

EVALUATION OF NUTRITIONAL STATUS OF ASSIUT UNIVERSITY SCHOOLS CHILDREN

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ABSTRACT

This investigation was carried out (during March and April 2003) as an attempt to clarify the effect of nutritional status on the incidence of the iron deficiency anemia among school children of Assiut University Schools (81 boys and 30 girls, aged from 10 to 15 years old). The nutritional status for school children included data about haemoglobin concentration (Hg g/dl), red cell count (RBC's count), white cell count (WBC count), red cell volume (haematocrit value, HCT), mean red cell volume (MCV), mean cell haemoglobin (MCH), mean cell haemoglobin concentration (MCHC) and blood platelets (PLT); and anthropometric measurements, height, weight, body mass index (BMI), arm circumference (AC), triceps skinfold thickness (TSF), waist, hump and chest were measured. A questionnaire schedule was given to the school children to assess their demographic data, income, socio-economic status, obtained diets and beverages, food fads and habits, nutritional knowledge as well as their acquaintance with dietetic and food regime. The obtained data revealed that, all the studied anthropometric measurements for both studied sexes in the three schools of Assiut University were below the corresponding anthropometric reference data. Furthermore, the mean blood values for both sexes school children were under the optimal international levels. The obtained data illustrated noticeable low haematocrit and haemoglobin (red blood cell measures) and small red blood cell as signs for iron deficiency anemia in all studied school children of both sexes. In conclusion results confirmed that the nutritional status of the three studied schools children (both sexes) was rather poor, despite the rather high socio-economic conditions and high income of the children's parents. Such findings need extensive improvement in these school children nutritional status. This could be accomplished by providing iron rich, protein rich diet in any form during school day. Likewise, providing all people with simplified knowledge on nutrition and its relationship to human health and welfare.

Keywords: *Hemoglobin, Hematocrit Value, Anthropometric Measurements, Demographic Data, Dietetic, Food Regime*

INTRODUCTION

The adolescent stage of human development corresponds roughly to the second decade of life. As societies have extended the years of education and skill training necessary for participation in adult life, that lengthened transition between childhood and adulthood has come to be recognized as a unique and important period in the life cycle (El-Boteny, 2003).

During adolescence, nutritional needs are high. According to Ibrahim *et al.* (1999) they have to ensure adequate growth and provide sufficient stores for adulthood. On the other hand, food intake of any group of people are influenced, besides the biological variables, by a great variety of socio-economic, cultural and environmental variables (Sobhy, 1998). Nutritional assessment evaluates many factors that influence or reflect nutrition status. The skilled dietitian gather specific informations from many sources including:

- 1- Lifestyle and food habits.
- 2- Dietary regimen.
- 3- Anthropometric measurements.
- 4- Blood values.
- 5- Biochemical analyses.

Each of these parameters involves collecting data and interpreting each finding in relation to the other to create a total real picture. The accurate collecting of this information and its careful interpretation provide the data for establishing a proper nutritional evaluation. The present investigation was carried out as an attempt to evaluate the nutritional status of randomly chosen Assiut University schools children (primary, preparatory and secondary schools) aged 10-15 years old as well as determining the anthropometric measurements for the investigated children (boys-girls). Meanwhile, the blood values of such children were assessed.

MATERIALS AND METHODS

Proper nutritional status is essential for normal organ development, function, growth and maintenance, optimal activity and working efficiency, for resistance of infection and for ability to repair bodily damage (Krause and Mahan, 1984).

1- Materials: A random sample of 111 school children aged between 10-15 years old from 3 schools (primary, preparatory and secondary) of Assiut University. This group included 81 boys and 30 girls. Data were collected during the period of March and April 2003.

Data in table (1) outlined the distribution of children in the studied schools of Assiut University.

Table (1): The distribution of total sample (boys-girls) in the three stages of Assiut University schools (aged 10-15 years).

School				
	Primary	Preparatory	Secondary	Total
Boys	27	26	28	81
Girls	6	12	12	30
				111

2- Methods:

2.1 Anthropometric measurements: Height, weight, body mass index (BMI), arm circumference (AC), triceps skinfold thickness (TSF), waist, hump and chest were measured and calculated to detect under nutrition and obesity in all studied boys and girls according to Jelliffe *et al.* (1989). Values for height, weight and body mass index were compared with the international NCHS (2002) and latest Egyptian data (Ibrahim *et al.*, 1999) median reference height, weight and body mass index values for the same age and the same group.

Weight (Wt): Weight was obtained by using a measured electronic scale. The child was weighed bare-footed with light under wear for which corrections were made. Weight was recorded to the nearest 1 kg. Calibration of the scale was done using a known weight.

Height (Ht): Height was recorded to the nearest centimeter according to the method described by Jelliffe *et al.* (1989).

Body mass index (BMI): This index is a measure of fatness or leanness, and is calculated according to (Ostetriche *et al.*, 2000) by dividing children weight in kilograms by the square of their height in meters, using the formula:

$$\text{BMI} = \text{Weight (kg)} / (\text{Height (m)}^2).$$

Body composition measurement and indices:

Triceps skinfold thickness (TSF): The triceps skin-fold thickness was measured according to the method described by Edwards *et al.* (1955). Measurement was taken half way down the arm between the tip of the acromion process of the scapula and olecranon process of the ulna, while the arm was relaxed at the side.

Arm circumference (AC): The measurement was made with flexible non-stretch tape, made of fiberglass according to the method of Jelliffe *et al.* (1989).

Waist, hump and chest circumferences: The measurement was made with flexible non-stretch tape, made of fiberglass.

Questionnaire schedule: A questionnaire schedule designed by Youssef (2000) was given to the schools children to assess their demographic data, income, socio-economic status, obtained diets and beverages, food fads and habits, nutritional knowledge as well as their acquaintance with dietetic and food regime.

Blood values: Both haemoglobin concentration (Hgb g/DL), red cell count ($\text{RBC} \times 10^6 / \text{mm}^3$), white cell count ($\text{WBC} \times 10^3 / \text{mm}^3$), red cell volume (Haematocrit value, HCT), mean red cell volume ($\text{MCV} \mu\text{m}^3$), mean cell haemoglobin (MCH-picogram), mean cell haemoglobin concentration (MCHC, g/100 ml), and blood platelets ($\text{PLT} \times 10^3 / \text{mm}^3$) were assessed in a 10 ml venous blood samples taken from each child by qualified nurses in a tube containing anticoagulant (1 cm of EDTA solution) and stored in the refrigerator in the hematology laboratory of the Clinical Pathology Department, Assiut University Hospital using Electronic LTD, Luton, Beds. Coulter Counter-T 660 as described by King and Fauker (1973).

Statistical Analysis: The data were analysed statistically using SAS computing procedure. The standard deviation, and correlation coefficient were calculated for all means using the procedure of (SAS, 1990).

RESULTS AND DISCUSSION

The results given in table (2) illustrated the most popular foods, beverages, pickles and spicy foods eaten by Assiut University Schools children as well as the quantity of drunk water per day as outlined from the Questionnaire schedule given to them. The data revealed that, among primary school female children of Assiut University the most popular foods, beverages, pickles and spicy foods were plant foods, carbonated beverages and moderate quantities of pickles and spicy foods. However, among primary school male children of Assiut University the most popular foods, beverages,

pickles and spicy foods were animal foods, carbonated beverages and much quantities of pickles and spicy foods. The daily water intake were 1-2 L and 2-3 L for female and male primary school children, respectively. Moreover, the data showed that, among preparatory female and male children of Assiut University the most popular foods, beverages, pickles and spicy foods were animal foods and carbonated beverages for both sexes, except that female children ate much pickles and spicy foods than male children. Meanwhile, both of them had 1-2 L of water as water daily intake.

Table (2):Outline of the data of the Questionnaire schedule given to Assiut University Schools children*.

School	Attributes									
	P. Foods		P. beverages		P. pickles		P. spicy foods		Water L/day	
	F	M	F	M	F	M	F	M	F	M
Primary	Plant** Foods	Animal* Foods	Carbo- nated B	Carbo- nated B	Moder- ate	Much	Moder- ate	Much	1-2	2-3
Preparatory	Animal Foods	Animal Food	Carbo- nated B	Carbo- nated B	Much	Moder- ate	Much	Moder- ate	1-2	1-2
Secondary	Animal + Plant Foods	Animal + Plant Foods	Fruit Juices	Carbo- nates B	Moder- ate	Moder- ate	Moder- ate	Moder- ate	2-3	1-2

* F = Female M = Male B = Beverages P = Popular

** Plant and animal foods were taken in minimal quantities, hence, such foods were lacking in iron intake.

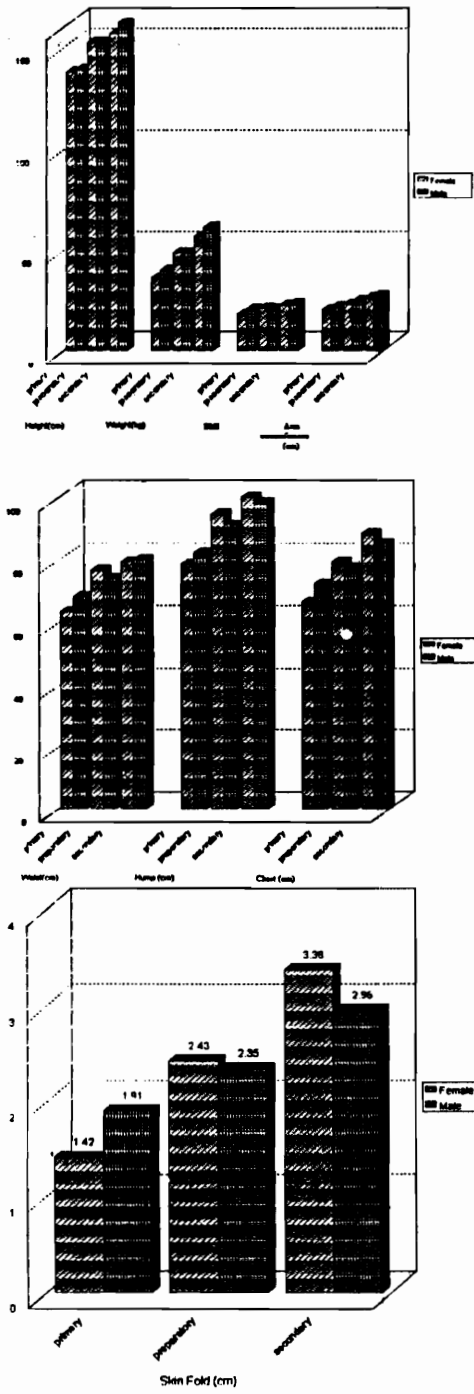
On the other hand, the data outlined in table (2) revealed that among secondary school female and male children of Assiut University, the most popular food, beverages, pickles and spicy foods were animal + plant foods, moderate pickles and spicy food, except females who preferred fruit juices and males preferred carbonated beverages. However, water daily intake was 2-3 L for females and 1-2 L for males.

Anthropometric measurements:

Anthropometric indices can be used to identify malnutrition of individuals and /or to assess the nutritional status of population groups. The World Health Organization (1995) recommended the use of the United States National Center for Health (NCHS) reference growth data as an international standard for comparison of health and nutritional status of children among countries of the world. Also, latest available data for Egyptian population (Ibrahim *et al.*, 1999) was used for comparison. Standard deviation (SD) score is a measure of an individuals value with respect to the distribution of the reference population (El-Boteny, 2003).

It is recommended for evaluating anthropometric data from developing countries because SD score can be defined beyond the percentile limits of the original reference data. The results given in Table (3) and Fig. (1) illustrated the mean values of anthropometric measurements for female and male primary, preparatory and secondary schools children of Assiut University. Such measurements were used to compare their values with the ideal values set up by National Center for Health Statistics Anthropometric

Fig (1) Mean anthropometric measurements of school children in Assiut University schools



Reference Data (NCHSARD), U.S. Department of Health and Human Services (1987). The data revealed that, all studied anthropometric measurements for female and male primary school children namely: height (cm), weight (kg), BMI, arm circumference (AC), triceps skin fold thickness (TSF), waist (cm), hump (cm) and chest (cm) recorded the following mean values: 138 ± 6.54 ; 35.75 ± 8.39 ; 18.77 ± 2.17 ; 20.00 ± 2.37 ; 1.42 ± 0.92 ; 63.67 ± 5.16 ; 79.00 ± 8.12 and 66.83 ± 4.79 for females; and 139.19 ± 9.30 ; 39.69 ± 11.56 ; 20.49 ± 5.21 ; 21.56 ± 4.55 ; 1.91 ± 1.45 ; 68.63 ± 9.05 ; 82.67 ± 10.56 and 72.74 ± 9.40 for males, respectively. The data revealed that, all the abovementioned studied anthropometric measurements were below the corresponding anthropometric reference data (NCHSAR,1987). Table (4) outlined correlation coefficient among anthropometric measurements of primary school children. The data showed that the correlation coefficients between height and weight, BMI, arm circumference (AC) and skin fold were highly significant for both females and males at $p\leq0.01$. Meanwhile, the correlation coefficient between height and waist, hump and chest were not significant for females and highly significant for males. On the other hand, all abovementioned studied anthropometric measurements for female and male preparatory school children recorded the following mean values 152.16 ± 4.80 ; 48.50 ± 14.56 ; 20.95 ± 5.67 ; 22.83 ± 4.28 ; 2.43 ± 1.24 ; 76.92 ± 11.24 ; 95.00 ± 12.09 ; and 79.67 ± 10.07 for females; and 152.19 ± 9.93 ; 48.44 ± 13.40 ; 20.41 ± 4.34 ; 24.42 ± 4.28 ; 2.35 ± 1.52 ; 74.35 ± 10.38 ; 91.38 ± 10.52 ; and 77.73 ± 9.42 for males; respectively. Such anthropometric measurements were below the corresponding anthropometric reference data (NCHSARD,1987). Meanwhile, all studied abovementioned anthropometric measurements for female and male secondary school children recorded the following mean values 156.50 ± 8.25 ; 56.75 ± 16.79 ; 23.17 ± 5.37 ; 25.83 ± 4.13 ; 3.38 ± 1.80 ; 79.75 ± 12.26 ; 100.42 ± 13.30 ; and 88.92 ± 12.18 for females; and 161.96 ± 8.50 ; 61.09 ± 15.55 ; 23.29 ± 5.64 ; 27.14 ± 4.31 ; 2.96 ± 1.42 ; 80.50 ± 10.57 ; 98.61 ± 11.24 ; and 85.75 ± 10.25 for males; respectively. Such anthropometric measurements were also below the corresponding anthropometric reference data (NCHSARD,1987) recording similar trend to that of primary and preparatory schools of Assiut University. The data in Tables (5 and 6) revealed that the correlation coefficients between height and weight, BMI, AC, skin fold, waist, hump and chest for preparatory and secondary school children were highly significant for both females and males at $p\leq0.01$. The anthropometric measurements are of major importance in defining the nutritional status when compared with the reference standard. It is note-worthy that the obtained data reflecting low weight for age index identified the condition of being under weight for a specific age. This index reflected both past (chronic) and/or present (acute) under nutrition among the female and male of the three studied schools of Assiut University, which agrees with Ibrahim *et al.* (1999) and NCHS (2002) reference and Lee and Nieman (2003). Meanwhile, the index of height for age recommended by WHO (1995) to detect stunted children in combination with weight for height. Stunting is a slowing of skeletal growth of stature, defined as the end result of a reduced rate of linear growth. According to Mann and Truswell (2002) the condition resulted from

extended periods of inadequate food intake and increased morbidity and hence is an index of chronic nutritional and hence is an index of chronic nutritional status. The data revealed that height for age was shorter than that of the international reference (NCHS, 2002) for both sexes in the three studied schools of Assiut University. Furthermore, the BMI although is a simple but objective anthropometric indicator of the nutritional status of population and seems to be closely related to their food consumption levels. The data revealed that, the body mass index (BMI) for both sexes was below the international reference NCHS (2002) and the latest Egyptian data (Ibrahim *et al.*, 1999). However, the BMI values for both studied sexes in the three schools of Assiut University were rather higher than that of the corresponding values reported by El-Boteny (2003) for Siwa oasis school children aged from 10 to 15 years.

Moreover, the skin fold thickness provides an estimate of the size of the subcutaneous fat depot, which in turn provides an estimate of the total body fat, and, therefore, of lean body in school children of both sexes (Mann and Truswell, 2002). The data given in table (3) and figure (1) for triceps skinfold thickness (TSF), arm circumference (AC), waist, hump and chest circumferences recorded lower values compared with the international reference reflecting the rather poor nutritional status of both sexes children of the three studied schools of Assiut University.

Table (3): Mean anthropometric measurements of school children in Assiut University schools (primary, preparatory and secondary schools)*.

Anthropometric measurements	School children					
	Primary		Preparatory		Secondary	
	Female	Male	Female	Male	Female	Male
Height (cm)	138 ±6.54	139.19 ±9.30	152.16 ±4.80	152.19 ±9.93	156.50 ±8.25	161.96 ±8.50
Weight (kg)	35.75 ±8.39	39.69 ±11.56	48.50 ±14.56	48.44 ±13.40	56.75 ±16.79	61.09 ±15.55
BMI	18.77 ±2.17	20.44 ±5.21	20.95 ±5.67	20.91 ±4.34	23.17 ±5.37	23.29 ±5.64
Arm circumference (cm)	20 ±2.37	21.56 ±4.55	22.83 ±4.28	24.42 ±4.28	25.83 ±4.13	27.14 ±4.31
Skin fold (cm)	1.42 ±0.92	1.91 ±1.45	2.43 ±1.24	2.35 ±1.52	3.38 ±1.80	2.96 ±1.42
Waist (cm)	63.67 ±5.16	68.63 ±9.05	76.92 ±11.24	74.35 ±10.38	79.75 ±12.26	80.50 ±10.57
Hump (cm)	79.00 ±8.12	82.67 ±10.56	95.00 ±12.09	91.38 ±10.52	100.42 ±13.30	98.61 ±11.24
Chest (cm)	66.83 ±4.79	72.74 ±9.40	79.67 ±10.07	77.73 ±9.42	88.92 ±12.18	85.75 ±10.25

* Mean values of the above-mentioned numbers of studied groups of females and males.

Table (4): Correlation coefficient among anthropometric measurements of Assiut University primary school children.

		Weight	BMI	AC	Skin Fold	Waist	Hump	Chest
Height	F	0.984**						
	M	0.554**						
Weight	F		0.980**					
	M		3.582**					
BMI	F			0.942**				
	M			6.137**				
AC	F				0.875**			
	M				0.934**			
Skin Fold	F					0.795		
	M					0.923**		
Waist	F						0.682	
	M						0.937*	
Hump	F							0.740
	M							0.841**
Chest	F							
	M							

F = Female M = Male * Correlation is significant at p? 0.05 level.

** Correlation is high significant at p? 0.01 level.

Table (5): Correlation coefficient matrix among anthropometric measurements of Assiut University preparatory schoolchildren.

		Weight	BMI	AC	Skin Fold	Waist	Hump	Chest
Height	F	0.532**						
	M	0.670**						
Weight	F		0.983**					
	M		0.856**					
BMI	F			0.887**				
	M			0.746**				
AC	F				0.602**			
	M				0.808**			
Skin Fold	F					0.640**		
	M					0.828**		
Waist	F						0.787**	
	M						0.939**	
Hump	F							0.951**
	M							0.940**
Chest	F							
	M							

F = Female M = Male

** Correlation is high significant at p? 0.01 level.

Table (6):Correlation coefficient matrix among anthropometric measurements of Assiut University secondary school children.

		Weight	BMI	AC	Skin Fold	Waist	Hump	Chest
Height	F	0.595**						
	M	0.545**						
Weight	F		0.929**					
	M		0.907**					
BMI	F			0.892**				
	M			0.755**				
AC	F				0.839**			
	M				0.799**			
Skin Fold	F					0.713*		
	M					0.795*		
Waist	F						0.906**	
	M						0.911**	
Hump	F							0.932**
	M							0.904**
Chest	F							
	M							

F = Female

M = Male

** Correlation is high significant at $p < 0.01$ level.

Blood values:

The mean blood values for female and male children of the three studied schools of Assiut University are shown in table (7) and figure (2). The data revealed that, all studied blood values, namely; white cell count (WBC); red cell count (RBC); haemoglobin concentration (Hgb); red cell volume (haematocrit ratio, HCT); mean red cell volume (MCV); mean cell haemoglobin (MCH); mean cell haemoglobin concentration (MCHC); and blood platelets (PLT) were below the normal corresponding mean blood values, except the WBC and MCV in primary school children of both sexes and PLT in females only. However, the mean blood values for both sexes in preparatory school children were all below the normal corresponding mean values, except the MCV and PLT values and the MCH values in females only, which exceeded the normal corresponding mean values. Furthermore, the mean blood values for both sexes in secondary school children were all below the normal corresponding mean values, except the PLT for females only. It is note-worthy that, the data given in table (7) and fig. (2) illustrated noticeable low haematocrid and haemoglobin (red blood cell measures) and small red blood cell as signs for iron deficiency anemia in all the 111 studied school children of both sexes in Assiut University schools (primary, preparatory and secondary aged from 10-15 years).

Such signs of the 111 studied school children were accompanied by the following symptoms: pale skin color, fatigue, weakness, sore tongue, brittle nails and white of eyes, which assured that all of them were anemic.

Fig (2) Mean blood values for school children in Assiut University schools

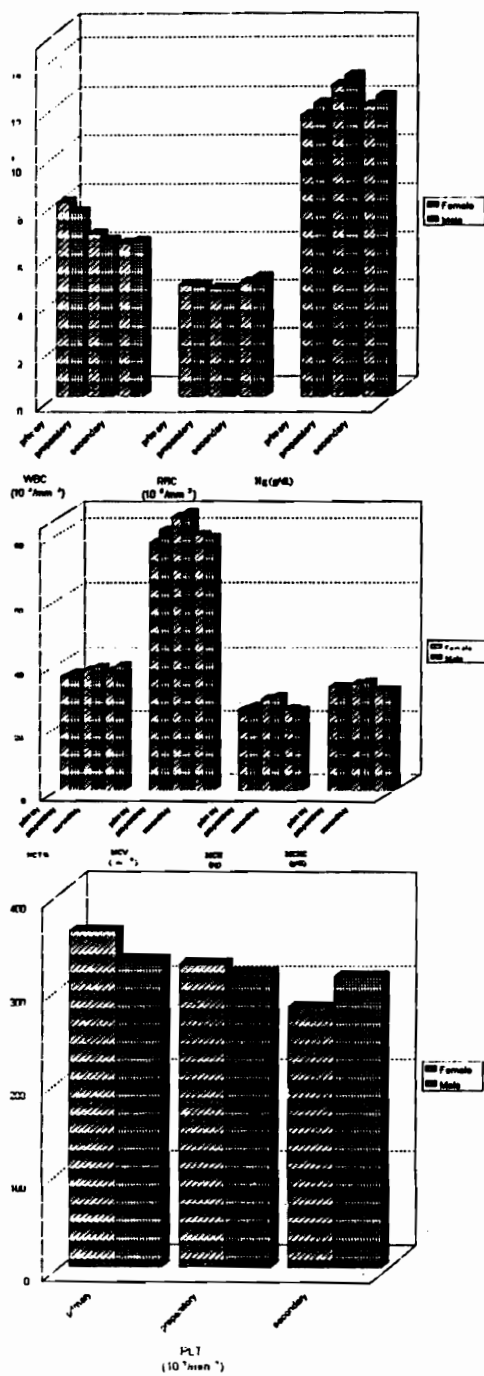


Table (7): Mean blood values of school children in Assiut University schools (primary, preparatory and secondary schools)*.

Blood values	School children					
	Primary		Preparatory		Secondary	
	Female	Male	Female	Male	Female	Male
WBC ($10^3/mm^3$)	8.10 ±0.79	7.66 ±2.65	6.77 ±1.63	6.53 ±2.00	6.40 ±2.14	6.50 ±2.87
RBC ($10^6/mm^3$)	4.65 ±0.38	4.61 ±0.38	4.50 ±0.31	4.50 ±0.29	4.74 ±0.29	4.99 ±0.35
Hgb (g/dl.)	11.63 ±0.55	12.13 ±0.72	12.88 ±0.97	13.30 ±1.03	12.04 ±0.94	12.46 ±1.01
HCT %	35.80 ±1.00	37.20 ±2.00	38.20 ±1.20	38.90 ±2.20	37.80 ±2.20	39.20 ±2.60
MCV (μm^3)	77.3 ±7.36	81.07 ±5.16	85.18 ±6.70	86.34 ±2.68	79.74 ±4.99	78.75 ±5.33
MCH (pg)	25.33 ±3.09	26.52 ±2.08	28.72 ±3.07	29.56 ±1.42	25.46 ±2.04	25.05 ±2.28
MCHC (g/dl)	32.73 ±0.89	32.66 ±0.78	33.65 ±1.68	34.22 ±1.18	31.92 ±1.02	31.77 ±1.01
PLT ($10^3/mm^3$)	359.67 ±39.31	329.67 ±78.46	325.00 ±41.80	315.83 ±67.67	278.70 ±48.48	312.31 ±66.75

* Mean values of the above-mentioned numbers of studied groups of females and males.

The lack of iron in these school children diets led to anemia abnormally low blood haemoglobin levels. Likewise, the presence of iron absorption inhibitors such as phytates and oxalates in their diets reduced the ratio of absorbed iron. Therefore oral iron supplementation might be necessary.

Ibrahim *et al.* (1999) noticed the prevalence of anemia in the school children of 21 Egyptian Governorates ranging between 44 and 63% until the age of 15 years. Both El-Zanaty and Way (2001), and El-Boteny (2003) confirmed the prevalence of anemia in Egyptian Governorates and Siwa Oasis, respectively.

In conclusion results confirmed that the nutritional status of the three studied schools children (both sexes) of Assiut University was rather poor, despite the rather high socio-economic conditions and high income of the children's parents.

Such findings need extensive improvement in these school children nutritional status. This could be accomplished by providing iron rich, protein rich diet in any form during school day. Likewise, the extensive nutritional educational programmes should be designed to good acquaint the parents and all people with simplified knowledge on nutrition and its relationship to human health and welfare.

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تقييم الحالة الغذائية لطلاب مدارس جامعة أسيوط

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تعتبر الأنيميا ظاهرة مرضية تتميز بانخفاض قدرة الجسم على حمل الأكسجين ، ويرتبط هذا الانخفاض بنقص تركيز الهيموجلوبين وعدد كرات الدم الحمراء ، وحجم كرات الدم الحمراء . وقد أجريت هذه الدراسة في محاولة لتقييم الحالة الغذائية لطلاب المدارس (ابتدائي - اعدادي - ثانوي) ، والذين تتراوح أعمارهم من ١٠-١٥ عام ، وذلك لدراسة تأثير الحالة الغذائية على انتشار أنيميا نقص الحديد بين هذه الشريحة من طلاب المدارس . ولقد تم اختيار مجموعة ممثلة من طلاب مدارس جامعة أسيوط بطريقة عشوائية ، وشملت الدراسة عدد (١١١) طالب وطالبة (٨١ طالب ، ٣٠ طالبة) ، وذلك في الفترة من مارس إلى ابريل ٢٠٠٣ . وتم تقييم الحالة الغذائية لطلاب المدارس موضع الدراسة بتقدير محتوى الهيموجلوبين ، عدد كرات الدم الحمراء ، متوسط حجم كرات الدم الحمراء ، عدد كرات الدم البيضاء ، محتوى الهيماتوكريت ، متوسط حجم خلية الهيموجلوبين ، تركيز متوسط حجم خلية الهيموجلوبين ، الصفائح الدموية . بالإضافة إلى ذلك تم عمل القياسات الجسمية المختلفة مثل الطول والوزن ومعامل كتلة الجسم. كما تناولت الدراسة عمل استمارة استبيان تتناول البيانات الديموجرافية ، الدخل ، الحالة الاقتصادية والاجتماعية ، مع أخذ العادات والمعتقدات الغذائية في الاعتبار . وقد أوضحت الدراسة ما يلي :

- أظهرت القياسات الجسمية المختلفة معدلات أقل من المعدلات المثالية الدولية ، وذلك بالنسبة لجميع الطلاب موضع الدراسة .
- أظهرت قيم الدم معدلات أقل من المعدلات المثالية الدولية ، حيث كانت قيم محتوى الهيموجلوبين ، عدد كرات الدم الحمراء ، محتوى الهيماتوكريت أقل من المعدلات الطبيعية بالنسبة لجميع طلاب المدارس موضع الدراسة . وهذه النتائج تفسر انتشار أنيميا نقص الحديد بين طلاب المدارس الذين تتراوح أعمارهم من ١٠-١٥ عام ، وهذه قد تكون بسبب انتشار العادات الغذائية الخاطئة بين طلاب المدارس .

وبصفة عامة أوضحت النتائج أن الحالة الغذائية لجميع الطلاب موضع الدراسة كانت منخفضة على الرغم من ارتفاع المستوى الاقتصادي والاجتماعي ، ومستوى الدخل . ولذا توصي الدراسة بأهمية تزويد طلاب المدارس بوجبات غذائية غنية بعنصر الحديد والبروتين ، بالإضافة إلى نشر وتعليم برامج التثقيف الغذائي بين طلاب المدارس وأولياء الأمور لما له من أهمية لصحة ورفاهية الإنسان .