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Assessment of Dietary Iron, Zinc, Vitamins A and C Intake among Children and Adolescents in South Sinai.

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ABSTRACT

This study was to assess food frequency and adequacy of some fruits, vegetables, legumes, liver, meat and chicken as sources for vitamins (A, C) and minerals (iron and zinc) using a quantitative Food Frequency Questionnaire (FFQ) among children and adolescents in five areas at South Sinai. Twenty four hour dietary recall and food frequency questionnaire was obtained in a sample of 862 children and adolescents. The food-list development was based on the contribution to vitamins A and C, iron and zinc intake. We found that the mean fruits, vegetables, legumes, liver, meat and chicken consumption per day are far less than the WHO recommendations. Vitamin A intake for children and adolescents range was 32-395 µg/d; while vitamin C intake was 28.6-130 mg/day in all 5 areas. Iron intake for the same group ranged from 1.8-11.8 mg/day in all 5 areas. Zinc intake ranged from 1.53-7.35 mg/day in all 5 areas. All obtained intake values were below the recommended needs for iron, zinc, vitamins A and C. organized health education program is mandatory for this community. Proper supplementation of the school meal with iron, zinc, vitamins A and C could help combating these nutritional deficiencies.

Keywords: children, adolescents, vitamins, minerals, food frequency questionnaire, South Sinai

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INTRODUCTION

The main worldwide nutrition problems affecting adolescent population would include under nutrition in terms of stunting, underweight, obesity, anemia, catch-up growth as well as the deficiencies of iron, zinc, calcium, iodine, vitamin A and folate [1]. However, three-quarters of the children who die worldwide of causes related to poor nutrition are considered to be mildly to moderately malnourished. Over half of South Asia's children are malnourished.

In Africa, one of every three children is underweight [2]. Stunting still remains a formidable problem in up to 40% to 60% of children in some Asian, African, and Latin American countries, or about 226 million children under age five [2&3].

In general, food insecurity is a widespread and daunting problem, particularly for subsistence farm families or the landless. Growth failure is due not only to low energy or food intake overall, but also to inadequate intake of high-quality protein and vital vitamins and minerals, and sometimes essential fatty acids. Dietary factors have a large impact on chronic disease morbidity and mortality [2, 3].

Dietary instruments must be developed for specific populations to improve their accuracy [4].

The use of methods with low validity seriously attenuates the associations between nutritional intakes and disease in epidemiologic studies, a problem known as regression dilution [5].

Food frequency questionnaires (FFQs) are commonly used for epidemiologic studies investigating the relation between habitual diet and disease. In many countries, FFQs have been shown to provide good measurements of energy and macronutrient intakes and a reasonable measurement of micronutrient intake [6-11]. FFQ for a specific population is usually developed by modifying an existing FFQ, which has already been validated in a population with similar characteristics. It has been argued that FFQs may need to be validated specifically for each region to be culturally sensitive and to correspond to the prevailing food culture [12 & 13]. In South Sinai area, there is no published validated FFQ developed to investigate usual food consumption of children and adolescents (4- 18 years old). In clinical practice, an adult quantitative FFQ has been repeatedly applied in evaluating adult usual food intakes for epidemiologic purposes without any appropriate investigation of its accuracy. The purpose of this study was to assess food frequency of fruits, vegetables, Legumes, liver, meat and chicken as sources for vitamin A, C, iron and zinc using a quantitative FFQ and to assess adequacy of these nutrients intake in South Sinai children and adolescents.

SUBJECTS AND METHODS

Eight hundred and sixty-two children and adolescents aged 4- 18 years old were recruited from five different cities (Tour, Ras Sadr, Abo-zenema, Sant Katreen and Nwebaa) in South Sinai governorate. The questionnaire sheet included: Repeated 24 hour recall and Food frequency method.

Dietary Assessment

According to some authors [14 - 16], the 24 hours dietary recalls (24-HDRs) are unannounced and conducted by trained interviewers. During the 24-HDR, each subject recalled and described in detail, all types and amounts of foods and beverages consumed in the previous 24 hours on two separate occasions, a weekday and a weekend day. The 24-hour period specified for the dietary recall was defined as the 24 consecutive hours between midnight on day one and midnight on the following day. To assist in estimating portion sizes of consumed foods, respondents were encouraged to view measuring cups and measuring spoons as they completed their 24-HDR by interview. At the end of this study, there were a total of four completed 24-HDRs for each participant.

The participants were asked to estimate, in as much detail as possible, all foods and beverages consumed over 3 days.

Statistical analysis

The obtained data were statistically analyzed using the statistical package for social sciences [17]. Data were analyzed with Nutrisurvey for SMART software [18]. The value of (p) less than 0.05 was considered statistically significant.

RESULTS AND DISCUSSION

Fruits and vegetables

Most fruits and vegetables are low in calories and fat. However, provide fiber and a range of vitamins including vitamins A and C, folic acid and an array of phytochemicals which are implicated in beneficial health effects.

There is mounting evidence to the effect that bio-actives present in fruits and vegetables help protecting against a number of diseases such as coronary heart diseases, hypertension and cancers [19].The results showed that the average vegetable consumption was quite higher while fruit consumption was rather low. In Tour and Ras Sadr cities, 60 % and 45 % respectively consumed fruits and vegetables two times weekly, while about 55 % of children in Sant Katreen and Noeba consumed fruits and vegetables once weekly **(**Table 1**).** Most of the time a majority had consumed at least one fruit during a day of the week rather than consuming a fruit every day. We found that the mean fruit and vegetable consumption per day which is far less than the WHO [20] recommendations. The results agreed with Perera [21]. Office of Nutrition Policy and Promotion [22] has a derived variable that groups the daily consumption of vegetables and fruits into three categories: Respondent eats vegetables and fruits less than 5 times per day; between 5 and 10 times per day; more than 10 times per day. Laura [23] reported that inverse associations with lung cancer are found for both vegetable and fruit intake for consumption 3 times per week.

Regular consumption of fruits and vegetables is associated with a myriad of health benefits. Maintenance of health of young adults in a country is of paramount importance [21]. Young adults aged between 18 and 24 years are in a stage of life which often leads the first chance to make their own food choices. Moreover, this is the age at which many students commence dietary education [24]. Thus, the general advice is to consume significant proportions of fruits and vegetables to ensure the protection from Non Communicable Diseases (NCDs). In this context, World Health Organization [25] has set standards with respect to consumption of fruits and vegetables by recommending a minimum of 400 g per day. Currently, NCDs have overtaken communicable diseases and are now the leading causes of mortality, morbidity, and disability. In 2001 NCDs accounted for 71 % of all deaths in Sri Lanka and in 1995, more than 20 % of cancers in Sri Lanka were attributable to inadequate fruit and vegetable intake and it has predicted that this value will further go up in the future [25]. According to the FAO food balance sheets [26], the per capita fruits and vegetables consumptions were 77 g and 70 g, respectively, which are much lower than the recommended quantities by WHO [26]. According to the consumer finances and socioeconomic survey, vegetable consumption is higher than that of fruit consumption.

Legumes

Legumes are often good sources of iron and zinc. These minerals, however, may be poorly available from certain plant foods [27]. Results showed that about 13 % (5-6 times) and 36 % (one time) of children in Tour city consumed legumes while about 50% and 53% (one time) of children in Ras sader and Sant Kadreen consumed legumes. About 43 % (3 times) of children in Nwebaa site consumed legumes (Table 1). Most of the legumes are consumed either a day or non-consumed in the week whereas around 22% and 24 % respectively. We found that the mean legumes consumption is far less than the WHO [20] and USDA [28] food guide recommendations. Consumption of dry beans, peas, and lentils is low in the US, with only 8 percent of adults consuming dry beans and peas on any one day [29], making it difficult to see relationships in existing cohorts.

Table 1: Frequency of consuming fruits,vegetables, carrot and legumes during the surveyed period for children and adolescents in South Sinai

City	Foods	Number of servings consumed per week					
		None	1	2	3	4	5-6
Tour	Fruits& vegetables	10%	30%	60%			
	Carrot	40%	30%	10%			20%
	Legumes	13%	36%	13%	13%	13%	13%
Abo-Zenema	Fruits& vegetables		19%	27%	54%		
	Carrot		19%	27%	54%		
	Legumes	48%	3%	21%	4%	11%	13%
RasSader	Fruits& vegetables		18%	45%	27%	10%	
	Carrot	55%	27%	9%	9%		
	Legumes	35%	50%		5%	5%	5%
SantKatreen	Fruits& vegetables	18%	55%	9%		9%	9%
	Carrot	45%	40%		9%		9%
	Legumes		53%	28%	19%		
Nwebaa	Fruits& vegetables	18%	55%	9%		9%	9%
	Carrot	42%	39%		9%		9%
	Legumes	25%	17%	8%	43%		7%

Chicken, meat and liver

Animal source foods are also an efficient source of micronutrients. The main micronutrients offered in abundant and bioavailable form by animal source foods are iron, zinc, and vitamin A from meat and liver [6 & 7]. In Tour city, about 23 % (5-6 times) of children consumed meat and chicken while about 11%, 9%, 47%, and 47 % (one time) of children in Tour city, Ras sader, Abo-zenema, Sant Katreen and Nwebaa cities consumed meat and chicken (Table 2). We found that the mean Chicken, meats and fish consumption is far less than the WHO [20] and USDA [28] food guide recommendations. To illustrate the utility of adding micronutrient-dense meat to a child's diet, one can look at a sample diet including maize and beans compared to one including meat. To meet the average daily requirements for energy, iron, or zinc, a child would need to consume 1.7–2.0 kg of maize and beans in one day. This is far more than a child can tolerate, while the same requirement could be met with 60 g meat per day.

Vitamin A

Vitamin A intake recommendations for adolescents were derived by extrapolating the recommendation for adults using metabolic body weight, accounting for growth. The RDA for adolescent boys aged 14 to 18 years is 900 mcg per day of Retinol Activity Equivalents (RAE), which is 3,000 international units (IU); the RDA for adolescent girls aged 14 to 18 years is 700 mcg of RAE, which is equivalent to 2,333 IU [30]. The vitamin A intake for adolescents and children (4-18years) under study ranged from 32.23-395 μg/d in all 5 areas.

These intakes for adolescents and children in age group (4-18) ranged 4.7-44 % compared to the recommend dietary allowances [31]. Many adolescents and children consume less vitamin A than they need without meeting recommended intakes for a number of nutrients (Table 3). Significant difference ($p<0.05$) of mean vitamin A intake between Tour and Abo-zenema areas in age groups 10-12 years old was found (Table 3). Also, significant difference ($p<0.05$) of mean vitamin A intake between Abo-zenema and Nwebaa areas in age groups 10-12 years old was found (Table 3). Vitamin A is a fat-soluble vitamin that is essential for growth and development, normal vision, the expression of selected genes, immunity and reproduction [30]. Vitamin A deficiency in children and adolescents is a major public health problem worldwide, especially in less developed countries [1 & 32]. Even marginal or subclinical deficiencies in vitamin A may have adverse effects on bone growth and sexual maturation of adolescents [33]. However, few vitamin A supplementation studies have been done in adolescents; most supplementation studies have included younger children who are more susceptible to vitamin A deficiency. The RDA for vitamin A is based on the amount needed to ensure adequate stores (four months) of vitamin A in the body to support normal reproductive function, immune function, vitamin A-dependent gene expression, and vision [30].

Table 2: Frequency of consuming liver, meat and chicken during the surveyed period for children and adolescents in South Sinai

City	Foods	Number of servings consumed per week					
		None	1	2	3	4	5-6
Tour	Liver	40%	30%	20%	10%		
	Meat& chicken	11%	11%	21%	11%	23%	23%
Abo-Zenema	Liver	91%	19%				
	Meat& chicken	29%	47%	12%	12%		
RasSader	Liver	61%	39%				
	Meat& chicken	27%	9%	55%	9%		
SantKatreen	Liver	52%	39%		9%		
	Meat& chicken	11%	47%	42%			
Nwebaa	Liver	70%	30%				
	Meat& chicken	16%		52%	12%	10%	10%

Table 3: Distribution of adults and children according to daily intake of vitamin A and % of RDA for vitamin A for children and adolescents in South Sinai

Age)year(	Tour		Abo-Zenema		Ras Sadr		SantKatreen		Nwebaa	
	µg/d	% of RDA	µg/d	% of RDA	µg/d	% of RDA	µg/d	% of RDA	µg/d	% of RDA
4 - 6	97.27^{a} ±48.34	14.0 ±7.02	78.52^{a} ±16.93	16.94 ±2.42	100.36^{a} ±18.38	14.29 ±2.6	32.23^{a} ±10.46	4.7 ±1.7	92.26^{a} ±25.16	13.3 ±3.65
7 - 9	229.4^{a} ±43.26	28.74 ±5.4	73.71^{a} ±30.35	9.1 ±3.8	141.13^{a} ±25.0	17.63 ±3.17	75.07^{a} ±38.45	9.14 ±4.8	235.66^{a} ±67.98	29.4 ±8.47
10 - 12	237.3^{a} ±36.92	26.4 ±4.1	70.48^{b} ±13.69	13.69 ±1.52	133.07^{ab} ±25.3	14.78 ±2.84	96.5^{ab} ±23.58	10.06 ±2.3	395.85^{a} ±83.47	44.27 ±9.3
13 - 14	198.98^{a} ±88.93	19.1 ±8.08	124.58^{a} ±50.89	12.2 ±5.2	87.78^{a} ±20.3	8.6 ±1.96	66.36^{a} ±16.13	6.28 ±1.55	325.74^{a} ±106.78	32.3 ±10.74
15 - 18	209.97^{a} ±41.7	21.15 ±4.3	66.3^{a} ±43.7	6 ±4.0			73.9^{a} ±26.9	7.14 ±2.7	232.83^{a} ±31.63	25 ±3.36

Values in the same row with the same superscripts are not significant at $p < 0.05$.

Vitamin C

Most dietary vitamin C comes from fruits and vegetables, most notably citrus fruits and juices, tomatoes and tomato juice, and potatoes. Other dietary sources are broccoli, brussels sprouts, cabbage, cauliflower, spinach and strawberries. For instance, vitamin C strongly enhances the absorption of non heme iron by reducing dietary ferric iron ($Fe3+$) to ferrous iron ($Fe2+$) and forming an absorbable, iron-ascorbic acid complex [34]. The results showed that vitamin C intake in our subjects ranged from 28.6-130 mg/day in all 5 sits. These intakes equal 36.6-86% of the recommended dietary allowances [31], (Table 4). In Sant Katreen area, the vitamin C intake of the children in age (10-12 years old) group was higher than that of other areas. No significant difference ($p<0.05$) of mean vitamin C intake between Sant Katreen area and all areas in ages 10–12 years old group was found.

Significant difference ($p<0.05$) of mean vitamin c intake between Sant Katreen and Abo-zenema and Nwebaa areas in age groups 4-9 years old was found. No significant difference ($p<0.05$) of mean vitamin C intake between all areas in ages 10–12 years old group was found. Significant difference ($p<0.05$) of mean vitamin c intake between Tour and Abo-zenema areas in age groups 15-18 years old was found (Table 4). Vitamin C is a water-soluble vitamin that performs a number of varied biological functions. It acts as an antioxidant and as a cofactor in enzymatic and hormonal processes, plays a role in the biosynthesis of carnitine, neurotransmitters, and collagen, and plays a crucial role in the absorption, transport, and storage of dietary iron. The requirements for adults between the ages of 19 and 30 years old are based on estimates of body pool or tissue vitamin C levels that have been deemed adequate to provide antioxidant protection with minimal urinary vitamin C loss, represented by near-maximal neutrophil concentration. Requirements for those between the ages of 1 and 18 and between 31 and 70 years of age are extrapolated from the data for those between 19 and 30 years of age [35 - 36].

Table 4: Distribution of adults and children in South Sinai according to daily intake of vitamin C and % of RDA for vitamin C

Age (year)	Tour		Abo-Zenema		Ras Sadr		Sant-Katreen		Nwebaa	
	mg/d	% of RDA	mg/d	% of RDA	mg/d	% of RDA	mg/d	% of RDA	mg/d	% of RDA
4- 9	59.6 [a] ±11.1	74.6 ±13.9	34.2 [b] ±7.8	45.4 ±10.9	55.9 [a] ±8.8	72.8 ±11.5	61.1 [a] ±8.9	75.2 ±11.1	28.6 [b] ±4.4	36.9 ±5.7
10 - 12	44.7 [a] ±5.4	49.6 ±6.0	48.8 [a] ±8.05	54.1 ±8.9	91.7 [a] ±11.8	101.8 ±13.1	130.3 [a] ±56.3	85.1 ±9.7	55.2 [a] ±7.6	61.3 ±8.5
13 - 14	68.4 [a] ±10.8	68.4 ±10.8	40.1 [a] ±14.3	39.9 ±14.3			74.9 [a] ±12.2	74.9 ±12.2	48.5 [a] ±8.5	48.3 ±8.5
15 - 18	84.3 [a] ±11.9	84.4 ±11.9	36.2 [b] ±6.7	36.2 ±6.7			60.1 [a] ±11.8	60.2 ±11.8	57.5 [a] ±10.03	57.5 ±10.04

Values in the same row with the same superscripts are not significant at $p < 0.05$.

Iron

Inadequate iron causes a decrease in hemoglobin levels and the potential for iron deficiency anemia in adolescent girls after menarche [37].

The prevalence of iron deficiency anemia of the adolescent population is estimated to be between 2% and 10% [2]. Our results indicated that iron intake for subjects under the present study ranged from 1.8-11.85 mg/day in all 5 areas which comprises 22-119.5% of recommend dietary allowances [31] (Table 5).

In Tour area, the iron intake of the adolescents and children in all age groups was higher than that of other sites. Significant difference (p<0.05) of mean iron intake between Tour area and Abo-zenema, Sant Katreen and Ras sadr areas in age group 4–6 y was found. Significant difference (p<0.05) of mean iron intake between Tour and Sant Katreen areas in age groups 10–12 y and 13-14 was found (Table 5). Iron deficiency is one of the most prevalent nutritional deficiencies worldwide; both in developing and developed nations.

Table 5: Distribution of adults and children in South Sinaiaccording to daily intake of iron and % of RDA for iron

Age (year)	Tour		Abo-Zenema		Ras Sadr		SantKatreen		Nwebaa	
	mg/d	% of RDA	mg/d	% of RDA	mg/d	% of RDA	mg/d	% of RDA	mg/d	% of RDA
4 - 6	9.6 [a] ± 0.3	119.5 ± 3.5	4.8 [b] ±0.65	60.25 ± 8.1	4.5 [b] ± 1.1	56.1 ± 13.6	1.8 [c] ± 0.1	22.3 ± 1.2	5.47 [b] ± 0.73	68.33 ± 9.01
7 - 9	8.77 [a] ± 0.7	87.7 ± 6.6	4.16 [bc] ±0.58	41.6 ± 5.76	7.7 [ac] ± 0.97	76.6 ± 9.7	6.1 [ac] ± 1.64	61.14 ± 16.44	8.6 [ac] ± 1.84	86.1 ± 18.4
10 - 12	11.58 [a] ± 0.7	83.7 ± 5.6	7.77 [ab] ±1.11	52.2 ± 7.3	8.96 [ab] ± 1.36	64.0 ± 10.4	5.9 [b] ± 0.87	41.7 ± 5.8	10.28 [ab] ± 1.26	68.47 ± 8.4
13 - 14	11.85 [a] ± 1.2	82.3 ± 8.6	6.94 [ab] ±1.43	52.0 ± 11.45	7.66 [ab] ± 1.8	56.3 ± 12.54	4.9 [b] ± 0.78	36.4 ± 6.5	11.6 [ab] ± 2.2	82.7 ± 15.2
15 - 18	12.13 [a] ± 1.0	91.0 ± 7.4	8.1 [ab] ±1.95	60.7 ± 9.8			6.2 [b] ± 1.4	49.8 ± 12.4	8.71 [ab] ± 1.15	62.5 ± 8.7

Values in the same row with the same superscripts are not significant at $p < 0.05$.

It has been estimated that at least 50% of women and children and 25% of men are iron deficient in poor countries. Our subjects also have inadequate iron intakes. NHANES III data show that the mean iron intake of American adolescent girls is less than 12 mg [28]. Whereas 40% of American adolescent girls meet two thirds of the RDA for intake of iron, only 34% of our subjects meet this level. The low iron intake of our subjects may be explained by the low consumption of meat, egg yolk, dry beans, green leafy vegetables, and traditional grape, mulberry, or carob molasses, which are main sources of iron. Moreover, in contrast to adolescents living in developed countries, iron fortified cereals and breads are not consumed in our region. Dietary intake recommendations for adolescents were based on a factorial modeling approach that accounts for the amount of iron needed to replace basal losses (losses in urine, feces and sweat), iron requirements associated with growth (increases in hemoglobin and iron content of tissues), and iron losses associated with menstruation in girls. The intake recommendations also account for average bioavailability (the fraction of iron retained and used by the body) of dietary iron for this age group [30]. The RDA of iron is 11 mg/day for adolescent boys and 15 mg/day for adolescent girls. A U.S. national survey [39] found that average dietary intake of iron was 19.1 mg/day in adolescent boys and 13.3 mg/day in adolescent girls; however, 16% of adolescent girls had intakes below the EAR of 7.9 mg/day. Because several different criteria have been used to identify iron deficiency, it is difficult to report the prevalence of iron deficiency among adolescents. The amount of bioavailable iron in food (or supplements) is influenced by the iron nutritional status of the individual and also by the form of iron (heme or non heme). Individuals who are anemic or iron deficient absorb a larger percentage of the iron they consume (especially non heme iron) than individuals who are not anemic and have sufficient iron stores [34]. Heme iron, found in meat, poultry, and fish, is more readily absorbed, and its absorption is less affected by other dietary factors than non heme iron, the form found in plants, dairy products, fortified foods, and supplements. Although heme iron generally accounts for only 10-15% of the iron found in the diet, it may provide up to one third of total absorbed dietary iron [34].

The absorption of non heme iron is strongly influenced by enhancers and inhibitors present in the same meal. Further, consumption of meat, poultry, and fish enhance non heme iron absorption, but the mechanism for this increase in absorption is not clear [30]. Inhibitors of non heme iron absorption include phytic acid, which is present in legumes, grains, and rice.

Polyphenols found in some fruits, vegetables, coffee, tea, wines, and spices can also markedly inhibit the absorption of non heme iron, but this effect is reduced by the presence of vitamin C [30]. Soy protein, such as that found in tofu, has an inhibitory effect on iron absorption that is independent of its phytic acid content [30].

Zinc

Table 6: Distribution of adults and children in South Sinaiaccording to daily intake of zinc and % of RDA for zinc

Age (year)	Tour		Abo-Zenema		Ras Sadr		SantKatreen		Nwebaa	
	mg/d	% of RDA	mg/d	% of RDA	mg/d	% of RDA	mg/d	% of RDA	mg/d	% of RDA
4 - 6	2.83^{a} ±0.79	56.67 ±15.76	2.55^{a} ±0.26	50.8 ±5.0	2.54^{a} ±0.53	51 ±10.77	1.53^{a} ±0.2	30.3 ± 4.3	2.4^{a} ± 0.36	49.1 ± 7.14
7 - 9	5.54^{a} ±0.47	79.1 ±6.7	2.21^{b} ±0.23	31.5 ±3.3	4.5^{ab} ±0.56	64.6 ±7.98	3.56^{ab} ±0.67	50.57 ± 9.4	4.4^{ab} ± 0.6	63.3 ± 8.6
10 - 12	6.5^{a} ±0.36	85.6 ±5.02	4.05^{b} ±0.47	57 ±6.74	4.98^{ab} ±0.59	66.8 ±7.7	3.01^{ab} ±0.47	38.9 ± 6.5	5.3^{ab} ± 0.6	76.2 ± 8.2
13 - 14	6.48^{a} ±0.64	87.33 ±8.47	4.22^{a} ±1.08	50.4 ±9.5	4.3^{a} ±1.05	54.8 ±14.86	3.76^{a} ±0.47	46.3 ± 5.5	4.88^{a} ± 0.9	65.3 ± 13.5
15 - 18	7.3^{a} ±0.55	86 ±7.1	4.87^{a} ±1.8	60.3 ±29.35			5.1^{a} ±1.03	55.7 ± 10.2	5.09^{a} ± 0.7	68.7 ± 9.4

Values in the same row with the same superscripts are not significant at $p < 0.05$.

Zinc deficiencies are caused by inadequate dietary intake, increased losses from the body, and/or increased requirements [39]. The results showed that zinc intake in our subjects ranged from 1.53-7.35

mg/day in all 5 sits. These intakes equal 30-87%of the recommended dietary allowances [31], (Table 6). In Tour area, the zinc intake of the children in all age groups was higher than that of other sites. Significant difference ($p<0.05$) of mean zinc intake between Tour area and all areas in ages 4–6 years old group was found. Also Significant difference ($p<0.05$) of mean zinc intake between Tour and Abo-zenema (7-9 years old), Sant Katreen (10-12), (13-14 years old), (15-18 years old) respectively was found (Table 6). The main reason for zinc deficiency, particularly in the poor nations of the world, is the low intake of animal source foods. These populations tend to rely on staples, particularly starchy roots and tubers that have low zinc content.

The worldwide prevalence of dietary zinc deficiency is believed to be 20.5% [40]. The prevalence of zinc deficiency among US children is unknown, although evidence of the condition among Mexican American children was reported in the 1970s [41]. The median dietary zinc of Mexican American boys and girls, 6–11 years old of age, were 9.27 and 8.07mg daily, respectively [42].

Consistent with an increased risk of dietary zinc deficiency in this population, commonly consumed ethnic foods, such as maize tortilla, an unfermented flat bread, and frijoles, a refried bean-paste, suppressed intestinal absorption of zinc from animal flesh (oyster) [43]. Foods with a high content of dietary zinc include oysters, beef, turkey, chicken, fortified cereals, and processed beans [28]. The zinc content in a recommended serving size varies in these foods, ranging from 76 mg in oysters to 15 mg in fortified cereals, 11 mg in turkey, 9 mg in beef, and 6 mg in chicken [28]. Deficiency of zinc is a major concern among children globally [44 - 45]. Considerable evidence exists to show that such deficiencies affect physical growth, cognitive development, reproduction, physical work capacity, and exposure to risks of infectious and several adult-onset chronic diseases [45 - 48].

Recent findings that Zn bioavailability from high-phytate, whole-day diets is lower than previous estimates suggest that revision of Zn estimated average requirement for low-income countries may be warranted [49].

The deficient dietary intake of vitamins A and C, iron and zinc may be one of the causes of delayed growth pattern shown in children and adolescents of South Sinai compared with other areas in Egypt and compared with international growth standards [50]

CONCLUSION

Diet of children and adolescents of South Sinai showed decrease intake below RDA of vitamins A and C, iron and zinc with expected health hazards consequences in this vulnerable group.

Organized health education program is mandatory for this community through various media. Proper supplementation of the school meal with iron, zinc, vitamins A and C could help combating these nutritional deficiencies.

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