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Original Article

The Prevalence of Short Stature among School Children and Adolescents in Tripoli, Libya in 2009-2010

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Abstract

Background: Short stature has an impact on children's physical and mental health. Data on the prevalence of short stature in Libyan children are limited. **Objectives:** We aimed to ascertain the prevalence of short stature among school children in Tripoli, Libya. **Patients and Methods:** In this cross-sectional study, we included 419 school children (235 boys and184 girls) selected from different primary and preparatory schools in the City of Tripoli. The study was conducted between April 2009 and October 2010. Trained pediatricians took their anthropometric measurements (i.e., height and weight). The WHO-2007 Z-score charts and UK-WHO growth charts were used to calculate the prevalence of short stature (defined as standard deviation score of height <2 in same gender and age). **Results:** The overall prevalence of short stature using WHO-2007 Z-score and UK-WHO growth charts were 5.0% and 5.7%, respectively. (4.3% was moderate and 0.7% was severe). Boys and girls had no significant difference in the prevalence of short stature using 2007 WHO reference data (5.5% vs. 4.3%; $P = 0.656$). Similarly, there was no difference between the prevalence of short stature between boys and girls when applying UK-WHO growth charts (6.8% vs. 4.3%; $P = 0.3$). There is a statistically significant relationship between the prevalence of short stature (increase) and students' increasing age. **Conclusions:** Short stature is not an uncommon problem in children; they need early assessment because intervention time is crucial in this condition.

Keywords: Anthropometric measurements, growth, Libya, schoolchildren, short stature, Tripoli

INTRODUCTION

Short stature denotes a height below the third percentile or >2 standard deviations (SD) below the mean height for chronologic age.[1] School age is a critical period for children's physical growth and mental development.[2,3]

Short stature is not a disease; it is a manifestation of an underlying health problem,[4] so the early discovery of short stature will help define the underlying disease and its proper treatment type

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and improve the quality of life among the affected children.[5]

Most children with short stature have normal variants such as familial short stature, constitutional delay of growth and puberty, or idiopathic short stature. However, the most common pathological causes are growth hormone deficiency, hypothyroidism, celiac disease, and Turner syndrome. Other causes include renal, hepatic, gastrointestinal diseases, and other genetic syndromes.[6,7]

In addition, short stature has an impact on children's physical and mental health. Children with short stature tend to experience psychological disorders, such as low self-esteem, academic difficulties, and social immaturity.[8,9] Moreover, short stature can still affect children's health after puberty. For example, short-stature women were susceptible to have preterm delivery when they became pregnant in adulthood.[9,10] Therefore, identifying short stature in childhood is very important in reducing physical and mental illness and should be an essential part of children's health programs.[8] Finally, several studies were done to determine the prevalence of short stature in school age children worldwide and in Arab countries. To the best of our knowledge, there are no published data on the prevalence of short stature among school children in Libya. Hence, we have conducted this study to explore the prevalence of short stature in Libyan school age children.

PATIENTS AND METHODS

Objectives and settings

This study aimed to find out the prevalence of short stature among school children in Tripoli.

The study was carried out in Tripoli, the capital city of Libya. It was carried out among school children in primary (years 6-12) and preparatory (years 13-15) school from April 2009 to October 2010.

Design and sampling

It is a descriptive, cross-sectional study. The sample size was calculated by using the following equation:[11]

$$n = \frac{z^2 \text{ p q}}{d^2}$$

$$n = \frac{1.96^2 \times 0.5(1-0.5)}{0.05^2} = 384.16$$

Where n = the sample size. $z = 1.96$ P = Prevalence. q = 1-p.

d = (reliability of coefficient) × (standard error).

Tripoli has six educational zones with 267 primary and preparatory governmental schools. Two stages stratified random samples were done as follows: The first sampling stage will classify schools into six groups according to geographical location, then one or two schools randomly selected from each location. In the second sampling stage, two or three classes will be selected randomly from each school, and all children in the selected classes will be included in the study. The total number of students in Tripoli is 152,457. The study group was selected as shown in Table 1. The sample size was calculated from the above equation, and it was 384 students. However, to avoid drop-out, more than 400 children were selected randomly for the study.

Inclusion criteria and exclusion criteria

Participating in the study based on the following inclusion criteria: Libyan students of both sexes, age from 5 to 16 years, and parents agree to participate in the study. The exclusion criteria were non-Libyan students, age <5 or above 16, and students or families refusing the participation in the study.

Study tool

The study data were collected through the performed questioner: which concentrated on age, sex, family history, past medical history, and parent's education level. The questionnaire was given to the students to be answered by their parents.

Table 1: The distribution of selected students according to the educational zones of Tripoli

Education zone	Number of students (%)	Selected students (%)
Souk Algoma	40,534 (26.6)	110 (26.3)
Hai Alandolous	33,165 (21.8)	89 (21.2)
Abosleem	29,724 (19.5)	85 (20.3)
Tajoura	25,111 (16.5)	72 (17.2)
Central Tripoli	15,926 (10)	42 (10)
Ein Zara	7997 (5)	21 (5)
Total	152,457	419

Assessments of anthropometrics were obtained for all students enrolled by trained pediatricians, and the chronological age was calculated using the date of birth. Weight was measured without shoes or heavy outer clothing. Height was measured without shoes and head in a Frankfurt plane and the occiput, shoulder, buttocks, and heels contacting a vertical board. Standing height was measured to the nearest 0.1 cm, and weight was measured to the nearest 0.1 kg.

Body mass index (BMI) was calculated as the weight to the square of height (kg/m^2).

Percentiles of weight, height, and body mass index for age and sex were determined by

WHO 2007-Z Score growth charts (www.who.int/child-growth-standards).

UK-WHO growth charts (www.rcpch.ac.UK/growth charts) by using an application to calculate Z score (download. cnet. com/Growth-Charts-UK-WHO)

Short stature was defined as a standing body height is under-2SD of average height in same gender and age by using the WHO 2007 growth charts; or height is below the second percentile of average height in same gender and age by using UK-WHO growth charts.

Assessment of BMI to detect overweight, which is defined as BMI is more than 91st centile, obese if BMI more than 98th centile and underweight defined as BMI is < 2nd centile by using UK-WHO growth charts.

Statistical analysis

SPSS software version 21 (IBM Corp. Released 2012. IBM SPSS Statistics for Windows, Version 21.0. Armonk, NY: IBM Corp.), used to analyze the collected data; mean, SD, and percentages used for descriptive statistics, Chi-square used for inferential statistics, and $P < 0.05$ considered significant.

RESULTS

A total of 419 students were included in the study. Of these, 235 students (56.1%) were boys. Their age ranges from 6 years to 15.4 years, and the mean age for students was 10.67 ± 2.6 years [Figure 1]. When applying UK-WHO growth charts, mean ± SD, height for all students was 140.38 ± 14.7 cm. It was –0.25 ± 1.11 Z score (the minimum was –3.65 and the maximum was 5.60) [Figure 2]. Mean ± SD for height by cm for boys was 139.8 ± 14.7 cm and for girls was 141.1 ± 14.6 cm. The mean height for boys and girls was –0.35 ± 1.05 versus –0.14 ± 1.16 Z score, respectively. The difference was statistically significant ($P = 0.05$). Furthermore, there is a significant difference in mean height Z score in different age groups ($P = 0.012$), as shown in Figure 3. Applying 2007 WHO reference to this sample defined the prevalence of moderate and severe short stature was defined as the proportion of children t whose SDs score (Z score) for stature for age was below-2 and-3, respectively. Based on this, we found that 21 students were counted to suffer from short stature, indicating a prevalence rate of short stature was 5% (4.3% was moderate short stature and 0.7% was severe short stature. On the other hand, 92.8% of students had normal height (Height between –2 and + 2 Z score) and 2.2% of students had tall stature (Height >+2 Z score), as shown [Figure 4]. The prevalence of short stature using the UK-WHO growth chart (Height below the second percentile of average height in same gender and age) was 5.7%. In 2007, WHO reference boys had no significantly higher prevalence than girls (5.5% vs. 4.3%; $P = 0.656$). Similarly, there was no significant difference in the prevalence in boys than girls when applying UK-WHO growth charts (6.8% vs. 4.3%; $P = 0.3$), as shown in Table 2.

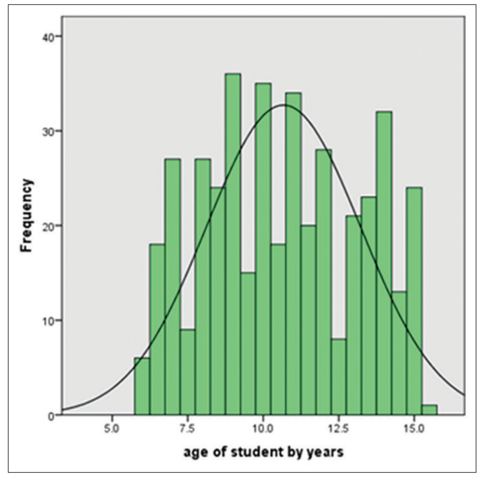

Figure 1: The age distribution of the students

Short statue prevalence was further considered by age groups. One hundred seventeen students were between 6 and 9 years of age, 155 were between 9 and 12 years, and 145 were between 12 and 16 years. There was a statistically significant increase of prevalence with increasing age when using both 2007 WHO charts (P = 0.026) and when using UK-WHO charts (P = 0.009) [Table 3]. The mean BMI for students was 0.14 ± 1.27 Z score, with a nonsignificant difference between BMI mean for boys and girls (0.12 ± 1.21 vs. 0.19 ± 1.36, P = 0.59). Results were showed that 35 students (8.4%) are obese. On the other hand, short students a mean BMI-0.48 ± 1.12 Z score, only two (9.5%) short students are underweight; the remaining had normal BMI (P = 0.240).

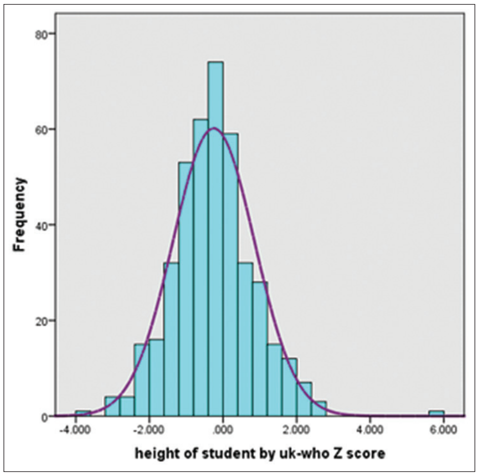

Figure 2: The height distribution of students by UK-WHO Z score

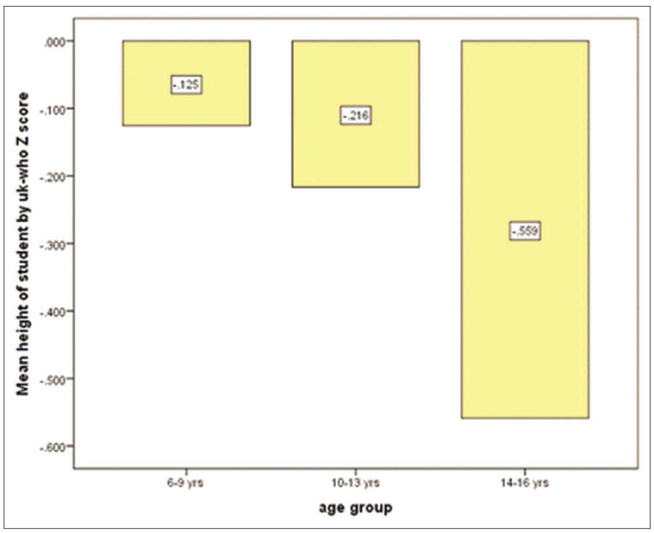

Figure 3: The mean height Z score for students in different Age groups

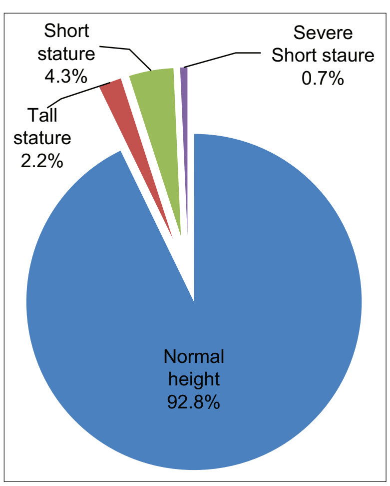

Figure 4: The percentage of short stature

DISCUSSION

The short stature has an impact on children's physical and mental health. Furthermore, detecting the prevalence of short stature in children can be considered a first step in addressing childhood health concerns. However, it is including in formulating relevant public health policy.

The results in the study regarding sex difference, age, mean age of students, and mean height supported by VP Wickramasinghe *et al*. 2005 in the study of nutritional status of schoolchildren in an urban area of Sri Lanka 1 224 were included in the anthropometric analyses. Forty eight percentage of the children were boys 8, and 9-year-old boys were slightly taller than their female counterparts, but at the age of 10–12 years, girls were taller than the

Table 2: Compare between *Z* score in WHO growth chart and UKWHO growth chart

Definitions and sex	WHO *Z* score		UK-WHO *Z* score	
	Boys	Girls	Boys	Girls
Number of children	13	8	16	8
Percentage HAZ < −2 SD	5.5	4.3	6.8	4.3

SD: Standard deviation, HAZ: Height for age *Z*-score

Table 3: Compare between prevalence of short stature and age groups

Age groups	Number of children (percentage HAZ < −2 SD)	
	WHO *Z* score, *n* (%)	UK-WHO *Z* score, *n* (%)
6.0-<9 years	2 (1.7)	3 (2.6)
9.0-<12 years	8 (5.2)	11 (7.1)
12.0-<16 years	11 (7.5)	10 (6.9)

SD: Standard deviation, HAZ: Height for age *Z*-score

Table 4: Comparison between prevalence of short stature in the present study and other studies of similar objectives

Country (city)	Study period	Age-group (years)	Number of students (percentage of boys)	Prevalence of short stature			Reference
				Total moderate* (severe)+	Male	Female	
Libya (Tripoli)	2009-2010	6-15	419 (56.1%)	4.3% (0.7%)	5.5%	4.3%	The present study
Saudi Arabia (Yanbu city)		6-15	4885 (49.9%)	4.2% (0.7%)	4.1%	4.7%	14
Saudi Arabia (national survey)	2004-2005	5-18	19,372 (50.8%)		11.3% (1.8%)	10.5% (1.2%)	15
Egypt (national survey)	2018-2020	6-11	33,150 (50%)	17%	19.2%	14.4%	16
China (national survey)	2014	7-18	213,795 (49.9%)	2.69%	2.21%	3.19%	17

These studies used WHO 2007 growth charts. *Moderate short stature (Height below - 2 SD), +Severe short stature (height below - 3 SD). SD: Standard deviation

boys, probably due to the early onset of the pubertal growth spurt in the former.[12]

This study used the most recent and globally accepted growth charts to monitor children's height, including 2007 WHO reference and UK-WHO growth charts. Since the local growth charts reference done in the 1980s were not updated.[13] The data analysis revealed the estimated prevalence of short stature in school children was 5% (4.3% was moderate short stature and 0.7% was severe) when applying 2007 WHO growth charts. However, the prevalence in boys was higher than girls, but the difference was nonsignificant (5.5% vs. 4.3%; $P = 0.656$). A comparison of our findings with other studies of similar objectives is presented in Table 4. This result is similar to a report from Yanbu city in Saudi Arabia, where moderate short stature subjects represented 4.2% and 0.7% was severe short stature. However, the gender difference is opposite to our result (4.1% males and 4.7% females). This difference may be attributed to the different percentages of the boys in their study (49%) or different sample sizes (4885 students).[14]

Our prevalence is lower than the national prevalence of short stature in Saudi children and adolescents[15] found a prevalence in boys and girls; 11.3% versus 10.5%, respectively. Moreover, reported prevalence in Egypt among children was 17% (19.2% in boys and 14.4%in girls).[7] These studies were national surveys with a larger sample size than the current study; 19,372 students in Saudi study and 33,150 students in Egyptian study.

Our results were higher than the reported nationwide prevalence of China included 213 795 students. The prevalence of short stature was 2.69% (2.21% in boys and 3.19% in girls, the difference in gender prevalence was statistically significant $P < 0.0001$).[8] Comparison of our result with other data reported in the literature about the prevalence of short stature in Libya and some Arabic countries was inappropriate because of differences in sample selection and references (using CDC 2000 or local growth charts) to calculate the prevalence of short stature.[16,17]

Globally, the prevalence of stunting under 5 years old declined from 39.7% to 26.7% between 1990 and 2010 (the prevalence in North Africa was 21.9% in 2010). However, the study revealed that Africa's rate of stunting has stagnated with slight improvement. At the same time, Asia showed a dramatic decrease. This reduction was caused by socioeconomic changes and specific infection control and dietary interventions.[18]

When analyzing the prevalence difference in different age groups, we found increasing prevalence with age similar to other studies.[5,7,19] This difference is partly explained by the acceleration of the rate of height growth in puberty in different age groups and the influence of school environment and cultural concerns about nutrition in adolescent age groups. This effect was documented in a previous Libyan study that reported that school children's growth pattern was similar to the international standards at early school age, but it dropped down with increased age.[16]

In the current study, most short stature had normal BMI, and only 9.5% of short-stature students were thin. This is unsupported by Zayed *et al*. 2016 who reported in the Jordan study that underweight showed similar distribution patterns to short stature among children in the study.[17]

Some limitations are noteworthy. The charts used were WHO charts in the absence of national charts. A small sample of students caused underestimation of true prevalence, which needs larger samples representing school children of the whole country (urban and rural) are needed on a national level to set up the final national Libyan growth charts.

CONCLUSION

Short stature is not an uncommon problem. Short children need early clinical assessment because intervention time is crucial in this condition.

In particular, school health programs should consider the growth parameters of students to detect and intervene timely to avoid adverse effects on children's health.

Acknowledgment

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Authorship contribution

All authors contributed to the conception, conduct, and data collection. They all contributed to the drafting, revision, and finalization of the manuscript.

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Conflicts of interest

There are no conflicts of interest.

Compliance with ethical principles

The study was approved by the Tripoli Children Hospital committee for scientific research and obtained from the Research and Consulting Department at the Faculty of the Medicine-University of Tripoli. All parents provided written informed consent for children to participate in the study, and data confidentiality was maintained throughout the study and any resulting publication anonymously.

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