Dietary Intakes among Kuwait Adolescents: Identifying Dietary and Non-dietary Determinants

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ABSTRACT

Adolescents (aged 10 to 19 years) represent the largest generation in Kuwait. The vulnerability of this age group to malnutrition is well documented due to increase nutritional requirements, an unhealthy food environment, and to inadequate attention in most health and nutrition awareness programs. Objective to assess the nutritional status, including dietary and anthropometric parameters, among school children in Kuwait. Three days of face-to-face multiple-pass 24-hour recalls were collected from 479 children in a cross-sectional design study. Weight, height, and blood hemoglobin were measured. Girls were more likely to be overweight (27.1%), whereas boys were more likely to be obese (25.5%), P = 0.028. Results show that most Kuwaiti adolescents exceed the recommendations for energy and most nutrients, except vitamin E, vitamin D, and calcium. Within middle school, the average energy intake was 2591.2 and 2201.4 kcal/day; while in the high school group was 2570.1 and 2056.0 kcal/day for boys and girls, respectively. Breakfast consumers have a higher intake of all nutrients than breakfast-skippers do. Adolescents, who are physically active, have a significantly higher intake of energy, carbohydrate, protein, fat, and fiber than inactive adolescents do. Physically active adolescents have a significantly higher intake of folate, iron, calcium, and zinc than inactive adolescents do. Conclusion: Monitoring adolescent dietary intake and nutrition status is key to preventing adolescent malnutrition in the short term and diet-related disease in the long term. Targeted nutrition intervention program and reevaluation of school feeding program and canteens are needed.

Keywords: *Adolescents, dietary intake, 24-hour recalls, nutrients, demographic factors*

ABBREVIATIONS

KNSS: Kuwait Nutrition Surveillance System; KBOS: The Kuwait Breakfast Obesity Study; MPRs: Multiple-Pass 24-Hour Recalls; EAR: Estimated Average Requirement; AI: Adequate Intake; AMDR: Acceptable Macronutrients Distribution Range; BMR: Basal Metabolic Rate.

Introduction

Adolescence is a critical period of life, characterized by a phase of rapid growth and development. It occurs between the ages of 10 and 19, after childhood and before adulthood **(World Health Organization, 2021)**. Consequently, adolescents are at high risk of malnutrition due to their high requirements for growth **(Christian and Smith, 2018).** It is well established from a variety of studies that a nutritious diet and healthy lifestyle during these crucial years of development are essential since this period can shape their food habits in later life and influence their future health **(Al-Jawaldeh et al., 2020, Cruz et al., 2018).** For instance, it is important to have an adequate amount of micronutrients such as iron to prevent iron deficiency and anemia, and calcium to maintain healthy bone and tooth development **(Weichselbaum and Buttriss, 2011)**. There is consistence evidence that high risk of insulin resistance and risk of cardiovascular diseases are associated with low nutrients intakes such as dietary fiber **(Ludwig et al., 1999),** vitamin C **(Gale et al., 1995),** vitamin D **(Michos and Melamed, 2008)** and folate **(World Health Organization, 2003).**

It has been shown that environmental factors such as poor diet and lack of physical activity can lead to obesity and obesity-related diseases **(Albataineh et al., 2019)**. It has previously been observed that childhood overweight and obesity tracks into adulthood and increases the risk of non-communicable diseases **(Weichselbaum and Buttriss, 2011, Sahoo et al., 2015).**

The current trend of the prevalence of obesity in Kuwait is alarming. According to the Kuwait Nutrition Surveillance System (KNSS), 2018; **Ministry of Health, (2019)** , 49% of children aged> 5 years to 19 years were either overweight (21.5%|) or obese (27.5%). This problem causes a burden on the health sector and has economic consequences. It has been shown that the pandemic of overweight and obesity in Kuwait has been caused by rapid modernization and nutrition transition **(Zaghloul et al., 2012, Musaiger et al., 2013, Al-Haifi et al., 2012)**. However, in Kuwait, studies on dietary habits and intake among adolescents are limited (Al Mousa et al., 2003, **Al-Haifi et al., 2012, Zaghloul et al., 2012, Jackson and Al-Mousa, 2000)**. Greater attention needs to be paid to the quality of adolescents' diets and their health outcomes.

The main aim of this study is to assess the nutritional status, including dietary and anthropometric parameters, among school-aged children in

Kuwait. In addition, the objective is to explore the relationship between sociodemographic factors and the average nutrient intake of such children.

POPULATION AND METHODS

Population

This cross-sectional study is part of the Kuwait Breakfast Obesity Study (KBOS), which was conducted in 2015-2016. Students were given details about the study protocol under the supervision of trained dietitians. Students were informed that they could withdraw at any time from the study. Informed consent was obtained for all participants from parents and guardians. Details about the KBOS have been highlighted in a previous study **(Aldwairji et al., 2018)**.

The study analyzed 11 items from the main structured questionnaire used in KBOS for (n=739), including age, sex, governorate, parents' education level, height, weight, regularity of main meal, breakfast consumption, snacking, physical activity, and hemoglobin level **(Aldwairji et al., 2018).** Biochemical kits were used to test hemoglobin-using HemoCue by finger pricks. WHO standard cut-off point was used to identify anemia **(World Health Organization, 2011).**

During the school visit for dietary data collection, the trained dietitians measured the weight and height of the participants according to standard anthropometric methods, details published elsewhere **(Aldwairji et al., 2018; IMSCS EDR, 1997)**.

Dietary assessment

Dietary data were collected by experienced dietitians using three days of face-to-face multiple-pass 24-hour recalls (MPRs) conducted on non-consecutive days, one of which was a weekend day **(Conway et al., 2004, Conway et al., 2003).** Portion sizes for the foods and drinks consumed were estimated using common household measurements (cups, spoons, and bowls). Students were asked to provide types and quantities of food and beverages consumed within the last 24-hour period.

Nutrient composition assessment

The data were entered into 'The ESHA Food Processor' nutritional analysis software Food Processor and Genesis SQL Database Sources version 10.3 (2006) and analyzed for nutrition composition by the researcher using the US dietary database. In addition, the local Kuwaiti composite dishes database was developed by the Kuwait Institute of Scientific Research Centre (n=157) **(Al-Amiri et al., 2009, Al-Amiri et al., 2011, Dashti et al., 2004, Dashti et al., 2001, Dashti et al., 2003, KISR, 1998).** Recipes were created for an additional 26 local foods reported in the 24-h recall. Moreover,

for some food items, food labels were used from the Kuwaiti market (n=7). When composition data were not available in the previously stated references, the closest similar food in The Food Processor program (ESHA) was utilized.

Dietary recalls were analyzed for macronutrients and selected micronutrients (vitamin A, vitamin E, thiamin, riboflavin, niacin, vitamin B_6, vitamin B_{12}, folate, vitamin C, vitamin D, calcium, iron, phosphorus, sodium, and zinc). Energy and nutrient intakes were compared with US dietary reference intakes since Kuwait does not have its own dietary guidelines **(IMSCSEDR, 1997)**. Students' nutritional status were compared with the Estimated Average Requirement (EAR) (**KISR, 1998**), Adequate Intake (AI), and Acceptable Macronutrients Distribution Range (AMDR) for all reported nutrients **(Table, 2005, Pitkin et al., 2000, Monsen, 2000, Russell et al., 2001, IMSCSEDR, 1997, Erdman and Appel, 2004, Lupton et al., 2002)**.

AMDRs reflect a percentage of intakes of macronutrients within the recommended range. AMDRs are estimated based on evidence indicating the risk of coronary heart disease at low intakes of fat and high intakes of carbohydrates, in addition to evidence of an increased risk of obesity at high intakes of fat **(Lupton et** al., 2002). Percentages of participants with macronutrients intakes below, meeting, or above the AMDR were calculated according to the cut-off points based on US dietary reference intakes (**IMSCSEDR, 1997)**.

In order to identify potential under- and over-reporters, standard equations were used in order to estimate Basal Metabolic Rate (BMR), which is age- and sex-specific and based on the measured weight of the participant **(Schofield, 1985)**. A cut-off value for EI: BMR of 0.9 was used to classify participants as under-reporters **(Zaghloul et al., 2012).** Under-reporters were excluded from the current statistical analysis (n=259, 35%). According to **Abdul Majid et al. (2016)** study, age- and gender-specific equations were used to exclude under-reporters from the current analysis.

Statistical analysis

The data from the three MPRs and questionnaires were entered into the Statistical Package for the Social Sciences (SPSS), version 23 **(IBM Corp, Released 2015),** for statistical analysis and descriptive statistics were derived. The level of significance used was $p < 0.05$. Nutrient intakes were checked for normality by inspection of the normal probability plots and by using the Shapiro-Wilk test. They were log- transformed when necessary. Mean and standard deviation (SD)

were calculated when the variable was normally distributed. Geometric mean and interquartile range (IQR) were used with log-transformed variables. Frequency and percentage were used for categorical variables, the mean and standard deviation for continuous variables. Parametric and non-parametric tests were used depending on the variable normality. Ethical approval was obtained from the Ministry of Health, number 273/2015, and the Ministry of Education, number 39641/2015.

RESULTS

A sample of 739 was pooled from 2,219 Kuwaiti students aged between 11 and 18 years (380 girls and 359 boys) and they completed three MPRs. Four hundred and seventy-nine participants (64.8%) were included in the analyses after the exclusion of under reporters (n=259, 35.0%).

Socio-demographic characteristics of the sample are presented in Table 1. The age of the adolescents ranged from 11 to 18 years (mean age 14.9± 2.0 years; mean age for boys and girls 15.1±1.9 and 14.7±1.8 respectively, p=0.026). BMI was classified using age and sex-specific cut-off points according to the WHO 2007 growth reference, which showed that more than half of the adolescents had a normal BMI (52.6%). The prevalence of being overweight and obese among the participants was 23.5% and 20.5%, respectively. Girls were more likely to be within the overweight category (27.1%), whereas boys were more likely to be within the obese category (25.5%), p=0.028.

Half of the participants were breakfast consumers (51.2%). Significant differences in breakfast consumption categories were found between boys and girls (57.3% vs 44.8% and 42.7% vs 55.2% respectively, p=0.012). More than two-thirds of the participants reported having regular main meal patterns (76.6%) and a significant difference was found between boys and girls, p=0.004. Surprisingly, almost half of the participants reported having a sedentary lifestyle (46.8%) and only 25.5% were physically active. Gender differences were observed; 58.5% of girls were found to be physically inactive in comparison to 35.4% of boys ($p \leq 0.001$). Only 16.4% were anemic according to their blood hemoglobin level and based on standard cut-off point values **(UNICEF/UNU/WHO, 2001).** The percentage of anemic girls was significantly higher than that of boys (23.5% and 9.7% respectively, $p \leq 0.001$).

Table 2 shows that more than half of the participants aged 11to13 years exceeded the recommended energy requirements for boys and girls

(58.5% and 55.9%, respectively). It has been noticed that the percentage of overconsumption declined with age, with no significant differences found based on sex. In addition, Table 2 highlights the percentage of participants with macronutrient intakes according to the AMDR by sex and age. The majority of adolescents met the AMDR for protein, carbohydrates, and fat. For saturated fat intake, almost two-thirds of the participants in both age groups were above the AMDR. However, hardly any of the participants met the AMDR for n-3 fatty acid and n-6 fatty acid, regardless of sex and age.

Table 3 shows that the intake of protein and carbohydrates among almost all participants in both age groups exceeded the EAR. In the older age group, girls' intake of protein was significantly lower than boys' (70.3g and 95.3g respectively, p=0.028). In the younger age group, only 10.8% of boys and 13.2% of girls exceeded the adequate intake of fiber. Whereas 6.2% of boys and 6% of girls in the older age group were above the adequate intake of fiber. The percentage of boys who exceeded recommended choles-terol intake was doubled that of girls in the older age group (41% and 21.4% respectively, $p \leq 0.001$).

Table 4 illustrates the consumption of vitamins and minerals compared with EARs by age and sex. Both boys and girls consumed inadequate intakes of vitamin E, vitamin D, and calcium. The table also shows that boys in the older age group consumed inadequate levels of vitamin A. In addition, the mean intakes of folate among young girls and both sexes in the older age group were below the EAR. Inadequate intake of phosphorus was detected only among girls in both age groups. Significant differences in the percentages that exceeded the EARs were observed between boys and girls in the younger age group for B12, folate, calcium, and phosphorus. Whereas significant differences in the percentages that exceed the EARs were found for all micronutrients, except vitamin A, vitamin C, and calcium in the older age group.

Table 5 and Table 6 provide results regarding the differences between nutrients and sociodemographic characteristics, dietary habits and anthropometric measurements. The results show that boys had a significantly higher intake of all nutrients, except vitamin A than girls did. Across BMI categories, it was observed that significant differences were found in energy, carbohydrate, protein, fiber, and sugar intakes (p=0.001, p<0.001, p=0.05, p=0.005, and <0.001, respectively). It was also observed that obese participants had a

higher intake of vitamin C, folate, iron, and calcium than other BMI categories (p=0.001, p=0.022, p=0.002, and p=0.005, respect-ively). Regarding education level, interestingly it was noted that middle scholars had a significantly higher intake of all macronutrients than high schoolers, except for protein did and cholesterol did. Whereas for micronutrients, higher intakes were only found in vitamin C, iron and calcium among middle schoolers (p<0.001, p=0.002 and p=0.002, respectively). Breakfast consumers had a higher intake of all nutrients than breakfast skippers did. Significant differences were found in macronutrients (energy,carbohydrates, protein, cholesterol, and fiber) and micronutrients (vitamin A, vitamin C, vitamin D, folate and iron). Similar findings were observed in the case of macronutrient intake with the regularity of the main meal. While for micronutrient intake, the only significant differences were found in vitamin C, iron, and zinc (p<0.001, p=0.017 and p=0.024, respectively). No significant differences were found between more frequent snacking and less frequent snacking adolescents in terms of nutrient intake, except for iron (p=0.020). Adolescents who were physically active had a significantly higher intake of energy, carbohydrates, protein, fat, and fiber than inactive adolescents did (p=0.001, p=0.005, p<0.001, p=0.024, and p=0.007, respectively). Whereas dietary cholesterol intake was significantly lower among physically active adolescents than those physically inactive (p=0.003). Regarding micronutrient intakes, physically active adolescents had significantly higher intake compare inactive adolescents, except for vitamin A, vitamin D, and sodium.

DISCUSSION

The present study has provided a comprehensive and detailed description of adolescent food intake in Kuwait for the first time using three face-to-face MPRs among adolescents, unlike previous studies **(Zaghloul et al., 2012, Al Mousa et al., 2003)**. This method guided the respondents through a 24-hour reference period of food intake more than one time, providing different opportunities for the respondents to remember food details **(Conway et al., 2004, Conway et al., 2003)**. The prevalence of overweight and obesity was 44%; this finding is consistent with previous studies **(Ministry of Health, 2019, Zaghloul et al., 2012, Al-Haifi et al., 2012)** indicating a lack of interventions programs for this age group.

The current study has highlighted overconsumption of energy, which partly explains the high

prevalence of overweight and obesity among the age group studied, as explained previously by the National Nutrition Survey **(Zaghloul et al., 2012).** In agreement with previous studies, it has been found that boys have a higher mean energy intake than girls **(Abdul Majid et al., 2016).** A possible explanation for this might be that girls are more concerned about their weight than boys, which may result in following an energy-restricted diet (Badr et al., 2019, Jodhun et al., 2016). Another reason for lower energy intake among girls than boys could be the high percentage of girls who were found to skip breakfast in the current study. Surprisingly, 11-13 years old (middle school children) had significantly higher energy intake than their 14-18 years counterparts (high school children). This may partly explain the high percentage of overweight and obesity among younger adolescents in this study. A study of 425 Greek children aged 9 to 12 years showed that energy intake was statistically higher among overweight and obese children compared to a normal group **(Papandreou et al., 2016).**

Unexpectedly, adolescents who reported regularity in their main meals have significantly higher energy intake compared to those who reported irregularity in their main meals. However, regularity in main meals may not reflect the number of meals actually eaten during the day, including snacks. A recent study demonstrated the role of eating frequency in total energy intake and found a significant, positive association between them among schoolchildren **(Evans et al., 2015**). To develop a full picture, further analysis is needed to explore meal frequency and its relation to energy intake in the studied population. High energy intake among active Kuwaiti schoolchildren, as found in the current study, should be considered with caution, since other factors can influence this relationship including body composition and obesity **(Cuenca-García et al., 2014).** Furthermore, a possible explanation for the high energy intake among Kuwaiti adolescents is the school environment, which may provide nonnutritive energy-dense food items **(Bell and Swinburn, 2004).** In addition, a previous study reported that Kuwait has an unlimited amount of food, mainly fast food, that is high in energy, trans fa,t and sugar, and that this abundance of food is available and accessible, creating an obesogenic environment **(Garduño-Diaz and Garduño-Diaz, 2014, Shaban and Alkazemi, 2019, Badr et al., 2019)**.

Despite the increased energy intake in all age groups, adolescents have a low mean intake of dietary fiber. This may be due to a low intake of

fruits and vegetables, which has been reported in a previous study of the same age group (Allafi et al., 2014). Consistent with findings in the literature, this study found low intakes of n-3 fatty acid, n-6 fatty acid, vitamin E, vitamin D, and calcium **(Zaghloul et al., 2012).** It seems possible that the above results indicate a low-nutrient-dense food choice among the studied population. Moreover, it might be related to a low intake of oily fish, seafood, and dairy products. It is difficult to explain these results, since those food-rich sources were not investigated in the current study nor at the national level. Further research is needed in this area.

A higher percentage of sodium and cholesterol intake also exceeded the recommended intakes, which may contribute to hypertension and cardiovascular disease risk in later life **(Wang et al., 2020).** It has been reported in a previous study that more than 95% of the food consumed in Kuwait comprises imported food items. Processed foods such as breakfast cereals, cheese, chips and processed meat that contain a significant amount of salt were found to be highly consumed by the Kuwaiti population **(Alhamad et al., 2015).** High consumption of those food items can partly explain the high sodium intake among the adolescents in the current study.

It has been observed that the mean intake of iron was almost triple the amount of EAR. A similar finding was made in the National Nutrition Survey for the same age group and gender **(Zaghloul et al., 2012)**. There are several possible explanations for this result. In the same study by **Zaghloul et al. (2012),** a national composite dish named Machbous Dajaj (chicken with rice) was found to be the first contributor to total iron intake for the same age group. In addition, it has been reported that the second main source of iron intake in the diet of Kuwaiti adolescents is Arabic white bread. The high iron content in Arabic white bread is partly related to the wheat flour iron fortification undertaken by the Kuwait Flour Mill since 2001 **(WHO, 2008)**.

This study is unique in that it has investigated dietary nutrient intakes among adolescents to assess nutritional status in Kuwait. The choice of using in depth face-to-face interviews multiple-pass 24-hour recalls for three days can be considered a gold standard method. Nevertheless, our results need to be interrupted with caution and the current study has some limitations. Dietary assessment of adolescents is challenging because it relies on participant memory in terms of them recalling their food intake. There may have also been difficulties

in establishing portion sizes, leading to recall bias. Moreover, the absence of a Kuwaiti comprehensive food composition database and reliance on the USDA national database may have led to an over-or underestimation of nutrient intakes. In addition, since no national dietary recommendations exist in Kuwait, the use of US dietary reference intakes may have led to some bias.

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CONCLUSION

The present study provides a new and comprehensive insight into nutritional statuses among a vulnerable age group. Almost half of the adolescents in this study were either overweight or obese, having a sedentary lifestyle. Kuwaiti adolescents exceed recommendations for energy and most nutrients, except vitamin E, vitamin D and calcium. Obesity is alarmingly common among Kuwaiti adolescents and it is a national public health problem. Data generated in this study can serve as a baseline to monitor dietary changes among schoolchildren and to evaluate future dietary interventions. Effective interventions are urgently needed to address the unhealthy dietary lifestyles of Kuwaiti adolescents. A more detailed investigation of intake of food groups in terms of food choices among adolescents is in progress.

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Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

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Table 1 Sociodemographic and anthropometric characteristics and dietary habits of Kuwaiti adolescents.

Characteristic		**Total (%)**	**Boys (%)**	**Girls (%)**	***p* value**
		479 (100)	243 (50.7)	236 (49.3)	
Age (years)	Mean ± SD	14.89 ± 2.03	15.10 ± 1.93	14.71 ± 1.87	0.026
Weight (kg) (n=464)	Mean ± SD	58.32 ± 18.98	61.62 ± 21.91	54.88 ± 14.60	≤0.001
Height (cm)	Mean ± SD	157.81 ± 10.30	161.13 ± 12.30	154.25 ± 5.89	≤0.001
Governorate	Al-Asimah	66 (13.8)	29 (11.9)	37 (15.7)	0.714
	Hawalli	61 (12.7)	31 (12.8)	30(12.7)	
	Al-Farwaniya	68 (14.2)	31 (12.8)	37 (15.7)	
	Al-Ahmadi	90 (18.8)	48 (19.8)	42 (17.8)	
	Al-Jahra	97 (20.3)	53 (21.8)	44 (18.6)	
	Mubark Al-Kabir	97 (20.2)	51 (21)	46 (19.5)	
Education levels	Middle	265 (55.3)	124 (51)	141 (59.7)	0.066
	High	214 (44.7)	119 (49)	95 (40.3)	
BMI (n= 464)	Thinness	16 (3.4)	9 (3.8)	7 (3.1)	0.028
	Normal weight	244 (52.6)	121 (50.6)	123 (54.7)	
	Overweight	109 (23.5)	48 (20.1)	61 (27.1)	
	Obese	95 (20.5)	61 (25.5)	34 (15.1)	
Breakfast (n=430)	Skipper, <5 times/week	210 (48.8)	94 (42.7)	116 (55.2)	0.012
	Consumer, ≥5 times/week	220 (51.2)	126 (57.3)	94 (44.8)	
Regularity of main meals	Irregular	112 (23.4)	43 (17.8)	69 (29.2)	0.004
	Regular	366 (76.6)	199 (82.8)	167 (70.8)	
Snacking	< 3 times/day	317 (66.3)	157 (64.9)	160 (68.1)	0.498
	≥3times/day	160 (33.5)	85 (35.1)	75 (31.9)	
Physical activity	Sedentary	224 (46.8)	86 (35.4)	138 (58.5)	≤0.001
	Moderately active	133 (27.8)	69 (28.4)	64 (27.1)	
	Active	122 (25.5)	88 (36.2)	34 (14.4)	
Hemoglobin status*	Anemic	75 (16.4)	23 (9.7)	52 (23.5)	≤0.001
	Normal	383 (83.6)	214 (90.3)	169 (76.5)	

Prevalence of anemic and normal (%) based on hemoglobin level by gender

Table 2 Percentage of participants with macronutrient intakes below, meeting or above the AMDR by age group and gender.

Age (years)	**11-13**		**14-18**	
Gender	**Boys n=65**	**Girls n=68**	**Boys n=178**	**Girls n=168**
Energy (kcal)				
EAR*	1800-2600	1600-2200	2000-3200	1800-2400
Mean	2591.2	2201.4	2570.1	2056.0
SE	117.5	81.4	59.7	59.4
% exceed	58.5	55.9 *p*=0.861	40.4	48.2 *p*=0.160
Protein				
% energy/d	14.2	13.4	14.8	13.9
% met AMDR	87.7	89.7	96.1	86.9
% below AMDR	10.8	10.3	2.8	13.1
% above AMDR	1.5	0.0 *p*=0.586	1.1	0.0 *p*=0.001
Carbohydrates				
% energy/d	55.2	54.7	53.7	54.2
% met AMDR	83.1	88.2	85.4	79.2
% below AMDR	9.2	5.9	9.0	11.3
% above AMDR	7.7	5.9 *p*=0.684	5.6	9.5 *p*=0.270
Fat				
% energy/d	31.2	32.9	32.3	32.7
% met AMDR	61.5	50.0	57.3	50.6
% below AMDR	13.8	11.8	10.1	13.7
% above AMDR	24.6	38.2 *p*=0.239	32.6	35.7 *p*=0.386
Saturated fat				
% energy/d	11.3	11.7	11.2	11.9
% met AMDR	41.5	30.9	34.8	33.3
% above AMDR	58.5	69.1 *p*=0.212	65.2	66.7 *p*=0.821
n-3 Fatty acid (Linolenic acid)				
% energy/d	0.4	0.3	0.4	0.3
% met AMDR	0	1.5	0	1.8
% below AMDR	73.8	75.0	77.0	75.6
% above AMDR	26.2	23.5 *p*=0.590	23.0	22.6 *p*=0.201
n-6 Fatty acid (Linoleic acid)				
% energy/d	4.2	4.1	4.1	4.1
% met AMDR	3.1	0	0	1.2
% below AMDR	83.1	63.2	80.9	69
% above AMDR	13.8	36.8 *p*=0.005	19.1	29.8 *p*=0.020

AMDR: Acceptable Macronutrient Distribution Range

Table 3 Mean, standard errors and percentage consumption of macronutrients in excess of Estimated Average Requirement by age group and gender.

Age (years)	**11-13**		**14-18**	
Gender	**Boys n=65**	**Girls n=68**	**Boys n=178**	**Girls n=168**
Protein (g)				
EAR**	27	28	44	38
Mean	92.1	72.5	95.3	70.3
SE	5.3	2.7	2.9	2.3
% exceed	95.4	98.5 p=0.358	98.3	93.5 p=0.028
Carbohydrates (g)				
EAR	100	100	100	100
Mean	357.8	302.2	343.2	278.0
SE	17.9	12.3	8.1	8.2
% exceed	100	100	100	98.8 p=0.235
Fat (g)				
EAR	ND	ND	ND	ND
Mean	90.0	80.8	93.4	76.1
SE	4.8	3.7	2.7	2.8
% exceed	ND	ND	ND	ND
Fibre (g)				
EAR	31	26	38	26
Mean	22.9	17.2	20.5	15.2
SE	2.4	0.9	0.7	0.6
% exceed ***	10.8	13.2 p=0.792	6.2	6.0 p=1.00
Cholesterol (mg)				
EAR	300	300	300	300
Mean	311.7	228.3	314.9	209.4
SE	31.3	14.0	14.6	9.6
% exceed ****	32.3	23.5 p= 0.333	41.0	21.4 $p\leq$0.001

**EAR of energy by gender, age and physical activity calculated for each participant*
***Percentage of participants who exceeded more than or equal to 100% of EAR*
****Percentage of participants who consumed more than or equal to 100% of the adequate intake of fibre*
*****Percentage of participants who consumed more than or equal to 300 mg/day*
EAR: Estimated Average Requirement; ND: Not Defined

Table 4 Mean, standard errors and percentage consumption of vitamins and minerals in excess of Estimated Average Requirement by age group and gender.

Age (years)	**11-13**		**14-18**	
Gender	**Boys n=65**	**Girls n=68**	**Boys n=178**	**Girls n=168**
Vitamin A (µg RE)				
EAR	445	420	630	485
Mean	653.0	610.1	571.0	573.8
SE	60.7	61.1	38.8	42.5
% exceed	58.5	54.4 *p*=0.727	29.2	38.1 *p*=0.088
Vitamin E (mg)				
EAR	9	9	12	12
Mean	7.8	6.4	6.9	5.7
SE	0.8	0.6	0.55	0.55
% exceed	13.3	10.3 *p*=0.600	12.9	6.5 *p*=0.049
Thiamine (mg)				
EAR	0.7	0.7	1.0	0.9
Mean	1.5	1.1	1.5	1.1
SE	0.10	0.06	0.05	0.04
% exceed	52.3	63.2 *p*= 0.223	47.8	61.3 *p*=0.013
Riboflavin (mg)				
EAR	0.8	0.8	1.1	0.9
Mean	2.0	1.5	1.9	1.4
SE	0.1	0.1	0.1	0.1
% exceed	76.9	80.9 *p*=0.672	82.6	72 *p*=0.021
Niacin(mg)				
EAR	9	9	12	11
Mean	24.4	22.1	27.0	20.3
SE	1.6	1.1	0.9	0.8
% exceed	92.3	91.2 *p*=1.00	93.8	82.7 *p*=0.001
Vitamin B_6 (mg)				
EAR	0.8	0.8	1.1	1.0
Mean	1.7	1.7	1.9	1.4
SE	0.1	0.1	0.1	0.1
% exceed	72.3	80.9 *p*=0.306	80.9	64.3 *p*=0.001
Vitamin B_{12} (µg)				
EAR	1.5	1.5	2.0	2.0
Mean	3.9	2.7	4.2	2.7
SE	0.3	0.2	0.3	0.1
% exceed	75.4	58.8 *p*=0.045	78.7	56.5 *p*≤0.001
Folate (µg)				
EAR	250	250	330	330

Mean	374.2	232.2	315.7	254.2
SE	27.3	14.7	12.6	9.9
% exceed	50.8	20.6 $p \leq 0.001$	40.4	22.0 $p \leq 0.001$
Vitamin C (mg)				
EAR	39	39	63	56
Mean	142.9	136.4	152.2	126.1
SE	16.5	14.0	10.4	10.8
% exceed	72.3	79.4 $p=0.418$	75.3	70.8 $p=0.396$
Vitamin D (IU)				
EAR	400	400	400	400
Mean	154.2	107.7	126.0	116.4
SE	17.2	11.2	8.0	7.9
% exceed	9.5	1.5 $p=0.057$	2.3	1.8 $p=1.000$
Ca (mg)				
EAR+	1100	1100	1100	1100
Mean	964.2	731.2	843.2	731.8
SE	104.7	43.6	34.8	40.8
% exceed	26.2	11.8 $p=0.045$	23.6	16.1 $p=0.082$
Fe (mg)				
EAR	5.9	5.7	7.7	7.9
Mean	15.4	12.2	15.4	12.0
SE	0.9	0.5	0.6	0.5
% exceed	95.4	97.1 $p=0.676$	98.3	91.1 $p=0.003$
P (mg)				
EAR	1055	1055	1055	1055
Mean	1340.7	952.1	1248.0	972.9
SE	99.2	45.2	39.0	43.2
% exceed	53.8	32.4 $p=0.015$	57.3	32.1 $p<0.001$
Na (mg)++				
UL	2200	2200	2300	2300
Mean	3531.7	3092.1	3662.5	2913.6
SE	215.1	167.1	125.8	242.2
% exceed	76.9	64.7 $p=0.132$	82.6	56.0 $p<0.001$
Zn (µg)				
EAR	7	7	8.5	7.3
Mean	9.3	6.8	9.9	6.9
SE	0.5	0.3	0.4	0.3
% exceed	47.7	38.2 p=0.297	50.6	33.3 p=0.002

+ EAR Estimated Average Requirement; UL, Tolerable Upper Intake Level

++ UL for Na was used to estimate the percentage of participants exceeding the safe Na intake level

Table 5 Univariate analyses of socio-demographic in selected macronutrients dietary nutrients intake among Kuwaiti adolescent population.

Sociodemographic Characteristics		Energy intake Kcal/day	CHO g/day	Protein g/day	Fat g/day	Saturated fat	Cholesterol mg/day	Fiber g/day	Sugar g/day
Gender	Boys	2576.8 (838.6)	347.1 (119.3)	94.4 (40.1)	92.5 (37.3)	32.5 (14.6)	314.0 (211.5)	21.1 (13.2)	123.8 (64.3)
	Girls	2097.9(744.3)	285.0 (105.5)	70.9 (28.6)	77.5 (35.5)	28.2 (15.5)	214.9 (122.9)	15.7 (7.9)	111.4 (67.6)
p value		<0.001	<0.001	<0.001	<0.001	0.002	<0.001	<0.001	0.041
BMI	Thinness	2222.5 (696.4)	296.6 (94.0)	80.6 (32.0)	81.6 (36.5)	29.7 (19.0)	270.2 (159.1)	14.9 (8.0)	112.9 (59.7)
	Normal weight	2293.5 (802.3)	308.5 (105.5)	81.8 (37.7)	83.9 (36.8)	29.5 (14.2)	259.2 (170.5)	18.0 (11.2)	112.0 (53.5)
	Overweight	2390.0 (838.5)	319.5 (108.9)	81.8 (31.8)	89.2 (44.2)	32.2 (19.2)	252.3 (161.1)	17.7 (8.4)	117.0 (61.2)
	Obesity	2613.2 (865.1)	364.4 (137.2)	93.2 (41.7)	90.6 (33.5)	32.6 (13.6)	300.8 (227.6)	22.1 (14.1)	143.8 (88.2)
p value		0.001	<0.001	0.054	0.391	0.308	0.205	0.005	<0.001
Educational level	Middle school	2447.8 (859.8)	334.7 (121.7)	85.0 (40.6)	88.4 (37.8)	31.7 (16.4)	267.8 (197.2)	19.7 (13.0)	127.4 (72.3)
	High school	2207.2 (768.2)	293.9 (106.5)	80.2 (31.3)	81.0 (36.1)	28.6 (13.2)	261.9 (157.4)	16.9 (8.4)	105.6 (55.6)
p value		0.002	<0.001	0.161	0.032	0.025	0.727	0.007	<0.001
Breakfast consumption	Breakfast skipper (<5 times a week)	2238.0 (763.8)	300.6 (109.8)	77.2 (30.5)	83.5 (35.3)	29.8 (15.5)	243.0 (174.3)	17.3 (8.7)	114.0 (65.5)
	Breakfast consumer (≥5 times a week)	2475.9 (899.6)	335.5 (124.6)	89.2 (42.6)	88.7 (40.0)	31.5 (15.6)	292.7 (192.5)	19.8 (13.6)	122.1 (69.8)
p value		0.003	0.002	<0.001	0.158	0.249	0.005	0.026	0.215
Regularity of main meals	Irregular	2147.0 (656.4)	288.7 (102.3)	73.4 (25.5)	79.9 (32.0)	28.2 (13.7)	228.5 (144.1	15.0 (6.2)	111.9 (60.7)
	Regular	2402.3 (864.5)	325.4 (119.6)	85.9 (39.1)	86.8 (38.5)	31.1 (15.5)	276.9 (188.7)	19.6 (12.2)	119.5 (67.8)
p value		0.004	0.003	0.002	0.089	0.082	0.013	<0.001	0.289
Snacking	<3 times per day	2303.3 (811.2)	310.6 (115.5)	81.8 (35.9)	84.0 (35.9)	30.2 (14.3)	257.6 (154.0)	18.2 (12.3)	115.0 (62.2)

	≥3 times per day	2419.0 (816.2)	328.5 (119.5)	85.2 (38.5)	87.6 (39.7)	30.8 (16.8)	281.8 (223.7)	19.1 (8.9)	123.5 (73.4)
p value		0.150	0.115	0.346	0.319	0.688	0.169	0.451	0.189
Physical activity	Sedentary	2230.8 (730.9)	303.3 (106.2)	76.7 (29.3)	81.4 (33.8)	29.2 (14.6)	248.7 (172.6	16.8 (7.9)	110.7 (60.2)
	Moderately active	2318.1 (915.1)	312.4 (128.8)	83.3 (39.2)	84.4 (40.6)	30.2 (15.5)	248.6 (142.2)	19.4 (13.4)	119.6 (70.9)
	Active	2565.7 (858.0)	345.3 (117.5)	93.6 (43.6)	92.7(38.2)	32.7 (15.7)	213.5 (220.0)	20.5 (13.4)	128.3 (70.3)
p value		0.001	0.005	<0.001	0.024	0.113	0.003	0.007	0.057

Table 6 Univariate analyses of socio-demographic in selected micronutrients dietary nutrients intake among Kuwaiti adolescent population.

Sociodemographic Characteristics		Vitamin A RE	Vitamin C mg	Vitamin D IU	Folate µg/l	Fe mg	Calcium mg	Sodium mg	Zinc mg
Gender	Boys	424.5 (528.3 – 657.5)[1]	102.3 (1.9 -2.0) [1]	102.9 (129.3-173.0)[2]	331.3 (185.5)	15.4 (8.0)	875.6 (590.9)	3627.5 (1691.9)	9.7 (5.5)
	Girls	423.8 (515.3 -635.2)[1]	80.3 (1.8-1.9)[1]	86.9 (102.8 – 130.4)[2]	247.8 (127.3)	12.1 (6.0)	731.6 (486.0)	2965.1 (2748.6)	6.9 (3.6)
p value		0.753	0.010	0.043	<.001	<0.001	0.004	0.002	<0.001
BMI categories	Thinness	401.9 (245.2-901.0)[1]	92.9 (58.2-246.6)[1]	60.5 (3.8-323.7)[2]	269.4 (139.3)	12.0 (3.6)	925.7 (1096.0)	2823.5 (963.3)	7.5 (3.7)
	Normal weight	439.4 (512.8-643.7)[1]	79.1 (104.2-132.0)[1]	104.9 (117.1-152.1)[2]	285.5 (165.4)	13.2 (5.9)	761.8 (467.0)	3232.5 (1390.0)	8.2 (4.3)
	Overweight	425.9 (463.5-658.8)[1]	111.0 (130.2-189.0)[1]	85.2 (99.9-165.3)[2]	279.9 (142.6)	13.9 (9.1)	774.4 (443.5)	3545.4 (4201.2)	8.1 (4.5)
	Obesity	518.5 (530.4-776.8)[1]	120.1 (147.2-215.8)[1]	122.3 (127.3-189.4)[2]	340.0 (191.8)	16.4 (8.7)	986.1 (669.6)	3593.2 (1816.7)	9.7 (6.5)
p value		0.173	0.001	0.146	0.022	0.002	0.005	0.366	0.37
Educational level	Middle school	453.5 (551.5-675.9)[1]	105.3 (136.9 -172.9)[1]	108.3 (129.9-171.7)[2]	297.8 (175.4)	14.7 (8.0)	874.9 (642.8)	3346.9 (1674.9)	8.7 (5.5)
	High school	418.9 (485.6-629.8)[1]	75.5 (104.9-136.2)[1]	95.3 (100.2- 126.7)[2]	280.8 (150.3)	12.6 (6.1)	717.7 (378.2)	3244.4 (2889.9)	7.9 (3.9)
p value		0.262	<.001	0.055	0.261	0.002	0.002	0.628	0.101
Breakfast consumption	Breakfast skipper (<5	399.3 (476.4-601.4)[1]	79.1 (109.3-143.9)[1]	86.9 (101.5-141.0)[2]	264.2 (147.1)	12.6 (6.0)	780.3 (602.4)	3258.6 (2930.4)	8.2 (5.4)

	times a week)								
	Breakfast consumer (≥5 times a week)	484.2 (569.2-725.3)[1]	106.7 (136.3-176.1)[1]	113.3 (133.0-137.4)[2]	324.8 (177.3)	15.1 (8.4)	845.4 (522.2)	3379.1 (1691.7)	8.9 (4.8)
p value		0.009	0.003	0.004	<0.001	<0.001	0.199	0.534	0.131
Regularity of main meals	Irregular	438.5 (484.0-678.8)	65.6 (95.1-136.4)[1]	89.0 (99.3-141.6)[2]	271.2 (143.1)	12.4 (5.0)	737.8 (354.0)	3252.4 (3694.7)	7.5 (3.5)
	Regular	439.3 (541.5-650.5)[1]	100.6 (132.5-162.1)[1]	108.3 (124.1-155.9)[2]	298.4 (170.2)	14.2 (7.8)	826.3 (593.0)	3328.1 (1670.7)	8.6 (5.2)
p value		0.982	<0.001	0.229	0.115	.017	0.125	0.722	0.024
Snacking	<3 times per day	441.4 (528.2-641.4)[1]	87.5 (122.6-152.8)[1]	97.7 (114.7-142.8)[2]	286.8 (161.7)	13.4 (6.6)	806.6 (541.5)	3291.3 (2562.4)	8.3 (5.2)
	≥3 times per day	433.7 (521.9-696.3)[1]	97.8 (122.5-165.9)[1]	107.0 (120.6-176.2)[2]	300.3 (196.5)	14.5 (8.5)	806.0 (561.3)	3342.5 (1701.2)	8.5(4.4)
p value		0.812	0.268	0.342	0.386	0.020	0.987	0.829	0.671
Physical activity	Sedentary	404.3 (479.1-609.1)[1]	81.1 (114.1-151.1)[1]	94.1 (106.4-134.4)[2]	283.2 (147.5)	12.6 (5.4)	737.5 (410.0)	3126.5 (2838.7)	7.7 (3.8)
	Moderately active	455.6 (512.0-715.9)[1]	94.5 (115.5-159.7)[1]	90.0(103.9-184.7)[2]	267.8 (163.0)	14.4 (7.8)	789.3 (606.5)	3242.4 (1692.1)	8.4 (6.4)
	Active	484.9 (564.0-743.4)[1]	106.9 (129.9-180.1)[1]	131.5 (135.2-210.0)[2]	333.7 (187.6)	15.3 (9.3)	944.0 (666.3)	3711.8 (1659.7)	9.4 (4.7)
p value		0.085	0.052	0.062	0.004	0.003	0.003	0.076	0.011

[1]*Log transformation was conducted and geometric mean (interquartile range) was obtained*

[2] *Nonparametric test was performed and median (IQR)*

الحالة الغذائية لدى المراهقين في دولة الكويت: تحديد العوامل الغذائية والغير غذائية المؤثرة

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الملخص العربي

تعتبر فئة المراهقين (من عمر ١٠ إلى ١٩ سنة) من أكثر الفئات العمرية عددا في دولة الكويت. هذه المرحلة تعتبر من المراحل الحساسة خلال حياة الفرد التي قد يتعرض بها لسوء التغذية نتيجة عدم الاهتمام في تطبيق البرامج الصحية والتغذوية في المجتمع بشكل فعال. **الهدف**: هو تقييم الحالة الغذائية لدى المراهقين في دولة الكويت باستخدام المعايير الغذائية والقياسات الجسمانية. **الطرق**: أجريت دراسة مقطعية على ٤٧٩ مراهق. تم فيها استخدام طريقة التذكر خلال ٢٤ ساعة، حيث قام بإجرائها اخصائيين تغذية مدربين وتم تكرار المقابلات ثلاث مرات لكل مشترك. تم قياس الوزن، الطول ونسبة الهيموجلوبين. **النتائج**: أظهرت النتائج أن الإناث أكثر عرضة لزيادة الوزن (٢٧,١٪)، بينما كان الذكور أكثر عرضة للسمنة (٢٥,٥٪)، مستوى الدلالة ٠,٠٢٨. فقد بينت النتائج أن معظم المراهقين الكويتيين يتجاوزون التوصيات من حيث الطاقة ومعظم العناصر الغذائية ماعدا فيتامين هـ ، فيتامين د والكالسيوم. في المرحلة المتوسطة، كان معدل استهلاك الطاقة ٢٥٩١,٢ كيلو كالوري/يوم و٢٢٠١,٤ كيلو كالوري/يوم للذكور والإناث، علي التوالي. بينما في المرحلة الثانوية، كان معدل استهلاك الطاقة ٢٥٧٠,١ كيلو كالوري/يوم و٢٠٥٦,٠ كيلو كالوري/يوم للذكور والإناث، علي التوالي. لوحظ وجود معدلات مرتفعة لجميع العناصر الغذائية لدى المراهقين الذين يتناولون وجبة الإفطار مقارنة بمن لا يتناولها. كما لوحظ أن المراهقين النشطين بدنيا يحصلون على معدلات أعلى من الطاقة، الكربوهيدرات، البروتين، الدهون والألياف الغذائية مقارنة بالمراهقين غير نشطين. أوضحت النتائج أن المراهقين النشطين بدنيا يحصلون على كميات أعلى من الفولات، الحديد، الكالسيوم والزنك مقارنة بالمراهقين غير نشطين **الخلاصة:** التقييم الدوري للحالة التغذوية لدي المراهقين من الأمور الواجب اجرائها للوقاية من سوء التغذية على المدى القصير بالإضافة إلى الوقاية من الأمراض المرتبطة بالنظام الغذائي على المدى الطويل.

الكلمات الدالة: المراهقين- الحالة التغذوية- طريقة التذكر خلال ٢٤ ساعة- العناصر الغذائية- العوامل الديموغرافية.