Growth of preschool children in the Libyan Arab Jamahiriya: regional and sociodemographic differences

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نمو الأطفال دون سن المدرسة في الجماهيرية العربية الليبية: الفروق الإقليمية والاجتماعية الديموغرافية

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الخلاصة: تم إجراء هذه الدراسة التي شملت مختلف القطاعات والفئات في اثنتين من مناطق الجماهيرية العربية الليبية، بهدف دراسة النمو والحالة التغذوية للأطفال دون سن الخامسة، وتأثير العوامل الاجتماعية الاقتصادية على نمو الطفل. وقد بيَّنت الدراسة اختلافاً في المَنَاسِب المتعلقة بالقياسات البشرية (مثل الوزن بالنسبة للعمر، والطول بالنسبة للعمر، والوزن بالنسبة للطول) بين المنطقتين. ولوحظ ارتفاع ملموس في نسبة التقزم بين الأطفال في منطقة الجبل الريفية (6.1٪) بالمقارنة مع مثيلتها في مدينة طرابلس (2.5٪). أما العوامل التي كان ترابطُها وثيقاً بنقص التغذية فهي: مستوى تعلم الأم، وعمر الطفل وجنسه، والمنطقة التي يعيش فيها الطفل. ولوحظ ترابط ملموس بين التقزم وبين عمر الطفل والمنطقة التي يعيش فيها ومستوى تعلُّم الأم وعدد أفراد الأسرة. كما لوحظ ترابط وثيق بين الهزال ومستوى تعلُّم الأم.

ABSTRACT This cross-sectional study was performed in two regions of the Libyan Arab Jamahiriya. The aim was to study the growth and nutritional status of children under 5 years of age and the effect of socioeconomic factors on child development. Anthropometric indices (weight-for-age, height-for-age and weight-for-height) differed in the two regions. The prevalence of stunting was significantly higher among children from mainly rural Al Jabel Al Garby (6.1%) than those from urban Tripoli (2.5%). The z-scores that correlated strongly with under-nutrition included: mother's education, child's age and sex, and region. Stunting was significantly related to age and region and to maternal education level and family size. Wasting was highly correlated with maternal education.

Croissance des enfants d'âge préscolaire en Jamahiriya arabe libyenne : différences régionales et socio-démographiques

RESUME La présente étude transversale a été réalisée dans deux régions de la Jamahiriya arabe libyenne. L'objectif était d'étudier la croissance et l'état nutritionnel des enfants de moins de cinq ans et l'effet des facteurs socioéconomiques sur le développement de l'enfant. Les indices anthropométriques (poids/âge, taille/âge, poids/taille) étaient différents dans les deux régions. La prévalence du retard de croissance était significativement plus élevée chez les enfants originaires de la région d'Al Jabel à prédominance rurale (6,1 %) que chez ceux de la région urbaine de Tripoli (2,5 %). Les valeurs de Z qui étaient fortement corrélées avec la dénutrition comprenaient l'instruction de la mère, l'âge et le sexe de l'enfant, et la région. Le retard de croissance était significativement lié à l'âge et à la région, ainsi qu'au niveau d'instruction de la mère et à la taille de la famille. L'émaciation était fortement corrélée avec l'instruction de la mère.

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Introduction

Assessment of growth is an important component of infant and child health care, and growth disorders are often the first recognizable signs of medical, social or nutritional problems [*1*]. Regular follow-up of preschool children and the use of weight and height to monitor growth are important features of child health services all over the world, particularly in poorer countries where auxiliaries with limited technical resources provide primary health care (services) [*2*].

Waterlow distinguishes three groups of children who are underweight for their age: those who are thin (wasted), those who are short (stunted), and those who are both thin and short (wasted and stunted) [*3*]. Stunting is a result of long-standing malnutrition, whereas thinness or wasting is normally due to recent weight loss. A combination of the two will cause a child to be both short and thin [*3*].

The aim of the present study was to assess the growth and nutritional status of children under 5 years of age in the Libyan Arab Jamahiriya, and to investigate the factors affecting child growth and development in two regions of the country.

Methods

A total of 1614 healthy preschool children aged 0 to 59 months, recruited between 1999 and 2000 from two areas of the Libyan Arab Jamahiriya (Al Jabel Al Garby and Tripoli) were assessed for weight and height. The total included two samples, recruited by two complementary methods. A simple random sampling method was applied at maternal and child health (MCH) centres, kindergartens, and the delivery section of obstetrics hospitals; and cluster sampling was used in residential areas. Both techniques were applied according to World Health Organization (WHO) methodology [*4*].

A questionnaire in Arabic was designed, pre-tested at the MCH centres and administered by the principal author and his team during field work in the Libyan Arab Jamahiriya. Mothers were interviewed about their children (e.g. age, sex, weight, height, breastfeeding and eating patterns) and about the general socioeconomic status of the family (i.e. educational and occupational level of the mother and father, family size, family income and type of residence). Anthropometric measurements were made at the time of interview, again using WHO methodology [*5,6*].

Children were weighed without shoes, either naked or with minimal clothing, on an infant baby scale with an accuracy of 0.1 kg. The scale was calibrated to zero before each measurement. When a child could not be weighed alone, the child and mother were weighed together and the mother's weight subtracted.

Children under 2 years of age were measured using a SECA-type measuring board graduated in 0.5 cm, barefoot and placed in a supine position on a flat surface. Children over 2 years old were measured while standing, with the measuring board placed on a hard surface against a wall. Measurements were read to the nearest 0.1 cm.

The children were classified using three indices: 'underweight' (low weight-for-age), 'stunting' (low height-for-age) or 'wasting' (low weight-for-height). Low anthropometric values were those more than 2 SD from the NCHS/WHO reference population from 1983.

Descriptive statistical analyses including means, standard deviations, percentages and medians were calculated. Analyses of variance (ANOVA) were used to look for

relationships between the distribution of z-scores (see below) for the three indices of weight-for-age, height-for-age and weight-for-height, and socioeconomic factors. All the analyses were performed with SAS software, version 8. The z-score was calculated as follows:

$$\text{z-score} = \frac{\text{(observed value)} - \text{(mean reference value)}}{\text{standard deviation of reference population}} \quad [7]$$

A total of 141 children were excluded from the analysis. These were 33 children less than 49 cm in birth length, 99 with a birth weight less than 2500 g, and 9 children with a z-score of –6 or +6. The final analyses were therefore conducted using data from 1473 of the original 1614 children.

Results

Demographic characteristics

Table 1 illustrates the demographic characteristics of subjects from the two regions of the Libyan Arab Jamahiriya: Al Jabel Al Garby and Tripoli. The mean size of the household was similar, at about six people, as was the mean age of mothers (approximately 32 years). However, the mean monthly household income in Tripoli [304 Libyan dinars (LD)] was higher than in Al Jabel (LD 239). In addition, the proportion of illiterate mothers in Al Jabel was higher than in Tripoli (24.9% versus 12.1%). Mothers from the Al Jabel Al Garby region were also less likely to have had a university education (3.2% versus 13.5% in Tripoli). These features reflect the difference in socioeconomic level between the urban Tripoli region and the more rural Al Jabel Al Garby region.

Growth indicators

The mean birthweight of children from Al Jabel Al Garby was 3.1 kg, compared with 3.3 kg in Tripoli ($P < 0.0001$). The prevalence of low birth weight (< 2500 g) was 6.1% in both regions.

The overall proportions of children with low anthropometric values compared with the NCHS/WHO reference population were: 1.8% underweight, 4.1% with stunting and 1.6% with wasting. Table 2 shows the proportions according to demographic variables. In Table 3 mean z-scores relative to the NCHS/WHO reference population show the influence of socioeconomic factors on the growth of Libyan children.

Table 1 **Distribution of socioeconomic and cultural characteristics among children in the two regions**

Characteristic	Al Jabel Al Garby (n = 720)	Tripoli (n = 894)
Mean household size (no.)	6.6	6.2
Mother's mean age (years)	31.8	32.0
Mean family income (LD[a])	239	304
Maternal education (% of respondents)		
Illiterate	24.9	12.1
Primary school	24.2	10.9
Preparatory school	19.4	20.7
Secondary school	28.3	42.8
University	3.2	13.5
Maternal occupation (% of respondents)		
Working	26.4	35.6
Not working	73.6	64.4

[a] *LD = Libyan dinar (1LD = US$ 2.8) at the time of the study.*
n = *number of respondents.*

Table 2 **Prevalence of children with low anthropometric values (more than 2 SDs below reference population) by variable**

Variable	Percentage of children		
	Low weight-for-age (underweight)	Low height-for-age (stunted)	Low weight-for-height (wasted)
Region			
Al Jabel Al Garby	2.4	6.1***	0.9
Tripoli	1.3	2.5	2.0
Sex			
Male	2.1	4.4	1.9
Female	1.4	3.7	1.2
Age (months)			
0–5	0.0	1.7	0.4*
6–11	2.1	4.6	2.6
12–23	2.4	5.3	3.2
24–47	2.0	4.4	1.6
48–59	2.4	4.5	0.7
Area of residence			
Urban	1.3*	2.8***	1.7
Rural	2.8	6.8	1.3
Maternal education			
Illiterate	3.4*	6.5	2.3
Primary school	2.9	4.5	0.8
Preparatory school	2.0	5.1	2.0
Secondary school	0.6	2.5	1.7
University +	0.0	2.3	0.0
Paternal education			
Illiterate	2.5	7.5	0.00
Primary school	0.8	2.9	1.7
Preparatory school	2.7	5.9	1.6
Secondary school	1.9	3.6	1.7
University +	0.4	2.3	1.5
Family size (no.)			
≤ 5	0.8*	3.4	1.5
6 +	2.5	4.6	1.6
Family income (LD[a])			
<100	0.00	5.0	0.0
100–199	2.0	6.6	1.3
200–299	2.5	3.8	2.0
300–399	1.5	3.1	1.9
400–499	0.6	3.8	1.3
500+	0.0	1.7	0.0

LD = Libyan dinar (1LD = US$ 2.8). SD = standard deviation.
*P < 0.05; ***P < 0.001;*

Table 3 **Analysis of variance for z-scores of anthropometric indices for the children**

Variable	Mean z-scores		
	Weight-for-age	Height-for-age	Weight-for-height
Region	***	***	NS
Al Jabel Al Garby	–0.04	–0.20	0.14
Tripoli	0.20	0.21	0.15
Sex	*	NS	*
Male	0.01	–0.02	0.08
Female	0.15	0.03	0.21
Age (months)	***	***	***
0–5	0.74	0.31	0.43
6–11	0.16	0.19	0.13
12–23	–0.02	0.57	–0.02
Area of residence	NS	NS	NS
Urban	0.09	0.02	0.12
Rural	0.07	–0.01	0.18
Maternal education	***	*	***
Illiterate	–0.22	–0.18	–0.09
Primary school	0.10	–0.09	0.23
Secondary school	0.12	0.09	0.12
University +	0.34	0.28	0.30
Paternal education	NS	NS	NS
Illiterate	0.01	–0.20	0.25
Primary school	0.20	–0.01	0.29
Preparatory school	0.02	0.05	0.02
Secondary school	0.06	0.08	0.06
University +	0.11	0.10	0.12
Family size (no.)	NS	*	NS
≤ 5	0.10	0.07	0.12
6 +	0.06	–0.07	0.18
Family income (LD[a])	NS	NS	NS
<100	0.11	–0.16	0.07
100–199	0.03	0.04	0.01
200–299	0.18	0.16	0.16
300–399	0.08	0.04	0.12
400–499	0.11	–0.09	0.29
500+	0.19	0.03	0.25

[a]*LD = Libyan dinar (1LD = US$ 2.8).*
*P < 0.05; **P < 0.001; NS = not significant.*

Underweight

Figures 1 illustrates the median weight-for-age in both sexes from the two regions. The curves for Al Jabel Al Garby are generally below those for Tripoli.

Table 2 shows a significant relationship between underweight (low weight-for-age) and area of residence (urban or rural), mother's education and family size ($P < 0.05$). A strong relationship was also observed between stunting (low height-for-age) and region and area of residence ($P < 0.0001$).

Mean z-scores of children from Al Jabel Al Garby (weight-for-age and height-for-age) were significantly lower than those of children from Tripoli ($P < 0.001$) (Table 3). The mean z-score of weight-for-age was lower in boys than in girls ($P < 0.05$). The z-scores of weight-for-age and height-for-age increased in direct proportion with age ($P < 0.0001$). Z-scores in children less than 1 year old were higher than those in the reference population, but this was not true of children above that age ($P < 0.0001$). A low level of maternal education was strongly correlated with the mean weight/age and weight/height z-scores ($P < 0.0001$) and was also correlated with mean height/age z-score ($P < 0.05$). There was no statistically significant relationship between mean weight-for-age z-score and any other factor studied (i.e. area of residence, father's education, family size or family income) (Table 3).

Obesity (weight/height > 2 SD above the reference) was also found in 3% of the Al Jabel Al Garby sample and 7% of the children from Tripoli. Girls were more likely than boys to be obese (7.5% and 3.3%, respectively). The prevalence of obesity was higher in urban (6.3%) than rural (3.0%) areas.

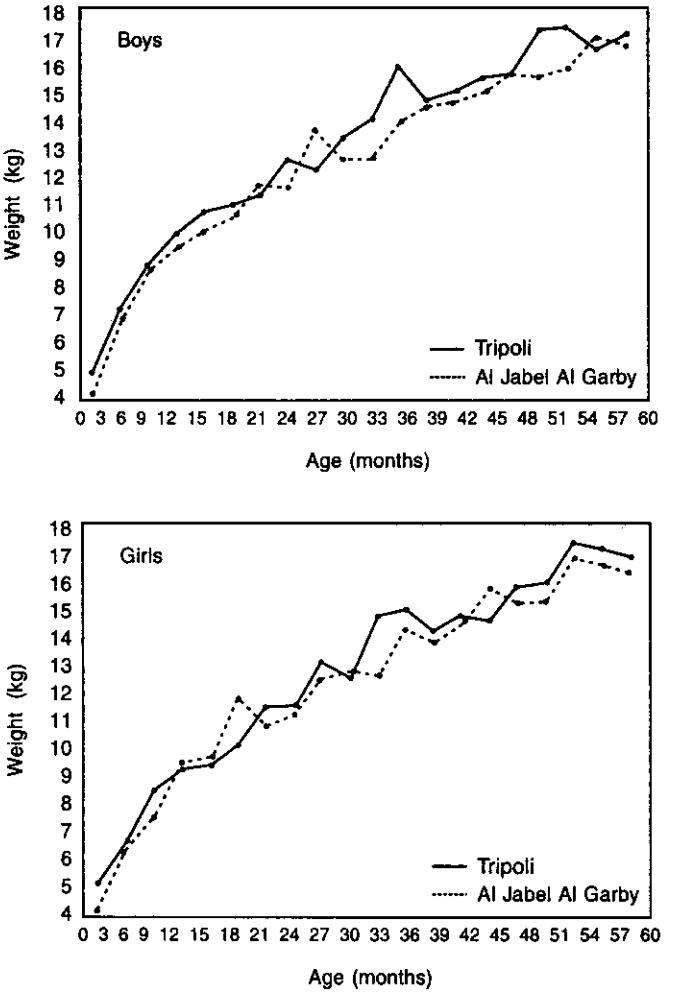

Figure 1 **Median distribution of weight-for-age for boys and girls aged 0–59 months**

Stunting

Figures 2 illustrates median height-for-age for both sexes in the two regions. The curves for Al Jabel Al Garby are slightly below those for Tripoli.

Table 2 shows that the prevalence of stunting (low height-for-age) was higher in Al Jabel Al Garby (6.1%) than in Tripoli (2.5%, $P < 0.0001$). Stunting was not related to either sex or age, but a strong correlation was found with the area of residence ($P < 0.0001$). Factors related to mean height for age z-score were region ($P < 0.0001$), age of the child ($P < 0.0001$), maternal education ($P < 0.05$) and family size ($P < 0.05$) (Table 3).

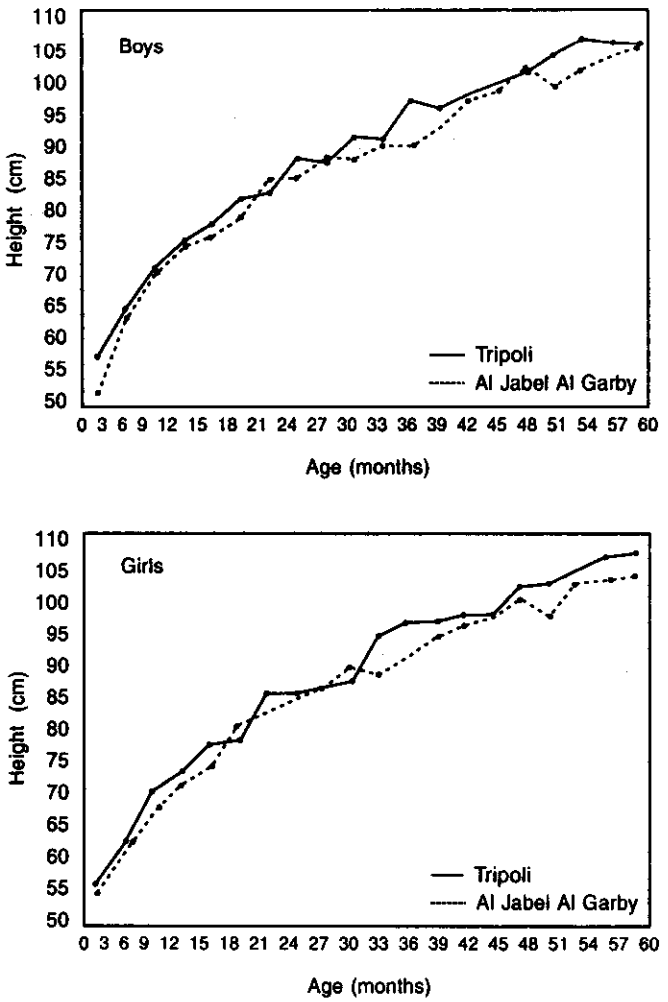

Figure 2 **Median distribution of height-for-age for boys and girls aged 0–59 months**

Wasting

Figures 3 shows that median weight-for-height data are similar in the two regions, particularly in boys.

As Table 2 shows, there was no significant association between wasting (low weight-for-height) and any factor studied except for the age of the child ($P < 0.05$).

The variables most strongly related to mean weight-for-height z-score ($P < 0.0001$) were the age of the child (greater between 12–23 months) and maternal education (increases as the education level increases) (Table 3). There was a significant difference between the sexes in the mean weight-for-height z-score ($P < 0.05$). No

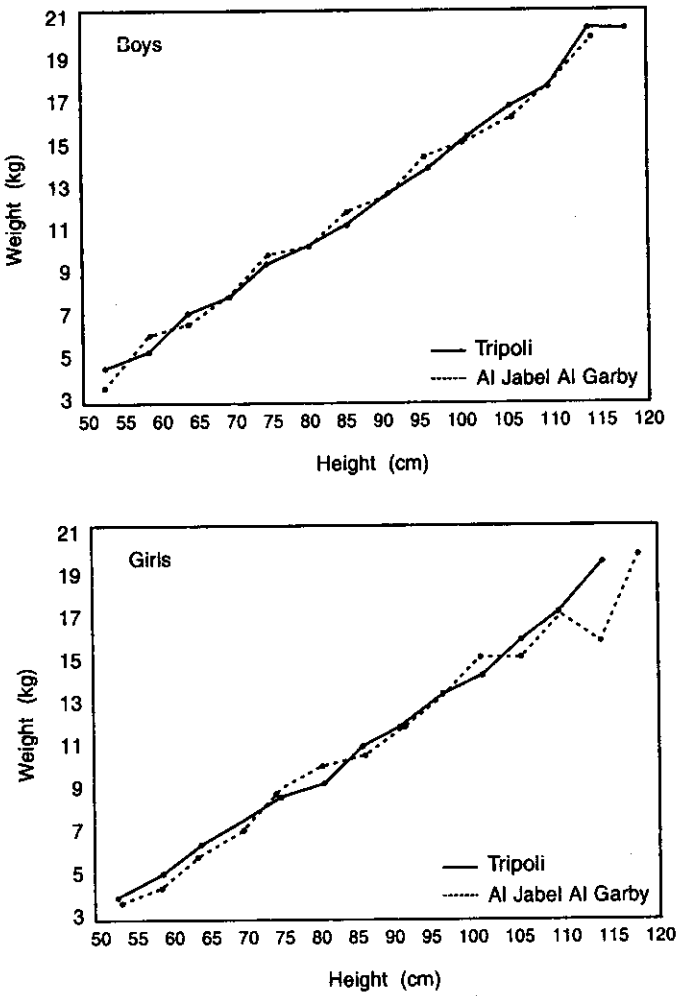

Figure 3 **Median distribution of weight-for-height for boys and girls aged 0–59 months**

other statistically significant relationship was seen between the mean weight-for-height z-score and any other variable in Table 3.

Infant feeding practices

Breastfeeding is common among Libyan mothers and is the principal way in which Libyan infants are fed. Prolonged breastfeeding is traditional in Moslem communities, as Islamic teachings recommend that a child be breastfed for 2 years before weaning.

In the present study, 96.4% of mothers surveyed started breastfeeding immediately after the birth of their children. The majority of mothers (87.0%) breastfed on demand.

The mean duration of exclusive breastfeeding among Libyan mothers in this

study was 3.0 months and was longer in Al Jabel Al Garby (3.3 months) than in Tripoli (2.6 months). The proportion of mothers who practised mixed feeding (both breastfeeding and bottle-feeding) from the time of birth of the child was 13.5% in both regions. A further 12.9% used mixed feeding after one month, 10.3% from the second month, 27% from the third month, 18% from the fourth, 7.5% from the fifth month and 8.0% from the sixth month.

Supplementation with semi-solid or solid foods started after 3 months. Supplementary foods included artificial milk, cereals, vegetables, fruit, home-made baby foods (e.g. rice water, potatoes and vegetable soup), and milk products like yoghurt and cheese. The overall mean duration of breastfeeding was 9 months, but the figure was higher in rural (10 months) than in urban (8 months) areas. The most common reasons for stopping breastfeeding were a lack of (or insufficient) milk, refusal of the child to suckle, illness of either mother or child, or the child becoming too old.

The common eating patterns of the children from both regions can be summarized as follows. Children too old to breastfeed often breakfasted on cheese and bread with tea or coffee with milk in the Al Jabel Al Garby region (15.1%), while in Tripoli children often breakfasted on eggs and bread with tea or coffee with milk (15.0%). The percentage of children who had tea with milk and bread for breakfast in the Al Jabel Al Garby region (9.5%) was higher than in the Tripoli region (3.6%). Others in the Tripoli region were given tuna and bread and tea or coffee with milk (7.6%), while in Al Jabel Al Garby this was 1.4%. The percentage of children who had yoghurt with other foods at breakfast in Tripoli was 2.3% and in Al Jabel Al Garby 1.9%.

Lunch included family dishes, such as couscous (Tripoli 17.1%, Al Jabel Al Garby 13.0%), macaroni (Al Jabel Al Garby 19.2%, Tripoli 17.8%), rice (Al Jabel Al Garby 21.9%, Tripoli 13.0%), or *bazeen* (a barley-based traditional meal in this country, very popular in rural areas: Al Jabel Al Garby 4.2%, Tripoli 2.6%). Soup was more frequently eaten for lunch in Tripoli (7.1%) than in Al Jabel Al Garby (1.6%).

The predominant component of the evening meal was bread in both regions, plus soup (Al Jabel Al Garby 25.1%, Tripoli 16.8%) or other light foods (including bread, eggs, tuna, salad and milk with dates: Tripoli 33.6%, Al Jabel Al Garby 23.0%). Large families, particularly in rural areas, often had macaroni for dinner.

Meat was eaten an average of 5.0 times a week in the Tripoli region compared with 4.7 times a week in the Al Jabel Al Garby region. Consumption of poultry (the least expensive meat) was high in both regions. Fish consumption was limited in the two regions, mainly in rural areas. Vegetables were eaten in both regions on average four times a week, fruit three times a week, and legumes three times a week. Fruit and vegetable consumption depended mainly on the season, on prices and on the family's sociocultural level.

Discussion

The results of the present study into growth patterns and nutritional status among children in two regions of the Libyan Arab Jamahiriya reveal significant differences in the z-scores of weight-for-age and height-for-age.

Z-scores for weight-for-age in children from mainly rural Al Jabel Al Garby were lower than children from mainly urban Tripoli. In addition, measurements of Al Jabel children were lower than the population reference (NCHS/WHO, 1983), whereas

those of Tripoli children were higher. Factors with the strongest influence on the mean weight-for-age z-score were sex, age and maternal education. Another study in the Libyan Arab Jamahiriya reported similar findings [*8*]. There was no significant difference between the two regions in the prevalence of underweight although it was more common in rural areas. This finding also agreed with the previous report [*8*].

There was a highly significant difference in z-scores of height-for-age between Al Jabel Al Garby and Tripoli. The negative z-score for Al Jabel Al Garby children means that their measurements were lower than the reference mean, while the positive z-score for Tripoli reflects measurements higher than the reference mean. Stunting, reduced stature or length for age, usually results from extended periods of inadequate food intake (past growth failure), particularly during the major growth periods. Hereditary factors and other influences may also play a role. Factors related to stunting observed in the present study were: the age of the child, level of maternal education and family size. The prevalence of stunting was higher among Al Jabel children (6.1%) than in Tripoli (2.5%) and in rural (6.8%) rather than urban (2.8%) areas. Another study reported similar findings of a higher prevalence of stunting in the Al Jabel Al Garby area than in Tripoli [*8*]. The difference may reflect differences in socioeconomic factors. A study in 1979 indicated that Libyan preschool children exhibited poor growth parameters (Tajouri RE, unpublished manuscript, 1979). The fact that the effect was strongest in the lower socioeconomic groups points to nutritional factors as a probable cause.

A highly significant relationship was observed between z-scores of weight-for-height and child's age. The peak effect was at 12–23 months, but the decline started after the age at which weaning commonly occurs (9 months). Wasting may be attributable to weaning or to other factors such as teething, but does not last long, with a catch-up of growth by the end of the third year. Of the socioeconomic characteristics studied, maternal education was most strongly related to mean weight-for-age and weight-for-height z-score. Family income had no significant influence on the prevalence of malnutrition (weight-for-age, height-for-age or weight-for-height).

The results of the present study were consistent with other findings [*8*] concerning the growth patterns and health status of Libyan children from the two regions concerned, and provide some explanatory information about the growth and nutritional status of the population studied. It was clear from the data that the families studied in Tripoli had socioeconomic advantages over those in Al Jabel Al Garby. The principal differences were in the proportion of illiterate mothers and the family income. Al Jabel Al Garby is one of the largest rural areas in the country (although the region also has urban districts), whereas Tripoli is the nation's capital city (although, again, there are rural areas). In the country as a whole, about 76% of the population live in an urban setting [*8*].

According to the literature, stunting is caused by a number of long-term factors including: chronically insufficient protein intake, frequent infection, sustained incorrect feeding practices and low socioeconomic family status, poor weaning foods, and environmental or genetic influences. The type of protein intake has been implicated, as have deficiencies in zinc, iron, copper, iodine and vitamin A, but no clear causal mechanisms have been identified [*9,10*].

Child malnutrition, manifested by stunting, is a major public health problem in

much of the developing world. It is estimated that about one-third of all children aged under 5 years and living in developing countries are stunted: approximately 70% of them live in Asia (mainly south-central Asia), 26% in Africa, and 4% in Latin America and the Caribbean [*11*].

The results of the present study and of others conducted in the Libyan Arab Jamahiriya have been compared with findings from other countries in the Eastern Mediterranean Region. In 1995, the incidence of stunting (more than 2 SD below the reference height-for-age) in the total population (the survey of 1995 was not based on healthy children only) of children under-5-years-olds in the Libyan Arab Jamahiriya was 10.6% [8]. In Morocco in 1992 the figure was 24.2%; in Tunisia in 1998, 8.3%; in Egypt in 1998, 24.9%; in Algeria in 1995, 18.3%; in Kuwait in 1995, 10.7%; in Oman in 1995, 15.7%; and in the Yemen in 1997, 42.4% [*11*].

Birth weights of Libyan children as indicated by the present study are a good indicator of the health and nutritional status of children and of mothers during pregnancy. They also provide a useful guide to the health status of the community as a whole. Furthermore, a child's birth weight has a major influence on his or her future life, and is an important determinant of the chances of a newborn surviving and continuing to grow and develop healthily. The prevalence of low birth weight in Libyan children (6.1%) differs little from that in industrialized countries and is lower than in some other Arabic nations, for example Saudi Arabia where the figure is 13.6% [*12*].

In general, the health and nutritional status of Libyan children has improved over recent decades for reasons including socioeconomic development, increased levels of education among women, prolonged breastfeeding, provision of high quality first solid foods as a complement to breastfeeding, and increased availability of higher energy foods. Heavy subsidies to several basic food commodities (such as couscous, rice, macaroni, flour, oil, sugar, tomato paste, tea and coffee) has also helped improve health, as has greater vaccination coverage and the use of oral rehydration solution in managing diarrhoea [*8*]. The consumption of milk, milk products, meat, fish, vegetables and fruit depends on socioeconomic status (mainly income, family size, sociocultural level and nutritional education).

According to the literature, protein-energy malnutrition is not a common problem in this country. Overall, children under 5 years of age have a low prevalence of underweight (4.1%), wasting (2.4%) or moderate stunting (10.6%) [*8*]. Among healthy children in the same age group, the present study shows the prevalence of underweight to be 1.8%, wasting 1.6%, and stunting 4.1%.

Interestingly, the present findings also revealed obesity (weight-for-height >2 SD above the reference) in 3% of the Al Jabel Al Garby sample and 7% of the children from Tripoli. Girls were more likely than boys to be obese (7.5% and 3.3%, respectively). The prevalence of obesity was also higher in urban (6.3%) than rural (3%) areas. That obesity is a particularly serious public health problem in Tripoli may reflect high carbohydrate consumption, genetic factors or infrequent physical exercise. Similar findings have been reported among preschool children in Kuwait [*13*].

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