**Original Research Article****DOI: 10.26479/2018.0406.20****FACTORS INFLUENCING THE NUTRITIONAL STATUS OF ADOLESCENT GIRLS IN RIYADH/ SAUDI ARABIA****Maha Al Turki<sup>1\*</sup>, Ali Karrar Osman<sup>2</sup>, Bushra Mohammed Alajmi<sup>3</sup>, Rahaf Khalaf Almutairi<sup>3</sup>,  
Afrah Salman Almutairi<sup>3</sup>, Kavita Sudersana das<sup>1</sup>**

1. Asst. Professor, COAMS, KSAU-HS, KAMC, KAIMRC, NGH, Riyadh, KSA
2. Professor, COAMS, KSAU-HS, KAMC, KAIMRC, NGH, Riyadh, KSA
3. Clinical Nutrition Program, COAMS, KSAU-HS, KAMC, KAIMRC, NGH, Riyadh, KSA

**ABSTRACT:** Faulty diets and dietary habits during the adolescent period can be a cause of a number of health and nutrition-related problems during adulthood. The study was conducted to assess the factors that affect Nutritional Status of Adolescent Girls of Secondary Schools in Riyadh, Saudi Arabia. For the study, 384 female students aged between 16 -18 were randomly selected from eight public and private secondary schools located in west, north, south, and east regions of Riyadh, KSA by using multistage stratified sampling and after excluding those with chronic diseases. The data with respect to demographic information, frequency of food consumption and skipping the meal, physical activity pattern and anthropometric measurements and hemoglobin levels were collected using a structured and validated schedule. SPSS Version 22 was used for analyzing the data. The categorical variables were described as frequencies and percentages, while the mean and standard deviation were used for continuous variables. Chi-Square test was used to find out the factors influencing the nutritional status ( $p = \leq 0.05$ ). The results of the study showed that the prevalence of overweight (18.2%), obesity (11.5%) and Iron Deficiency Anemia (77.6%) were high among adolescent females. A statistically significant association was observed between canned juices consumption and high body fatness. It was evidenced that lifestyle and faulty food habits are strongly associated with obesity and anemia among adolescent girls. Hence awareness programs for adolescent girls should be planned and implemented in schools and community centers to promote a healthy lifestyle and food habits.

**KEYWORDS:** Adolescents, nutritional status, dietary habits and anemia.

**Corresponding Author: Dr. Maha Al Turki\* Ph.D.**

College of Applied Medical Sciences, King Saud Bin Abdulaziz University for Health Sciences,  
KAMC, KAIMRC, NGHHA, Riyadh, KSA. Email Address: AlTurkimahaa@gmail.com.

---

**1.INTRODUCTION**

Adolescents represent 20% of the world population and 16.7 percent of the population in KSA is adolescents. [1] After infancy, adolescence is considered a fast period of growth due to hormonal changes [2, 3] and as a sensitive period with respect to physical, psychological, and cognitive features.[3,4] Because of all these changes, the adolescent needs special attention for adopting a healthy lifestyle. Nutritional Status is a measurement of the degree to which the individual's physiological need for nutrients is being met. [5] Over the past decades, the prevalence of obesity and overweight, particularly among children and adolescents has become a major concern in Arab countries. [6] Earlier reports indicated that overweight and obesity were higher among private school students than public school students as the private school students had a higher level of socioeconomic status. [7] Abahussain et al. carried out a study among female adolescents in Al-Khobar, KSA, and found that 11% percent of females were underweight while 28% were obese or overweight. [8] Dietary habits are habitual decisions about what food that individuals or group of people eat. There are some common unhealthy dietary practices and habits among adolescents such as skipping breakfast, poor consumption of vegetables, fruits, milk, and milk products and high consumption of fast foods, and sugar-sweetened drinks, energy drinks and drinks containing caffeine. [9, 10] In Kuwait, it was observed that the consumption of milk and milk products, vegetables, sweetened beverages, energy drink, and fast foods were higher among male adolescents than females. However, the consumption of sweets was higher among female adolescents.[10] Previous studies in KSA stated that 49 percent of females in Abha and 15 percent of females from Jeddah skipped their breakfast.[9] Adolescents with poor food choices consume food low in minerals and vitamins and high in sugar and fat resulting in obesity and associated co-morbidities.[11] The adolescents of KSA did not carry out physical activity regularly and female adolescents had the habit of spending more than 2 hours per day for using the electronic devices such as TV, video games, and computer browsing the web. [9] Iron Deficiency Anemia is common in KSA among adolescents because of iron deficient diet and lack of knowledge about iron-rich foods and a balanced diet.[12] It was reported that more than half of the girls were anemic in Jeddah. [1] A study among female adolescents in India stated that 75 percent of female adolescents had iron deficiency anemia and the mild form of anemia is the most prevalent anemia among them. [13] Since there are limited studies to assess factors influencing the nutritional status of adolescent females in Riyadh province of KSA, the present study was designed to assess the factors influencing the nutritional status of adolescent

girls attending secondary schools in Riyadh/ Saudi Arabia.

## 2. MATERIALS AND METHODS

The subjects for the study were selected from four public and four private schools located in north, south, east and western regions of Riyadh province of KSA. The samples were equally distributed among the public ( $n_1=192$ ) and private ( $n_2=192$ ) schools and also among the four regions. Accordingly, 48 adolescent girls each, without any chronic disease, were chosen from the schools selected for the study. Multistage stratified sampling was used to select the sample of size of 384 after considering a population size of 81617 adolescents attending various schools licensed under Ministry of Education, KSA by using check market sample size calculator at 5 percent level of significance at 95% confidence level. Suitably structured and validated schedules were used to conduct face to face interview of the selected subjects to collect the data with respect to demography, physical activity pattern, the frequency of food consumption and skipping of meals. Nutritional status of the subjects was assessed by anthropometric measurements such as weight, height, skinfold thickness and waist and hip circumferences. Hemoglobin level of the subjects was observed to analyze iron nutrition. Data were analyzed using SPSS version 22. The categorical variables were described as frequencies and percentages, while mean and standard deviation were used for continuous variables. Relationships between variables were analyzed by using Yates and Pearson Chi-square test and the level of significance used was  $\leq 0.05$ . The study was approved by Institutional Review Board of King Abdullah International Medical Research Centre, Riyadh, KSA.

## 3. RESULTS AND DISCUSSION

The study was conducted among adolescent girls with a mean age of 17.1 years.

### Demography of the subjects

Nutritional status during adolescent years is an essential mainstay of health status and quality of life in adulthood. Various factors were reported to influence the nutritional and hence the health status of adolescents with different demographics such as the influence of immediate environments resembling the studentship in public or private school and lifestyle and dietary habits. The demographic characteristics of the study subjects were illustrated in Table 1. The subjects were equally distributed among public ( $n_1=192$ ) and private schools ( $n_2= 192$ ) and among the four regions. Majority of the subjects (46.60percent) belong to families of income  $\geq 10000$ SAR and of size 7-10 (59.60 percent) with  $\leq 2$  adolescent girls (86.70 percent).

**Table 1: Demographic characteristics of the study subjects**

Demographic characteristic	Details of study subjects (n=384)*
<b>Region</b>	
North	95(24.70)
West	95(24.70)
East	96(25.00)
South	98(25.50)
<b>Income (SAR)</b>	
<2000	18(4.70)
2000-5000	82(21.40)
5000-10000	105(27.30)
≥10000	179(46.60)
<b>Family size</b>	
3-6	106(27.60)
7-10	229(59.60)
≥11	49(12.80)
<b>No. of adolescent girls in the family</b>	
≤2	333(86.70)
3-4	47(12.20)
5-7	2(0.50)
≥8	2(0.50)

\*Numbers in parenthesis indicate the percentage

It was observed that the selection of the type of the school was significantly influenced by the income of the family (Table 2).

**Table 2: Influence of the family income in selecting the type of school**

Monthly Family income (SAR)	Type of school*		Total
	Public school	Private school	
<2000	12(66.70)	6(33.30)	18(100)
2000-5000	59(72.00)	23(28.00)	82(100)
5000-10000	69(65.70)	36(34.30)	105(100)
≥ 10000	52(29.00)	127(71.00)	179(100)
$\chi^2$ value = 59.601	Significant at 0.001		

\*Numbers in parenthesis indicate the percentage

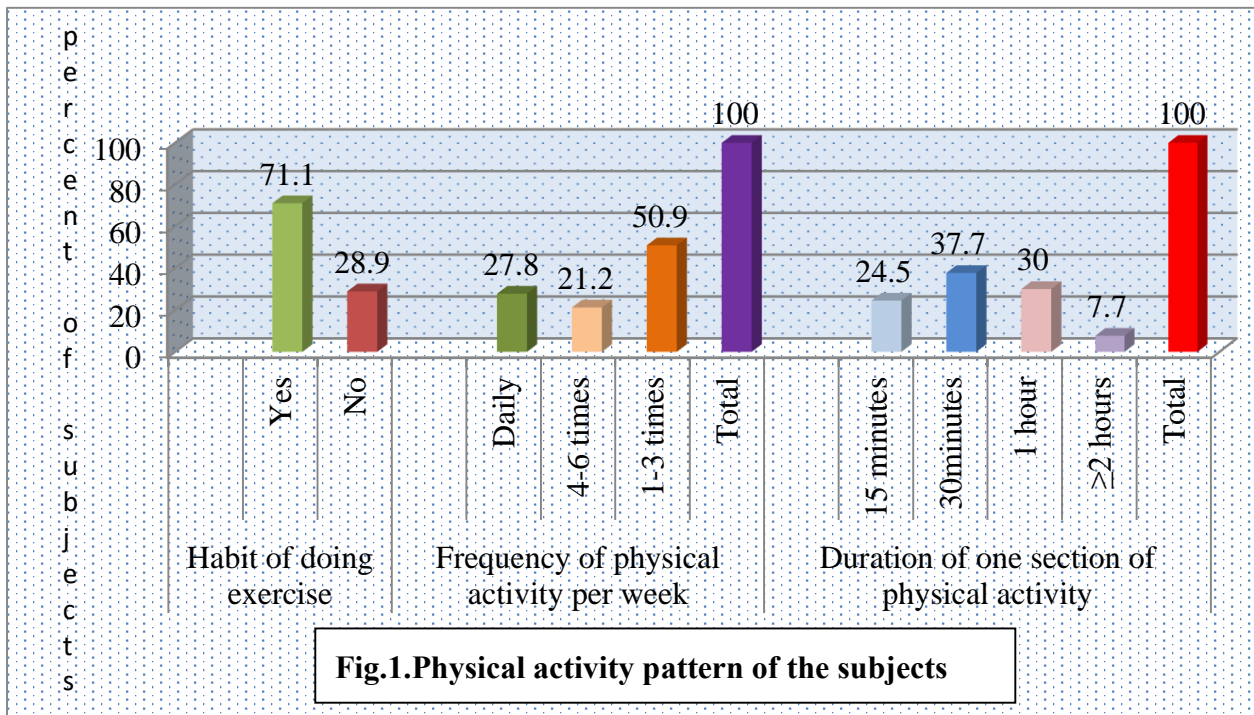
The parental choice of the type of the school influenced by family income ( $\chi^2 = 59.601$ ;  $p = 0.001$ ) as the parents of higher socio-economic class prefers to educate their children in private schools. [14]

**Physical activity pattern of the subjects**

The physical activity patterns of the selected adolescent girls were detailed in Figure 1. From the figure, it was perceived that 71.1 percent of the subjects had the habit of taking exercise. Among them, 50.90 percent exercise 1-3 times in a week whereas 27.8 percent exercise daily. Duration of one section of physical activity ranged from 15 minutes (24.50 percent); 30 minutes (37.70percent); 1 hour (30 percent) and ≥2 hours (7.7 percent). It was observed that the regularity of doing physical activity had a significant influence ( $\chi^2 = 18.557$ ;  $p = 0.001$ ) on the nutritional status of adolescent girls. Insufficient physical activity was reported in the Eastern Mediterranean Region.[15]

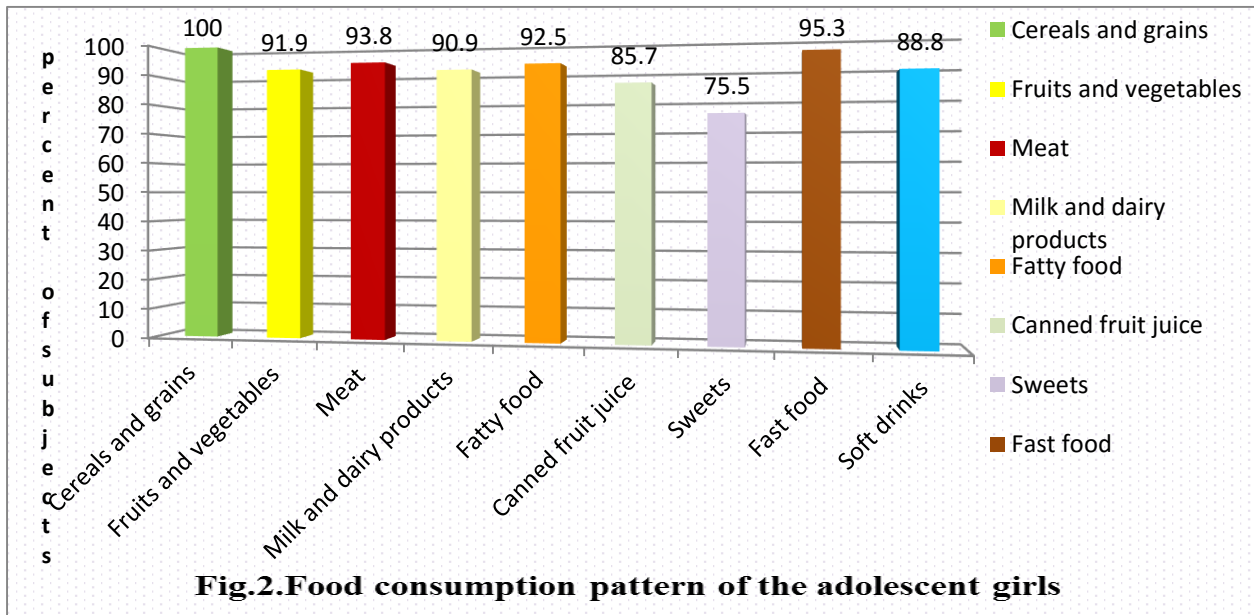
**Usage of electronic gadgets**

About 99.2 percent of the adolescents under study use electronic gadgets and gaming. The duration of their usage ranged from 7-12 hours for 48.8 percent, 3-6hours for 38.6 percent and ≤ 2hours for 12.6 percent. The adolescent girls of the study had the habit of using electronic gadgets from 2 to 12 hours a day which might have adversely affected their physical activity.



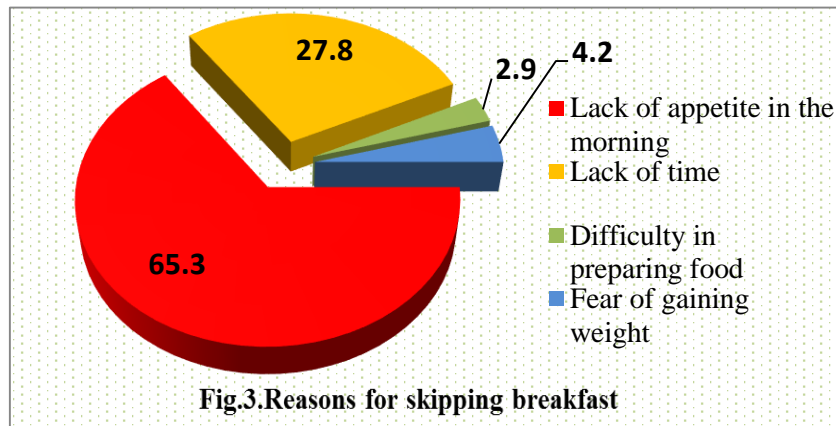
**Food consumption pattern of the subjects**

The food consumption pattern of the subjects (Fig.2) indicated that starchy foods such as cereals and grains, fast food items, meat and fatty foods, fruits and vegetables, milk and dairy products, soft drinks, canned fruit juice and sweets were included in the daily dietaries of the adolescent girls.



**Habit of skipping breakfast**

Results of the study indicated that 37.5 percent of the subjects had the habit of skipping breakfast regularly. Among them 65.3 percent skipped breakfast due to lack of appetite in the morning (Fig.3) and 27.80 percent skip breakfast as they had a lack of time.

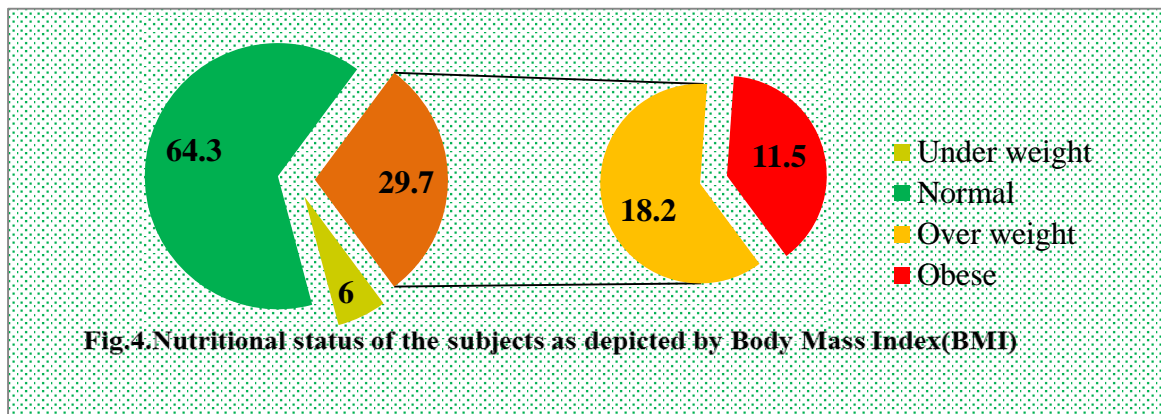


About 27.80 percent of the girls skipped their breakfast complaining that they didn't get time to have it. Cross-sectional and longitudinal studies have shown that regularity of skipping breakfast is associated with a high body mass index (BMI). [16-22] However, it was found from the study that the association between breakfast skipping and overweight/obesity was attenuated, and not statistically significant.

**Nutritional status of the subjects**

Nutritional status of the subjects as depicted by Body Mass Index (BMI) showed that majority (64.3 percent) of them were in the normal BMI range while 35.7 percent of the adolescent girls were either over-nourished (29.7 percent) or undernourished (6 percent) (Fig.4). Among the over nourished subjects, obesity was prevalent among 11.5 percent and 18.2 percent were overweight. Earlier, [23] it was reported that about 34.4 percent of children and adolescents from KSA altogether had over

nutrition by overweight, obesity and severe obesity. Region wise distribution of malnutrition indicated that southern and eastern region of Riyadh had a high prevalence of underweight (30.4 percent) whereas western region had the high occurrence of obesity (29.50 percent). The results are on par with the findings of the Hamdan and Fahmy. [24] The incidence of obesity increased with the increase in family income. Around 54.50 percent of the obese adolescent girls belonged to families with monthly family income greater than 10000 SAR. An earlier study from KSA reported that overweight and obesity were more prevalent among high-income subjects. [25]



Distribution of skinfold thickness of the subjects based on BMI is detailed in Table 3.

**Table 3: Distribution of body fat percentage as per skinfold thickness and Body Mass Index (BMI) of the subjects**

Body Fat percentage*	Classification of Body Mass Index **				Total	p-value
	Under weight	Normal	Over weight	Obese		
Ideal	5(21.7)	9(3.6)	1(1.4)	0	15(3.9)	0.001***
Average	17(73.9)	153(61.9)	20(28.6)	4(9.1)	194(50.5)	
Above average	1(4.3)	85(34.4)	49(70)	40(90.9)	175(45.6)	
Total	23(100)	247(100)	70(100)	44(11.5)	384(100)	

\*Source: <http://newscellar.info/wp-content/uploads/2018/05/body-fat-caliper-measurements-chart.jpg>

\*\*Numbers in parenthesis indicate the percentage \*\*\* Significant at  $p \leq 0.05$  Yates Corrected Chi-square = 93.12

It was observed that fat percentage was significantly influenced by BMI of the subjects ( $p = 0.001$ ). None of the obese subjects were with ideal skinfold thickness whereas 90.9 percent of the obese subjects were presented with a skinfold thickness of above average. Among the overweight subjects, 70 percent had average skinfold thickness and the majority of normal (61.9 percent) and underweight (73.9) subjects were with average skinfold thickness. Vide table 4, more than half of the adolescent girls were found to have moderate (44.79 percent) to high (10.94 percent) health risk of having diet-related non-communicable chronic diseases. The health risk associated with waist hip

ratio is significantly influenced by body mass index. Nooyens et al. carried out a study among male and female adolescents and reported that overweight adolescents had high skinfold thickness [26] and Waist-Hip Ratio (WHR).[27] General and abdominal obesity were highly prevalent among adult Saudi females as measured by BMI and WHR.[28].

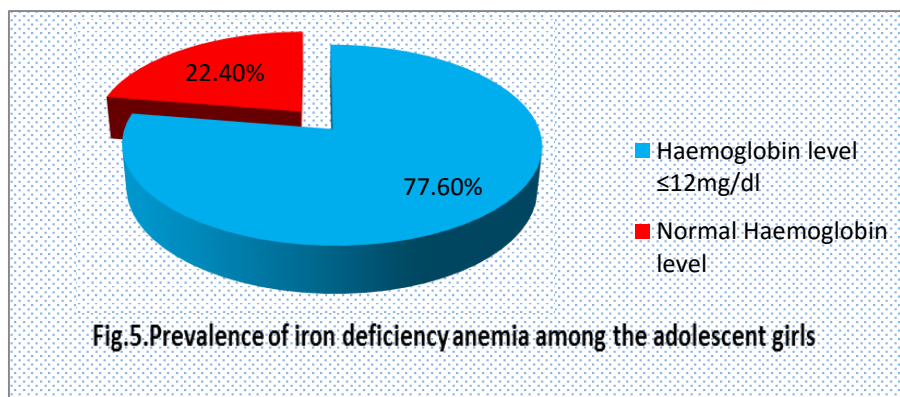
**Table 4: Distribution of health risk of the subjects based on waist to hip ratio and BMI**

Health risk **	BMI category*				Total	p value
	Under weight	Normal	Over weight	Obese		
Lower risk ( $\leq 0.80m$ )	15 <sub>(65.22)</sub>	141 <sub>(57.09)</sub>	14 <sub>(20.00)</sub>	0	170 <sub>(44.27)</sub>	p= 0.001 **
Moderate risk (0.81-0.85m)	8 <sub>(34.78)</sub>	106 <sub>(42.91)</sub>	30 <sub>(42.86)</sub>	29 <sub>(65.90)</sub>	172 <sub>(44.79)</sub>	
High risk ( $\geq 0.86m$ )	0	0	26 <sub>(37.14)</sub>	15 <sub>(34.10)</sub>	42 <sub>(10.94)</sub>	
Total	23 <sub>(100)</sub>	247 <sub>(100)</sub>	70 <sub>(100)</sub>	44 <sub>(100)</sub>	384 <sub>(100)</sub>	

\*Numbers in parenthesis indicate the percentage \*\* Source: WHO (2008) \*\*\*Yates Corrected Chi square =132.22

### Prevalence of iron deficiency anaemia among the adolescent girls

Figure 5 presents the prevalence of iron deficiency anaemia among the adolescent girls



It was observed that the majority (77.6%) of the adolescent girls were with iron deficiency anemia. This result is on par with an earlier study, which observed that 64 percent of female college students from KSA had Iron Deficiency Anemia.[29] WHO estimated that 27 percent of adolescents in developing countries are anemic.[30] Similarly, the previous studies found that 53.6 percent of adolescents in Jeddah were anemic.[5] However, the findings of the present study exceeded this prevalence rates observed in earlier studies.

### Factors that affect the nutritional status of adolescent girls

Table 5 details various factors that have a significant influence on the nutritional status of adolescent girls.



**Table 5: The factors that affect the nutritional status of adolescent girls**

Factors	Classification of BMI*				Test statistic( $\chi^2$ ) and level of significance (p)
	Underweight	Normal	Overweight	Obese	
<b>Type of school</b>					
Public	12 <sub>(52.2)</sub>	124 <sub>(50.2)</sub>	35 <sub>(50)</sub>	21 <sub>(47.7)</sub>	0.138, 0.987
Private	11 <sub>(47.8)</sub>	123 <sub>(49.8)</sub>	35 <sub>(50)</sub>	23 <sub>(52.3)</sub>	
<b>Region</b>					
North	6 <sub>(26.1)</sub>	58 <sub>(23.5)</sub>	21 <sub>(30)</sub>	10 <sub>(22.7)</sub>	7.693, 0.565
West	3 <sub>(13)</sub>	68 <sub>(27.5)</sub>	11 <sub>(15.7)</sub>	13 <sub>(29.5)</sub>	
East	7 <sub>(30.4)</sub>	63 <sub>(25.4)</sub>	17 <sub>(24.3)</sub>	9 <sub>(20.5)</sub>	
South	7 <sub>(30.4)</sub>	58 <sub>(23.5)</sub>	21 <sub>(30)</sub>	12 <sub>(27.3)</sub>	
<b>Monthly Family Income (SAR)</b>					
<2000	0 <sub>(0.0)</sub>	14 <sub>(7.6)</sub>	3 <sub>(4.3)</sub>	1 <sub>(2.3)</sub>	2.727, 0.974
2000-5000	5 <sub>(21.7)</sub>	54 <sub>(21.9)</sub>	14 <sub>(20)</sub>	9 <sub>(20.5)</sub>	
5000-10000	7 <sub>(30.4)</sub>	70 <sub>(28.3)</sub>	18 <sub>(25.7)</sub>	10 <sub>(22.7)</sub>	
≤10000	11 <sub>(47.8)</sub>	109 <sub>(44.1)</sub>	35 <sub>(50)</sub>	24 <sub>(54.5)</sub>	
<b>Family size</b>					
2	1 <sub>(4.3)</sub>	0 <sub>(0.0)</sub>	0 <sub>(0.0)</sub>	0 <sub>(0.0)</sub>	8.172, 0.517
3-6	4 <sub>(17.4)</sub>	68 <sub>(27.5)</sub>	21 <sub>(30)</sub>	12 <sub>(27.3)</sub>	
7-10	15 <sub>(65.2)</sub>	149 <sub>(60.3)</sub>	42 <sub>(60)</sub>	23 <sub>(52.3)</sub>	
≥ 11	3 <sub>(13)</sub>	30 <sub>(12.1)</sub>	7 <sub>(10)</sub>	9 <sub>(20.5)</sub>	
<b>Regularity of doing physical activity</b>					
Yes	8 <sub>(2.9)</sub>	182 <sub>(66.7)</sub>	47 <sub>(17.2)</sub>	36 <sub>(13.2)</sub>	18.557, 0.001**
No	15 <sub>(13.5)</sub>	65 <sub>(58.6)</sub>	23 <sub>(20.7)</sub>	8 <sub>(7.2)</sub>	
<b>Electronic devices</b>					
Yes	23 <sub>(6)</sub>	246 <sub>(64.6)</sub>	69 <sub>(18.1)</sub>	43 <sub>(11.3)</sub>	4.004, 0.261
No	0 <sub>(0)</sub>	1 <sub>(33.3)</sub>	1 <sub>(33.3)</sub>	1 <sub>(33.3)</sub>	
<b>Habit of skipping breakfast</b>					
Skip	6 <sub>(4.2)</sub>	96 <sub>(66.7)</sub>	25 <sub>(17.4)</sub>	17 <sub>(11.8)</sub>	1.595, 0.661
Non-skip	17 <sub>(7.1)</sub>	151 <sub>(62.9)</sub>	45 <sub>(18.8)</sub>	27 <sub>(11.2)</sub>	
Total	23 <sub>(100)</sub>	247 <sub>(100)</sub>	70 <sub>(100)</sub>	44 <sub>(100)</sub>	

\*Numbers in parenthesis indicate the percentage \*\* Significant at 0.05 percent level

As per the table, regularity of doing physical activity has significant influence ( $\chi^2 = 18.557$ ;  $p = 0.001$ ) on the nutritional status of the adolescent girls.

It was found that that the consumption of fatty foods, canned juice, fast food and sweets are very high among adolescent girls (Table 6).

**Table 6: Influence of the type of food consumed on body fat percentage**

Type of food	Body fat percentage*			$\chi^2$ Value	p-value
	Ideal	Average	Overfat		
<b>Fatty food</b>					
Yes	14 <sub>(93.30)</sub>	181 <sub>(93.30)</sub>	160 <sub>(91.40)</sub>	0.479	0.787
No	1 <sub>(6.70)</sub>	13 <sub>(6.70)</sub>	15 <sub>(8.60)</sub>		
<b>Canned juice</b>					
Yes	10 <sub>(66.70)</sub>	172 <sub>(88.70)</sub>	147 <sub>(84.00)</sub>	6.225	0.044**
No	5 <sub>(33.30)</sub>	22 <sub>(11.30)</sub>	28 <sub>(16.00)</sub>		
<b>Fast food</b>					
Yes	14 <sub>(93.30)</sub>	175 <sub>(90.20)</sub>	152 <sub>(86.90)</sub>	1.360	0.507
No	1 <sub>(6.70)</sub>	19 <sub>(9.80)</sub>	23 <sub>(13.10)</sub>		
<b>Sweet</b>					
Yes	15 <sub>(100)</sub>	186 <sub>(95.90)</sub>	165 <sub>(94.30)</sub>	0.558	0.757
No	0	8 <sub>(4.10)</sub>	10 <sub>(5.70)</sub>		

\*Numbers in parenthesis indicate the percentage \*\* Significant at  $\leq 0.05$  percent

The body fat percentage was significantly influenced by consumption of canned fruit juices ( $\chi^2 = 6.225$  at  $p=0.044$  significant at 0.05%). Excessive fruit juice consumption is associated with increased risk for obesity.[31] Table 7 shows the influence of food intake on the hemoglobin level. Low hemoglobin levels were indicated for those with regular consumption of sweet and soft drink (78.3percent and 78.4percent respectively). The study shows that the percentages of students who are anemic relatively consume more fast food (77.6%) and fatty food (77.6%). The habit of consuming meat was found among 22.2% of the anemic subjects and 77.8% of non-anemic subjects. Food consumption pattern of the adolescent girls indicated that the consumption of foods rich in calorie but low in iron such as fatty foods, canned juice, fast food, and sweets was very high among them. There is recent scientific evidence that sucrose consumption with low fiber, as in fruit juice, is associated with the metabolic syndrome, liver injury, and obesity. [32]

**Table 7: Influence of type of food intake on hemoglobin level**

Type of food	Hemoglobin(mg/dl)*		Total	$\chi^2$ Value	P value**
	< 12	Normal or >12			
<b>Starchy food</b>					
Yes	266 <sub>(77.6)</sub>	77 <sub>(22.4)</sub>	343 <sub>(100)</sub>	-	-
<b>Fruits &amp; vegetables</b>					
Yes	241 <sub>(76.8)</sub>	73 <sub>(23.2)</sub>	314 <sub>(100)</sub>	1.363	0.243
No	25 <sub>(86.2)</sub>	4 <sub>(13.8)</sub>	29 <sub>(100)</sub>		
<b>Meat</b>					
Yes	249 <sub>(77.8)</sub>	71 <sub>(22.2)</sub>	320 <sub>(100)</sub>	0.187	0.665
No	17 <sub>(73.9)</sub>	6 <sub>(26.1)</sub>	23 <sub>(100)</sub>		
<b>Milk &amp; dairy products</b>					
Yes	238 <sub>(76.8)</sub>	72 <sub>(23.2)</sub>	310 <sub>(100)</sub>	1.117	0.291
No	28 <sub>(84.8)</sub>	5 <sub>(15.2)</sub>	33 <sub>(100)</sub>		
<b>Fatty food</b>					
Yes	246 <sub>(77.6)</sub>	71 <sub>(22.4)</sub>	317 <sub>(100)</sub>	0.006	0.936
No	20 <sub>(76.9)</sub>	6 <sub>(23.1)</sub>	26 <sub>(100)</sub>		
<b>Canned juice</b>					
Yes	222 <sub>(76.8)</sub>	67 <sub>(23.2)</sub>	289 <sub>(100)</sub>	0.569	0.451
No	44 <sub>(81.5)</sub>	10 <sub>(18.5)</sub>	54 <sub>(100)</sub>		
<b>Soft drink</b>					
Yes	203 <sub>(78.4)</sub>	56 <sub>(21.6)</sub>	259 <sub>(100)</sub>	0.416	0.519
No	63 <sub>(75)</sub>	21 <sub>(25)</sub>	84 <sub>(100)</sub>		
<b>Fast food</b>					
Yes	236 <sub>(77.6)</sub>	68 <sub>(22.4)</sub>	304 <sub>(100)</sub>	0.010	0.920
No	30 <sub>(76.9)</sub>	9 <sub>(23.1)</sub>	39 <sub>(100)</sub>		
<b>Sweet</b>					
Yes	256 <sub>(78.3)</sub>	71 <sub>(21.7)</sub>	327 <sub>(100)</sub>	2.184	0.139
No	10 <sub>(62.5)</sub>	6 <sub>(37.5)</sub>	16 <sub>(100)</sub>		

\*Numbers in parenthesis indicate the percentage \*\* Level of significance  $p = \leq 0.05$

#### 4. CONCLUSION

Based on the results of the study, it is recommended to conduct a population-based study to identify the actual food and nutrient intake of the adolescents and the contribution of energy and carbohydrates from canned juices. Accordingly, nutrition and health awareness programs are to be conducted to include balanced diet in the daily dietaries of the adolescent girls and to enhance the physical activity of them so as to avoid macro and micronutrient deficiencies or surfeit.

#### ACKNOWLEDGEMENT

The authors acknowledge Dr. Mohammed Khalaf Al-Mutairi, Dean of College of Applied Medical Sciences, King Saud Bin Abdulaziz University for Health Sciences, KAIMRC, KAMC, NGHA and Dr. Nesrin Alharthy, Associate Dean of College of Applied Medical Sciences for King Saud Bin Abdulaziz University for Health Sciences, KAIMRC, KAMC, and NGHA for giving permission to do the study. We are thankful to the Ministry of Education (MOE) and Directorate of Education, Riyadh for giving us consent to conduct the research in affiliated schools under MOE. We would like to show a deep sense of gratitude to the school administrators and teachers and the students for their cooperation during the data collection process.

#### CONFLICT OF INTEREST

The authors declare that there are no conflicts of interest associated with this publication

#### REFERENCES

1. El-Kholy T, Elsayed E. Association of physical activity and health status with intelligence quotient of high school students in Jeddah. *J. Phys Ther Sci.* 2015;27(7):2039–43.
2. Alkoly TA, Abdallah AM, Alghamidi AK. Nutritional status and eating behaviors among adolescents of some intermediate schools in Jeddah. *JKAU: Med. Sci.* 2011;18(2):1-17
3. Reiter E, Root A. Hormonal changes of adolescence. *Med Clin North Am.* 1975;59(6):1289–304.
4. Rao, Vijayapushpam T, Rao S, Antony G, Sarma K. Dietary habits and effect of two different educational tools on nutrition knowledge of school going adolescent girls in Hyderabad, India. *Eur. J. Clin. Nutr.* 2007;61(9):1081–5.
5. Washi S, Ageib M. Poor diet quality and food habits are related to impaired nutritional status in 13- to 18-year-old adolescents in Jeddah. *Nutr Res. (New York, N.Y.).* 2010; 30(8):527–34.
6. Rolland-Cachera MF, Bellisle F, Deheeger M. Nutritional status and food intake in adolescents living in western Europe. *Eur J Clin Nutr.* 2000; 2000;54 Suppl 1:S41-6.
7. Madani KA. Obesity in Saudi Arabia. *Bahrain Med Bull.* 2000; 22(3):113-118
8. Abahussain N. Was there a change in the body mass index of Saudi adolescent girls in Al-Khobar between 1997 and 2007? *J Family Community Med.* 2011;18(2):49–53.

9. Hazzaa HM Al-, Abahussain NA, Sobayel HI Al-, Qahwaji DM, Musaiger AO. Physical activity, sedentary behaviors and dietary habits among Saudi adolescents relative to age, gender and region. *Int J Behav Nutr Phys Act.* 2011;8:140
10. Allafi A, Haifi A Al-, Fayez M Al-, Athari B Al-, Ajmi F Al-, Hazzaa H Al-, Musaiger A, Ahmed F. Physical activity, sedentary behaviours and dietary habits among Kuwaiti adolescents: Gender differences. *Public health Nutr.* 2013; 17(9):2045–52.
11. Al-Muammar M.N, El-Shafie M, Feroze S. Association between dietary habits and body mass index of adolescent females in intermediate schools in Riyadh, Saudi Arabia. *EMHJ.*2014;20(1):39-45
12. Mason K, Gibson F, Hambleton I, Serjeant B. Iron deficiency among Jamaican adolescents. *West Indian Med J.* 2015; 63(6):561-565
13. Kotecha PV, Nirupam S, Karkar PD (2009) Adolescent girl's anaemia control program, Gujarat, India. *IJMR.* 2009; 130: 584-589
14. Graziela Serroni Perosa, Andriana Santiago Rosa Dantas. The choice of private schools in families from low income groups. *Educ.Pesqui.*2017;43(4):987-1002
15. Mabry R M, Reeves M M, Eakin E G, et al. Evidence of physical activity participation among men and women in the countries of the Gulf cooperation council: a review. *Obes . Rev.* 2010;11: 457–64
16. Ma Y, Bertone ER, Stanek EJ3rd, Reed GW, Hebert JR, Cohen NL, Merriam PA, Ockene IS. Association between eating patterns and obesity in a free-living US adult population. *Am J Epidemiol.* 2003; 158: 85–92.
17. Song WO, Chun OK, Obayashi S, Cho S, Chung CE. Is consumption of breakfast associated with body mass index in US adults? *J Am Diet Assoc.* 2005;105: 1373–1382.
18. Cho S, Dietrich M, Brown CJ, Clark CA, Block G. The effect of breakfast type on total daily energy intake and body mass index: results from the Third National Health and Nutrition Examination Survey (NHANES III). *J Am Coll Nutr.* 2003; 22:296–302.
19. Stockman NK, Schenkel TC, Brown JN, Duncan AM. Comparison of energy and nutrient intakes among meals and snacks of adolescent males. *Prev Med.* 2005;41: 203–210.
20. Sjöberg A, Hallberg L, Höglund D, Hulthén L. Meal pattern, food choice, nutrient intake and lifestyle factors in the Göteborg Adolescence Study. *Eur J Clin Nutr.* 2003;57: 1569–1578.
21. Berkey CS, Rockett HR, Gillman MW, Field AE, Colditz GA. Longitudinal study of skipping breakfast and weight change in adolescents. *Int J Obes Relat Metab Disord.* 2003;27: 1258–1266.
22. Affenito SG, Thompson DR, Barton BA, Franko DL, Daniels SR, Obarzanek E, Schreiber GB, Striegel-Moore RH. Breakfast consumption in African-American and white adolescent girls

- correlates positively with calcium and fiber intake and negatively with body mass index. *J Am Diet Assoc.* 2005; 105:938–945.
23. El Mouzan MI, Foster PJ, Al Herbish AS, et al. Prevalence of overweight and obesity in Saudi children and adolescents. *Ann Saudi Med.* 2010;30(3):203-208
  24. Hamdan AE, Fahmy MM. Socioeconomic factors and complete edentulism for female patients at King Saud university, Riyadh, Saudi Arabia. *Tanta Dent J.* 2014;11(3):169–73
  25. al- Nuaim AR, al- Rubeaan K, al- Mazrou Y, al-Attas O, al-Daghari N, Khoja T. High prevalence of overweight and obesity in Saudi Arabia. *Int J Obes Relat Metab Disord.* 1996;20(6):547-52
  26. Nooyens AC, Koppes LL, Visscher TL, Twisk JW, Kemper HC, Schuit JA, van Mechelen W, Seidell JC. Adolescent skinfold thickness is a better predictor of high body fatness in adults than is body mass index: The Amsterdam growth and health longitudinal study. *American Society for Nutrition. Am J Clin Nutr.* 2007;87(6):1533-1539
  27. Kowsalya T, Periyar R, Nadu T, Parimalavalli R, Food Science. Prevalence of overweight /obesity among adolescent girls in Salem district, India. *Indian J Health Sci Biomed Res (KLEU).* 2014;7(2):73-77
  28. Bahiga Galal Abd El-Aal. Studying the Relationship between Body Mass Index, Waist-Hip Ratio and Quality of Life Among Adult Saudi Females. *AJNS.* 2016;5(6):251-257
  29. Nora Nasir Al Hassan. The prevalence of iron deficiency anemia in Saudi University female students. *J Microsc Ultrastruct.* 2015; 3(1):25-28
  30. WHO and FAO (World Health Organization and Food and Agriculture Organization of the United Nations). Diet, nutrition and the prevention of chronic disease: report of a joint WHO/FAO expert's consultation. Report no. 916. WHO, Geneva; 2003; pp 34-38
  31. Wojcicki JM, Heyman MB. Reducing Childhood Obesity by Eliminating 100% Fruit Juice. *Am J Public Health.* 2012;102(9):1630-1633
  32. Lim JS, Mietus-Snyder M, Valente A, Schwartz JM, Lustig RH. The role of fructose in the pathogenesis of NAFLD and the metabolic syndrome. *Nat Rev Gastroenterol Hepatol.* 2010;7(5):251–264