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Nutritional Status of School Children in Tripoli City, Libya 2012

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Abstract This investigation aimed to assess the nutritional status & the prevalence of obesity among school children in Tripoli, Libya. 94 children were chosen randomly from primary private schools in central Tripoli. A structured questionnaire was done, then administered to mothers to get demographic data. Anthropometric measurements (weight, height, Mid-Upper Arm Circumference (MUAC), and Body Fat Percentile (BFP)). Each mother was asked to complete 24 hour recall on three days for every child. *Blood biochemical parameters of children (hemoglobin, minerals & vitamins) were estimated.* About 90% of children took over their requirements of fat and carbohydrates. Most of the children did not get their requirements from vitamin D according to 24 h recall. One third of children were stunted (H/A average 133.78cm). About 50% of children were over-weighted or obese according to anthropometric measurement. The values of serum hemoglobin, and vitamin B_{12} levels were normal in all children. On the contrary, 66% of school students had low concentrations (<10 ng/ml) of vitamin D. Fat intake of the majority of children (90.4%) was high. However, 78.8% of them consumed potato chips (p= 0.027). More than half of obese children (21.3%) got daily expenses of two LYD or more (p= 0.05) (relationship between pocket money and BMI). A positive correlation (r = 0.222; P < 0.005) was noted between pocket money and body fat percentile. A highly significant correlation (r = 0.332; P < 0.001) was observed between body fat percentile and arm circumference. This study found a prevalence of over-weight, obesity, stunting and deficiency of vitamin D among primary school children in Tripoli, Libya. Similar studies are needed to do in the future in different areas in Libya.

Keywords: *24 hour recall, Anthropometry, Nutrient Intake, BMI Percentiles, Blood Analysis, School children, Libya*

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1. Introduction

The children are the future, they need nutritional and health care to prevent them from developing nutrition-related diseases especially malnutrition. It has been found that a lot of the developing countries have suffered from nutrition-related diseases, especially in children as a result of unbalanced diets [1], being more susceptible and quicker to develop symptoms. So, special attention has to be given for their overall nutrition [2].

Primary school is a transitional phase from childhood to adulthood, and teenagers are usually described as being "difficult to deal with" and "having bad eating habits". [3]. [4] confirmed that these nutritional habits have to be amended.

Nutrition is a major environmental influence on physical and mental growth and development in early life [5]. Malnutrition, with constituents, continues to be a major health burden in developing countries. It is globally the most important risk factor for illness and death, with hundreds of millions of pregnant women and young children particularly affected [6]. Malnutrition was found to be a result of socio-economic and environmental factors. These findings are of great importance because they identify potential actions that can be used to improve the nutritional status of children [7]. Nutritional status in children is an indicator of health and well-being at both the individual and the population level [8].

As accurate and comprehensive epidemiological studies on the prevalence of children obesity in the Middle East countries, especially in Libyan Arab Jamahiriya are very rare, comparing with Saudi Arabia, Kuwait, and Bahrain [9]. Surveys are needed to verify secular trends of the nutritional problems, particularly overweight in the early stages of transition with evidence of the dual-burden in some regions [10]. [11] added that anthropometric surveys which carried out in the north of Africa, particularly in Libya were low. [12] confirmed this need for studies on the prevalence of obesity in developing countries now than ever before.

The accurate assessment of food intakes in children is an essential prerequisite for monitoring the nutritional status of these age groups, as well as for conducting epidemiological and clinical research on the links between diet and health [13]

There are limited studies concerned with the different variables affect on the nutritional status of the Libyan primary school children. Thus, this study was designed to

assess the nutritional status of children in some primary schools in Tripoli, Libya and its relations to their demographic characteristics.

2. Subjects and Methods

2.1. Subjects and Place of the Study

The random sampling technique was used to choose primary private schools of children. First, we randomly selected 3 areas which similar in the economic and social level from downtown (Al-Mansoura, Ben-Ashour & Al-Jomhoria). Then, about 30 children were selected from each school. Socioeconomic classification incorporates occupation and education of parents.

A total 94 school children aged between 6 to 12 years old (55 boys and 39 girls), they were randomly chosen from 3 private schools and divided into two groups (Group1: 6-8 year old), (Group2: 9-12 year olds) from central Tripoli, Libya (Figure 1). Data were collected from May to June 2012, using a self-administrated questionnaires by the children's mothers to assess their demographic characteristics (age, sex, number of family members and family type, parents' education, job and income) and nutritional status of children.

Figure 1. Map of sampling site

2.2. Ethical Consideration

This study is a part of a Master thesis. Protocol of thesis was discussed and accepted from the committee of the college for research. The aims and benefits of this study were explained to the children's parents by one of Authors. She declared that there is no conflict of interest. An informed written consent was taken from each child's mother prior to commencement by school administrations. School administrations were made the arrangements for children to come with their mothers. They had the right to accept or refuse to join the study without any consequences.

2.3. Assessment of Nutritional Status

2.3.1. 24 Hour Recall

A twenty-four hour dietary recall method was used to determine the food intake for three days, nonconsecutive days and one weekend day, to estimate the mean values and percentages of macro and micro-nutrients intake. Mothers were asked for the amount of food. The nutrient intakes were compared with the DRI according to Institute of medicine [14].

2.3.2. Anthropometric Measurements

Height, weight and mid upper arm circumference (MUAC) for each were measured according to the methods described by [15,16]. Children were weighed on personal Seca scales. Weight was recorded to the nearest 0.1 kg. Height was measured using a stadiometer attached to scales to the nearest 0.5 cm. Weight and height were measured with the children barefooted and lightly clothed.

Body mass index (BMI) percentiles were computed by an internet program [17] using height and weight measurements, sex, date of birth and date of measurement information. Body fat percentiles (BFP) were estimated by using Sequoia Warrior Digital Body Mass Caliper[18] and compared with the standard measurement as proposed by [19].

2.3.3. Blood Biochemical Analysis

Blood samples (approximately 3.0 ml for each child) were collected from children at their schools by an experienced nurse from the anesthesia venipuncture site. Haemoglobin was determined according to the method described by [20]. Serum was separated by centrifugation at 4500 rpm for 15 min. at room temperature, then stored at (-18ºC) until analysis. Laboratory tests were performed to determine minerals (calcium, potassium, magnesium, sodium) and vitamins (D & B12) according to [21,22].

2.4. Statistical Analysis

Results were expressed as mean and standard deviation. Chi square, Pearson's correlation coefficient and coefficient of variance (CV) were calculated to analyze data using SPSS version 18. A value of $P < 0.05$ was interpreted as statistically significant.

3. Results

3.1. Demographic Characteristics

Data in Table 1 revealed the majority of children's parent were married (94.7%). Most of the children belonged to nuclear families (88.3%). 46.8% of families had between 4-6 children while 41.5% of them had 1-3 child. These results might be ascribed to most of Libyan families getting married at an early age and consequently would be expected to have a number of children and it is a tradition to have a large family.

Regarding the educational status of parents, data indicated (Table 1) that 40.4% of fathers and 51.1% of mothers had a university level education, Meanwhile, lower percentage of fathers and mothers were illiterate (4.3 and 3.2% respectively).

Concerning the father's occupation, it could be noticed that about half of fathers were employees, while 30.9% of them had private work. On the contrary, more than two third of mothers were housewives while a third of them were employees. The highest percentage of fathers' monthly income (31.9 and 28.7%) was between 300–500 and 700–1000 LYD, in succession. However, 22.3% of them earned money in between. While fathers who earned ≥1000 were 13.8%.

More than two third of children ranked between the first or second or third child. All children received daily pocket money from their parents, 60.6% of them received <2 LYD followed by 31.9% of children got 2-4 LYD.

Table 1. Demographic Characteristics of Children and their Families

Items	%
Marital status of father/Mother	
Married	94.7
Divorced/Widow	5.3
Type of family	
Nuclear	88.3
Extended	11.7
Number of children	
1 – 3	41.5
4 – 6	46.8
7+	11.7
Father's education	
Illiterate	4.3
Primary and preparatory	22.3
Secondary	33.0
College	40.4
Mother's education	
Illiterate	3.2
Primary and preparatory	23.4
Secondary	22.3
College	51.1
Father's occupation	
Laborer	8.5
Employee	48.9
Private work	30.9
Unemployed	11.7
Mother's occupation	
Laborer	1.1
Employee	33.0
Housewife	65.9
Father's income/month (LYD)	
< 300	3.2
300 – 500	31.9
501 – 700	22.3
701 – 1000	28.7
≥ 1000	13.8
Birth order	
1st – 3rd	69.1
4th +	30.9
Daily pupils' pocket money (LYD)	
< 2	60.6
2 – 4	31.9
≥ 5	7.4

3.2. Nutrients Daily Intake

Data in Table 2 representing the main daily nutrient intake of children. Children were getting more than their needs of protein with average 82.74 g for children 6-8 years old and 81.98 g for children 9-12 years old. It could be noticed that 91.6% & 99.7% and 91.6% & 94.8% of the two age groups (6-8 and 9-12) received the highest amount of both fat and carbohydrate intakes, respectively than their requirements. On the contrary, the fiber intake of the two age groups were lower than their needs. Increases of macronutrient intakes could lead to the overweight or obesity prevalence among the studied children.

It could be noticed that the amounts of calcium, phosphorous & Magnesium were inadequate for most pupils aged from 6-8 years while the pupils aged 9-12 years did not receive these three minerals. However, the mean potassium intake was inadequate among 100% of the two studied groups compared to their requirements. That could be ascribed to the pupils who neither ate fresh vegetables nor fruits. While the same table revealed that the mean of sodium and selenium intakes was covered in excess than the dietary reference intake (DRI) among the studied groups aged from 6-8 years & 9-12 years old. The high sodium intake could be attributed to that children under study tended to eat more snacks that contained salts as chips, popcorn, etc.

The majority of children (6-8 years) had not got their efficiency from iron, zinc & copper while, reasonable percentage of their counterparts (9-12 years) received higher amount, but all the groups had low amounts in comparison with their needs. Data (Table 2) showed a severe deficiency of these important vitamins among all studied children especially vitamin D & B. From Table 2, it could be noticed that the values of CV of four macronutrients (protein, fat, carbohydrates & energy) were a bit high.

3.3. Anthropometric Measurements

Regarding the anthropometric measurements of pupils under study are illustrated in Table 3. Over one third of children were stunted (H/A average 133.78cm) when it was compared with the standards. About 50% of children were over-weighted or obese (BMI-for-age 85 percentile or more). The percentage of obese children are more in the group from 6- 8 years old than 9-12 years. Over three quarter of children had normal percent of body fat, but the pupils in age between 6 to 8 (21.1%) had higher body fat percent (≥ 95 percentile) than body fat percent (10.7%) of group aged 9-12.

It could be revealed that half of children were over-weighted or obese. Obesity trend increased with the age of the children.

CV values of anthropometric measurement (Table 3) ranged from 11.77 for height for age to 27.92 for weight for age, values of them were less than CV of macronutrients. That means anthropometric methods are more reliable to assess nutritional status than 24 hour recall.

3.4. Blood Analysis

The obtained results illustrated that the values of serum hemoglobin, and vitamin B12 levels were normal in all studied children. However, data demonstrated that the majority of children (69.2, 87.2, and 79.7%) had normal serum level of calcium, potassium, and magnesium. On the contrary, 66% of school pupils had low concentrations of vitamin D (<10 ng/ml). While in third of sample had normal level. Sera of half of children exhibited sodium values <144 mmol/L (Table 4). While, nearly half of those children recorded normal levels.

3.5. Relations Between Some Variables

A positive correlation ($r = 0.222$; $P < 0.005$) was noted between pocket money and body fat percent. A highly significant correlation ($r = 0.332$; $P < 0.001$) was present between body fat percent and arm circumference (Table 5).

The result presented in Table 6 demonstrated that fifty percent of children had normal BMI, more than half of them received less than 2 LYD. More than half of obese children (21.3%) received two LYD or more ($p= 0.05$). Regarding Pocket money and its relationship with BMI, it could be noticed that the pocket money was received by children found to be an influencing factor when the BMI category is considered. Data in Table 7 disclosed that the majority of children (90.4%) recorded high fat intake. However, 78.8% of them consumed potato chips ($p= 0.027$).

Table 2. Nutrients' intake of children by 24-hour Dietary Recalls

Nutrient's intake	Mean ± SD		% Children Intake			
	6-8 y	9-12 y	6-8 y		9-12 y	
			Adequate	Inadequate	Adequate	Inadequate
Macro-nutrients:						
Protein (g)	82.74 ± 54.1	81.98 ± 41.6	100	-	94.8	5.2
Fat (g)	93.05 ± 46.3	85.49 ± 46.8	5.6	2.8	3.4	6.9
Carbohydrates (g)	214.35 ± 55.3	221.55 ± 43.5	2.8	5.6	5.2	-
Fiber (g)	4.43 ± 1.8	5.01 ± 1.5	-	100	-	100
Energy (kcal)	1675.70 ± 359.4	1730.46 ± 393.2	86.1	13.9	98.3	1.7
Micro-nutrients:						
Minerals						
Calcium (mg)	614.38 ± 196.0	610.91 ± 135.4	2.8	86.1	-	100
Phosphorus (mg)	754.86 ± 187.0	828.14 ± 156.5	16.7	5.6	-	100
Magnesium (mg)	109.51 ± 31.0	118.54 ± 28.8	13.9	80.6	-	100
Potassium (mg)	2039.38 ± 437.9	2114.52 ± 431.4	-	100	-	100
Sodium (mg)	1904.83 ± 488.5	1837.51 ± 439.3	11.1	5.6	29.3	22.4
Iron (mg)	8.15 ± 2.4	8.97 ± 2.0	8.3	83.4	36.2	32.8
Zinc (mg)	6.83 ± 2.0	7.35 ± 1.5	25	13.9	25.9	68.9
Selenium (µg)	137.49 ± 32.6	142.09 ± 32.0	-	-	-	-
Copper (µg)	0.77 ± 0.6	0.79 ± 0.4	16.7	27.8	15.5	51.7
Vitamins						
Vitamin A (µg)	617.82 ± 298.2	624.0 ± 303.3	8.3	27.8	13.7	44.9
Vitamin D (µg)	6.44 ± 8.7	11.51 ± 13.88	-	75.8	1.8	60.7
Vitamin C (mg)	66.68 ± 31.9	73.01 ± 37.4	2.8	8.4	13.8	29.3
Vitamin B1 (mg)	0.49 ± 0.1	0.52 ± 0.2	11.1	83.3	1.7	98.3
Vitamin B2 (mg)	0.78 ± 0.3	0.82 ± 0.3	13.9	27.8	12.1	75.8

Coefficient of variation (CV) CV: protein 56.51, fat 16.65, CHO 22.02, energy 18.68

Table 3. Children's distribution according to anthropometric measurement percentiles

Items	Mean ± SD	CV*	(%)	
			6 - 8 y	9 - 12 y
Weight/Age	34.652 ± 9.68	27.92		
5th - 95th (Normal)			97.4	100.0
≥ 95th			2.6	-
Height/Age	133.78 ± 15.74	11.77		
< 5th			47.4	30.4
5th - 95th (Normal)			50.0	67.9
≥ 95th			2.6	1.8
Mid upper arm/Age	23.266 ± 3.02	12.97		
5th - < 95th (Normal)			97.4	96.4
≥ 95th			2.6	3.6
Body mass index	19.611 ± 3.59	18.32		
< 5th			2.6	-
5th - < 85th (Normal)			44.7	53.6
85th - < 95th			21.1	32.1
≥ 95th			31.6	14.3
Body fat %	18.905 ± 3.46	18.29		
< 5th			-	1.8
5th - < 95th (Normal)			78.9	87.5
≥ 95th			21.1	10.7

*Coefficient of variation (CV).

Table 4. Blood biochemical parameters obtained from pupils under study (n=94)

Blood parameter	%	Mean ± SD	CV*
	Hemoglobin (g/dl)		
Normal (11-18)	100		
Calcium (mg/dl)		9.647 ± 0.89	9.20
Low (<8.8)	10.6		
Normal (8.8- 10.2)	69.2		
High(>10.2)	20.2		
Potassium (mmol/L)		4.294 ± 0.54	12.54
Low (<3.6)	12.8		
Normal (3.6-5.5)	87.2		
Magnesium: (mg\dl)		2.156 ± 0.17	8.05
Low (<1.7)	4.3		
Normal (1.7 - 2.5)	79.7		
High (>2.5)	16		
Sodium: (mmol/L)		141.446 ± 4.51	3.19
Low (<144)	55.3		
Normal (144 - 157)	44.7		
Vit. D: (ng/ml)		9.171 ± 2.39	26.09
Low (<10)	66		
Normal (10 - 30)	34		
Vit. B12: (pg/ml)		487.07 ± 186.12	38.22
Normal (176 - 1100)	100		

*Coefficient of variation (CV).

Table 5. Correlation matrix of some variables

	Pocket Money	BFP	AC	K.cal	Fat
Pocket Money	-				
BFP	0.222*	-			
AC	0.024	0.332**	-		
K.cal	0.011	0.136	0.216*	-	
Fat	0.181	0.148	0.119	0.369**	-
CHO	-0.136	0.108	0.142	0.857**	0.043

* Significant at P≤0.05 ** Significant at P≤0.01.

Table 6. Association of BMI with Child's Pocket Money

BMI	Child's Pocket Money/day (%)		Total
	<2 LYD	2+	
<5 (Under-weight)	1.1	---	1.1
5-<85 (Normal)	28.7	21.3	50.0
85-95 (Over-weight)	22.3	5.3	27.7
>95 (Obese)	8.5	12.8	21.3
Chi-square (χ2) value 12.470 sig. = 0.05			

Table 7. Association of fat intake with consumption of potato chips

Fat intake	Consumption potato chips (%)		Total
	No	Yes	
In-adequate	3.2	2.2	5.4
Adequate	-	4.2	4.2
Over-intake	11.7	78.8	90.4
Chi-square (χ2) value 14.240 sig. = 0.027			

4. Discussion

This study assessed the nutritional status (by different methods) of primary school children in central Tripoli, Libya. By the first method, we found that the majority of children received a higher amount of protein, fat and carbohydrate intakes than their requirements. On the contrary, the fiber intake of the two age groups was lower than their needs. Increasing of macronutrient intakes could lead to the overweight or obesity prevalence among the children. These findings are alarming and really mean that the energy intake derived from food may be the cause of obesity due to the high amount of calories consumed by children [23], or imbalance between calorie intake and calories utilized [24].

The high prevalence of over-weight and obesity detected by the second method (anthropometry) in our study. It has been reported in Libya or other parts of the world. Such as the prevalence of obesity among the younger and the older Indian children [25]. Libya still had a low prevalence of underweight, and high prevalence of overweight [10], although different ages in our study and that study was done in Libya, but they have a similar trend of obesity in Libyan children.

A mild prevalence of stunting found between one third of the school children. Also, [10,26,27] bonded between stunting and obesity. They reported that stunted children had an opportunity to become obese. This rapid increase in the prevalence of childhood obesity has alarmed public health agencies [28]. This observation was attributed to high consumption of fatty and vendor foods and lunch box avoiding behavior [29], or to the quality and quantity of pupil's food intakes as taking junk food, snacks & their bad meal choices [30].

With regard to blood analysis, The main finding in this study is two third of primary school children had a vitamin D deficiency. That differs from the results of other countries such as Brazil, high levels of 25-hydroxy vitamin D were found in Brazilian children, are probably due to the intense solar radiation of Brazil and the argue against the diet being an important source of vitamin D in poorly nourished children [31]. In general, the source of vitamin D is the reaction of sunlight (ultraviolet B irradiation) with 7-dehydrocholesterol; however, the multitude of variables that affect the skin synthesis of vitamin D make it difficult to recommend a specific amount of sunlight exposure for all infants and young children [32]. It could be concluded that the Libyan children suffered from the deficiency of vitamin D. This might be attributed to the bad eating habits, advertisements, particularly T.V, as well as high frequency eating snacks that increase the energy dense food and saturated fat also decrease the vital vitamins and minerals. In addition, the exposure to sunlight of children in Libya is very difficult due to the political unrest and armed conflict reflecting bad environmental conditions that impedes the children form going out in the sunshine.

In comparison, between data sets with different units or widely different means, one should use the coefficient of variance instead of the standard deviation. Generally, blood parameter CV values are the lowest among the method that was used in the study. Blood analysis is more reliable, followed by anthropometric measurement then 24 hour recall. This may be referred to errors in food reporting and quantification can vary with the type of dietary methodology. Agreement between observed and reported intakes from 3-day food records made it the best overall choice [33]. Anthropometry is an accepted method for defining the nutritional status of children, which require relatively simple equipment [34]. But Anthropometric measurement error is unavoidable, and should be minimized by paying close attention to every aspect of the data collection process. This includes ensuring that there is good lighting in which to take measurements, regular calibration of equipment, and the prevention of tiredness among personnel to reduce the possibility of mistakes [35].

The discrepancy between the results in the food intake of some metals (sodium - calcium-magnesium- potassium) by 24-hour recall and analysis of blood serum may be attributed to Firstly, one of the main errors in dietary assessment is misreporting [36,37], of consumed portion size to respondent memory lapses, eating habits, age, sex [37] and ability to read & write[38].Secondly, Diet reports are particularly prone to underestimation of sodium intake because the databases used to assign nutrient values to foods included in dietary interviews often do not account for a discretionary addition of salt, or losses during cooking such Potassium. Daily intakes especially of sodium and potassium vary substantially [39]. In general, the conscious or unconscious behaviour of respondents and/or interviewer bias cannot be prevented in the 24-HDR method [40].

In children aged less than 12 years, children's recall skills, the ability to estimate and indicate portion size, and knowledge of foods are limited, which in turn, constrains their ability to self-report their food intake without parental assistance. Nevertheless, from the age of about 7-8 years there is a fairly rapid increase in the ability of children to participate in unassisted recall, but only for food eaten in the immediate past and for no longer than the previous 24 h. Even then, it is likely that children may

just be old enough to cope with remembering weekday food intake, but less so with the more irregular eating pattern associated with weekend days [26].

With respect to iron and haemoglobin the study was conducted by[42] revealed that even if there is enough iron in blood the haemoglobin can be low or vice versa as there is no direct correlation between iron concentration and haemoglobin level in blood. This may be due to intrinsic and extrinsic factors which affect haemoglobin metabolism causing anemia.

Variation in obesity rates of children in (Table 3) between BMI and BFP may be referred to, Body mass index (BMI) is limited to discriminate between fat and lean mass [43].

The Chi-square test showed that there is a relation between child pocket money and BMI. It was explained by [29] who revealed that children were using money for buying lunch meal rich in fat and nitrogen free extract (NFE) and low in protein and fiber contents. Also [44] showed that children receiving pocket money from parents could influence their eating habits in turn affect general health, increasing BMI [26] so, parents and teachers should motivate children on healthy spending of their pocket money.

The relationship between fat intake and consumption of potato chips (Table 7) confirmed by [45] who reported that obese children consumed significantly more servings of potato chips, which contributed to higher calories, and fat compared to non-obese children.

5. Conclusion

This study concluded that half of Libyan children were over-weighted or obese. Obesity trend increased with the age of the children. Libyan school children have suffered from vitamin D deficiency due to the political unrest and armed conflict reflecting bad environmental conditions that impedes the children form going out in the sunshine. In addition, There is a moderate prevalence of stunting among Tripoli children in Libya. Blood analysis is more reliable, followed by anthropometric measurement then 24 hour recall.It should be combined between indices as BMI & BFP for screening overweight and obesity.

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