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Evaluation of the Nutritional Status of Sudanese Respondents in Riyadh City, Kingdom of Saudi Arabia

Ali ZA[1], Sabahelkhier MK[1] and Babiker EE[2]*

1 Alneelain University, Faculty of Science and Technology, Department of Biochemistry and Molecular Biology, Khartoum, Sudan
2 Food Science and Nutrition Department, College of Food and Agricultural Sciences, King Saud University, P. O. Box 2460, Riyadh 11451, Saudi Arabia

***Corresponding author:** Babiker EE

ebabiker.c@ksu.edu.sa

Food Science and Nutrition Department, College of Food and Agricultural Sciences, King Saud University, P. O. Box 2460, Riyadh 11451, Saudi Arabia.

Tel: +96611469-3311
Fax: +9661467-8394

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Abstract

Background: This study was designed to evaluate the nutritional status of randomly selected respondents (boys and girls) living in areas around Riyadh City, Kingdom of Saudi Arabia.

Methods and finding: A simple random sample of 400 respondents with age between 6 and 19 years (200 boys and 200 girls) were selected randomly from sampling frame using random numbers table. Two types of data were collected; socioeconomic and anthropometric data. Data about the socio-economic characteristics of the respondent's families was collected through personal interview using a questionnaire. Anthropometric measurements of the respondents were taken. Food frequency and 24-hour recall method was used to evaluate their daily food intake. The respondents average daily intake of dietary fiber and copper was significantly ($P \leq 0.01$) lower than that of the DRI. For boys the average daily intake of vitamin D and E and calcium was significantly ($P \leq 0.01$) lower than that of the DRI and only folate for girls. Their intake of other nutrients was significantly higher than that of the DRI (unbalanced meals). 41.5% of boys and 46% of girls were underweight and 6.5% of boys and 4.5% of girls were suffered from severe malnutrition. Apart from the family monthly income, age, father's education and mother's work none of the hypothesized predictors of the respondent's nutritional status were found to be significantly correlated with the respondent's nutritional status indicators. However, mother work negatively correlated with the girl's nutritional status.

Conclusion: The study revealed that more than 40% of the respondents were overweight due to the fact that both respondents average daily intake of carbohydrates, protein and saturated and unsaturated fat was significantly higher than that of the DRI, while the amount of some vitamins and minerals was significantly lower than that of the DRI. None of the hypothesized predictors of the respondent's nutritional status were found to be significantly and negatively correlated with the student's nutritional status indicators except mother work.

Keywords: Sudanese respondents; Malnutrition; Overweight; Stunting; Saudi Arabia; Nutritional awareness

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Introduction

The objective of assessing nutrition in childhood is to recognize and prevent nutritional disorders. The health behaviors of children and young people have been of interest to many researchers, especially in recent years. A proper lifestyle, which includes proper eating habits, is considered the basis for the health status of adolescents and adults should be monitored to ensure children's correct physical and psychological development [1]. Many studies indicated the existence of numerous irregularities

in the nutrition of children and adolescents which result in malnutrition such as overweight and obesity [2]. The consumption of soft drinks is usually associated with lower intake of milk, natural juices and calcium as well as many health problems, including diabetes [3-5]. The change in eating pattern results in consumption of excess fat, saturated fat, trans fats, and added sugars along with insufficient consumption of micronutrients such as calcium, iron, zinc, and potassium, as well as vitamins A, D, and C and folic acid [6]. Such habits are not consistent with dietary recommendations due to lack of content of certain nutrients, vitamins and minerals [7]. Chandon and Wansink [8] stated that the increased prevalence of fast-food restaurants and lack of awareness and failure to appreciate the damages, leads to increase the rate of consumption of fast-food with soft drinks and lowered the rate of fruits and vegetables consumption. Bere and Kleppk [9] stated that people income, knowledge and access to information have direct impact on their consumption of fruits and vegetables and tendency to eat outside the home. Liu et al. [10] showed that the amount of snacks intake, which contributed about 8% of the amount of energy consumed by children and adolescents, is positively related to the income level of the Chinese families and they observed a direct correlation between the consumption of soft drinks and age. Nutrition education in schools is considered useful in improving knowledge about nutrition, but few studies suggest that it is effective in altering eating behaviors in the absence of environmental change [4]. Dietary habits may contribute to the incidence and severity of overweight in children and adolescents [11]. Skipping breakfast has been associated with higher adiposity measures in children/adolescents and is more prevalent than in the past among many groups [12]. Compared to breakfast consumers, those who skipped breakfast had reduced intakes of many nutrients, including vitamins, minerals and dietary fiber that were rarely compensated for at other meals [13]. Breakfast skippers were also less likely to meet the daily recommendations for food groups such as vegetables and fruits [14]. Many different factors influence food habits in a complex interactive way. Parents and the family environment are very important for young children to learn and develop food preferences and eating habits in a dual way [4].

In Saudi Arabia there is an increase in the incidence of certain diseases associated with food and bad eating habits such as obesity, high blood pressure and diabetes [15]. There is no doubt that the assessment of the nutritional status and daily food intake of the students is important to identify their bad dietary habits and practices. This will help to improve their nutritional status through recommending proper eating habits and food intake compatible with their food needs, especially during the critical phases of rapid changes in their physical, sexual, mental and social characteristics. Therefore, the present study was designed to assess the nutritional status of Sudanese respondents and explore its correlates.

Research Methods

The study was conducted in areas around Riyadh city, Saudi Arabia. A simple random sample of 400 respondents with age between 6 and 19 years (200 boys and 200 girls) were selected randomly from sampling frame using random numbers table. Two types of data were collected; socioeconomic and anthropometric data. Socioeconomic data was collected through personal interviews using an interview schedule. The collected data included the student's physical activities, parent's education and dietary intake (type, quantity and frequency of eating and a brief description of a typical daily food intake). Anthropometry is widely recognized as one of the useful techniques to assess the nutritional status of individuals because it is highly sensitive in detecting under-nutrition [16]. Some concepts **(**height in cm, weight in kg and age in year) were obtained. Gomes et al. [17] and Waterlow [18] classifications were applied to calculate stunting, wasting and malnutrition of children.

Determination of Food Nutrients using Esha Program

Student's intake from each type of food was given a code according to Esha program menu. For the mixed and cooked food the constituents were provided separately in a cooked form. First we entered the name of data sample e.g., (B1or G1) and then entered the 24 hour recall food intake data for each respondent to Esha food processor program, e.g., 1 cup milk, slices toast with 40 g white cheese. After insertion of the data the software analyzes the food and gives the percentage of calories and other nutrients that had been taken up by the respondent and compared with the DRI [19].

The respondent's nutritional status was evaluated using Waterlow classifications. Accordingly, the indicators of respondents' nutritional status were obtained using the following equations:

$$\text{Height-for-age} = \frac{\text{Height of the pupil}}{\text{Height of reference pupil in the same age}} \times 100$$

$$\text{Weight-for-age} = \frac{\text{Weight of the pupil}}{\text{Weight of reference pupil in the same age}} \times 100$$

$$\text{BMI} = \frac{\text{Weight in kg}}{(\text{Height in m})^2} \times 100$$

Then the respondent's nutritional status was classified as normal, mild, moderate or severely stunted and/or malnourished according to Waterlow [18] classification. T-test was used to compare between the respondents food intake (24-hour recall) and dietary requirement intake [19]. To explore the correlates of the respondent's nutritional status, Spearman correlation coefficient between the respondent's nutritional status as a dependent variable and some hypothesized independent variables were calculated.

Statement regarding ethics review committee, authors would like to indicate the following:

1. The study does not involve any threat or invasion of the respondent's privacy.
2. Prior to data collection the respondents and their families were fully informed by the nature and objective of the study.

Results

The respondents' nutritional status is evaluated by assessing their food intake (nutrients) and anthropometric characteristics. The daily average amount of food intake was analyzed using Esha program to get the average composition (calories, protein, carbohydrates, dietary fiber, total fat, saturated fat, unsaturated fat, cholesterol, vitamins, folate and minerals). Then the mean of each constituent was compared to the mean of dietary reference intake (DRI) by using T-test. **Table 1** shows the average intake of nutrients for boys and girls compared to that of DRI. The data showed that the average daily intake of calories for boys (2736.62 kcal) and girls (3207.20 kcal) were significantly ($P \leq 0.01$) higher than that of the DRI (2000.00 kcal). Moreover, for both respondents the amount of protein (90.01 and 94.99 g), carbohydrates (279.47 and 524.82 g), saturated fat (23.83 and 44.55 g), unsaturated fat (208.81 and 198.35 g), some vitamins and minerals taken daily were significantly ($P \leq 0.01$) higher than that of the DRI. On the other hand, the amount of dietary fiber for boys (20.09 g) and girls (18.67 g) taken daily was significantly ($P \leq 0.01$) lower than that of the DRI. However, the amount of saturated fat, some vitamins and minerals taken daily by boys and girls was significantly ($P \leq 0.01$) higher than that of the RDI. The lower percentage of saturated fat compared to that of unsaturated was due to low intake of animal protein and vegetable oils such as corn oil, sunflower, olive oil which will minimize the use of animal fats. The average intake of cholesterol was about 374.64 mg/day for boys and 304.45 mg/day for girls whom significantly ($P \leq 0.01$) exceeded the recommended level (300 mg/day). The amount of vitamins in diet of the respondents was significantly ($P \leq 0.01$) higher than that of the DRI except vitamins D and E for boys which were significantly ($P \leq 0.01$) lower than that of DRI. Regarding selenium, zinc and phosphorous the results showed that the amount taken daily by the boys and girls was significantly ($P \leq 0.01, 0.05$) higher than that of the DRI, while the intake from copper and calcium was significantly ($P \leq 0.01$) lower than the DRI. However, for boys, iron was taken in amount significantly ($P \leq 0.01$) higher than the DRI. The increase in consumption of iron may be due to excessive intake of proteins. The low consumption of fruits and vegetable as reported by the respondents is the main factor that lowered the intake of some vitamins and minerals [20]. According to the WHO recommendations the most widely accepted indicators for assessment of nutritional status in childhood, besides the body mass index (BMI) are height-for-age, weight-for-age, weight-for-height and anthropometry of the upper-arm [21]. The three most frequently used anthropometric indices are weight-for-age, weight-for-height and height-for-age**. Table 2** shows the BMI of the respondents. The data showed that 14.0% of the respondents have normal BMI, while 41.5% of the boys and 46% of the girls are underweight and 19.25% and 18.5% suffer from overweight and obesity me respectively. This means that more than half (63.0%) of the respondents suffer from malnutrition (underweight or overweight). Furthermore, the respondent's weight for age was determined and the data are shown in **Table 3**. According to Waterlow [18] classification, 59.50% of the respondents (boys and girls) have normal weight for age. On the other hand, 13.75%, 21.25% and 5.5% of the respondents suffered from mild, moderate and severe malnutrition respectively. **Table 4** shows height for age of the pupils according to Waterlow [18] classification. The data showed that 63.5% of the respondents have normal height for age, while about 36.5% suffer from different levels of stunting which is higher than the world prevalence rate (33.0%) [22], this is an annoying situation. To investigate some of the determinants of the respondent's nutritional status, Spearman

Table 1 Average consumption of nutrients (24-hours recall) in relation to dietary requirement intakes (DRI) for boys and girls using T-test.

Items intake	Mean for boys	Mean for girls	DRI	Difference for boys	Difference for girls
Calories (kcal)	2736.62	3207.2	2000	736.62**	1207.2**
Protein (g)	90.01	94.99	32	58.01**	62.99**
Carbohydrates (g)	279.47	524.82	130	149.47**	394.82**
Dietary fiber (g)	20.09	18.67	28	-7.91**	-9.33**
Total fat (g)	75.58	64.24	65	10.58**	-0.76
Saturated fat (g)	23.83	44.551	20	3.83**	24.551**
Unsaturated fat (g)	208.81	198.35	45	163.81**	153.35**
Cholesterol (mg)	374.64	304.45	300	74.64**	4.45**
Vit A µg (RE)	1781.9	1224.21	550	1231.9**	674.21**
Vit B1 (mg)	7.65	1.22	0.8	6.85**	0.42
Vit B2 (mg)	1.98	2.62	0.8	1.18	1.82
Niacin (mg)	24.28	138.98	11	13.28**	127.98**
Vit B6 (mg)	1.6	1.32	0.9	0.7	0.42
Vit B12 (mg)	48.88	6.88	1.6	47.28**	5.28*
Vit D (mg)	2.47	18.95	15	-12.53**	3.95*
Vit E (mg)	6.03	24.19	10	-3.97**	14.19**
Folate (mg)	320.88	240.7	270	50.88**	-29.3**
Calcium (mg)	801.55	1439.49	1200	-398.45**	239.49**
Copper (mg)	7.37	5.37	600	-592.63**	-594.63**
Iron (mg)	23.35	97.24	9	14.35**	88.24**
Phosphorus (mg)	1241.93	1876.19	1000	241.93**	876.19**
Selenium (mg)	106.78	95.8	37	69.78**	58.8**
Zinc (mg)	9.2	9.93	6.96	2.24*	2.97*
** P ≤ 0.01; * P ≤ 0.05					

Table 2 Body mass index (BMI) of the pupils (n=400) according to WHO (1998) classification.

Interpretation		Gender		Total
		Boys	Girls	
Underweight	Count	83	92	175
	% within gender	41.50%	46%	43.75%
Normal	Count	28	28	56
	% within gender	14%	14%	14%
Overweight	Count	29	48	77
	% within gender	14.50%	24%	19.25%
Obesity I	Count	45	29	74
	% within gender	22.50%	14.5%	18.50%
Obesity II	Count	14	3	17
	% within gender	7%	1.50%	4.25%
Obesity III	Count	1	0	1
	% within gender	0.50%		0.25%
Total	Count	200	200	400
	% within gender	100	100	100
Chi-Square (P=0.048)				

Table 3 Weight for age (malnutrition) of the pupils (n=400) according to Gomez classification system.

Interpretation		Gender		Total
		Boys	Girls	
Normal	Count	121	117	238
	% within gender	60.5	58.5	59.5
Mild	Count	25	30	55
	% within gender	12.5	15	13.75
Moderate	Count	41	44	85
	% within gender	20.5	22	21.25
Severe	Count	13	9	22
	% within gender	6.5	4.5	5.5
Total	Count	200	200	400
	% within gender	100	100	100
Chi-Square (P=0.281)				

Table 4 Height for age (stunting) of the pupils (n=400) according to Waterlow classification.

Interpretation		Gender		Total
		Boys	Girls	
Normal	Count	115	139	254
	% within gender	57.5	69.5	63.5
Mild	Count	56	34	90
	% within gender	28	17	22.5
Moderate	Count	29	27	56
	% within gender	14.5	13.5	14
Severe	Count	0	0	0
	% within gender	0	0	0
Total	Count	200	200	400
	% within gender	100	100	100
Chi-Square (P=0.233)				

Table 5 Correlation between socioeconomic characteristics and anthropometric measurements of respondents (boys & girls).

Depended Variable	BMI		% Height-for- age		% Weight-for-age	
In depended Variable	Boys	Girls	Boys	Girls	Boys	Girls
Age	0.323**	0.279**	0.021	-0.067	-0.132	-0.005
Family Member	0.066	-0.037	0.003	-0.119	-0.069	-0.068
Fathers Education	0.007	0.140*	-0.053	0.095	-0.069	0.035
Mothers Education	0.051	-0.007	0.045	0.032	0.032	0.058
Monthly Income	0.032	0.271**	0.061	0.155*	0.145*	0.093
Mothers Work	0.103	-0.176*	0.026	-0.187**	-0.096	-0.137
**P ≤ 0.01; *P ≤ 0.05						

correlation coefficient between the respondent's nutritional status and socioeconomic characteristics of their families were determined **(Table 5).** Unexpectedly, the three anthropometric measurements used as proxies for the respondents nutritional status (BMI, Height-for-age and Weight-for-age) were found to be significantly correlated with none of the traditional correlates of the nutritional status; family size, parents education, family income and mother work [23]. However, for boys the significant positive correlation between the age and BMI as well as family monthly income and the respondent weight-for-age was observed. Also, for girls a significant positive correlation between the age, father education and monthly income with BMI was observed, but mother work negatively correlated with BMI (P ≤ 0.01) as well as height-for-age (P ≤ 0.05).

Discussion

The increase in daily intake of iron may be due to high intake of proteins. Low intake of fruits and vegetable as reported before is believed to be the main factor that lowered the intake of some vitamins and minerals [20]. Generally, the data obtained for the respondents indicated that they took more food rich in carbohydrates, unsaturated fat and protein and their food intake was deficient in vitamins and minerals. The results also indicated that most of respondents under evaluation depend on carbohydrates rich diets and dislike to eat food prepared at home; bad food habits. Malnutrition expected to be caused by the respondent's lifestyle that adversely impacted their eating habits. Respondents, particularly those suffering from overweight and obesity, are expected to spend long time watching TV and playing computer or other devices games. This reduces their physical activities and encourages sedentary lifestyle which in turn will adversely affect their eating habits and nutritional status. The results obtained agree with the literature about nutritional status conducted in Saudi Arabia which concluded that the nutritional problems in Saudi Arabia are mainly due to change in food habits, illiteracy and ignorance, rather than shortage of food supply or low income [24]. This agree with Park et al. [25] who concluded that the main cause of obesity and overweight is an energy imbalance between calories consumed and calories expended which is caused by changes in dietary and physical activity patterns that accompany environmental and societal changes associated with development and lack of supportive policies. Also Al-Nuaim et al. [26] showed that the prevalence of overweight and obesity among male schoolchildren aged 6-18 years in Saudi Arabia was 11.7% and obesity was 15.8%. Further they reported that one in every six children aged 6 to 18 years old is obese. The results of the study are also agree with the findings of Nicklas et al. [27] and Parsons et al. [28] which showed that 25% of the children in the US were overweight and 11% were obese. The prevalence of obesity is increasing worldwide at an alarming rate in both developing and developed countries [29]; the results of this study reflect the seriousness of what this report stated. Stunting is an important public health problem in developing countries because of its association during childhood with poor functional outcomes such as impaired cognitive development [30], increased susceptibility to infection and increased risk of mortality [31]. Long-term consequences of childhood stunting include short stature, reduced work capacity and elevated risk of poor reproductive outcomes. Recent research also suggests that stunting in childhood may increase later risk of obesity and chronic diseases [32]. Prolonged under-nutrition during gestation and extending into early childhood is common in developing countries and causes stunting. Stunting is caused by poor

maternal nutrition status at conception, under-nutrition in utero, inadequate breast-feeding, delayed complementary feeding, inadequate quality or quantity of complementary feeding and impaired absorption of nutrients due to intestinal infections and parasites [33]. The significant negative correlation between the family monthly income and the respondents height-for- age could be attributed to the fact that Sudanese working in Saudi Arabia have reasonable income that enables them to live decent life and consequently the traditional correlates of nutritional status that are related to income and food availability are not important determinant of their nutritional status [33]. Some studies revealed that during the last 20 years the Kingdom of Saudi Arabia witnessed un-preceded development in all aspects of life which has resulted in the adoption of a sedentary lifestyle and consumption of high fat and low-fiber diet which is believed to be associated with malnutrition related health problems [34]. Thus, factors such as nutritional awareness and lifestyles are expected to be the significant correlates of nutritional status in contexts such as that of this study.

Conclusion

The study revealed that more than 40% of the respondents were overweight. This is expected to be caused by the respondent's sedentary lifestyle that adversely affected their eating habits. This is confirmed by the finding that the respondents (boys and girls) average daily intake of carbohydrates, protein and saturated and unsaturated fat was significantly higher than that of the DRI, while the amount of some vitamins and minerals was significantly lower than that of the DRI. None of the hypothesized predictors of the respondent's nutritional status were found to be significantly and negatively correlated with the student's nutritional status indicators except mother work. Thus, factors such as nutritional awareness and lifestyles are expected to be the significant correlates of nutritional status in contexts such as that of this study. The study highlighted the need to conduct further research to explore the correlates of nutritional status of Sudanese students living in Saudi Arabia.

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