Kuwait nutritional survey: comparison of the nutritional status of Kuwaiti children aged 0-5 years with the NCHS/CDC reference population*

AHMED BAYOUMI¹ & MOHAMED A. A. MOUSSA²

A national cross-sectional survey of the heights and weights of Kuwaiti preschool-age children of 0-5 years was conducted on a stratified multistage sample of 2554 subjects from high and low socioeconomic levels. The collected data were used to compare the nutritional status of these children with their American counterparts using the NCHS/CDC reference population. The basic indices for comparison were height for age and weight for height, each considered in terms of centiles and standard deviation (SD) scores and cross-classified using the SD scores. The results indicated that Kuwaiti children in the studied age groups were shorter than American children, 47.7% falling below the 30th centile of the reference population. Conversely, the weights of Kuwaiti children aged 0-5 years were much closer to their American counterparts, 51.8% falling above the 50th centile of the reference population.

In 1976 a Joint FAO/UNICEF/WHO Expert Committee on Nutritional Surveillance recommended the use of height for age and weight for height as primary indicators of nutritional status of children (1). Waterlow et al. then suggested methods of classification that would allow the results of cross-sectional surveys of nutritional status in different regions to be analysed and reported in such a way that comparisons are facilitated (2), and recommended that primary reliance should be placed on height for age as an indicator of the past state of nutrition and on weight for height as an indicator of present nutrition. They further suggested that the data recommended by the US National Academy of Sciences, known as the National Center for Health Statistics/Center for Disease Control (NCHS/CDC) reference population, were the most suitable for use as an international reference.

Based on the above recommendations by Waterlow et al., the object of the present study was to compare the heights and weights of assumed well-nourished Kuwaiti preschool-age children (0-5 years old) with the American NCHS/CDC reference population. The data presented in this communication form part of the Kuwait National Nutritional Survey for

children aged 0-9 years. In a separate article we have presented the results of a similar study on Kuwaiti schoolchildren aged 6-9 years (3).

DEFINITIONS

Socioeconomic districts. The various residential districts in Kuwait are characterized by two distinct socioeconomic levels: high and low. This categorization is an integration of the many factors that contribute to living standards such as housing conditions, level of education, population density, family income, child-rearing practices, and attitudes to health. The residential areas where the rich Kuwaiti families live were "high", and the areas where Kuwaiti bedouins had recently been resettled from tents to National Housing Corporation houses were "low".

Standard deviation (SD) score. The SD score =

$$\frac{\text{Individual's value} - \text{Median value of reference population}}{\text{SD value of reference population.}}$$

* From the Department of Community Medicine, Kuwait University Medical School, P.O. Box 24923, Safat, Kuwait.

¹ Associate Professor of Nutrition/Health Planning/Epidemiology. Correspondence and requests for reprints should be addressed to this author.

² Associate Professor of Biostatistics.

Cut-off points of $\pm 2SD$ were used in this survey, and individuals with values outside -6.0 and 6.0 were excluded.

MATERIALS AND METHODS

Sampling design

A national cross-sectional survey of Kuwaiti preschool-age children, 0–5 years old, was conducted during 1983–4. The survey involved 2554 subjects (1319 males and 1235 females) drawn from two socioeconomic districts, a sample size of about 2% determined to guarantee at least 200 children in each age–sex–district group and believed to be adequate for achieving precise and comparable estimates. The country has an overall population of 1 556 952 of whom only 565 613 (280 649 males and 284 964 females) are Kuwaiti (1980 census) (4). In the study year 1983–84 the number of 0–5-year-old children was 121 426 (61 214 males and 60 212 females), which was projected from the 1980 census data using an annual growth rate of 3.5% for males and 3.9% for females (4).

The sampling plan was designed by first controlling the factors underlying heterogeneity among preschool-age children, namely, socioeconomic level, sex, and age. Accordingly, the sampling plan included stratification based on these variables, together with multistage sampling (5). The schematic organization of the sampling procedure was as follows: (1) the country was divided into 12 socioeconomic districts using our definition; (2) one district (primary unit) was randomly selected in each socioeconomic stratum; (3) the sample (comprising 2554 subjects) was allocated to the two selected districts with probability proportional to the corresponding stratum size; (4) nurseries, kindergartens, and immunization centres in each selected district were stratified according to the children's sex (male and female) and age; (5) nurseries, kindergartens, and immunization centres were then randomly drawn from each substratum (second-stage sampling); and (6) the number of children (units of the final sampling stage) to be sampled from each unit was chosen with probability proportional to the substrata sizes. A

simple random sample of the above predetermined size was then drawn from each unit (third-stage sampling). Selection procedures were based on a directory of children's names in each nursery, kindergarten, and immunization centre.

Methods of measurement

The survey included the determination of age and the measurement of height and weight. Age was determined to the nearest month using the date of birth ascertained from birth certificates and the date of examination. Height was measured to the last 0.1 cm using a Nivotoise portable height gauge. Weight was measured to the nearest 0.1 kg using a scale with non-detachable weights. Methods of measurement recommended by the Committee on Nutrition Advisory to CDC were followed (6). Two research assistants who had been trained and supervised by the main author measured the children throughout the survey; one was solely concerned with measuring height and the other with measuring weight, thus avoiding intra-observer error.

Data analysis

Computer analysis of data was performed using a program developed by WHO incorporating the CDC series 9Z sub-routine package, as recommended by Waterlow et al. (2). Comparisons were made with the NCHS/CDC reference population recommended by the US National Academy of Sciences. The basic indices analysed were height for age and weight for height, each considered in terms of centiles and standard deviation scores and in a cross-classification scheme using the SD score.

RESULTS

Sample distribution and mean indices

Table 1 shows the mean heights and weights of the population sample classified by age and sex. It

Table 1. Mean heights and weights, by age and sex, of Kuwaiti children aged 0–5 years

Age group (years)	Males			Females			Total (n = 2554)
	No. (n = 1319)	Height (cm)	Weight (kg)	No. (n = 1235)	Height (cm)	Weight (kg)	
< 1	378	65.6	7.2	332	64.1	6.7	710
1	230	80.0	10.9	216	78.9	10.4	446
2	200	88.8	12.9	194	87.9	12.4	394
3	188	95.5	14.5	185	95.4	14.3	373
4	178	102.7	17.0	171	101.5	16.7	349
5	145	107.4	18.8	137	106.6	18.0	282

Table 2. Centile distribution of height for age of Kuwaiti children aged 0–5 years, compared with the NCHS/CDC reference population

Centile	No. of males (n = 1319)	No. of females (n = 1235)	No. of males and females (n = 2554)
00.0–04.9	270 (20.5) ^a	235 (19.0)	505 (19.8)
00.0–09.9	341 (25.9)	306 (24.8)	647 (25.3)
10.0–19.9	165 (12.5)	135 (10.9)	300 (11.7)
20.0–29.9	149 (11.3)	125 (10.1)	274 (10.7)
30.0–39.9	126 (9.6)	109 (8.8)	235 (9.2)
40.0–49.9	115 (8.7)	91 (7.4)	206 (8.1)
50.0–59.9	87 (6.6)	101 (8.2)	188 (7.4)
60.0–69.9	86 (6.5)	84 (6.8)	170 (6.7)
70.0–79.9	80 (6.1)	82 (6.6)	162 (6.3)
80.0–89.9	76 (5.8)	87 (7.0)	163 (6.4)
90.0–99.9	94 (7.1)	115 (9.3)	209 (8.2)
95.0–99.9	71 (5.4)	74 (6.0)	145 (5.7)

^a Figures in parentheses are percentages.

illustrates the fairly even distribution of the randomly selected individuals over the range of ages studied for both sexes. The ranges of values for height were 65.6–107.4 cm for males and 64.1–106.6 cm for females. The ranges of values for weight were 7.2–18.8 kg and 6.7–18.0 kg for males and females, respectively.

Height for age

The centile distribution of height for age of all children aged 0–5 years, compared with the NCHS/CDC reference population, is shown in Table 2. It can be seen that the Kuwaiti sample contains an excess of children whose height for age lies in the lower centile ranges of the reference population and that this excess steadily decreases towards the upper centile ranges. This disparity is as high as 25.3% in the lower centile ranges and as low as 6.3% in the upper ranges, compared with the expected frequency of 10% according to the reference population.

Weight for height

The centile distribution of weight for height, compared with the reference population, is shown in Table 3. This shows a striking similarity between the Kuwaiti sample and the American reference population because in all centile ranges the difference did not depart more than $\pm 2.5\%$ from the expected frequency of 10% according to the NCHS/CDC reference population.

Height for age against weight for height

We also looked at the relationship of height for age (as an indicator of stunting) and weight for height (as an indicator of wasting) together and expressed this relationship as multiples of the standard deviation of the NCHS/CDC reference population (7–10). This cross-tabulation is given, by sex, in Table 4. While the great majority of Kuwaiti children (both male and female) fall between ± 2.00 SD scores of height for age (80.1%) and weight for height (93.9%), a sizeable proportion (75.6%) lay between ± 2.00 SD scores of both height for age and weight for height. Negligible numbers had less than -2.00 SD and more than $+2.00$ SD scores for both indices (0.3% and 0.1%, respectively).

The effect of socioeconomic level on the results will be analysed in detail in another article (Bayoumi et al., in preparation), but Table 5 in the present paper shows some of our findings. Except for the infant age group, the percentage distribution of children below -2 SD of the NCHS/CDC reference population was higher in the low socioeconomic level for each of the basic indices studied (height for age, weight for age, and weight for height).

DISCUSSION

In this study, the Kuwaiti sample of preschool-age children of 0–5 years exhibited an excess of both male

Table 3. Centile distribution of weight for height of Kuwaiti children aged 0–5 years, compared with the NCHS/CDC reference population

Centile	No. of males (n = 1317)	No. of females (n = 1230)	No. of males and females (n = 2547) ^a
00.0–04.9	82 (6.2) ^b	71 (5.8)	153 (6.0)
00.0–09.9	136 (10.3)	118 (9.6)	254 (10.0)
10.0–19.9	140 (10.6)	119 (9.7)	259 (10.2)
20.0–29.9	135 (10.3)	116 (9.4)	251 (9.9)
30.0–39.9	118 (9.0)	107 (8.7)	225 (8.8)
40.0–49.9	122 (9.3)	119 (9.7)	241 (9.5)
50.0–59.9	129 (9.8)	141 (11.5)	270 (10.6)
60.0–69.9	139 (10.6)	131 (10.7)	270 (10.6)
70.0–79.9	139 (10.6)	97 (7.9)	236 (9.3)
80.0–89.9	110 (8.4)	113 (9.2)	223 (8.8)
90.0–99.9	149 (11.3)	169 (13.7)	318 (12.5)
95.0–99.9	110 (8.4)	127 (10.3)	237 (9.3)

^a Seven individuals with Z-score values outside -6.0 and 6.0 were excluded.

^b Figures in parentheses are percentages.

Table 4. Cross-tabulation of SD scores of weight for height and of height for age for male and female children aged 0–5 years in Kuwait

SD scores of weight for height	SD scores of height for age			Total
	2.00 or more	– 1.99 to 1.99	– 2.00 or less	
<i>Males:</i>				
2.00 or more	2 (0.3) ^a	19 (2.5)	3 (0.4)	24 (3.2)
– 1.99 to 1.99	13 (1.7)	570 (75.1)	127 (16.7)	710 (93.5)
– 2.00 or less	5 (0.7)	18 (2.4)	2 (0.3)	25 (3.3)
Total	20 (2.6)	607 (80.0)	132 (17.4)	759 (100)
<i>Females:</i>				
2.00 or more	0 (0)	13 (1.8)	3 (0.4)	16 (2.2)
– 1.99 to 1.99	15 (2.1)	544 (76.2)	114 (16.0)	673 (94.3)
– 2.00 or less	6 (0.8)	16 (2.2)	3 (0.4)	25 (3.5)
Total	21 (2.9)	573 (80.3)	120 (16.8)	714 (100)
<i>Males and females:</i>				
2.00 or more	2 (0.1)	32 (2.2)	6 (0.4)	40 (2.7)
– 1.99 to 1.99	28 (1.9)	1114 (75.6)	241 (16.4)	1383 (93.9)
– 2.00 or less	11 (0.7)	34 (2.3)	5 (0.3)	50 (3.4)
Total	41 (2.8)	1180 (80.1)	252 (17.1)	1473 (100)

^a Figures in parentheses are percentages.

and female children whose height for age fell in the lower centile ranges of the NCHS/CDC reference population; fewer children in both sexes were therefore in the upper ranges of the reference population. This finding shows that Kuwaiti children are generally shorter than American children, 47.7% falling below the 30th centile of the reference population. On the other hand the weights of Kuwaiti children aged 0–5 years were comparable with those of the American reference population. While there is an obesity problem in adolescence and middle age in the highly affluent, rapidly modernized society of Kuwait, this tendency is not displayed in early childhood, but starts in the school age group (3).

Tests of significance of the trend in proportions (11, 12) in those children aged 0–5 years who fell below –2SD of the NCHS/CDC reference population (Table 5) showed that:

(a) for height for age, there was a significant trend towards increasing proportions with increasing age ($\chi^2_{1df} = 42.622$, $P < 0.005$);

(b) for weight for height, there was a significant trend towards decreasing proportions with increasing age ($\chi^2_{1df} = 18.678$, $P < 0.005$).

These findings show that relating height for age with past nutrition and weight for height with present

nutrition is of great value in distinguishing between stunting and wasting in the under-fives and that it is not only of value in the infant age group.

Socioeconomic influences on nutritional status among 0–5-year-old Kuwaiti children are of great interest and will be reported separately in detail (Bayoumi et al., in preparation), but we have shown here (Table 5) that Kuwaiti children from low socioeconomic areas are generally much shorter, more underweight, and more wasted than those from high socioeconomic areas and that, by and large, Kuwaiti children in this age group are severely stunted in comparison with their American counterparts, except for infants (under 1 year old).

The underweight and wasting characteristics among Kuwaiti children, especially those from low socioeconomic areas, dramatically improve by the age of 4 years when compulsory public education starts. In the past and up to June 1983, the Kuwait Ministry of Education used to provide nutritious school meals which could have been the determining factor for the dramatic improvement in weight and lean body mass. While stunting could be a hereditary phenomenon, it could also be a reflection of inadequate nutrition in the past. It is regrettable that these school meals were stopped as of September 1983 because they probably contributed significantly to

Table 5. Percentage of 0–5-year-old Kuwaiti children below – 2SD of the NCHS/CDC reference population, by socioeconomic status

			Percentage of children below – 2SD of the reference population		
No. of children measured		Age (years)	Height for age (stunting)	Weight for age (underweight)	Weight for height (wasting)
<i>Low socioeconomic area:</i>					
331		0–0.99	6.3	6.6	9.5
211		1–1.99	19.9	10.4	3.3
217		2–2.99	21.7	12.9	2.3
210		3–3.99	20.5	14.8	1.4
257		4–4.99	30.6	5.1	0.4
251		5–5.99	19.5	6.8	1.2
Total	1477	0–5.99	17.3	9.0	3.4
<i>High socioeconomic area:</i>					
379		0–0.99	4.7	0.8	0.8
235		1–1.99	7.2	3.4	0.9
177		2–2.99	3.4	5.1	2.8
163		3–3.99	3.7	4.3	2.5
92		4–4.99	4.3	3.3	1.1
31		5–5.99	12.9	0.0	0.0
Total	1077	0–5.99	5.1	2.8	1.4
<i>Both areas:</i>					
710		0–0.99	5.5	3.5	4.8
446		1–1.99	13.2	6.7	2.0
394		2–2.99	13.5	9.4	2.5
373		3–3.99	13.1	10.2	1.9
349		4–4.99	16.3	4.6	0.6
282		5–5.99	18.8	6.0	1.1
Total	2554	0–5.99	12.2	6.4	2.6

improving the nutritional status of Kuwaiti children from low socioeconomic districts and of primary schoolchildren aged 6–9 years (3).

The results of this study show the similarities and the differences between Kuwaiti children aged 0–5 years and the American NCHS/CDC reference population. With regard to the nutritional status of the children in this age group, it appears that the present

state of nutrition in Kuwait (as reflected by the values of weight for height) is strikingly better than the past nutrition (as reflected by height for age). The nutritional status of these young children thus serves as a sensitive index of the rapid socioeconomic development experienced by the nationals of this oil-rich country in recent years.

ACKNOWLEDGEMENTS

This work was supported by Kuwait University Research Council Grant No. MC 001. We are grateful to Ms Zinaz Mundegar, Dr Nahid Al-Sobky, and Ms Berlenti Ouda for help in collection and analysis of the data. We are thankful to Mr H. Dixon, statistician in WHO, for supplying and modifying the computer program that uses the NCHS/CDC reference population. The authors also acknowledge the help rendered by the doctors and nurses of the Kuwait School Health Service.

RÉSUMÉ

ENQUÊTE NUTRITIONNELLE AU KOWEÏT: COMPARAISON ENTRE L'ÉTAT NUTRITIONNEL DES ENFANTS KOWEÏTIENS ÂGÉS DE 0-5 ANS ET CELUI DE LA POPULATION DE RÉFÉRENCE NCHS/CDC

En 1976, un comité d'experts FAO/UNICEF/OMS de la surveillance nutritionnelle a recommandé d'utiliser, comme principaux indicateurs de l'état nutritionnel des enfants, le rapport taille/âge et le rapport poids/taille. Waterlow et al. ont alors suggéré des méthodes de classification qui permettraient de faciliter les comparaisons dans l'analyse et la notification des résultats des enquêtes transversales sur l'état nutritionnel dans différentes régions du monde. Ils ont recommandé d'utiliser essentiellement, dans les enquêtes transversales, la taille par rapport à l'âge comme indicateur de l'état nutritionnel antérieur, et le poids par rapport à la taille comme indicateur de l'état nutritionnel présent. Ils ont en outre suggéré que les données recommandées par l'US National Academy of Science—et qui sont plus connues sous la dénomination de population de référence du National Center for Health Statistics/Center for Disease Control (NCHS/CDC)—étaient celles qui convenaient le mieux comme référence internationale.

Sur la base des recommandations qui précèdent, une enquête transversale nationale a été exécutée sur la taille et le poids des enfants koweïtiens d'âge préscolaire (0-5 ans), dans le cadre d'une enquête nutritionnelle effectuée dans le pays à partir d'un échantillon stratifié à multiples degrés de 2554 sujets de condition socio-économique élevée ou modeste. Les données ainsi recueillies ont servi à établir des comparaisons entre l'état nutritionnel des enfants koweïtiens et leurs homologues américains, d'après la population

de référence NCHS/CDC. Les indices de base employés pour ces comparaisons étaient la taille par rapport à l'âge, et le poids par rapport à la taille, chacun de ces éléments étant traité en termes de centiles et d'écart-types, avant de faire l'objet d'une classification à double entrée fondée sur les écart-types. Il ressort de cette étude que les enfants koweïtiens des groupes d'âge enquêtés étaient d'une taille moins élevée que les enfants américains, 47,7% d'entre eux se situant en dessous du trentième centile de la population de référence. Inversement, le poids des enfants koweïtiens âgés de 0 à 5 ans était beaucoup plus proche de celui de leurs homologues américains, 51,8% d'entre eux se situant au-dessus du cinquantième centile de la même population de référence. Les tests de signification applicables aux proportions ont montré que 1) pour le rapport entre la taille et l'âge, il existait une tendance significative à une augmentation des proportions avec l'avancement en âge ($P < 0,005$), et que 2) pour le rapport entre le poids et la taille, il existait une tendance significative à la diminution des proportions avec l'avancement en âge ($P < 0,005$). Ces constatations montrent que le rapprochement établi entre la taille et l'âge pour connaître l'état nutritionnel antérieur, et entre le poids et la taille pour connaître l'état nutritionnel présent, est très utile pour faire la distinction entre le retard de croissance et l'émaciation chez les enfants de moins de 5 ans, et pas seulement chez les très jeunes enfants.

REFERENCES

1. WHO Technical Report Series, No. 593, 1976. (*Methodology of nutritional surveillance: report of a Joint FAO/UNICEF/WHO Expert Committee*).
2. WATERLOW, J.C. ET AL. The presentation and use of height and weight data for comparing the nutritional status of groups of children under the age of 10 years. *Bulletin of the World Health Organization*, 55: 489-498 (1977).
3. BAYOUMI, A. & MOUSSA, M.A.A. Kuwait nutritional survey: comparison of the nutritional status of Kuwaiti children aged 6-9 years with the NCHS/CDC reference population. *International journal of epidemiology*, 1985 (in press).
4. *Kuwait Census 1980*. Kuwait, Central Statistical Office, Ministry of Planning, 1982, Part I, Vol.1.
5. COCHRAN, W. G. *Sampling techniques*. New York, John Wiley, 1977, pp. 107-111, 292-318.
6. US FOOD AND NUTRITION BOARD, Committee on Nutrition Advisory to CDC. *Comparisons of body weights and body heights of groups of children*. Atlanta, GA, US Department of Health, Education and Welfare, 1974.
7. WATERLOW, J. C. & RUTISHANSER, I. H. E. Malnutrition in man. In: *Early malnutrition and mental development* (Symposia of the Swedish Nutrition Foundation, XII). Uppsala, Almqvist and Wiksell, 1974, pp. 13-26.
8. SEOANE, N. & LATHAM, M. C. Nutritional anthropometry in the identification of malnutrition in childhood. *Journal of tropical paediatrics and African child health*, 17: 98-104 (1971).
9. WATERLOW, J. C. Note on the assessment and classification of protein-energy malnutrition in children. *Lancet*, 1: 87-89 (1973).
10. WATERLOW, J. C. Classification and definition of protein-calorie malnutrition. *British medical journal*, 3: 566-569 (1972).
11. ARMITAGE, P. Tests for linear trends in proportions and frequencies. *Biometrics*, 11: 375-385 (1955).
12. FLEISS, J. L. *Statistical methods for rates and proportions*. New York, John Wiley, 1981, pp. 143-146.