Assessing the Nutritional Status of Palestinian Adolescents from East Jerusalem: a School-based Study 2002–03

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Summary

In Palestine, there is a little information about nutrition of adolescents compared to other age groups. This study was designed to assess the nutritional status of Palestinian school-aged children (11–16 years) in East Jerusalem during 2002–03. A school-based cross-sectional study targeted randomly 313 adolescents from public and private schools. A previously validated and reliable questionnaire was administered through interviews that included anthropometric and hemoglobin measurements, 24-h dietary intake recall and physical activity questionnaire. It was found that being overweight (24.3%) or obese (9.9%) coexisted with being underweight (4.8%) and/or anemic (23.3%). Only 22.4% of the study subject had physical activity for $\geq$5 days a week with boys being more physically active than girls ($p < 0.01$). Inadequate energy intake had 55.66% of boys and 64.81% of girls; inadequate protein intake was reported by 15.07% of boys and 43.08% of girls. The majority of them met <80% of the recommended daily allowances for most micronutrients. The whole sample and especially boys consumed more total, saturated fat, less monounsaturated fat and carbohydrates than what is advised. Obese and overweight adolescents had lower energy intake ($p < 0.05$) and a lower trend in being physically active than normal weight counterparts. School health education programs targeted at adolescents and parents need to be developed as part of overweight-obesity, malnutrition and anemia prevention.

Key words: adolescents, nutritional status, anemia, dietary intake, East Jerusalem.

Introduction

Assessing the nutritional status of children is a widely used method to monitor and evaluate their health. Satisfactory dietary intake and consequently good nutritional status is important for the physical and mental development during the paediatric years. Children gain up to 50% of their adult weight, >20% of their height and 50% of their adult skeletal mass and especially adolescents who reach their final height [1] and being malnourished in this age exposes them to serious health problems on the short and long term [2, 3].

Evidence from many studies from developing countries have shown that adolescents received little attention regarding their nutrition [4] and suggests that intakes of several essential dietary nutrients do not meet the recommendations, whereas intakes from fat exceeds the recommendations [5].

In Palestine, dietary habits and nutritional status of pre-school children, non-pregnant women (aged 15–49 years) and adults (aged 18–64 years) have

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been studied extensively, while little attention has been paid to adolescents [3, 6, 7], who represent 32% of the total population [8]. However, at the time of our study, no data about the nutrition intake and physical activity among school adolescents was available. Consequently, the purpose of the present study was to assess the nutritional status of Jerusalemite school children during puberty by applying anthropometric measurements, biochemical test, dietary intake estimation and lifestyle assessment. The study was part of a broader initiative of the World Health Organization (WHO) to explore the health and nutrition status of children and adolescents in more than 35 countries including Palestine.

Methods

Settings

This cross-sectional study is part of The Health Behavior for School-Aged Children Project (HBSC) targeting school aged children in East Jerusalem during 2002–03. The four school ownerships [Palestinian schools, United Nations Relief and Works Agency (UNRWA) schools, Israeli Municipality schools and Private schools] were eligible. However, the authorities of the Israeli Municipality refused our request to blood samples from school participants and they allowed us to administer the questionnaire outside school hours, this proved to be a difficult exercise because students were in a rush to go home. Furthermore, the idea of administrating the questionnaire at their respective homes was not easily attainable due to lack of information about their addresses. Nonetheless, we managed to administer ~15% of the total number. The authors took the decision to exclude them from the total sample due to the low number.

Due to lack of financial means, a cross-sectional study rather than case-control study design was pursued.

Sampling

Based on the WHO 1997/1998 research protocol, three age groups of school aged children were selected with a year interval; these age groups were considered as adolescents based on the WHO criteria [9]. The selection of study population was multi-staged stratified and designed according to school ownerships, classes (6th, 8th, 10th grade) and gender. Official letters were sent to the four school ownerships informing them of the researcher's intention to implement the study and requesting their approval. Lists of the schools under their supervision were also requested from them. Upon receiving the school lists, names of school were entered on the computer for random selection. Introductory visits to the selected schools were made. The researcher delivered the approval letter and distributed the letter of content to be signed by the students' parents. After several days, these letters were collected and names of students were entered on the computer to be randomly selected. Considering that the Israeli Municipality schools were excluded, a total of 313 students 11–16 years old were finally studied (159 males and 154 females). All the invited students participated in this study, giving a response rate of 100%.

Measurement tools

Questionnaire. The questionnaire used in the study was developed during the First Palestinian National Health and Nutrition Survey in 2000 [10]. It included several dimensions such as socio-demographic, anthropometric, nutritional 24-h recall and life style.

Outcome measurements

Anthropometric measurements. Weight was measured without shoes in light clothes using TANITA digital scale (model 1582) to the measurement 0.1 kg while height in standing position to the nearest 0.1 cm using a coil-spring tape measure. An experience field worker carried out these measurements in the school before the interview.

The anthropometric categorization of children was made according to Centers for Disease Control (CDC) and International Obesity Taskforce (IOTF) [11, 12]. For analytic reasons, children were divided into four groups: underweight, normal, overweight and obese.

Hematological screening test. Blood samples for hemoglobin level assessment were collected using an instantly calibrated finger prick Hemocue machine (Hemocue AB, Angelholm, Sweden). Anemia was defined as hemoglobin value below $12\,g\,dl^{-1}$ for girls and boys younger than 14 years and $<13\,g\,dl^{-1}$ for boys older than 14 years [13].

Dietary assessment. A 24-h recall technique was applied to describe dietary intake of school children. A modified USDA food database to include the Palestinian typical dietary patterns [10] was used to assess the dietary intake.

An expert in this field was responsible for administrating the 24-h recall according to protocol. There was little burden on the child, as each interview generally took about 20–45 min. Children were asked to describe the type and amount of food, as well as all beverages consumed during the day preceding the interview. To improve the accuracy of food descriptions, a food intake booklet, including pictures of

Palestinian food, was used to define amounts when appropriate.

Physical activity assessment. The students' responses to physical activity questionnaires were categorized based on a recently published study [7].

Data analysis

The Statistical Package for Social Sciences (SPSS) Version 15 was used for data analysis.

Pearson chi-square test was performed to test the difference between categorical data. Fisher's exact test was used when expected cell values were <5. We tested the normality of all variables by using the normal curve and Kolmogorov–Smirnov test. Independent Student's *t*-test was employed for normally distributed variables (hemoglobin, height) to compare the mean level of parameters between boys and girls, presenting standard deviation to show the individual variability for the studied parameters. In case of non normality we used a non parametric Mann–Whitney U-test to compare mean level of continuous variables (weight, BMI, energy, macronutrients, and micronutrients) between different sexes. The Recommended Daily Allowances (RDAs) used were based on (National Research Council 1989) less than 80% of RDA considered as a marginal intake of nutrients [6, 14] Kruskal–Wallis H-test was used to compare the mean energy and physical inactivity among different categories of anthropometric indices (underweight, normal, overweight, obese). For dietary components showing significant difference among the previous indices, Mann–Whitney U-test followed the previous test for multiple comparison of each pair of these indices.

Ethics

The study was approved by the Human Research Ethics Committee at Al-Quds University. Approvals to carry out this study were granted by three school ownerships as well as the students' parents. Prior to the interview, children were asked verbally if they agreed to go on with the interview and the hemoglobin test. All respondents were guaranteed anonymity.

Results

The socio-demographic, lifestyle and anthropometric characteristics of the study participants are presented in Table 1. In total, 314 children were recruited ranging from 11 to 16 years of age. The gender was almost equally distributed among the different age groups.

Overweight was prevalent in 24.3% of all children and 9.9% of the subjects was obese while 4.8% was underweight. No significant differences regarding these anthropometric characteristics were observed between the two sexes.

A total of 252 (80.5%) subjects rated their health as an excellent, with boys reporting themselves as healthier ($p < 0.01$).

The mean hemoglobin level ($g\,dl^{-1}$) among the 313 children was 13.11 ± 1.36 and anemia prevalence was 23.30%. Although the mean hemoglobin level was significantly higher in boys (13.35 ± 1.40) than in girls (12.87 ± 1.28) ($p < 0.01$), anemia prevalence was not found to differentiate significantly between them. On the other hand, the prevalence of anemia was higher in underweight (26.7%) compared to normal-weight children (22.5%).

Out of the total interviewed students, 22.4% reported to have physical activity for >5 days a week, with boys being more active ($p < 0.01$), whereas girls reported to work longer with their homework ($p < 0.01$).

Table 2 illustrates the energy and macronutrient intake (expressed as percentage of daily energy intakes) of all participants and according to gender. The reported energy intake from males was higher than females ($p = 0.001$). When dietary intakes of the whole sample were compared with current recommendations (WHO 2002), it was observed that total and saturated fat were higher than recommended (<30 and <10% respectively), contrary to carbohydrates and monounsaturated fat that were lower (>55 and 15–20%). After categorizing children to males, their total and saturated fat intake was found to be considerably higher than recommended. On the other hand, in females the reported protein, monounsaturated fat, carbohydrate consumption were lower than recommended (protein intake should range between 12 and 20%). Finally, we checked for any gender differences in micronutrients intake and no statistical significance was indicated.

Table 3 depicts the number and percentage of schoolchildren in relation to age groups with inadequate (<80% RDA) intakes of energy, protein and selected vitamins and minerals. More than half of boys (55.66%) and higher number of girls (64.81%) had inadequate energy intake. Nearly one-fifth of boys (15.07%) and half of girls (43.08%) showed inadequate protein intake. More than 50% of adolescent boys and girls were below 80% of the RDA for vitamins A, B6, B12, thiamin, riboflavin, niacin, iron (girls), calcium phosphorous, magnesium and zinc.

Table 4 shows the distribution of children in different anthropometric categories based on BMI cut-off values [11, 12]. It is observed that energy intake was significantly higher in the normal weight than the other categories ($p < 0.05$). The distribution of physical inactivity according to each anthropometric category revealed that obese adolescents were considerably more physically inactive than their normal weight counterparts. In regards to either

TABLE 1
General characteristics of school-aged children in East Jerusalem

Characteristics	Total ($n=313$)	Male ($n=159$)	Female ($n=154$)	p-value
Age, years				
11–12, n (%)	117 (37.40)	60 (37.70)	57 (37.00)	
13–14, *n* (%)	118 (37.70)	59 (37.10)	59 (38.30)	
15–16, *n* (%)	78 (24.90)	40 (25.20)	38 (24.70)	0.976[a]
Perceived health				
Healthy, *n* (%)	252 (80.50)	137 (86.20)	115 (74.70)	
Un-healthy, *n* (%)	61 (19.50)	22 (13.80)	39 (25.30)	0.008[b]
BMI ($kg\,m^{-2}$), mean ± SD	21.18 ± 4.24	20.72 ± 3.98	21.65 ± 4.48	0.024[c]
Underweight,[d] *n* (%)	15 (4.80)	6 (3.80)	9 (5.80)	0.390[a]
Overweight,[e] *n* (%)	76 (24.3)	35 (22.00)	41 (26.6)	0.340[a]
Obese,[e] *n* (%)	31 (9.9)	13 (8.20)	18 (11.70)	0.290[a]
Hemoglobin ($g\,dl^{-1}$), mean ± SD	13.11 ± 1.36	13.35 ± 1.40	12.87 ± 1.28	0.001[f]
Anemia[g]	73 (23.30)	32 (20.10)	41 (26.60)	0.110[b]
Physical activity				
≥5 days a week, *n* (%)	70 (22.4)	46 (28.9)	24 (15.6)	
<5 days a week, *n* (%)	243 (77.6)	113 (71.1)	130 (84.4)	0.003[b]
TV viewing				
≥4 h a day, *n* (%)	80 (25.60)	36 (22.60)	44 (28.60)	
<4 h a day, *n* (%)	233 (74.40)	123 (77.40)	110 (71.40)	0.142[b]
Homework				
≥4 h a day, *n* (%)	35 (11.20)	7 (4.40)	28 (18.20)	
<4 h a day, *n* (%)	278 (88.80)	152 (95.60)	126 (81.80)	0.001[b]
Using computer				
Yes, *n* (%)	196 (62.60)	102 (64.20)	94 (61.00)	
No, *n* (%)	117 (37.40)	57 (35.80)	60 (39.00)	0.326[b]

[a] p-value of Pearson chi-square test.
[b] p-value of Fisher's exact test.
[c] p-value of Mann–Whitney U-test.
[d] Underweight defined as BMI-for-age <5th percentile [11].
[e] Overweight and obesity defined according the international cutoff values of BMI for age and gender [12].
[f] p-value of independent Student's t-test.
[g] Anemia was considered present if the hemoglobin value was below $12\,g\,dl^{-1}$ for girls and boys <14 years and <$13\,g\,dl^{-1}$ for boys >14 years [2, 42].

TABLE 2
Reported energy and macronutrients daily intake of school-aged children in East Jerusalem

Nutrient (unit)	Total ($n=313$)	Male ($n=159$)	Female ($n=154$)	Recommended intakes[a]	p-value[b]
Energy (kcal)	1909.73 ± 886.30	2158.17 ± 944.51	1651.40 ± 742.43		0.001
Protein, % of energy	12.7 ± 8	15.4 ± 9.1	9.9 ± 5.4	12–20	0.001
Total fat, % of energy	34.7 ± 19.6	39.8 ± 21.4	29.5 ± 16.1	<30	0.001
Saturated fat, % of energy	10.3 ± 6.6	12 ± 7.5	8.6 ± 5	<10	0.001
Monounsaturated fat, % of energy	12.2 ± 5.6	14.2 ± 5.7	10.3 ± 5.4	15–20	0.001
Polyunsaturated fat, % of energy	9.4 ± 5.6	10.4 ± 5.7	8.4 ± 5.4	≤10	0.001
Carbohydrate, % of energy	54 ± 23.5	59.2 ± 24.7	48.4 ± 20.8	>55	0.001

[a] Ref. [42]
[b] p-value of Mann–Whitney U-test.

TABLE 3
Energy and selected nutrients by school-aged children in east Jerusalem compared with RDA

Nutrient (unit)	11–14 years ($n=235$)				15–16 years ($n=78$)			
	Male ($n=119$)		Female ($n=116$)		Male ($n=40$)		Female ($n=38$)	
	<80% RDA (n, %)	RDA	<80% RDA (n, %)	RDA	<80% RDA (n, %)	RDA	<80% RDA (n, %)	RDA
Energy (kcal)	70 (58.82)	2500	71 (61.21)	2200	21 (52.50)	3000	26 (68.42)	2200
Protein (g)	21 (17.65)	45	45 (38.79)	46	5 (12.50)	59	18 (47.37)	44
Vitamins								
Vitamin A (IU)	70 (58.82)	3330	57 (49.13)	2664	17 (42.50)	3330	27 (71.05)	2664
Vitamin E (mg)	47 (39.49)	10	42 (36.21)	8	16 (40.00)	10	20 (52.63)	8
Folic Acid (μg)	16 (13.44)	150	51 (44.96)	200	3 (7.50)	150	10 (26.31)	180
Vitamin C (mg)	31 (26.05)	50	43 (37.06)	50	14 (35.00)	60	16 (42.10)	60
Vitamin B6 (mg)	78 (65.54)	1.7	72 (62.06)	1.4	23 (57.50)	2.0	26 (68.42)	1.5
Vitamin B12 (mg)	72 (60.50)	2.0	87 (75.00)	2.0	17 (42.50)	2.0	27 (71.05)	2.0
Thiamin (mg)	105 (88.23)	1.3	85 (73.27)	1.1	35 (87.50)	1.5	26 (68.42)	1.1
Riboflavin (mg)	79 (66.38)	1.5	75 (64.65)	1.3	23 (57.50)	1.8	27 (71.05)	1.3
Niacin (mg)	77 (64.70)	17	79 (68.10)	15	25 (62.50)	20	27 (71.05)	15
Minerals								
Iron (mg)	57 (47.89)	12	90 (77.58)	15	17 (42.50)	12	29 (76.31)	15
Calcium (mg)	113 (95.95)	1200	112 (96.55)	1200	33 (82.50)	1200	37 (97.36)	1200
Phosphorous (mg)	68 (57.14)	1200	87 (75.00)	1200	15 (37.50)	1200	31 (81.57)	1200
Magnesium (mg)	55 (46.21)	270	71 (61.20)	280	24 (60.00)	400	29 (76.31)	300
Zinc (mg)	99 (83.19)	15	97 (83.62)	12	28 (70.00)	15	34 (89.47)	12

[a]The RDA of <80% used, based on the Nutritional Assessment of the West Bank and Gaza Strip, 2003 [6] and according to the National Research Council, 1989 [31].

TABLE 4
Energy intake and physical activity among different anthropometric characteristics

Dietary component (unit)		Normal weight 191 (61.00%)	Underweight 15 (4.80%)	Overweight 76 (24.30)	Obese 31 (9.90)	p-value[a]
Energy (kcal)	Mean ± SD	2016.12 ± 929.31	11644.11 ± 6665.87	11841.44 ± 83.51	1541.11 ± 705.70	0.021[b]
Physical inactivity[c]						
<5 days a week,	n (%)	141 (73.80)	14 (93.3)	60 (78.90)	28 (90.30)	0.083[d]
TV viewing ≥4 h a day	n (%)	50 (26.20)	2 (13.30)	21 (27.60)	7 (22.60)	0.675[d]
Homework ≥4 h a day	n (%)	22 (11.50)	1 (6.70)	7 (9.20)	5 (16.10)	0.708[d]
Using Computer	n (%)	117 (61.30)	6 (40.00)	49 (64.50)	24 (77.40)	0.092[d]

[a]p-value of Kruskal–Wallis H-test unless otherwise mentioned.
[b]For statistically significant parameters (by Kruskal–Wallis H-test), Mann–Whitney U-test was used for multiple comparison between each pair of nutritional indices as follows: energy (obese vs normal), $p=0.006$.
[c]Categorized based on the HBSC project [7].
[d]p-value Pearson chi-square.

having physical activity less than five days a week or using computer the difference in percentages of adolescents from each anthropometric category was almost significant ($p=0.083$ and $p=0.092$).

Cross tabulation of micro and macronutrients with anthropometric categories showed no statistical significance.

Discussion

The present study aimed to give information about the nutritional status of school adolescents from East Jerusalem with special emphasis to nutrients.

The high participation of adolescents to the questionnaire interview indicated well awareness about nutrition related health problems in this critical age

period and good intentions to participate in this study that is the first attempt to highlight the nutritional status of adolescents.

A majority of the adolescents under study assumed that they are in good health. Boys reported themselves as healthier, which based on author knowledge could be attributed to the fact that in Arab community, families pay more attention in boys than girls including nutrition. However, this study showed that nutritional status of most children was not compatible with their health perception.

The present study found that the prevalence of being underweight among participants was 4.8% slightly lower than that of adolescents in Northern Gaza (5.3%) [2] and almost half of that in Egypt (9%) [15], while it is a bit higher than their counterparts in Israel (4.1%) [16]. The overweight percentage recorded here (24.3%) for all schoolchildren lies within the range (15–45%) estimated in Eastern Mediterranean Region [17] and almost reached the highest percentage (15–25%) derived from South Mediterranean countries [18]. A similar study in Israel also taking place around the same time found 13–15% of adolescents to be overweight that was somewhat less and a lower trend (4–9%) for obesity [19] compared to our study (9.9%). Another study conducted in an urban area of Turkey showed a considerably lower percentage of obesity (2.8%) among adolescents [20].

More than one-fifth adolescents met the criteria [2, 13] to be classified as anemic, which was slightly lower either than in preschool children [21] or pregnant women [22] in Palestine. Anemia could be either of an inheritable or a nutritional basis. Thalassemias are a fairly common reason for anemia in the Middle East (1–15%) [23]. On the other hand, lack of some nutrients (iron, B12, folic acid) intake, as shown in the present study, for prolonged period would result in anemia occurrence [24]. The latter means that adolescents, especially underweight, are vulnerable group for anemia and its complications. Our findings showed about two times less prevalence of anemia as compared with other two cross-sectional studies from Northern Gaza Strip [2] and Egypt [25] for the same age group, which could be explained by the fact that Palestinians in East Jerusalem are covered by the Israeli National Health Insurance Scheme [26]. However, anemia prevalence among adolescents in East Jerusalem is still higher than in developed countries [27]. The higher mean hemoglobin level found among boys is in line with the normal value of hemoglobin concentration for both sexes [28]. In girls there was a higher trend in anemia prevalence maybe due to that menstrual cycle has started.

The trend found in regards to physical activity of adolescents based on sex is in line with that reported from WHO [29] showing that adolescent girls are more inactive. Our findings showed that girls in East Jerusalem engage in doing homework a sitting activity whereas boys are involved in regular outdoor activities reflected in Arab culture. This is also consistent with an international study explaining adolescents' lifestyle [30].

Gender differences in energy and macronutrient intake were observed in this study. Boys rather than girls consumed higher intakes of energy, protein, carbohydrates and total fat that are reflected by the fact that required daily intake of these dietary components is generally less in girls [31]. A high fat intake including saturated fat was reported among all study subjects. This is a health concern, especially as it is associated with obesity in children and an increased burden of cardiovascular disease later in adulthood [32, 33]. Unfavorable nutritional habits among Palestinian adolescents particularly boys have been reported previously [7].

Malnutrition is a widespread problem and an important concern for public health in Middle East [34]. Many studies have been carried out to identify the extent of this situation in different age groups like infants, preschool children, pregnant and lactating mothers. The present study has showed that a substantial percentage of Jerusalemite adolescents have not met the RDA for energy, protein and essential micronutrients such as thiamin, vitamin B12, folic acid, iron, calcium. Appropriate nutrition in puberty is important for healthy growth and chronic disease prevention in adult life [35]. It has been suggested that adequate energy and protein intake is important to ensure proper growth, development and maturation [36]. There are also increased demands for other nutrients. The available evidence suggests that both vitamin A and iron are essential for skeletal and sexual growth [37]. Calcium intake is crucial for skeletal development which is high during adolescence [38]. Another mineral, zinc, which was inadequately consumed by study's subjects (Table 3), would adversely affect the immune system and growth in lack of it [39].

It is widely known that energy balance in humans is controlled by two energy regulators, energy intake and energy expenditure [40]. The positive energy balance accompanying overweight and obese adolescents, even consuming less energy than non-overweight, could be interpreted by the fact that most of them were physically inactive leading to low energy output [41].

This study has several limitations. Although this is a small group of adolescents from the selected schools and by no means representative of the entire Palestinian population, it offers comprehensive information about the nutritional status in school adolescents in East Jerusalem. The participation of enrolled students from Israeli Municipality schools could affect the results. It does reflect the inter individual variation for most studied parameters which are observed by high standard deviations, while it does not reflect the intra participant variability

which could be achieved by applying multiple 24-h recall. The onset of puberty could be delayed in the underweight category of adolescents and checking sexual maturation stage would be important.

In conclusion, the present study showed that school adolescents in East Jerusalem are at risk of overweight, anemia and malnutrition and their health related consequences. Further research including a more representative sample of Jerusalemite adolescents is needed in order to give a broader picture of the current situation. Furthermore, a westernization of their lifestyle was indicated reflected by a high saturated and low monounsaturated fat intake in addition to physical inactivity. Education school programs promoting healthier food choices of adolescents in general and physical activity in overweight and obese in particular is a necessity.

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