. Measurements were taken midway between the lateral projection of the acromion process of the scapula and the inferior margin of the olecranon process of the ulna (Grodner, Anderson, and DeYoung 2004).

Anthropometric data analysis

Body mass index (BMI) was calculated as weight in kilograms divided by height in meters squared and the corresponding BMI z-scores were compared with International Obesity Task Force (IOTF) reference data (Reilly 2002). The z scores were calculated using the recent version of the WHO program for anthropometric measurements *(WHO 2009, see also below)* for children aged 0-19 years. BMI-for-age, height-for-age (H/A), and weight-for-age (W/A) were also determined using this program. BMI-for-age was used to define overweight and obese, as well as wasting. Height-for-age (H/A) was used for stunting, whereas W/A values defined whether a child was underweight.

WHO AnthroPlus software

The AnthroPlus software package includes growth reference data for children and adolescents aged between 5 and 19 years (61-228 months). Recent versions of this software facilitate analysis of nutritional status in children and adolescents, and were developed by WHO using data collected from six countries, including Oman, which is closest to the lifestyle, growth patterns, and socioeconomic distribution of Saudi Arabia. AnthroPlus does not include weights for children over 10 years-old.

The WHO Reference 2007 is a reconstruction of the 1977 National Center for Health Statistics (NCHS)/WHO reference. This resource uses the original NCHS data set supplemented with data from the WHO child growth standards sample for children under 5-years-old., The same statistical methodology used to construct the WHO standards was used to develop this reference.

Bioimpedance assessment (BIA)

BIA is a body composition measurement technique based on the principle that lean tissue has higher electrical conduction and lower impedance than fat.

Body composition using a Bodystat® 1500MDD device and the BIA technique was determined for some children by entering the weight and height into the Bodystat® 1500MDDdevice, which was used to measure BMI, total body fat, lean body mass, fluid amount, and waist-hip ratio. This device has equations for child body compositions, anthropometric measurements, and basal energy expenditure (BEE) by estimation (http://www.bodystat.com/science.php, accessed on 2010).

Determination of daily nutrient intake

Daily nutrient intake on three different days was obtained and nutritional values of the consumed food were calculated using United States Department of Agriculture (USDA) software (2012). The dietary adequacy with respect to daily reference intake (DRI 2002) and Recommended Daily Allowances (RDA 1989) was assessed.

Statistical Analysis

Statistical analyses were carried out using SPSS version 20 for Windows. Frequencies, relative and cumulative percentages, means, standard deviation (SD), and range were computed. Quantitative data are presented as mean ± standard deviation. Qualitative data are expressed as percentages. For quantitative variables, compliance with the normal distribution was assessed using the Kolmogorov-Smirnoff test as appropriate. For comparing groups, the chi-square test or Fisher's exact test were used for qualitative variables and the t-test together with the Mann-Whitney U test or ANOVA together with the Kruskal-Wallis test for quantitative variables. P values below 0.05 were considered to indicate statistical significance. Mean and SD of the anthropometric data were calculated for each age group. The mean values of food and nutrient intakes were calculated separately for each age group (6-8-years old, and 9-12-years old). The subjects were divided in this manner because when children reach 9 years of age their nutritional requirements differ.

RESULTS

Socio-demographic status

The study sample included 300 girls, aged between 6- and 12-years-old (Table 1).

Table 1. *Age distribution and the mean age of study subjects*

Age	No.	%	X^2	P	Mean ± SD	P*
≤ 8-years-old	114	38.0	145.5	0.0	7.28 ± 0.77	0.0
> 8- years-old	186	62.0			10.35 ± 1.12	

SD = standard deviation. P: Mann-Whitney test.*

Most (62%) of the children were older than 8-years-old, and the mean age was 10.35-years-old (± SD 1.12, range 8–12 years). The study participants were divided into two groups: ≤ 8-years-old and > 8-years-old.

Table 2. *Socio-demographic status of study subjects* [y = years a : X^2 Chi-Square]

Age groups	≤ 8-years-old n = 114		> 8-years-old n = 186		Total n = 300		X^2	P
	No.	%	No.	%	No.	%		
Social status of students' guardians								
Married	102	89.5%	168	90.3%	270	90	0.77 3	0.6 8
Widow\widower	0	0	3	1.6%	3	1		
Divorced	12	10.5%	15	8.1%	27	9		
Father's educational level								
Illiterate & primary	9	7.9%	3	1.%	12	4	5.66 2	0.1 3
Intermediate & secondary	21	18.4%	69	73.1%	90	30		
Graduate	81	71.1%	111	59.7%	192	64		
Post graduate	3	2.6%	3	1.6%	6	2		
Mother's educational level								
Illiterate & primary	12	10.5%	15	8.1%	27	9	1.68 9	0.6 4
Intermediate & secondary	57	50.0%	75	40.3%	132	44		
Graduate	42	36.8%	93	50%	135	45		
Post graduate	3	2.6%	3	1.6%	6	2		
Average family income								
< 3000 RS	12	10.5%	30	16.1%	42	14	1.26 7	0.5 3
3000-6000 RS	60	52.6%	78	41.9%	138	46		
> 6000 RS	42	36.8%	78	41.9%	120	40		
% of child's pocket money spent on food								
40%	24	21.1%	27	14.5%	51	17	1.51 6	0.8 2
50%	54	47.7%	87	46.8%	141	47		
60%	15	13.2%	21	11.3%	36	12		
70%	15	13.2%	39	21%	54	18		
>70%	6	5.3%	12	6.5%	18	6		
Family Size								
3 persons	9	7.9%	18	9.7%	27	9	3.75 6	0.8 1
4 persons	27	23.7%	36	19.4%	63	21		
5 persons	21	18.4%	39	21.0%	60	20		
6 persons	33	28.9%	39	21.0%	72	24		
7 persons	12	10.5%	30	16.1%	42	14		
8 persons	6	5.3%	18	9.7%	24	8		
9 persons	0	0	3	1.6%	3	1		
10 persons	6	5.3%	3	1.6%	9	3		

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Table 2 shows the socio-demographic status of the study subjects' families. For both groups, the majority of subjects' parents or guardians were married (89.5% and 90.3%, for ≤ 8- and > 8-years-old, respectively). Most fathers or male guardians had at least a graduate education level (71.1% and 59.7% for ≤ 8- and > 8-years-old, respectively). Meanwhile, half of the subjects' mothers or female guardians had at least an intermediate or secondary educational level, and the remainder achieved graduate level work. Family incomes ranged between 3000 and 6000 RS/month (52.6% and 41.9% for ≤ 8- and > 8-years-old, respectively). In the ≤ 8- and > 8-year-old groups, 18% and 29%, respectively, of girls spent 50% of their daily pocket money on food. For family size, 28.9% of ≤ 8-year-old girls had families of 6 or more persons, and about one-fifth (21%) of girls older than 8 had family sizes between 5 and 6.

Body composition

Girls' body composition was analyzed in terms of mean and SD for body fat as a percentage of total body weight, body fat (kg), lean muscle mass (kg), and total fluid as a percentage of weight (Table 3).

Table 3. *Body composition of study subjects*

Parameters		≤ 8-years-old	> 8-years-old	P*
	RR	Mean ± SD	Mean ± SD	
Fat %	18 – 25	28.20 ± 15.44	22.89 ± 10.05	0.099
Fat weight (kg)	2 – 13	7.43 ± 6.66	7.96 ± 6.85	0.231
Lean (kg)	13 -62	16.96 ± 4.10	25.47 ± 1.63	0.000
Dry lean weight (kg)		3.85 ± 0.89	5.91 ± 1.63	0.000
Water %	57 -66	55.48 ± 12.33	59.23 ± 7.72	0.146
Water (L)		13.10 ± 3.27	19.56 ± 5.22	0.000

RR =Recommended Range SD = standard deviation. P: Mann-Whitney test.*

The mean body fat % of girls in the ≤ 8-year-old group was greater than that of the > 8-year-old group (28.2 ± 15.4 kg and 22.9 ± 10.1, respectively). The mean values of body lean and dry mass (kg), as well as body fluid (liter) for girls in the > 8-year-old age group were significantly higher ($p < 0.01$) than those for girls younger than 8 (Table 3).

Anthropometric measurements

The mean of waist and hip circumferences, as well as mean MAC in the > 8-year-old group were significantly higher ($P < 0.001$) than those of girls in the ≤ 8-year-old group (64.76 ± 8.3 cm, 76.00 cm ± 8.3 and 22.8 ± 3.3 cm vs. 57.5 ± 6.5 cm, 68.05 ± 6.8 cm and 20.2 ± 2.4 cm, respectively) (Table 4).

Table 4. *Waist, hip, and mid-arm circumference of study subjects*

Parameters	≤ 8-years-old	> 8-years-old	P*
	Mean ± SD	Mean ± SD	
Waist circumference (cm)	57.50 ± 6.48	64.76 ± 8.28	0.000
Hip circumference (cm)	68.05 ± 6.76	76.00 ± 8.28	0.000
MAC (cm)	20.16 ± 2.37	22.93 ± 3.27	0.000

y = years RR =Recommended Range SD = standard deviation.
P: Mann-Whitney test.* MAC =Mid-Arm Circumference

About 8.1% of girls in the > 8-year-old group were underweight (i.e., < -2 SD of weight for their age) compared to 5.3% of girls in the ≤ 8-year-old group. Meanwhile, in both age groups, most girls (31.6 and 41.9% of younger and older groups, respectively) were overweight (Wt for age > -1 SD). A significant difference between mean weight across the weight categories for both age groups was observed (Table 5).

Table 5. *Weight for age and mean weight distribution of study subjects*

Wt for age Z-scores	≤ 8-years-old		> 8-years-old		X^2	P	Wt of ≤ 8-year-olds	Wt of > 8-year-olds	P*
	No.	%	No.	%			Mean ± SD	Mean ± SD	
< -2 SD Underweight	6	5.3	15	8.1			29.5±0.35	35.7±9.88	0.857
-2 to -1 SD Normal	21	18.4	9	4.8	5.26	.072	25.7±6.43	27.3±2.3	0.267
> -1 SD Over weight	36	31.6	78	41.9			23.3±5.69	32.47±7.8	0.001
Total	63	55.3	102	54.8			24.4±6.8	33.4±9.4	0.000

y = years a: X^2 Chi-Square; SD = standard deviation. P: Mann-Whitney test.*

Using the cutoff value of –2 Z-score of height-for-age, the overall prevalence of stunting was 18.4% and 11.3% in the ≤ 8-year-old and > 8-year-old groups, respectively, whereas differences between means for height for all height categories were statistically significant (Table 6).

Table 6. *Height for age and the mean height distribution of study subjects*

Ht for age Z-scores	≤ 8-years-old		> 8-years-old		X^2	P	Ht. of ≤ 8-years-old	Ht. of > 8-years-old	P*
	No.	%	No.	%			Mean ± SD	Mean ± SD	
<-2 SD Stunting	21	18.4	21	11.3			109.0±5.82	130.4±11.5	0.004
-2 to -1 SD height	30	26.3	57	30.6	1.04	0.59	118.20±2.8	133.21±7.9	0.000
>- 1 SD Normal height	63	55.3	108	58.1			124.29±7.3	141.7±11.1	0.000
total	114	100	186	100.			119.87±8.3	137.8±11.1	0.000

y = years a: X^2 Chi-Square SD = standard deviation. P: Mann-Whitney test.*

In both groups, heights increased gradually when height-for-age Z-score levels increased. Nevertheless, the stunting was more prevalent among those in the younger age group (≤ 8-years-old).

The majority of students (73.7%) had normal BMI-for-age Z-scores at the level -2 to 1 SD, and this outcome was confirmed by the mean BMI for girls in both groups in (15.6 ± 3.16 vs. 17.53 ± 3.8 kg/m^2 for ≤ 8-years-old and > 8-years-olds, respectively) (Table 7).

Notably, 13.2% and 16.1% of girls in the younger and older groups, respectively, were overweight. A small percentage (2.6% and 6.5%, younger and older, respectively) of girls in both age groups were obese.

Table 7. *BMI for age and mean height distribution of study subjects*

BMI-for-age Z-score	≤ 8-years-old No.	≤ 8-years-old %	> 8-years-old No.	> 8-years-old %	X^2	P	BMI of ≤ 8-years-old Mean ± SD	BMI of > 8-years-old Mean ± SD	P*
< -3 SD Severe thinness	3	2.6	6	3.2	1.94	0.75	11.0 ± 0.01	11.75 ±1.1	0.953
-3 to < -2 SD Thinness	9	7.9	24	12.9			12.17 ± 0.3	16.4 ± 5.75	0.893
-2 to 1 SD Normal	84	73.7	114	61.3			15.3 ± 2.79	16.48 ±1.7	0.859
1 to 2 SD Overweight	15	13.2	30	16.1			19.3 ± 1.14	19.96 ± 1.5	0.993
> 2 SD Obesity	3	2.6	12	6.5			20.8 ± 0.01	26.7 ± 3.15	0.959
Total	114	100	186	100			15.6 ± 3.16	17.53 ± 3.8	0.853

y = years a : X^2 Chi-Square SD = standard deviation. P: Mann-Whitney test.*

Nutrient intake for girls relative to adequate intake (AI)

Overall, the calorie intake by study subjects was lower than the AI (64.05% vs. 75.7% of AI for the >8-year-old and ≤ 8-year-old groups, respectively, P=0.696) (Table 8).

Table 8. *Macro-nutrient intake and percentage of AI for study subjects*

ParametersParameters	≤ 8-years-old Mean ± SD	≤ 8-years-old AI	≤ 8-years-old % AI	> 8-years-old Mean ± SD	> 8-years-old AI	> 8-years-old % AI	P*
Energy (Kcal)	1135.7 ± 737.5	1500	75.7	1152.9 ± 672.8	1800	64.05	0.696
Protein (g)	49.27 ± 46.18	19	259.3	44.59 ± 33.13	34	101.3	0.812
Total Fat (g)	43.25 ± 41.4	-	-	44.79 ± 42.57	-	-	0.895
Carbohydrate (g)	137.35 ± 101.1	130	105.7	142.87 ± 92.1	130	109.9	0.614
Fiber (g)	7.8 ± 5.3	25	31.2	8.31 ± 4.9	26	32	0.382

y = years AI = Adequate Intake - Source: IOM, 2005SD = standard deviation. P: Mann-Whitney test.*

Table 9. *Mean and SD for protein, fat and carbohydrate energy ratios for study subjects*

Parameters	≤8-years-old (Mean ± SD)	> 8-years-old (Mean ± SD)	P* value
Protein Energy Ratio (PER)	16.84 ± 7.49	16.49 ± 9.71	0.532
Fat Energy Ratio (FER)	32.21 ± 16.21	32.26 ± 16.9	0.876
Carbohydrate Energy Ratio (CER)	50.95 ± 17.77	51.25 ± 16.7	0.926

y = years SD = standard deviation. P: Mann-Whitney test.*

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The total protein intake of girls in the ≤ 8-year-old was higher compared to AI (259.3%) and to the >8-year-old group (101.3% of AI; P=0.812). Meanwhile, the fiber intake for both groups was far below AI (32%). The groups had non-significant (p>0.05) differences in macronutrient intake. Moreover, the two age groups had energy ratios for protein (PER), fat (FER), and carbohydrate (CER) that all differed by less than 1% (Table 9).

With the exception or iron and phosphorous, which was at or above AI, for older and younger girls, respectively, both age groups had average daily intakes of Ca, Mg, K, Na and Zn that were markedly lower than the AI (Table 10). Both groups consumed similar amounts of minerals, except for Na (p= 0.011) and K (p= 0.047).

Table 10. *Mineral intake of subjects relative to average intake (AI)*

Parameter (mg)Parameters	≤ 8-years-old			> 8-years-old			
	Mean ± SD	AI	% of AI	*Mean ± SD*	AI	% AI	P*
Ca	341.38 ± 227.17	800	42.6	339.71 ± 190.39	1300	26.1	0.652
Fe	9.05 ± 7.55	10	90.5	10.14 ± 13.33	8	126.8	0.187
Mg	107.24 ± 96.6	130	82.49	113.22 ± 80.92	240	47.2	0.469
P	500.55 ± 149.47	500	100.1	588.43 ± 109.69	1250	47.1	0.354
K	738.71 ± 143.85	3,800	19.5	1207.9 ± 153.3	4500	26.8	0.047
Na	748.52 ± 155.28	1,200	62.38	1000.3 ± 272.49	1500	66.7	0.011
Zn	4.04 ± 1.1	5	89.8	4.46 ± 2.89	8	55.8	0.438

y = years AI= Adequate Intake - Source: IOM, 1997, 2000a, 2000b, 2004
SD = standard deviation. P: Mann-Whitney test.*

The folic acid intake was lowest compared to AI for both groups (Table 11), whereas both age groups met or exceeded AI values for the daily intake of vitamins C, B_1, and B_2. For vitamin C in particular, the intake was more than double the AI (247%).

Table 11. *Vitamin intake and percentage of AI for study subjects*

	≤ 8-years-old			> 8-years-old			
Vitamin	*Mean ± SD*	AI	% of AI	*Mean ± SD*	AI	% of AI	P*
C (mg)	61.74 ± 16.4	25	246.9	55.77 ± 17.9	45	123.9	0.68
B_1 (mg)	0.93 ± 0.29	0.6	155	0.9 ± 0.11	0.9	100	0.918
B_2 (mg)	0.9 ± 0.7	0.6	150	1.24 ± 0.7	0.9	137.8	0.314
B_3	7.3 ± 2.8	8	91.25	7.9 ± 6.08	12	65.8	0.657
Folic acid	135.87 ± 36.0	200	67.9	137.4 ± 31.78	300	45.8	0.809
A (IU)	543.45 ± 161.05	400	134.8	660.42 ±192.70	600	110.1	0.332

y = years AI= Adequate Intake - Source: IOM, 1997, 2000a, 2000b, 2004
SD = standard deviation. P: Mann-Whitney test.*

Table 12. *Correlation coefficients between some social variables, body composition and nutrients* *[**. Correlation is significant at the 0.01 level]*

	Weight	Height	Waist	Hip	MAC	Fat %	Lean	Water%	weigh-for-age	weight-for-age (z-score)	Ht. for age percentile	Ht. for age (z-score)	BMI-for-age	BMI-for-age (z-score)	energy	protein	fat	Carb.	Ca	Vit. C	Age	Family Size	Income
Height	.583**																						
Waist	.732**	.491**																					
Hip	.794**	.657**	.822**													.*							
MAC	.798**	.568**	.832**	.898**																			
Fat %	.239*	-.089-	.091	.086	.019																		
Lean	.828**	.661**	.699**	.769**	.811**	-.313**																	
Water %	-.249*	.058	-.102-	-.101-	-.030-	-.997**	.298**																
Wt. for age percentile	-.048-	-.092-	-.018-	.000	.024	-.161-	.044	.169															
Wt. for age (z-score)	-.124-	-.131-	-.099-	-.085-	-.099-	-.078-	-.071-	.084	.963**														
Ht. for age percentile	.362**	.454**	.155	.305**	.266**	.220*	.230*	-.230*	-.224-	-.312*													
Ht. for age (z-score)	.219*	.379**	.185	.277**	.283**	.101	.195	-.108-	-.258-	-.307*	.875**												
BMI-for-age	.395**	.010	.444**	.449**	.475**	.387**	.200	-.376**	-.065-	-.144-	.141	.236*											
BMI or A (z-score)	.383**	.003	.455**	.440**	.486**	.329**	.249*	-.318**	-.066-	-.129-	.138	.193	.911**										
Energy	.056	.053	.234*	.183	.168	.002	.075	-.009-	-.098-	-.158-	.175	.139	.080	.107									
Protein	-.020-	-.020-	.209*	.078	.110	.073	-.034-	-.077-	-.102-	-.089-	.175	.201*	.133	.148	.670**								
Fat	.042	.072	.174	.205*	.155	-.041-	.082	.028	-.009-	-.100-	.141	.099	.024	.014	.752**	.290**							
carbohydrate	.068	.032	.170	.100	.108	.014	.068	-.014-	-.129-	-.159-	.108	.075	.068	.121	.808**	.530**	.263**						
Ca	.024	-.006-	-.076-	-.016-	-.041-	.064	-.023-	-.063-	.369**	.313*	-.145-	-.151-	-.057-	-.138-	-.131-	-.066-	-.136-	-.077-					
Vit. C	.184	.113	.185	.207*	.135	-.002-	.181	.003	-.080-	.003	.169	.127	.137	.124	.099	.182	-.022-	.129	.150				
Age	.503**	.687**	.503**	.539**	.477**	-.206*	.639**	.184	.075	.043	-.011-	-.003-	-.091-	-.085-	.042	-.051-	.040	.057	.079	.126			
Family Size	-.083-	-.014-	-.041-	-.009-	-.010-	-.196-	.009	.211*	-.025-	.097	-.002-	.114	-.089-	.003	.148	.082	.153	.086	.021	.032	.056		
Income	.118	.137	.131	.198*	.149	.047	096	-.049-	.092	.059	.119	.138	.178	.099	.096	.013	.217*	-.045-	-.062-	-.022-	.025	.164	
Mother's Educational	.189	.165	.247*	.201*	.241*	.053	.159	-.066-	-.025-	.050	.157	.140	.037	.018	.110	.035	.124	.063	-.004-	.130	.008	-.009-	.249*

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Correlation coefficients between some social variables, body composition and nutrients

The correlation coefficients between some social variables, body composition and nutrient intake for girls are shown in Table 12. A positive, highly significant relationship ($p<0.01$) existed between weight and height, waist, hip, MAC circumferences, lean body weight, height for age percentile, BMI for age percentile, and BMI or age Z-score and age. There was also a positive significant association between fat %, but there was a significant negative correlation between weight and water % of study subjects.

Meanwhile, there was a positive significant correlation ($p<0.05$) between waist circumference and energy, protein intake, and mother's educational level. A positive, highly significant correlation ($p<0.01$) was reported between hip circumferences and MAC circumferences, lean body weight, height for age percentile, height for age Z-score, BMI for age percentile, BMI for age Z-score, and subject age, whereas there was a significant positive correlation ($P<0.05$) between hip circumference and fat and each vitamin measured, income, and mother's educational level. MAC circumference had a highly significant ($p<0.01$) positive relationship with lean body weight, height for age percentile, height for age Z-score, BMI for age percentile, and BMI for age Z-score and subject age. Meanwhile, a positive significant correlation ($p<0.05$) was reported between MAC circumference and mother's educational level.

Concerning fat%, a positive significant correlation ($p<0.01$) was reported between %fat and BMI for age percentile and BMI for age Z-score. There was also a significant positive correlation ($P<0.05$) between fat% and height for age percentile. In contrast, hand fat% had a negatively significant ($p<0.05$) correlation with age. Lean body weight showed a positive highly significant correlation ($p < 0.01$) with both water% and age, and significantly ($p<0.05$) correlated with height for age percentile and BMI for age Z-score. Water % had a positive significant correlation with family size, but correlated negatively significant with BMI for age percentile and BMI for age Z-score ($P<0.01$), as well as with height for age ($P<0.05\%$).

A noticeable significant positive correlation between weight for age and calcium was observed ($P<0.01$). Meanwhile, a positive significant correlation ($p<0.05$) was reported between BMI for age and protein intake.

A highly positive significant correlation ($P<0.01$) was reported between energy intake and protein and fat intake. There was also a significant positive correlation ($P<0.01$) between carbohydrate intake and both protein and fat intake. Table 12 also indicates that family income correlated significantly and positively ($p<0.05$) with fat intake and mother's educational level.

DISCUSSION

In this study we examined nutritional intake of 300 schoolgirls in Saudi Arabia and its relationship with socioeconomic and anthropomorphic factors. In our study cohort, we found that family income had a significantly ($p<0.05$) positive correlation with fat intake and the mother's educational level, which is consistent with results reported by Zarnowiecki et al. (2015), but in contrast to those of Nathalie et al. (2012) that saw no significant socio-demographic differences among children who were or were not enrolled in the Children's Body composition and Stress (ChiBS) study. Despite the differing outcomes of this study with earlier studies, tailoring interventions and health promotion to particular needs of socio-economically disadvantaged children could produce more successful outcomes and reduce socio-economic disparities in dietary intake.

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The increasing prevalence of obesity during children's growth and development is significantly related to educational factors, both for children and the parents, who influence food intake and physical activity beginning early in life (Parizkova 2008).

For example, in the past 20 years obesity among Canadian children increased by 3-fold and those children living in low-income neighborhoods exercise less and are more overweight than those living in more affluent neighborhoods after accounting for family socio-economic status (Merchant et al. 2007).

In the ChiBS study, Nathalie et al. (2012) confirmed that its sample represented the general population by comparing the study sample SD demographics to the general public using information provided by Flemish governmental agencies to find that environmental factors should be taken into account when studying factors that contribute to obesity in children. On other hand, Merchant et al. (2007) suggested that lifestyle intervention should be customized according to community needs.

We compared results from a previous study in Bahrain using body measurement methods that differed from those used in this study to evaluate our findings (Musaiger and Gregory 2000). We found that the younger and older age groups had a stunting (height-for-age < 5^{th} percentile in NHANES III-based references) prevalence of 7.5% and 16.7%, respectively, and linear growth deficits (lower than –1 SD of the median of NCHS/WHO values) were 25.0% and 33.3%, respectively. Height levels for both groups increased gradually with increasing height-for-age Z-score. A study of Mayan children in Mexico by Wilson et al. (2012) found that childhood stunting is associated with an increased risk for obesity in adulthood and that stunting affects 35% of physically active children. The Wilson *et al.* study also used multiple linear regression analysis to show that greater lean body mass, but not stature, predicted higher resting and activity energy expenditure. Moreover, a lower height-for-age *z*-score, but not stunting, as a categorical variable significantly predicted lower activity energy expenditure (Wilson et al. 2012).

Several studies from developing countries reported similar prevalence data for stunting: 6.2%–15.2% in public schools in Brazil in 1990 (Gross et al. 1990), 15.8% in Nigeria (Abidoye and Akande 2000), 12.7% (at age 7 years) to 18.8% (at age 12 years) in Indian school-aged boys (De Onis et al. 2001), 18.7% in Chad in 2002 (Beasley et al. 2002)**,** 15%–40% in South Africa in 2003 (Jinabhai, Taylor, and Sullivan 2003), 25% in Morocco in 2004 (Aboussaleh et al. 2004), 18.3% in Kenya in 2005 (Friedman et al. 2005), and 16.5% in rural areas of southern Pakistan in 2005 (Khuwaja, Selwyn, and Shah 2005). In a study of children in Baghdad, Iraq, the prevalence of stunting alone, and concurrent stunting with being underweight, was 18.7% and 13.5% respectively (Al-Saffa 2009). Chronic undernutrition, as evidenced by the proportion of stunted children, was of mild prevalence in this primary school-aged cohort (18.7%) and the overall prevalence of linear growth deficit was 53.3%. Subtracting the normal baseline or expected stunting prevalence of 2.3% in the general population (WHO 2007) produced a prevalence of 16.4%, which is below the 22.2% in the 3^{rd} report on the world nutrition situation for the Near East/North Africa region by the Administrative Committee on Coordination/Sub-Committee on Nutrition (ACC/SCN) (TRWNS 1997).

Our results revealed that heights increased gradually in both group when height-for-age Z-score levels increased. Nevertheless, the stunting was more prevalent among those in the younger age group (≤ 8-years-old). However, the Wilson et al. study (2012) showed that Mayan children in Mexico who have shorter stature and less lean body mass had lower total energy expenditure.

Wilson et al. (2012) found a high correlations between obesity and both metabolic activity and body composition among Maya children

Obesity arises from excess body fat (Flodmark et al. 2004) and childhood obesity can have long-term health effects (Hodgkin et al. 2010). The rate of childhood obesity is growing worldwide Fisher et al. (2006)

A study by Michels et al. (2012) also indicated that the prevalence of childhood obesity is increasing. Apart from other lifestyle factors, the effect of chronic psychosocial stress on obesity is recognized.

In the current study, 6.5% and 13% of girls aged > 8-years-old and ≤ 8-years-old were overweight, which is similar to previous studies. Moreover, further funding to prolong the follow-up phase to the ages of adolescence as this would provide sensitive information on stress-related changes from childhood to adolescence (Michels et al. 2012).

As noted by Hodgkin et al. (2010)**,**

> Rural children had a significantly lower BMI, smaller waist circumferences and thinner skinfold measurements than urban children. The differences in skinfold thicknesses remained after controlling for ethnicity and socioeconomic status. Furthermore, urban boys were 1.3 times more likely to be overweight or obese than rural boys (95% confidence limits 1.1-1.6, p <0.01) and urban girls were 1.4 times more likely to be overweight or obese than rural girls (95% CL 1.2-1.7, p <0.01).There was no significant difference in the energy intake per day of rural and urban children. Similarly, there was no significant difference in the frequency of bouts of physical activity undertaken by rural and urban children.

Flodmark et al. (2004) found that a high priority needed to Evidence- based health promotion programs to prevent child and adolescent obesity

Our results revealed a significant positive correlation (P<0.01) between carbohydrate intake and both protein and fat intake. In addition, calorie intake was lower than AI, and older girls consumed fewer calories than younger girls (Table 8). Meanwhile, total protein intake was significantly greater than AI for the younger girls relative to older girls, but the fiber intake of both groups was markedly below the AI (Table 8).

Another study involving healthy Spanish children (n = 245, 124 girls and 121 boys), aged 4-16 years was carried out by Lavado-Garcia et al. (2012).

Lavado-Garcia et al. (2012) revealed a significant difference in total body fat, total body water and all anthropometric measurements for both gender analysis using amplitude speed of sound and broadband ultrasound attenuation.

Our results revealed that the average daily intake of iron, magnesium, phosphorus, and sodium were lower than the intake for girls in the older age group (> 8-years-old. Regarding vitamin intake, the average daily intake of folic acid and was markedly lower than AI for both groups of students, whereas daily intake of vitamins A, B1, B_2 and B_3 for all students met AI values (Table 11) also our results revealed that both groups had Ca, Mg, K, Na and Zn intakes that were significantly lower than AI and all of these minerals needed to maintain cellular metabolism specially zinc (Sheng et al. 2015).

Neyestani et al. (2010) reported that nutritional status of physically disabled children more liable for complicated malnutrition specially girls as they have lower intake of fat and riboflavin .Zhao et al. (2010) found that vegetarian population more liable to growth retardation and malnutrition compared with non-vegetarian.Singhal et al. (2010) mentioned

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that an increase knowledge of nutrition and lifestyle habits was important in improving biochemical analysis and anthropometric measurements

CONCLUSION

Calories, Ca, Mg, K, Na and Zn, vitamin B_3, and folic acid intakes were significantly lower than AI for girls in both age groups. Girls in the $\leq$ 8-year-old group were leaner than girls in the > 8-year-old group.

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