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4 Testlerine Beslenmelerine Etkisi

5 **İngilizce Başlık:** The Effect of A School-Based Nutritional Program on The Anthropometric
6 Measurements, Blood Test Results and Eating Habits of Adolescents

7 **İngilizce Kısa Başlık:** A School-Based Nutritional Program

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1 **The Effect of A School-Based Nutritional Program on The Anthropometric Measurements, Blood**
2 **Test Results and Eating Habits of Adolescents**

3 **Abstract**

4 **Objectives:**To determine the effects of a school-based nutritional program (SBNP) designed for
5 adolescents in high school, who are for various reasons unable to eat a midday meal, on their
6 anthropometric measurements, blood test results and eating habits.

7 **Patients and Methods:**The research used one group and was of a pretest-posttest design. 148
8 adolescent high school students who had difficulty accessing a midday meal and expressed
9 willingness to participate in the study. As part of the SBNP, four sessions of nutrition education, each
10 for one hour once a week, were held and the students were regularly provided with lunch at school
11 for 3 months. A sociodemographic form, an "Eating Habits Inventory," anthropometric
12 measurements and blood tests.

13 **Results:**Mean waist measurements were significantly lower at the last evaluation compared to the
14 preliminary assessment. The increases in Rbc, Hb and Htc after the SBNP compared to pretest results
15 were found to be statistically significant. Mouth sores, gingival bleeding and hair loss rates showed a
16 significant decrease.

17 **Conclusion:**The SBNP had a positive impact on increasing erythrocyte, hemoglobin and hematocrit
18 counts and reducing waist circumference measurements. In addition, the SBNP also contributed to
19 reducing certain skin and mucosal conditions (sores on the edges of the mouth, canker sores, gingival
20 bleeding) and the hair loss rates that may be associated with vitamin deficiency. It is recommended
21 that the impact of an SBNP be tested for a longer duration with a larger sample that includes a
22 control group.

23

24 **Keywords:** Adolescent, hematologic tests, schools, nursing

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1 INTRODUCTION

2 Developing healthy eating habits in childhood and adolescence increases the probability that
3 individuals will continue to maintain this behavior in later periods of their lives. Adolescence is a
4 period where growth is rapid and energy and nutritional needs increase; it is one of the best times to
5 instruct individuals about healthy nutrition (1,2). Various studies have revealed that adolescents do
6 not have adequate knowledge, attitudes or behavioral skills regarding nutrition (2-8).

7

8 Skipping meals, snacking between meals (eating food of low nutritional value with too many calories
9 and containing oil), eating outside of the home and consuming fast foods are the most frequently
10 seen unhealthy forms of eating among adolescents (9,10). The low or high body mass index (BMI)
11 readings of adolescents that do not have a healthy eating style have an adverse effect on
12 adolescents, both psychologically and physically, and this effect can be carried into later years (11-
13 13). Eating inadequately and in an unbalanced manner, it has been shown, results in lower than
14 normal anthropometric measurements and is a cause of anemia (11,14).

15

16 Among the factors that cause inadequate nutrition in adolescents is their economic situation (5). In
17 particular, adolescents that come from a low socioeconomic background constitute a risk group in
18 terms of their nutritional habits (1,4,7,14). Adolescents in families of low socioeconomic status are
19 unable to practice healthy eating or acquire adequate information about nutrition (15). At the same
20 time, children and adolescents of a low socioeconomic background have been found to be shorter in
21 height, and are seen to have lower serum zinc, iron levels and average hematocrit ratios (11).

22 Decreases in drawing iron from foods especially and related problems are more frequently seen in
23 individuals and girls that come from low socioeconomic backgrounds (16,17).

24

25 Foods that are available around school have an impact on children's nutritional habits (18-20). Some
26 full-day high schools in Turkey do not provide lunch. Because of this and due to economic and

1 environmental factors, many students have difficulty accessing a midday meal. This constitutes a
2 health risk for this age group in their adolescent years. Studies carried out abroad have shown that
3 supporting nutrition at school increases some vitamin and mineral ratios in adolescents (9,18,20). It
4 has been found that in schools that provide breakfast, students that benefit from this service have
5 lower BMI than students that do not, and students who eat breakfast are less likely to be obese
6 compared to other students(21). In Turkey, the interventional studies related to developing healthy
7 nutritional habits in children and adolescents are quite limited (22).

8

9 The present study is differentiated from others in the literature in that this is the first study to be
10 conducted in Turkey that evaluated the results of nutritional education accompanied by the offering
11 of a noon meal. This study was carried out to determine the effects of a school-based nutritional
12 program (SBNP) designed for adolescents in high school, who are for various reasons unable to eat a
13 midday meal, on their anthropometric measurements, blood test results and eating habits.

14

15 **METHODS**

16

17 **Design**

18 This quasi-experimental study was of pretest-posttest, one-group design.

19 **Population**

20 The study population consisted of 148 adolescents who had difficulty accessing a midday meal at a
21 high school in a district of Istanbul that generally represented a community of middle socioeconomic
22 status (total number of students in the 63 classes=1754).

23

24 **Recruitment criteria:** The study recruited students who lived at a distance from school, whose
25 parents were divorced or who had lost one or the other or both parents, those who lived with family
26 elders and whose parents did not work. Classroom teachers evaluated all of the children in the

1 school (N=1754) in terms of the research criteria. There were 246 students who matched the study
2 criteria. The study was completed with 148 students who agreed to participate in the research along
3 with their families.

4

5 Instruments

6 Five tools were used for data collection in this study (Figure 1):

7

8 1. The demographic data questionnaire included information about the participants'
9 sociodemographic characteristics (age, gender, grade, parents/family type, parents' education,
10 number of siblings, etc.). Additionally, the students were queried as to sores in the mouth, gingival
11 bleeding and hair loss with the thought that these conditions could be associated with vitamin
12 deficiency.

13 2. Anthropometric measurements

14 The students' height-weight, waist and arm circumference measurements were taken. Third-year
15 nursing students took the measurements before and after the SBNP, using the same measuring tapes
16 and height measurement instruments. To avoid mistakes in the measurements, the same persons
17 took the measurements before and after the program.

18 3. Biochemical tests

19 An agreement was made with a hospital close to the school for the biochemical tests; the technicians
20 at the hospital laboratory independently tested for iron in the blood, iron binding, total iron binding
21 capacity and also drew up a hemogram (hemoglobin, hematocrits, erythrocytes, leukocytes). Normal
22 values were accepted as: Iron: 50-200 mg/l, iron binding: 50-150 mg/dl, total iron binding capacity:
23 300-360 mg/dl, hemoglobin: 13 mg/dl, hematocrits: 40% (23), erythrocytes: 4,200,000-6,000,000
24 mm³, leukocytes: 5,000-10,000 mm³. Hemoglobin below 12 g/dl in girls and below 13 g/dl in boys
25 was accepted as a low Hb level and an anemia risk (24).

1 4. Blood pressure was measured by the same person with the same sphygmomanometer in the
2 morning hours, from the left arm with the student in sitting position.

3

4 5. Eating habits inventory

5 The Eating Habits Inventory (EHI) was developed and revised by Demirezen and Coşansu as a six-item
6 questionnaire (4). The item total correlation coefficients of the EHI ranged between .37-55; the
7 Cronbach alpha value was found to be .68. The statements in the index were: "(1) I eat oily and sweet
8 foods; (2) I add salt to my food; (3) I drink more than 3 cups/glasses of coffee, soda or tea; (4) I eat
9 veal, lamb and frankfurters, salami, sausage, and other processed meats made from these, (5) I eat
10 hamburgers, French fries, pizza and other fast foods when I'm out; (6) I eat fruit and dishes made
11 from vegetables, bulgur, haricot beans, chick-peas, lentils and other dry legumes." The items are
12 scored as Never=0 points; Seldom=1; Sometimes=2; Often=3; and Always=4.

13

14 Data collection

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16 The data were collected by university third-year nursing students under the supervision of the
17 researchers. The post test data were collected 4 months after the basic data were collected.

18

19 Intervention

20

21 **School-Based Nutritional Program:** The SBNP consists of two stages.

22

23 1. The school principal was contacted.

24

25 Monetary assistance was provided to the underprivileged families in the parents-teachers association
26 that the Principal indicated.

1

2 2. Providing students with lunch

3 The dieticians of private catering company drew up a menu for the adolescents that would support
4 their growth and development and the students were provided with lunch five days a week over a
5 period of three months.

6

7 3. Nutrition Education

8

9 The education program drawn up by Geçkil and Yıldız, which had proved to be effective, was used to
10 prepare the content of the nutrition program(25). The program was conducted by the primary author
11 at the school meeting room with the students divided into two groups. The instruction benefited
12 from the teaching methods of discussion, question-and-answer periods, demonstrations and
13 brainstorming. The program included various warm-up techniques and games.

14

15 At the start of the instruction, the adolescents were handed out a "Nutritional Guide for Young
16 People," a booklet prepared by Geçkil. This guidebook contains information on the scope of the
17 education program, going into such topics as a description of the adolescent period and the
18 importance of nutrition, eating a balanced and adequate diet, adolescents' food needs, food groups,
19 the magical principles in healthy eating, eating with awareness, purchasing foods, and preparing,
20 cooking and preserving food(26). As part of the nutritional program, four sessions of nutrition
21 education that took place for an hour once a week were held.

22

23 Statistical analysis

24

25 The statistical analysis was performed using SPSS 17.0 (SPSS Inc.; Chicago, USA). Descriptive statistics
26 were used to assess the distribution of the socio demographic characteristics of the adolescents.

1 Normal distribution of the variables was tested using the Kolmogorov- Smirnov test. Leukocytes,
2 erythrocytes, hemoglobin, hematocrit and iron mean scores were normally distribution. Waist and
3 arm circumferences, blood pressure, total iron binding capacity and iron binding did not shown
4 normally distribution (Table 1).

5
6 The pretest-posttest comparison of the data on Wbc, Rbc,Hb, Htc values, was performed with the
7 paired samples T test; the pretest-posttest comparison of the mean scores of the BMI, waist, arm
8 circumferences, blood pressure, TIBC, iron binding and items on the EHI was performed using the
9 Wilcoxon Signed Ranks Test. Comparisons for the variables with three or more categories were made
10 with the Marginal Homogeneity Test (MHT) and Mc Nemar test was used for the two categories. The
11 pretest-posttest comparison of the daily meal frequencies was performed with the MHT. All tests of
12 significance were evaluated at the $p < .05$ level.

13

14 **Ethics pattern**

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16 Permission was obtained from the Clinical Research Preliminary Evaluation Committee of XXXX
17 University, Institute of Health Sciences. Approval for the study was obtained from the city provincial
18 education director and the school principal. Written permission for the study was obtained from the
19 adolescents' families. The students were asked to provide verbal willingness. The SBNP was offered
20 to the adolescents in the sample after a pre-assessment.

21

22 **RESULTS**

23

24 Of the adolescents participating in the study, 85.1% were boys at a mean age of 16.67 ± 1.05 . The
25 mothers of 89.9% of the students and the fathers of 81.1% had less than an eight-year education.

26 The comparison of the pretest-posttest daily meal frequencies of the adolescents is shown in Figure

1 2. Of the adolescents, 61.9% (n=70) stated prior to the SBNP that they ate three or more meals a day;
2 this rate climbed to 78.8% (n=89) after the SBNP. A statistically significant difference was found
3 between the pretest and posttest frequencies ($p < .001$).

4

5 A comparison of the adolescents' BMI and arm circumference pretest and posttest mean scores did
6 not reveal a statistically significant difference ($p > .05$). There was a statistically significant difference,
7 however, in the posttest compared to the pretest ($p < .001$) in the waist circumference
8 measurements. There was also a statistically significant drop in both systolic and diastolic blood
9 pressure ($p < .001$) (Table 2).

10

11

12 The students' posttest Rbc, Hb and Htc values were significantly higher than in the pretest ($p < .001$)
13 (Table 3). While iron, iron binding and total iron binding values were high on the posttest as
14 compared with the pretest, no statistically significant difference was found ($p > .05$).

15 Table 4 presents a comparison of the pretest and posttest in terms of the items of the EHI. Outside of
16 the "adding salt" item, there was no statistically significant difference found between the mean
17 scores on the pretest and posttest ($p > .05$). It was observed that the use of salt displayed a significant
18 drop in the posttest as compared to the pretest ($p < .05$). The nutritional group of foods that the
19 students consumed the least in both the pretest and the posttest were foods made with fruits,
20 vegetables and dry legumes; the nutritional group of foods they consumed the most was oily and
21 sweet foods (Table 4).

22 There was a significantly reduced number of students suffering from canker sores or cold sores in the
23 mouth, gingival bleeding or hair loss in the posttest as compared with the pretest ($p < .001$) (Table 5).

24

25 **DISCUSSION**

26

1 The results of this study showed that the SBNP had a positive impact on reducing many health risks.
2 The SBNP was found to instigate an increase in the number of meals adolescents ate, decrease their
3 salt intake, raise Rbc, Hb and Htc values, pare down waist circumferences and reduce blood pressure
4 values, as well as decrease the percentages of canker sores and cold sores in the mouth, gingival
5 bleeding and hair loss. The strengths of this study included the implementation of an education
6 program whose effectiveness had been previously proved and additionally, the fact that lunch was
7 provided at school.

8 It was determined that before the nutritional program, a significant percentage of the adolescents
9 (38.1%) ate two meals or less. At the same time, the adolescents used to eat more oily food and
10 sweets, and preferred to eat fruit, vegetables and dried legumes the least. The reason adolescents
11 chose to eat a great deal of unhealthy foods might be that they had difficulty accessing healthy foods
12 at school or because the school canteens usually sell mostly sweet, oily and salty foods, or even
13 perhaps because these readymade foods are more fulfilling and cheaper. The results of studies
14 carried out with adolescents have shown that especially in the case of children from lower
15 socioeconomic backgrounds(1,11,15), skipping meals and making unhealthy choices is a common
16 habit (3,6-9,17).

17 It was seen in this study that according to the EHI, salt intake had been reduced after the SBNP. It is
18 reported in studies that a significant percentage of adolescents sprinkle salt on their food without
19 first tasting it (27). Salt intake increases risks for many health issues, particularly hypertension and
20 other cardiovascular problems (28,29). Reducing salt intake at early ages will make an important
21 contribution to reducing these risks. The lack of change in the EHI items outside of salt intake at the
22 end of the program showed that it is difficult to change the deep-rooted eating habits of adolescents.

23 The fact that the SBNP was not effective in increasing the consumption of fruits, vegetables and
24 dishes made with dry legumes may be associated with the absence of these foods at school canteens
25 and the difficulty of making these at home.SBP showed a statistically significant decrease in the
26 posttest. However, it would be difficult to assume that this result was solely related to the salt

1 restriction imposed within the scope of the SBNP. As much as the fall in SBP may be associated with
2 the reduction of salt in the diet, it may also have been caused by many other factors.

3 Studies demonstrate that, particularly in homes with lower socioeconomic means, adolescents are at
4 risk of developing anemia but also show that the risk of anemia may be reduced by consuming the
5 appropriate foods (11,17). In this study, it was observed that following the nutritional program, there
6 were statistically significant increases in the adolescents' Rbc, Hb and Htc values. While iron, iron
7 binding and total iron binding values were not found to display a significant change on the posttest
8 as compared with the pretest, they were still observed to have increased. Also, although on the
9 posttest, the Hb and Htc values of adolescents with less than normal readings did not display a
10 significant change, they had decreased. This improvement seen in the blood values suggests that the
11 program will be effective in reducing health problems that are associated with nutrition such as
12 anemia.

13 There was no significant difference found in this study between the mean scores on the pretest and
14 posttest in terms of BMI or arm circumference measurements; there was however a significant
15 decreases seen in waist measurements. A reduction of waist measurements when BMI is in normal
16 boundaries is a desired objective. A thickening of the waist can be an identifying symptom for chronic
17 disease risk (28,30). Studies have shown that the nutrition support programs made available to
18 adolescents at the schools have increased their intake of healthy foods and for that reason are
19 helpful in promoting a healthier lifestyle (18). It has also been shown that, contrary to expectations,
20 serving breakfast and lunch at schools does not contribute to increasing the BMI (21).

21 Studies report that adolescents display vitamin deficiency due to their eating habits (7). In this study,
22 students were asked about canker and cold sores, gingival bleeding and hair loss in order to evaluate
23 their vitamin deficiency and it was found that after the SBNP, there were statistically significant
24 decreases in the incidence of these conditions.

25 **CONCLUSION**

1 To conclude, the strength of the SBNP and its positive effects were seen in its implementation in a
2 small group for a short period; it was observed that the program contributed to increasing the
3 number of meals adolescents were eating, reducing their salt intake, raising their Rbc, Hb and Htc
4 values, paring down their waists, and reducing their blood pressure values, as well as to decreasing
5 the percentages of canker and cold sores in the mouth, gingival bleeding and hair loss. The study also
6 showed that providing students with lunch is an important environmental application that supports
7 children and adolescents, helping them to incorporate basic nutrients in their diet. Since it is known
8 that habits formed in adolescence are likely to become permanent, the nutritional program
9 implemented in this period of life will contribute to the growth of healthy future generations. At the
10 same time, we believe that since there could be no control over the foods sold at school canteens,
11 this placed a limitation on the results of the study. This program may be implemented across the
12 network of schools. Enlisting the cooperation of local administrations, school administrations,
13 families, teachers and students may increase the program's effectiveness. In addition, ensuring the
14 sale of healthy products at the shops and canteens around the school may be another useful
15 endeavor.

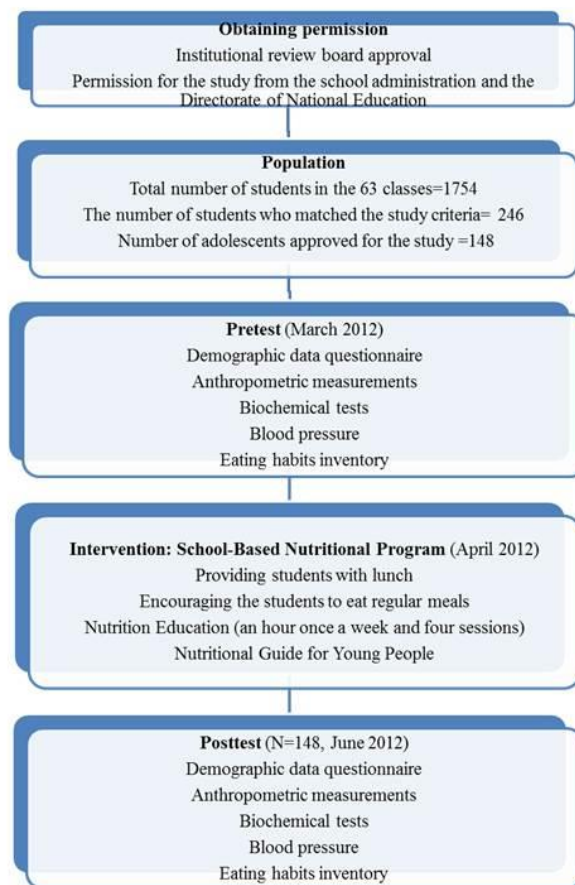
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17 **PRACTICAL APPLICATIONS**

18 This research showed that a School-based Nutritional Program conducted by school nurses engaged
19 in multi-sector cooperation has a positive impact on reducing students' nutrition-related health risks,
20 especially their risks with respect to vitamin deficiency and their ability to reduce their intake of salt.
21 At the same time, the SBNP helped to increase the number of meals eaten in a day and to reduce
22 waist measurements and blood pressure readings.

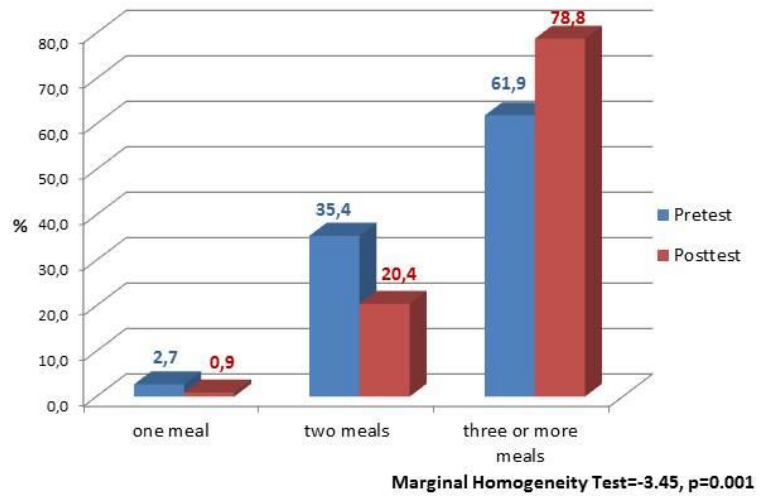
23 In the light of these results, it can be suggested that, when the SBNP is implemented at the schools, it
24 would be useful for the program to include additional environmental initiatives that allow for fruits
25 and vegetables to be available in the school canteens as an effort to increase the consumption of the
26 food groups of fruits, vegetables and dry legumes. Also, on the basis of the knowledge that peer

1 influence is very strong in adolescence, it might be suggested that the success of the program can be
2 enhanced if peer leaders can lend their support in selecting healthy alternatives to substitute for
3 unhealthy food choices. While the EHI is useful in providing the basic information to evaluate risky
4 eating behavior, it might be more beneficial in terms of understanding the impact of the program if
5 other scales were used for a more detailed nutritional evaluation. Additionally, it might also be
6 suggested that the impact of SBNP is tested with a comparison between healthy adolescents and
7 those with nutrition-related health problems such as obesity and anemia.



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Figure1. TheResearchProcess



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2 **Figure 2. Comparison of students' pretest-posttest daily mean percentages**

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Table 1. Kolmogorov-Smirnov testing the normal distribution of variables.

Variables	Kolmogorov-Smirnov		
	Statistic	p	
BMI	.144	<.001	
Waist	.112	.002	
Arm	.092	.021	
Blood Pressure	Systolic	.200	<.001
	Diastolic	.214	<.001
Leukocytes (Wbc)	.073	.200	
Erythrocytes (Rbc)	.068	.200	
Hemoglobin (Hb)	.083	.106	
Hematocrit (Htc)	.066	.200	
Iron	.048	.200	
TIBC*	.110	.006	
Iron binding	.106	.010	

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Table 2. Comparison of students BMI and blood pressure mean measurements on the pretest and posttest

Measures	Pretest		Posttest		Statistic	
	M±SD	Min-Max	M±SD	Min-Max	Z*	p
BMI	21.54 ± 3.48	16.50-33.5	21.66 ± 3.44	16.5-34	1.49	.135
Waist	79.66 ± 10.32	60-117	76.46 ± 9.9	60-120	-4.78	<.001
Arm	25.76 ± 4.47	19-54	25.25 ± 3.01	19-34	-1.15	.249
Blood Pressure						
Systolic	112.06 ± 12.32	80-150	106.81 ± 13.44	70-150	3.55	<.001
Diastolic	70.26 ± 9.14	50-90	66.90 ± 8.56	40-90	3.40	.001

Z= Wilcoxon Signed Ranks Test

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Table 3. Comparison of Students' pretest-posttest blood results

Measures	Pretest		Posttest		Statistic	
	M±SD	Min-Max	M±SD	Min-Max	t	p
Leukocytes (WBC)	6.40 ± 1.62	2.20-11.40	6.44 ± 1.73	3.67-12.20	.25	.803
Erythrocytes (RBC)	4.77 ± .35	3.88-5.57	4.87 ± .38	3.96-5.62	5.31	<.001
Hemoglobin (HGB)	13.6 ± 1.07	10.4-16.1	14.11 ± 1.21	10.9-16.6	8.13	<.001
Hematocrit(HCT)	39.65 ± 2.91	31.3-47.0	40.91 ± 3.21	32.1-47.1	7.36	<.001
Iron	86.04 ± 38.5	14-177	91.83 ± 40.33	18-180	.048	.200
TIBC*	341.97 ± 47.69	253-493	347.22 ± 46.12	263-484	.991	.302
Iron binding	255.36 ± 68.01	102-473	257.61 ± 71.41	127-465	.815	.415

*TIBC=total iron binding capacity

t=PairedSamples Test

z=PairedSamples Test

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Table 4. Comparison of EHI on pretest-posttest

	Pretest	Posttest	Statistic	
Items (never= 0, always =4 points)	M±SD	M±SD	Z*	p
I eat oily and sweet foods	1.85±1.04	1.97±1.00	-1.04	.298
I add salt to my food	1.81±1.23	1.51±1.21	-2.64	.008
I drink more than 3 cups/glasses of coffee, soda or tea.	1.31±1.38	1.38±1.35	-.41	.681
I eat veal, lamb and frankfurters, salami, and other processed meats made from these.	1.62±1.05	1.71±1.07	-.82	.407
I eat hamburgers, French fries, pizza and other fast foods when I'm not out.	1.38±1.11	1.43±1.12	-.46	.644
I eat foods made from fruit, vegetables, bulgur, haricot beans, chick-peas, lentils and other dry legumes.	0.91±1.03	0.95±0.97	-.29	.772

*Z=Wilcoxon Signed Ranks Test

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Table 5. Pretest-Posttest comparison of students with canker sores or cold sores in the mouth, gingival bleeding or hair loss

Variables	Pretest	Posttest	Statistic*
	n (%)	n (%)	p
Canker sores, cold sores in the mouth	30(26.5%)	8(7.1%)	<.001
Gingival bleeding	39(34.5%)	26(23.0%)	.028
Hair loss	45(39.8%)	34(30.1%)	.022

*McNemar test

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Ethics Committee Approval: No. 2012/49.

Informed Consent: Permission was obtained from the written informed consent form was obtained from all of the students' parents. The students were asked to provide verbal willingness.

Peer-review: Externally peer-reviewed.

Author contributions: Concept – S.A.; Design - S.A.; Supervision - A.E; Resource - S.A.; Materials - S.A.; Data Collection and/or Processing – S.A.; Analysis and/or Interpretation - S.A.,A.E.; Literature Search - S.A...; Writing - S.A. Critical Reviews - A.E.

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