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3 **Relationship of BMI with Junk Food, sleep pattern, exam**
4 **performance and awareness about its ill health effects in healthy**
5 **teenagers**

6
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13
14 **Abstract**

15 **Objective:** To evaluate the relationship of body mass index of healthy teenagers
16 with junk food, sleep pattern, exam performance and awareness about its ill
17 effects.

18 **Methods:** The cross-sectional study was conducted from March to June 2017 at
19 University Medical and Dental College, University of Faisalabad, Faisalabad,
20 Pakistan, and comprised subjects aged 13-19. Data was collected using face-to-
21 face interviews, getting the examination results from respective educational
22 institutions and calculating the body mass index, Data was analysed using SPSS
23 22.

24 **Results:** Of the 226 subjects, 96(42.5%) were boys with a mean age of $15.68 \pm$
25 1.83 years, and 130(57.5%) were girls with a mean age of 17.00 ± 1.74 years.
26 Based on body mass index, 35(15.5%) subjects were underweight, 88(39%) were
27 normal, 28(12.4%) overweight, 56(24.7%) pre-obese and 19(8.4%) were obese.
28 The independent predictors of body mass index were higher consumption of soft

29 drinks in males and higher consumption of soft drinks and salt in females
30 ($p < 0.05$).

31 **Conclusion:** Teenagers were found to be well aware of the ill effects of junk
32 food, but they were found to be happy with their dietary habits and unwilling to
33 change it.

34 **Key Words:** Teenagers, BMI, Food habits, Fast food, Soft drinks.

35

36 **Introduction**

37 Healthy diet is essential in combating non-communicable diseases, like diabetes
38 mellitus (DM) and obesity.¹ Junk food, also known as fast food, has become
39 increasingly popular in Pakistan. Many factors have led to an increase in junk
40 food consumption; one of the important factors is its easy availability to students
41 in school and college cafeterias. It has also been seen that the junk food
42 restaurants have grown rapidly across Pakistan which provide door-to-door
43 delivery of junk food.² The increasing trend of consuming junk food has been
44 witnessed all over the world due to easy availability and accessibility of a variety
45 of delicious fast food items at very affordable prices.³ However, the fact should
46 not be ignored that junk food has a high caloric value which results in serious
47 health problems when consumed excessively, leading to obesity, dental cavities
48 and DM which are few of the diseases whose prevalence is increasing and it can
49 affect the exam performance as well of the students.⁴

50 A disturbed sleep pattern has been associated with obesity as it results in
51 increased appetite and craving for salty, sweet and fried food, which, when
52 consumed excessively, have a detrimental effect on the health of teenagers.⁵

53 Studies have shown that a decreased intake of fruits and vegetables along with an
54 increased intake of fast food results in sleep disturbance which has an overall
55 impact on daily routine of the individuals.⁶

56 A healthy diet exalts exam performance unlike junk food which can lead to poor
57 exam performance.^{7, 8} The current study was planned to see the relationship of

58 body mass index (BMI) with junk food, sleep pattern, exam performance and
59 awareness about its ill effects on health.

60

61 **Subjects and Methods**

62 The cross-sectional study was conducted from March to June 2017 at University
63 Medical and Dental College, University of Faisalabad, Faisalabad, Pakistan, and
64 comprised teenaged students. After approval from the institutional ethics review
65 committee, the sample size was calculated using the formula $n = NX / (X + N - 1)$,
66 where $X = (Z\alpha/2)^2 [p(1-p)] / e^2$. In the formula, n = sample size, $Z\alpha/2$ = critical
67 value of normal distribution at $\alpha/2$, α is 0.05 and critical value is 1.96, while p is
68 the sample proportion and N is the population size). The prevalence of junk food
69 consumption was taken as 11%,⁹ errors (e) of 5% and confidence interval (CI) of
70 95%.

71 The sample was raised using multistage sampling technique. A list of all private
72 schools in Faisalabad providing secondary education to the students was
73 collected. From the list five schools were selected randomly, and from these five
74 ,schools lists of all students enrolled were obtained from their respective
75 managements. Those included were healthy subjects aged 13-19 who were
76 willing to volunteer for the study. Students with any known disease, such as
77 inflammatory bowel disease, cystic fibrosis, celiac disease, and known food
78 allergy or food intolerance, were excluded, and so were those having any
79 psychiatric eating disorder.

80 After taking written informed consent from the participants or their guardians,
81 data was collected through face-to-face interviews regarding demographics,
82 dietary and sleeping habits using a specially designed proforma.¹⁰ Test scores of
83 the students were obtained from the respective educational insititutions. BMI was
84 calculated after taking height and weight measurements using standardised
85 equipment and standard procedure. The subjects were divided into various BMI
86 groups using the the Asian classification of the World Health Organization

87 (WHO)¹¹, labelled as: underweight <18.5, normal 18.5-22.9, overweight 23-24.9,
88 pre-obese 25-29.9, and obese >30.

89 Data was analysed using SPSS 22. For qualitative variables, data was presented
90 as frequencies and percentages. For quantitative variables, it was presented as
91 mean±standard deviation (SD). Independent sample t test and chi-square tests
92 was used for inter-group comparisons. Analysis of variance (ANOVA) followed
93 by post-hoc analysis was done for multiple comparisons among BMI groups.
94 Pearson's correlation was applied to observe correlation between quantitative
95 variables. Multivariate linear stepwise regression analysis was used to see the
96 predictors of BMI. $P \leq 0.05$ was considered statistically significant.

97

98 **Results**

99 Of the 226 subjects, 96(42.5%) were boys with a mean age of 15.68 ± 1.83 years
100 and mean BMI 22.79 ± 4.31 , and 130(57.5%) were girls with a mean age of
101 17.00 ± 1.74 years and mean BMI 22.43 ± 5.39 . Exam performance of girls was
102 significantly higher compared to boys ($p < 0.05$). The reasons given by students
103 for their consumption of junk food and their perception of factors causing
104 obesity or health problems were noted (Table 1).

105 Based on BMI, 35(15.5%) subjects were underweight, 88(39%) normal,
106 28(12.4%) overweight, 56(24.7%) pre-obese and 19(8.4%) were obese. Healthy
107 and unhealthy food consumption in various BMI groups were noted and there
108 were significant differences (Table 2).

109 The relation of BMI with unhealthy and healthy food consumption, average sleep
110 hours and test scores in college students were explored (Table 3).

111 Stepwise multiple regression analysis model accounted showed that
112 independent predictors of BMI in males were higher consumption of sports and
113 soft drinks, while in females, the independent predictors were higher
114 consumption of soft drinks and salt, and low consumption of fresh fruits and low
115 performance in exams (Table 4).

116 Despite having a significant perception about the ill effects of obesity and related
117 factors, most teenagers regardless of gender were happy with their dietary habits
118 and had no intention to change it for the better (Figure).

119

120 **Discussion**

121 The study found that the main reason for eating junk food was that the young
122 population liked it and it was easily available. Also, though female students were
123 more aware compared to male counterparts of the ill effects of fast food, like
124 obesity, they were happy consuming such food. Several studies have shown
125 similar liking of teenagers towards fast food.¹²⁻¹⁴ Our study also found that
126 consumption of salty snacks, fried food and fast food was significantly higher in
127 the obese group. One of the reasons could be that these snacks are easily available
128 at school canteen and students are left with no other choice. A study in Brazil also
129 found that food environment in school is one of the major causes of consumption
130 of unhealthy food among teenagers.¹⁵ Soft, sports and energy drinks were
131 significantly consumed in obese groups compared to the others. Teenagers liked
132 energy drinks because it enhanced their physical performance, cognition and
133 concentration level during study.¹⁶ A study reported that these energy drinks
134 improved myocardial contractility within one hour of consumption.¹⁷ However,
135 the adverse effects weigh far more than the therapeutic effects of the energy
136 drinks. It was found in a study that students who are on sports drinks have more
137 tendencies towards eating fried and high-sugar foods than those who did not.¹⁸
138 Another study found that increased consumption of energy drinks is significantly
139 associated with high BMI.¹⁹ In a study in Mexican females, researchers tried out
140 to find food associated with obesity, and it was observed that obese females were
141 taking more soft drinks and fat compared to overweight and normal-weight
142 females.²⁰ Another study showed a significant association between intakes of soft
143 drinks and type 2 DM.²¹ Another study saw that although students knew that
144 sports drinks could cause dental caries and other health-related issues, they liked

145 them because of their taste and were unable to avoid them.²² Researchers
146 suggested that the reduction in the use of energy drinks and sports drinks is
147 associated with a decreased risk of obesity and type 2 DM.²³

148 Another finding of the current study was that there was less consumption of fruits
149 and vegetables in the obese group compared to other groups. One study found
150 that lower intake of fruits and vegetables were associated with obesity.²⁴ A
151 prospective cohort of 133,468 United States men and women showed that
152 vegetables high in fibre and low in glycemic content were associated with weight-
153 loss.²⁵ Similarly, a study showed that an increased intake of fruits and vegetables
154 in females had a 24% lower risk of becoming obese.²⁶ Thus, it is important to
155 motivate teenagers to include fruits and vegetables in their diet. Researchers
156 suggested that autonomous motivation results in increased intake of fruits and
157 vegetables both in adolescents and their parents.²⁷ In contrast to our findings, a
158 study found higher consumption of fruits and vegetables amongst teenagers in
159 their diet.²⁸

160 The current study also observed that students having a higher BMI performed
161 poorly in exams. This result is similar to a study in which obese Japanese
162 adolescents had low grades in their exams.²⁹ In another cross-sectional study
163 conducted on 893 school-children showed that good fitness level was associated
164 with higher academic performance in males compared to obese boys who showed
165 significantly lower academic performance. This is due to the fact that higher
166 fitness is related to improved cardio-respiratory and improved cognitive
167 function.³⁰ Another study explained that obesity is one of the most important risk
168 factors of obstructive sleep apnoea which leads to daytime sedation, fatigue,
169 depression and overall poor academic performance.³¹ Obese students are also
170 likely to miss school more frequently, especially those with chronic health
171 conditions, such as DM, which also leads to poor academic performance and low
172 grades in exams. Unhealthy lifestyle is one of the major factors in gaining weight,

173 and exercise and dietary modification is necessary among students to manage the
174 issue.^{32,33}

175 The current study found that individuals with more average sleep hours were
176 obese. A study also found that an increase in sleep duration was significantly
177 associated with obesity.³² However, there are studies showing an inverse
178 relationship between sleep hours and obesity.^{34,35}

179 It was also observed in the current study that although teenagers were well aware
180 of the ill effects of junk food, they were happy with their dietary habits and were
181 not willing to change it. This is a matter of great concern for the policy makers,
182 as obesity prevalence is increasing in Pakistan³⁶ and junk food consumption is
183 one of the major contributing factors.

184

185 **Conclusion**

186 Consumption of junk food in teenagers was found to be increasing their BMI,
187 affecting their exam performance and sleep duration. Students were also aware
188 about the ill health effects of junk food, but were unwilling to decrease its
189 consumption.

190

191 **Disclaimer:** The Abstract has been submitted to an AMEE 2019 international
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196

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Table 1: Comparison of study variables between the groups

Anthropometric measures			
	Male (n=96) Mean ± SD	Female (n=130) Mean ± SD	p-value
Age (years)	15.68 ± 1.83	17.00 ± 1.74	<0.05*
Height (meters)	1.55 ± 0.17	1.52 ± 0.13	0.101
Weight (kgs)	54.73 ± 12.72	53.04 ± 9.64	0.258
Body mass index (BMI)	22.79 ± 4.31	22.43 ± 5.39	0.34
Average sleep hours	7.88 ± 1.65	7.70 ± 1.75	0.448
Average scores	73.99 ± 13.34	82.12 ± 10.52	<0.05*
Reasons for the consumption of junk food among teenagers			
	Males n (%)	Females n (%)	p-value
You like it	60 (62.5)	95 (73.1)	0.061
It's easy to find, it's everywhere	29 (30.2)	23 (17.7)	<0.05*
It's convenient and fast	16 (16.7)	22 (16.9)	0.554
It doesn't cost much	16 (16.7)	7 (5.4)	<0.05*
The servings are larger	9 (9.4)	9 (6.9)	0.333
You want to be like others	16 (16.7)	1 (0.8)	<0.05*
Teenagers perception of factors causing obesity or health problems			
	Males n (%)	Females n (%)	p-value
Frequent consumption of soft drinks and sweetened drinks	16 (16.7)	42 (32.3)	<0.05*
Frequent consumption of fast food meals	17 (17.7)	54 (41.5)	<0.05*
Lack of physical activity	38 (39.6)	49 (37.7)	0.440

The influence of marketing of junk food (e.g., advertising, packaging, low prices, etc.)	13 (13.5)	9 (6.9)	0.104
You don't know	6 (6.3)	4 (3.1)	0.206

322 *p-value ≤ 0.05 is considered statistically significant

323 Comparison is done using independent sample t test and chi-square test

324 SD: Standard deviation

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327 **Table 2: Comparison of healthy and unhealthy food consumption between various body**
 328 **mass index (BMI) groups using analysis of variance (ANOVA).**

Food items [#]	BMI groups					
	Underweight n=35	Normal n=88	Overweight n=28	Pre- obese n=56	Obese n=19	p- value
Sweet snacks	5.00 \pm 3.21	4.33 \pm 3.34	3.50 \pm 3.59	4.95 \pm 3.65	5.89 \pm 4.28	0.150
Salty snacks	3.51 \pm 2.46	3.82 \pm 2.80	4.57 \pm 2.66	4.52 \pm 3.28	6.84 \pm 6.35	<0.05*
Fruit flavoured drinks	2.69 \pm 2.46	2.83 \pm 3.27	2.89 \pm 3.07	3.02 \pm 2.82	3.21 \pm 3.06	0.972
Fried foods	2.89 \pm 2.21	4.20 \pm 2.69	4.07 \pm 2.85	4.93 \pm 2.44	5.84 \pm 2.77	<0.05*
Soft drinks	2.97 \pm 3.03	5.14 \pm 3.43	4.43 \pm 3.59	5.89 \pm 4.06	9.68 \pm 5.46	<0.05*
Fast food meals	1.26 \pm 1.13	2.10 \pm 1.85	2.18 \pm 2.19	3.52 \pm 2.71	2.26 \pm 2.86	<0.05*
Sports drinks	0.06 \pm 0.23	0.74 \pm 1.68	0.57 \pm 1.77	1.05 \pm 2.22	1.53 \pm 2.36	<0.05*
Vitaminised sugary waters	0.37 \pm 1.03	0.59 \pm 1.33	0.39 \pm 1.42	0.55 \pm 1.27	1.26 \pm 1.96	0.187
Energy drinks	0.46 \pm 0.85	0.82 \pm 1.61	0.93 \pm 1.82	0.79 \pm 1.86	2.05 \pm 4.77	0.104

Water, bottled or tap	30.11 ± 3.32	30.74 ± 3.22	31.57 ± 3.08	31.23 ± 3.43	30.16 ± 4.35	0.342
Fresh fruits	4.00 ± 2.21	3.24 ± 2.03	2.64 ± 2.34	2.59 ± 2.73	1.63 ± 1.92	<0.05*
Vegetables	3.54 ± 2.34	3.45 ± 1.94	2.64 ± 1.87	2.73 ± 1.98	1.47 ± 1.58	<0.05*
Test scores	85.37 ± 9.57	77.48 ± 14.42	82.21 ± 7.53	76.20 ± 10.40	73.89 ± 13.63	<0.05*
Average sleep hours	7.91 ± 1.80	7.50 ± 1.64	6.89 ± 1.28	8.30 ± 1.69	8.53 ± 1.74	<0.05*

329 BMI groups = Underweight <18.5, Normal 18.5-22.9, Overweight 23-24.9, Pre-obese 25-29.9,
330 Obese >30

331 # Consumption frequency per week is assessed for all food items

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333

334 **Table 3: Relation of body mass index (BMI) with unhealthy, healthy food consumption,**
335 **average sleep hours and test scores in college students.**

Food items	Male n=96		Female n=130	
	r	p-value	r	p-value
Sweet snacks (e.g., candies, chocolate, cupcakes, etc.)	-0.060	0.560	0.205	<0.05*
Salty snacks (e.g., chips, pretzels, nachos, etc.)	0.171	0.096	0.288	<0.05*
Fruit flavoured drinks (e.g., Fruitopia)	0.075	0.466	0.061	0.487
Fried foods (e.g., fries, fried chicken, etc.)	0.233	<0.05*	0.328	<0.05*
Soft drinks	0.303	<0.05*	0.426	<0.05*
Fast food meals (e.g., McDonald, Pizza Hut, etc.)	0.065	0.531	0.299	<0.05*
Sports drinks (e.g., Gatorade, Powerade, etc.)	0.357	<0.05*	0.133	0.131
Vitaminised sugary waters	0.165	0.109	0.101	0.254
Energy drinks (e.g., Red Bull, Monster, Guru, etc.)	0.074	0.473	0.188	<0.05*
Water, bottled or tap	0.075	0.466	0.072	0.414
Fresh fruits	-0.198	0.054	-0.311	<0.05*
Vegetables	-0.181	0.077	-0.306	<0.05*

Test scores	-0.205	<0.05*	-0.297	<0.05*
Average sleep hours	0.142	0.167	0.174	<0.05*

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339 **Table 4: Multivariate linear stepwise analysis showing independent predictors of body**
 340 **mass index (BMI).**

	Parameters	β -coefficient	R ² change	sr ²	p-value
Males R ² = 0.166	Sports drinks	0.643	0.128	0.074	<0.05*
	Soft drinks	0.230	0.038	0.038	<0.05*
Females R ² = 0.297	Soft drinks	0.275	0.173	0.026	<0.05*
	Fresh fruits	-0.612	0.057	0.064	<0.05*
	Scores	-0.126	0.037	0.053	<0.05*
	Salt consumption	0.322	0.030	0.029	<0.05*

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Dependent variable is BMI,

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sr² is the squared semi-partial correlation,

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p-value ≤ 0.05 is considered statistically significant

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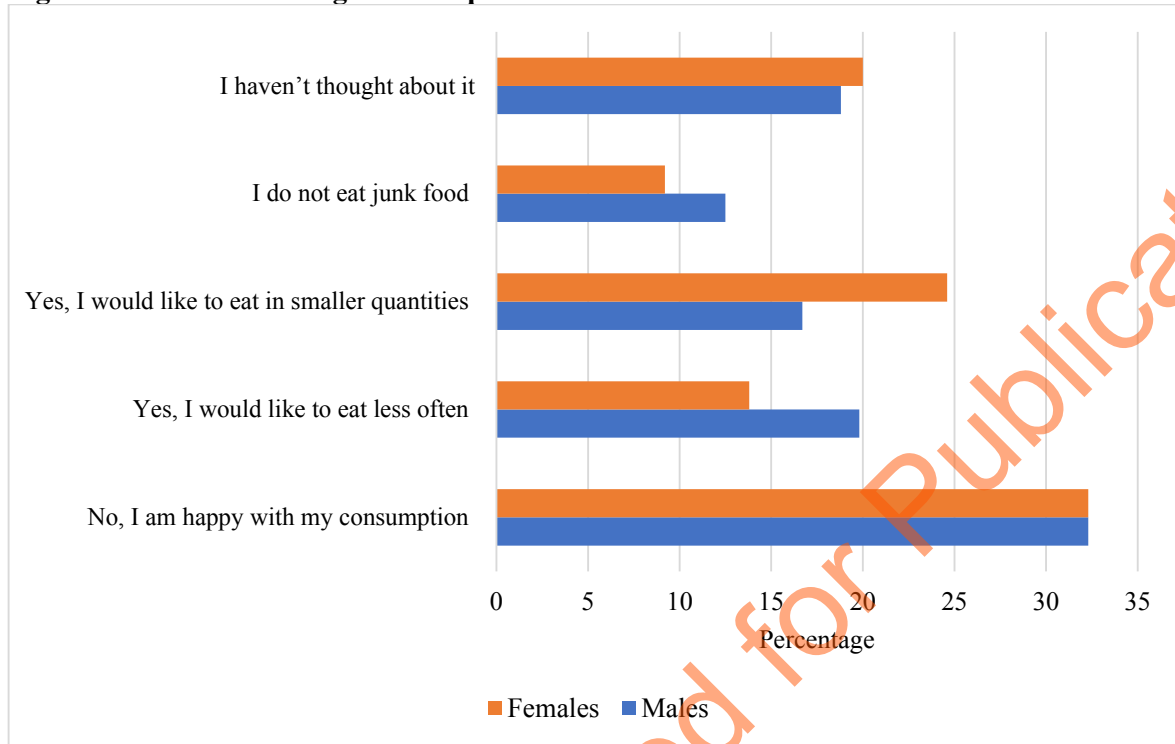
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366 **Figure: Intention to change consumption of Junk food in next few months**



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Provisionally Accepted for Publication