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Original Research Article

Nutritional status of Adolescents in Benghazi

Mariam Omar*[1], Faiza Gheith Senussi Nouh[2], Manal Younis[3], Faraj Barasi[4], Mohammed Elzwai[5], Ahmed Nagi[6]
[1, 2, 4, 5, 6] Department of Nutrition, Faculty of Public Health, University of Benghazi
[3]Royal College of Obstetrics and gynecologists, Cumh Cork University Maternity Hospital, Cork Ireland

***Corresponding author**
Mariam Omar
Email: mariam.omar@uclmail.net

Abstract: The recent increase in both adolescent over-weight and obesity in the developing world has underlined the important consequences these trends may impact on public health. Therefore, it is necessary to monitor prevalence rates and trends in under-nutrition and overweight (including obesity) among adolescents. A nutritional surveillance system has been implemented in the Benghazi's schools to estimate the nutritional status. The main objectives were to assess the prevalence of under-weight, over-weight and obesity among Benghazi's adolescents. Anthropometric measurements were taken by professionally trained researchers and subject's weight status was defined according to BMI. The sample, representing adolescents aged between 14 and 19 years, consisted of 552, subjects, 324 of whom were females (58.7 %), while 228 were males (41.3 %). The current study reports a 18.3% and 12.1% prevalence of overweight and obesity in Benghazi adolescents, with a lesser underweight prevalence (4.9%) ; reflecting a presence of two faces of malnutrition in the country.
Keywords: Prevalence, Underweight, Overweight, Obesity, Adolescents, Benghazi, Libya

INTRODUCTION

Adolescence is the second most critical period of physical growth after infancy. It is a time of intense growth; the only period in an individual's life when growth velocity increases. Throughout adolescence, 15% of the ultimate adult height and 50% of adult weight can be gained [1]. The United Nations (UN) and the World Health Organisation (WHO) have agreed to have the age of 10-19 years refer to adolescent populations in Africa [3, 4].

In adolescence, malnutrition encompasses both under nutrition as well as over nutrition [2]. Under nutrition, is associated with higher rates of morbidity and mortality and remains to be an important contributor to the global burden of disease [3, 4]. Globally, 852 million people were reported as undernourished in 2000–2002, with most of the estimate (815 million) live in developing countries [5].

Over nutrition in adolescents is considered an important early predictor of adulthood obesity [6] and its sequences [7, 8]. Early cardiovascular risk factors have been found in obese children and adolescents [9]. The increasing rates of overweight and obesity prevalence among adolescents is affecting countries worldwide, sixteen countries worldwide have over-weight and obesity prevalence higher than 20%, five countries have prevalence above 30% some of which are developing countries [10].

As obesity is evidently becoming more prevalent in developing countries [4], there however is a scarceness of nutrition research in adolescents in such countries. WHO recognizes adolescents as "a neglected, difficult-to-measure and hard-to-reach population" [1].

In Libya, the picture is even less clear, there is little information on nutritional status of adolescents [11]. The purpose of this paper is to estimate the prevalence of underweight, overweight and obesity in adolescents in the city of Benghazi using Body mass index (BMI) or Quetelet index, which has been established as an important diagnostic method for nutritional profile assessment in several populations [12].

SUBJECTS AND METHODS

This study was conducted in Benghazi, Libya.

The study subjects were recruited from secondary public schools in Benghazi. A list of names of government schools was obtained from the office of the director of general education in the ministry of education of Benghazi. A multi-stage stratified sampling process was used to select the schools and subsequently the students within each school. The sample included 46 urban secondary schools, 27 female schools, and 19 male schools listed by. Overall 552 students, (324 females, and 228 males) were randomly recruited.

Questionnaire:

Students were interviewed, they were given a brief explanation about the study, and questionnaire filling procedure, its objectives, and it's ultimate goal. Each of the students was given a form with enough privacy. The questionnaires were reviewed for missing portion or ambiguity. Incomplete or unclear questionnaires were excluded from the study. The questionnaire was divided into two subsections. The first section covered various characteristics like preliminary information like gender and age. There were additions questions within this section regarding student address, school address, father and mother's education, father and mother's profession, type of housing, living condition (with both parents, father, mother or relatives) and number of family members in the household.

The next part of the questionnaire had a detailed section for obtaining information about Height, weight, Physical activity, either if the subject is smoker or not, average night sleep hours, employment status, and type of employments and number of working hours if existed, Activity levels were defined based on the contribution of the type, duration and frequency of the self-reported activities.

Measurements:

Anthropometric measurements were taken by professionally trained researchers. Weight was measured according to the National health and nutrition examination survey (NHANES) [12] using a mounted stadiometer from Seca (Model 769; Seca, Hamburg, Germany) was used to record weights, along with a measuring tape for height measurements for reconfirmation.

Students were asked to stand erect on the scale; that was calibrated periodically; barefoot, with heavy clothing like a coat removed. For taking height, students were asked to stand erect against a wall, with their back head, shoulder blades, buttocks, and legs touching the wall and their head in a Frankfurt position. Afterward a headboard was lowered slowly and with a minimal compression enough to press the hair subjects weight status was defined according to BMI (BMI = weight (kg) / height (m) ²) standards. For adolescents up to 19 years old [13] estimates of the prevalence of underweight, healthy weight, overweight and obesity were based on the cut-off points of CDC values. CDC defines underweight as BMI below 5^{th} percentile for sex and age, healthy weight as BMI equal to or greater than 5^{th} percentile and less than 85^{th} percentile for sex and age. Overweight as BMI equal to or greater than 85^{th} percentile and less than 95^{th} percentile for sex and age, obesity as BMI equal to or greater than 95^{th} percentile for sex and age. Same as that mentioned in the introduction (BMI Interpretation) [14]. For students 20 years or older, Under-weight was defined as BMI less than 18.5Kg/m^2, healthy weight as BMI 18.5-24.9Kg/m^2, overweight as BMI 25- 29.9Kg/m^2, obesity as BMI 30Kg/m2 and above. According to the Clinical guidelines established in 1998 by the National Heart, Lung, and Blood Institute, were followed. Same as that mentioned in the introduction (BMI Interpretation) [15]. For comparison of results subjects weight status was also defined according to weight for age CDC growth charts for Boys and girls aged 2- 20 years standards [16-18].

Ethics

The University Ethics Committee and the Libyan Ministry of Education approved the protocol. Informed consent was obtained from the subjects who were also assured of the confidentiality of the information collected. The research was approved by the administration of the concerned schools. Prior to the start of the project the respective schools administrations were informed in writing about the aim of the study to obtain the maximum possible cooperation to conduct the study.

STATISTICAL ANALYSIS:

The data were entered and processed on computer by SPSS (statistical package for social sciences, Chicago IL, USA). A percentage of BMI categories were calculated to determine the prevalence of under, over and normal weight distributions among Benghazi adolescent.

RESULTS

Sample characteristics are shown in table (1). The sample, representing adolescents aged between 14 and 19 years, consisted of 552, subjects, 324 of whom were females (58.7 %), while 228 were males (41.3 %) as shown in table (2). From the male subjects whose

total number was 228, 7.9% were underweight, and 2.8% of female subjects (n=324) were underweight as presented in table (3).

The total under-weight prevalence was 4.9 %. Among males; 13.2 % were overweight, 10.1 % were obese. In females 21.9 % were overweight while 13.6 % were obese. Total overweight and obesity prevalence in sample was 18.3 % and 12.1% respectively as shown in table 2.

Table 1: Sample demographics

Characteristics	Total	
	Number	%
Class		
First year	194	35.1
Second year	181	32.8
Third year	177	32.1
Total (N)	**552**	**100**
Student Address		
Berka	195	35.3
Benghazi square	81	14.6
El-Selawi	218	39.5
Benghazi suburbs	58	10.5
Total (N)	**552**	**100**
School Address		
Berka	264	47.8
Benghazi square	96	17.4
El-selawi	192	34.8
Total (N)	**552**	**100**
Father Education		
Illiterate	25	4.5
Basic education	103	18.7
Secondary education	220	39.9
University degree	163	29.5
Postgraduate degree	41	7.4
Total (N)	**552**	**100**
Mother Education		
Illiterate	78	14.1
Basic education	140	25.4
Secondary education	167	30.3
University degree	151	27.4
Postgraduate degree	16	2.9
Total (N)	**552**	**100**
Father Occupation		
Employees	269	48.7
Retired	71	12.9
Business	162	29.3
Defense or internal ministry	46	8.3
Unemployed	4	0.7
Total (N)	**552**	**100**
Mother Occupation		
Employees	125	22.6
Retired	13	2.4
Business	5	0.9
Housewives	409	74.1
Total (N)	**552**	**100**

Family Size		
1-3	17	3.1
4-6	191	34.6
7-9	254	46
≥10	90	16.3
Total (N)	**552**	**100**
Type of Housing		
Villa	115	20.8
Classic newly built house	117	31
Classic old house	29	5.3
Flat	237	42.9
Total (N)	**552**	**100**
Smoking		
Yes	21	3.8
No	531	96.2
Total (N)	**552**	**100**
Night Sleep Hours		
<6	95	17.2
6-8 hours	315	57.1
8-10	108	19.6
>10	34	6.2
Total (N)	**552**	**100**
Student Job		
Yes	38	6.9
No	514	93.1
Total (N)	**552**	**100**
Student Life Style		
Lived with both parents Lived with fathers	506	91.7
	12	2.2
Lived with mothers	26	4.7
Lived with relatives	8	1.4
Total (N)	**552**	**100**

Table 2: Subject characteristics by age and gender

Age (Years)		**Sex**		**Total**
		Male	**Female**	
14	**No.**	7	7	14
	%	1.3	1.3	2.6
15	**No.**	10	15	25
	%	1.8	2.7	4.5
16	**No.**	88	73	161
	%	15.9	13.2	29.2
17	**No.**	101	86	187
	%	18.3	15.6	36.2
18	**No.**	18	117	135
	%	3.3	21.2	24.5
19	**No.**	4	26	30
	%	0.7	4.7	5.4
Total	**No.**	228	324	552
	%	41.3 %	58.7	100
Mean + SD		17 + 1.2	18 + 1.7	

Table 3: Distribution of BMI among gender

% BMI Distribution among gender	Males	Females	Total
Under weight	7.9	2.8	4.9
Normal	68.9	61.7	64.7
Over weight	13.2	21.9	18.3
Obese	10.1	13.6	12.1
Total	100 %	100%	100

DISCUSSION:

The current study reports a 18.3% and 12.1% prevalence of overweight and obesity in Benghazi adolescents, with a lesser underweight prevalence; reflecting a presence of two faces of malnutrition in the country. Not long ago under-nutrition was considered the main problem in the developing world including Libya [19]. More recent studies have described a double burden of malnutrition in Libya (both obesity and underweight problem) [20]. This study shows that Libya could be joining countries that suffer from obesity epidemic rather than under-nutrition problem alone. More adolescents are becoming obese in the city of Benghazi, obesity burden are almost doubled during the last decade. While underweight is lowered considerably from 12.9 to 4.9 % [21].

Libya is not the only North African country with the overweight and obesity problem as reported in this study in its second main city, in Egypt a national survey estimated that 31.4 % of Egyptian adolescents are overweight, 9.3 % are obese [22]. Benghazi apparently shares the double over nutrition and under-nutrition problem with Tunisia; in which the Prevalence of underweight, overweight and obesity are respectively, 8.1 %, 17.4 % and 4.1 % among boys and 1.3 %, 20.7 % and 4.4 % among girls [23]. In Ghana, adolescents are thinner, with total overweight estimated at 8.7% of total adolescents in Benin however, the rate is considerably lower, where obesity rate is only 0.6% of total population [24].

High obesity prevalence was previously reported in some places in Asia, Taipei and Saudi Arabian adolescents reportedly held the highest obesity/overweight problems [25, 26] and the similar results come up in the current study. In Qatar, the prevalence of underweight, overweight, and obesity was estimated to 7.9%, 28.6%, and 7.9%, respectively, among adolescent boys and 5.8%, 18.9%, and 4.7% among girls [27].

Obesity problem In Bangladesh and India is comparable to ours, 14% of adolescent Bangali girls are obese, 23% are overweight, and while in India 15 % are Obese [28 Over-nutrition (both overweight and obesity), affects 30.1 % of the current study, same as previously reported in Taiwan; 30.5%. While in China adolescents are thinner, over-nutrition affects 11.5% of girls and 14.4% of boys [29].

Our adolescents appear more overweight and obese than the Turkish counterparts; in Turkey overweight and obesity was reported as 16.8%. In the adolescent girls, the prevalence of underweight, overweight and obesity were found as 11.1%, 10.6% and 2.1%, respectively, while Turkish adolescent boys are thinner 14.4%, 11.3% and 1.6% underweight, overweight and obesity respectively [30].

In Port Harcourt the prevalence of underweight, overweight, and obesity were 6.4%, 6.3%, and 1.8% respectively [31]. Among Italian adolescents during period from 2004 to 2006, the prevalence of under-weight declined from 9.8% to 8.0%; the prevalence of normal weight rose from 77% to 71.6%, while the prevalence of overweight rose from 13.3% to 19.7%. The Italian study is similar to the current study in decreasing of under-nutrition prevalence and the increasing in over-nutrition [32].

In a systematic review carried by Bibiloni and colleagues in 2013 [11]. a total of forty studies worldwide were included; the authors reported that the overweight and obesity prevalence was higher in America, Europe and Oceania, and lower in Africa and some parts of Asia (in Iran and China the total prevalence was lower than 10% as defined by the IOTF cut-offs). Over- all, about 30% of adolescents in America and 22%–25% of adolescents in Europe (except the Italian and Czech Republic adolescents' that showed a prevalence of 17.9% and 13.7% respectively) were overweight or obese. Among Oceania adolescents the prevalence ranged from 23.2% in Australia in 2004 to 34.2% in New Zealand in 2007. In Africa, the over nutrition prevalence was less than 20%. Among Asian adolescents there was a broad range of overweight plus obesity. Using IOTF cut-off, the prevalence of being

overweight or obese for Asian boys and girls ranged from 5.2% in China in 2002 to 36.4% in Bahrain in 2000. Even though Libya was not included in the review, and different cut-offs could hinder the precision of comparison, our figures seem to fall in between the first and third category prescribed by the authors.

The authors also described a substantial geographic variation in adolescent overweight and obesity within the countries included for the study, and that could hinder the generality of our study to all Libyan regions and comparisons to other national studies [11]. The higher overweight and obesity prevalence and lower rates of underweight in Benghazi adolescents might be due to the economic and nutrition transition that Libya has endured during the few years preceding this study [33, 34] as well as an overall higher socioeconomic status, which have been previously associated with overweight and obesity [35, 36].

Over the past decades, there has been increasing evidence that the structure of dietary intakes and the prevalence of obesity around the developing world have been changing at an increasing rapid pace [38]. Countries of the Middle East are believed to have the highest dietary energy surplus among developing countries. Libya, among other countries of the developing countries has undergone rapid transition in patterns of nutrition [33, 34].

In Nigeria, the prevalence of under-weight was 20.1 % while the obesity prevalent in 3.2% of the adolescent; which similar to Benghazi's current findings [38]. In Lebanon, 34.8% were overweight, 13.2% were obese [39] which higher than the same figures in this study that mean Lebanon has more obese adolescent community than Benghazi. On the other hand, in Oman under-weight adolescent makes 2.48 % which is lower than Benghazi's findings; while the over-weight 26.73% that is higher than the figure of Benghazi; while only 1.49 % was obese among Omani adolescent [40]. Urbanization, increasingly sedentary lifestyles and unhealthy diets, remain to be a problematic to adolescents worldwide, and have contributed to the increased the prevalence of obesity, particularly in developing countries [11] and Libya might not be an exception. Diwa *et al.;* 2003 [21] reported that 76.6 % of adolescents did not eat at a regular meal times, 75.9 % miss meals, and 90.6 % eat outside home.

BMI is a convenient and feasible overweight and obesity screening tool in children and adolescents [41] However, It is important to note that the choice of a reference and a cut-off point would determine the absolute prevalence of underweight, overweight and obesity and their trends, and hence different information would be obtained when comparing different figures [42].

The main three reference tools are the International Obesity Task Force (IOTF) criteria 2005, the United States Centers for Disease Control and Prevention (CDC) growth charts issued in 2000, and the World Health Organization (WHO) criteria [42]. The IOTF extrapolated the adult BMI cutoff points for overweight (25 kg/m2) and obesity (30 kg/m2) to data sets from six countries [39]; and some evidence suggests this classification system has lower sensitivity than the WHO, CDC, and local classification systems for diagnosing overweight and obesity in children and adolescents compared with percentage of body fat as the gold standard [43].

The United States Centers for Disease Control and Prevention (CDC) growth charts issued in 2000, is a revision of the National Center for Health Statistics (NCHS) 1977 growth reference that incorporated data from five national surveys conducted between 1963 and 1994 in the United States of America and used statistical smoothing techniques [44]. The World Health Organization (WHO) criteria, which were developed by a WHO expert committee in 2007 using the 1977 NCHS growth reference from 5 to 19 years, supplemented with data from the WHO Child Growth Standards for children ages 5 years and younger (to facilitate the transition at age 5) [45].

WHO interpretation of BMI was shown to reflect the highest prevalence estimate of overweight and obesity because it's based on non-obese population as a reference, and it is the only system designed using data from before the obesity epidemic; hence, it is thought be the more appropriate for countries where the prevalence of childhood obesity is still relatively low [43].

We decided to use the CDC system because of its frequent use internationally, and because it's derived using more recent data in which the BMI distribution of the reference populations is already shifted toward the right because of the recent increase in child and adolescent BMI [43]. It should be noted however, that CDC cut- offs was designed with the objective of detailing obesity trends in the United States using national data only and the lack of conclusive evidence to prove the validity of such criteria for developing

countries could be a limitation in our study neither there is a clear consensus on which BMI classification system should be used to diagnose overweight and obesity [43].

The use of a relatively small sample is considered another limitation, even though the sample may be representative of the population as far as locality, gender and age are concerned. The measurements of the subjects could only be performed once, and it has not provided direct indications of the chronology of overweight and obesity development. Despite those limitations, the data described in this study still provides a valuable profile for the physical characteristics of a major segment of the adolescent population of Benghazi. New longitudinal studies are needed for a better estimation of adolescents' nutritional status.

As overweight and obesity is increasing worldwide, it is important that countries monitor weight status of children and adolescents. The critical issue is which definition is used. A clear consensus on which BMI classification system should be used to diagnose overweight and obesity [23, 24, 43]. It could also be argued that using robust anthropometric measures that are validated for these populations will yield more accurate and informative results, which will be beneficial in formulating policies and strategies for dealing with this problem. Regional differences in prevalence and associated risk factors are important to consider when policy initiatives are being formulated and implemented. Further studies are needed to confirm the current findings and to determine the contributing factors for the increase of in obesity prevalence to demonstrate causality of risk factors on malnutrition in our community.

CONCLUSION

This study demonstrates the existence of the double burden of malnutrition among adolescents in Benghazi Libya. Although the prevalence of underweight was relatively low in the sample, the findings of this study have important public health implications because of unhealthy weight status (underweight, overweight and obesity). Our findings also underscore the need to explore other potential risk factors for overweight and underweight among adolescents in Benghazi.

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