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Growth of children in Iran

M. HOSSEINI†‡, R. G. CARPENTER‡ and K. MOHAMMAD†

† Department of Epidemiology and Biostatistics, Tehran University of Medical Sciences, I.R. Iran
‡ London School of Hygiene and Tropical Medicine, London, UK

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Summary. Weights and Heights of 22 349 children and adolescents aged 2 to 18 in Iran are reported. Data are from the 1990–1992 National Health Survey, a random cluster sample survey of 1 in 1000 families in all provinces of Iran. Multilevel models (Goldstein 1995) which take account of the survey design, reveal significant differences between provinces and between urban and rural children. Differences between urban and rural children, like differences between girls and boys, persist across all provinces and are certainly real. Differences between provinces may be partly due to differences in calibration. Charts based on the homogeneous subset of children living in urban Tehran may be used for all urban children, and in modified form, for all rural children. All the centiles of these charts are substantially below those of the NCHS charts, but the spread is similar so that there is no suggestion that the difference is due to the prevalence of gross malnutrition. The difference shows that the use of locally based growth charts are essential for assessing the growth of children in Iran.

1. Introduction

At present there are no reliable national data on growth patterns of children and adolescents in Iran. Several previous studies relate to small selected groups of clinic attenders. None of these studies provides any reliable information regarding growth patterns of children in different provinces of the country and provides no basis for construction of population norms. School children 6–12 years old in a city in south Iran (Shiraz) were surveyed by Ayatollahi (Ayatollahi and Carpenter 1991), and they suggested that children in Iran may be a good deal smaller than in the US. If this is so, the general use of imported American and European norms in clinical work may be seriously misleading.

Iran is the 16th largest country in the world, is bounded on the north by the Republics of the former USSR and the Caspian sea; on the south by the Persian Gulf and the Sea of Oman; on the east by Afghanistan and Pakistan; and on the west by Turkey and Iraq. The total area of the country is 1 648 000 km^2. According to the results obtained from the 1991 census, Iran's population was 55 837 163 with a sex ratio of 106. Fifty seven per cent of the population live in urban areas, 42% live in rural communities and 1% are nomads (SCI 1991). The population of Iran is extremely young with over 44% below 15 years of age and only 3.5% over 65. The population growth rate was among the highest in the world, estimated 2.3% per year in 1991 and decreased to 1.75% in 1995 with a rate of 1.5% for urban and 2.0% for rural areas respectively (MOH&ME 1995).

In this paper an analysis of growth of children 2–18 years old, using measurements on weight and height from the recent Iranian National Health Survey, is presented. Differences between the provinces led us to use data for children in urban Tehran as a baseline for the construction of the standard charts which are presented in the companion paper (Hosseini, Carpenter and Mohammad 1998b). In this paper we show that these charts are generally appropriate for all urban children

in Iran and can be adapted for use with rural children. Also the growth of Iranian children is compared with the NCHS standard.

2. Materials and methods

Data on weights and heights of children 2–18 years old in Iran were obtained in a National Health Survey of families in 1990–1992, with a sampling ratio of 1 in 1000. In total 10 660 households were surveyed in random clusters of households in all 24 provinces of Iran. Data collection was carried out in the form of cluster sampling, each cluster containing seven families. The sampling framework was based on the regularly updated registers of families that were available in each health department of every province (except for a few large cities like Tehran where maternity hospital registers of recent first live births were used as a sampling frame). Clusters were formed by systematically selecting 1 in 7000 families from these registers. Each cluster comprised the selected family together with the six nearest neighbouring families. This sampling scheme resulted in data which are hierarchically structured, with children in families, families in clusters, and clusters in provinces.

Outliers in the data on weight and height measurements were removed by multivariate analysis (Hosseini, Carpenter and Mohammad 1998a). After excluding discordant measurements, the data set included measurements on 22 349 individuals, 11 159 (49.9%) boys and 11 190 (50.1%) girls. Weights were recorded to the nearest kilogram, and heights to the nearest centimetre. Age was recorded from identification cards in completed years.

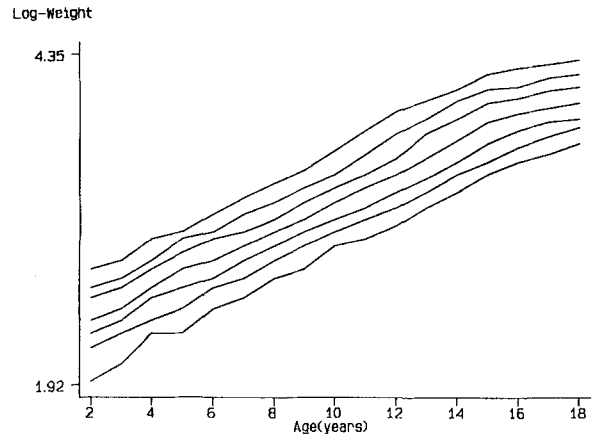
Multilevel models (Goldstein 1995) were constructed using MLn (1995) in order to take account of the structure of the data and to investigate regional variations in growth patterns. Growth charts for representative data from urban Tehran were constructed using Healy's method (Healy, Rasbash and Yang 1988) as developed by Pan (Pan, Goldstein and Yang 1990) as described by Hosseini, Carpenter and Mohammad (1998b). EPINUT implemented within WHO (1996) was used to compare Iranian children with the NCHS growth standard.

3. Results

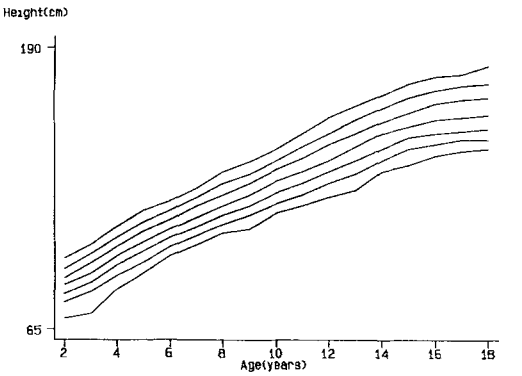
3.1. Growth ages 2 to 15

Inspection of the data and examination of the centiles 3rd, 10th, ..., 97th of weight and log(weight) showed that increments of log(weight) centiles with age were approximately linear up to the age 15 (figure 1(a)). After the age of 15, the centile curves begin to flatten off. This pattern was observed to be similar for both sexes. Also over the age range 2–15 years the spread of the percentiles is fairly uniform. Height centiles are also approximately linear and equally spread in the 2–15 age range (figure 1(b)). Because the data relating the age groups 2–15 years could be modelled simply, these data were analysed to investigate the factors affecting growth and the extent to which the growth of children varies across the country.

After preliminary tabulations, the data for each province were analysed with three-level models. These confirmed that there were significant differences between patterns of growth in the different provinces. Four-level models were therefore fitted to the weight and height data with provinces, clusters, families and subjects defining the levels. The following equation shows the fixed part of model



a) Weight



b) Height

Figure 1. Percentiles of log(weight) and height of Iranian children and adolescents aged 2–18 (years); centiles 3rd, 10th, 25th, 50th, 75th, 90th, 97th.

$$\left.\begin{matrix} LWT \\ HT \end{matrix}\right\} = \beta_0 Cons + \beta_1 Cage + \beta_2 SEX + \beta_3 UR + \beta_4 Cage^2 + \beta_5 S * CA + \beta_6 S * UR + \beta_7 UR * CA$$

Where LWT is 'log(weight) × 100', the natural logarithmic transformation of weight multiplied by 100 to avoid decimals. In order to increase robustness of estimates, age was centred at 8 years old. The other terms in the model are: *Cons* is constant; *Cage* is centred age (age-8); $Cage^2$ is cage squared; UR is urban or rural (urban = 0, rural = 1); *Sex* is boys = 0, girls = 1, the interaction terms are; $S * CA$ is sex * cage; $S * UR$ is sex * (urban or rural); and $UR * CA$: (urban or rural) * cage.

Table 1 presents the estimates of fixed parameters of this model. These represent the overall average values of these parameters for Iran. Because the analysis is centred at age 8, table 1 shows that the average height of 8 year olds is 122.1 cm, and their median weight is 21.52 kg. Height is increasing by 5.6 cm per year and

Table 1. Estimated coefficients (and standard errors) of the fixed part of the four-level models for log(weight) × 100 and height centred at age 8. Weight in kilogram, height in centimetres.

Log(weight) × 100			Height		
Parameter	Estimate	(s.e)	Parameter	Estimate	(s.e.)
Cons	306.90	(1.21)	Cons	122.1	(0.29)
Cage	10.69	(0.13)	Cage	5.59	(0.03)
SEX	−0.61	(0.32)	SEX	−0.50	(0.14)
U/R	−3.74	(0.56)	U/R	−2.66	(0.25)
$Cage^2$	0.04	(0.02)	$Cage^2$	−0.08	(0.01)
S * CA	0.72	(0.08)	S * CA	0.02	(0.03)
S * UR	−1.94	(0.53)	S * UR	−0.74	(0.20)
UR * CA	−0.59	(0.07)	UR * CA	−0.23	(0.03)

weight by 11.3% per year, i.e. by 2.43 kg per year at age 8. At this age girls are half a centimetre shorter than boys and slightly but not significantly lighter. The interaction terms of sex with age shows that the girls are putting on weight significantly faster than boys and also on average growing slightly faster.

Table 1 also shows that there is a large difference between the size of urban and rural children. At age 8 rural children are on average 2.7 cm shorter and 3.8% (0.82 kg) lighter. Furthermore the sex × urban-rural ($S * UR$) interaction shows that these differences are larger for girls than boys as shown in figure 2a–d.

3.2. *Inter-province variation in growth*

Table 2 shows the random components in the four-level models for log(weight) × 100, *LWT*, and height. Extensive three-level analysis of the data for each province showed that the constant parameter varied significantly between families and clusters, $p < 0.001$, but that the other model parameters could be regarded as constant within provinces. The variances σ_e^2, σ_u^2, σ_v^2, and σ_w^2 of the four-level analyses (table 2), show that for urban boys at age 8, 60% of the total variance of LWT was at the individual level, 20% at the family level, 12% at the cluster level and 8% at the province level. The comparable percentage of the total variance for height were 70%, 18%, 10%, 2%. The level 4 residual variances were both significant, $p < 0.001$, and at age 8 the constant terms for the different provinces ranged from −9.9% to 9.4% of the mean weight and ±2 cm i.e. 1.6% of the mean height. These constants representing the variation across the provinces in mean weight and height are correlated, $r = 0.34$ ($p = 0.10$). It should be noted also that the residual estimates are shrunken towards zero (Goldstein 1995); i.e. the deviations from the overall mean of the estimated constants for each province are reduced as far as possible by removing a random component that can be attributed to residual variation at lower levels in the model.

Estimates of the level four residuals, corresponding to the random components in table 2, for *Cons*, *Cage* and $Cage^2$ may be used to derive the mean growth curves for urban boys in each of the provinces. Figures 3a and b show the National mean growth curves and the range of the median growth curves for urban boys in the 24 provinces. In any age group the median curves are spread almost uniformly across the range. Up to the age of 11, the upper bound for weight is given by boys in West Azarbaijan and the lower bound by boys in Zanjan; the median curve for boys in Tehran is well within the range. For heights of all ages, the upper bound is given by

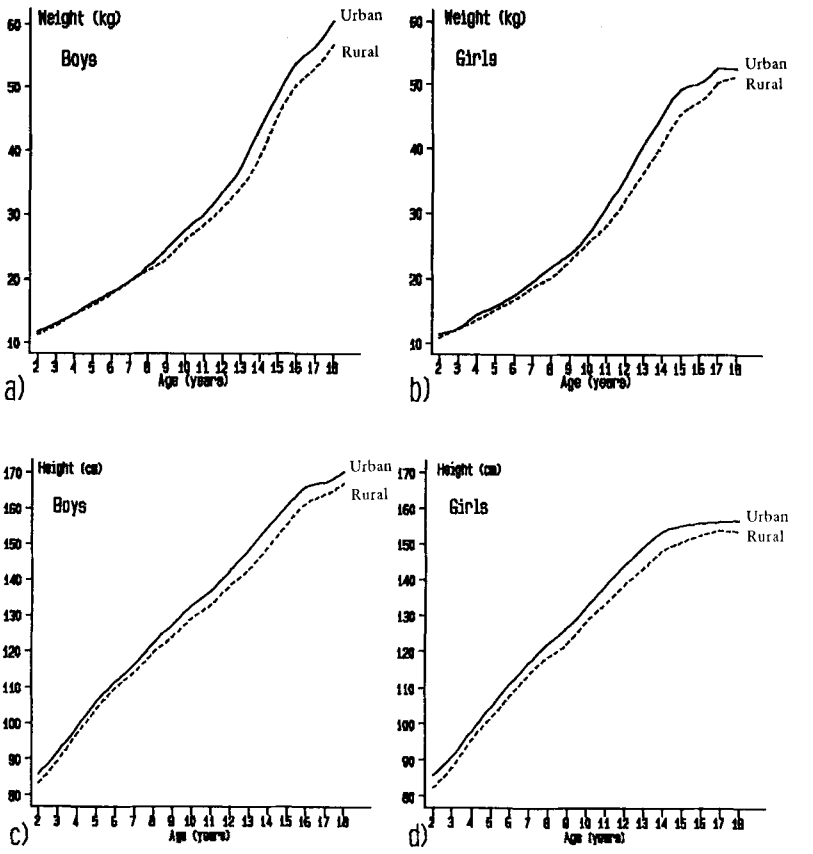


Figure 2. Mean weight (kg) and height (cm) of urban and rural boys and girls.

boys in Tehran very closely followed by boys in Semnan and Khozestan. The lower bound is given by urban boys in Kohkiloyeh-Boyerahmad. Figure 3a shows that over the 24 provinces between the ages of 2–15 the median weight of urban boys shows a consistent spread of about ±2 kg either side of the mean, which only increases slightly after the age of 12. This pattern of median lines arises from a combination of inter-province variation in the *cons*, *cage* and $cage^2$ terms in the model for weights. Figure 3b is a similar presentation of the inter-province variation in average heights. Proportionately, there is less variation in the average heights of the urban boys across the provinces, and again the magnitude of the variation is remarkably constant up to the age of 12 and only increases slightly thereafter.

There is no evidence that average differences between the sexes in either log(weight) or height vary between the provinces, nor is there evidence of significant inter-province variation in the difference in log(weight) between urban and rural children. However, the difference between the average height of urban and rural children ranges from 2.25 to 1.74 cm across the provinces. These findings show that the spread of average growth curves, shown in figure 3 for urban boys would be similar for rural boys and for urban and rural girls too.

Table 2. Random coefficients of four-level models of the data on weight and height of children in Iran.

Random components					
Log(weight) × 100			Height		
Parameter	Estimate	(s.e)	Parameter	Estimate	(s.e)
Level 4			Level 4		
σ^2_{w0} (between provinces)	30.26	(9.47)	σ^2_{w0} (between provinces)	1.33	(0.50)
σ^2_{w1}	−2.54	(0.86)	σ^2_{w1}	0.03	(0.04)
σ^2_{w2}	0.29	(0.10)	σ^2_{w2}	0.01	(0.005)
σ^2_{w4}	0.0034	(0.0016)	σ^2_{w3}	0.27	(0.31)
σ^2_{w5}	0.05	(0.04)	σ^2_{w4}	0.0002	(0.0002)
σ^2_{w6}	0.99	(1.02)	σ^2_{w7}	0.004	(0.005)
σ^2_{w7}	0.01	(0.03)			
Level 3			Level 3		
σ^2_{v0} (between clusters)	43.00	(2.97)	σ^2_{v0} (between clusters)	5.95	(0.45)
Level 2			Level 2		
σ^2_{u0} (between families)	74.49	(3.15)	σ^2_{u0} (between families)	10.81	(0.53)
Level 1			Level 1		
σ^2_{e0} (between children)	219.2	(2.72)	σ^2_{e0} (between children)	41.36	(0.51)

σ^2_{w1} = Cov('Cons'/'Cage')
σ^2_{w2} = Var('Cage'/'Cage')
σ^2_{w3} = Var('U/R'/'U/R')
σ^2_{w4} = Var('Cage^2'/'Cage^2')
σ^2_{w5} = Var('S * CA'/'S * CA')
σ^2_{w6} = Var('S * UR'/'S * UR')
σ^2_{w7} = Var('UR * CA'/'UR * CA')

3.3. *Standard charts*

The finding of significant inter-province differences in growth raised difficulties in the selection of data for the construction of standard growth charts. Cluster analysis of the model parameters for weights and heights for each province did not suggest any regional grouping of the provinces such as north–south, west–east or of provinces with similar climate or urbanization. Also, cluster analyses of growth patterns of children in urban and rural areas gave inconsistent results.

However, although the level four residual constants for Tehran were positive for both weight and height, being 3.4% and 2 cm respectively, they were not significant in relation to the inter-province variation of these parameters, $p > 0.5$ and 0.09 respectively. Moreover, at the time of the survey, urban Tehran included 27% of all the urban children in Iran. The data for Tehran was therefore selected as a homogeneous subset for the construction of growth charts. This choice was subsequently vindicated by the finding that, for girls' weights, the centiles for urban Tehran all lie within the confidence limits of the raw centiles for all other urban girls in Iran.

Figures 4a–d compare the seven standard raw centiles of heights and weights of boys and girls in urban areas, excluding Tehran, with smooth centiles of charts based on the Tehrani children. Clearly the upper centiles of the charts are generally above the raw centiles so that in older age groups the 90th chart centile corresponds to the

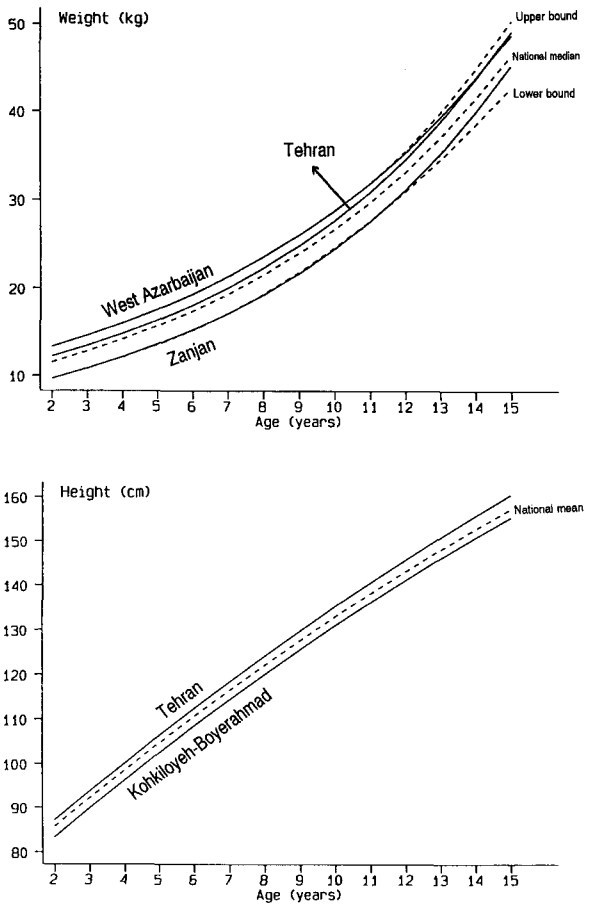


Figure 3. The National mean growth curves and the range of the mean growth curves for weight and height of urban boys over all provinces of Iran derived from four-level analysis of data on log(weight) and height. Curves for selected provinces are also shown.

97th raw centile. However, in all four figures the important 3rd and 10th centiles correspond closely. The worst deviation is of the 3rd centile for heights of boys aged 2–4 years old. The irregular shape of the raw centiles at this point indicate that despite the numbers of children, the deviation is due to some unusually small heights in these age groups. Further inspection of figures 4a–d shows that the charts fit the raw centiles best in the younger age groups.

It has been noted that rural children are generally smaller than urban children. For rural boys the standard weight centiles on the charts correspond on average to the 5.5th, 17th, 38th, 66th, 85th, 95th and 99th centiles, and for rural girls to the 5.6th, 18th, 40th, 62nd, 88th, 96th, and 99th centiles. For heights, the 1st centile has been added to the charts because this corresponds to the 3rd or 4th centile for rural children. The other standard centiles correspond on average to the 9th, 24th, 50th, 76th, 91st, 97th, and 99th centiles for rural boys and to the 8th, 25th, 51st, 78th, 92nd, 97th, and 99th centiles for rural girls as shown on the charts presented in the companion paper (Hosseini, Carpenter and Mohammad 1998b).

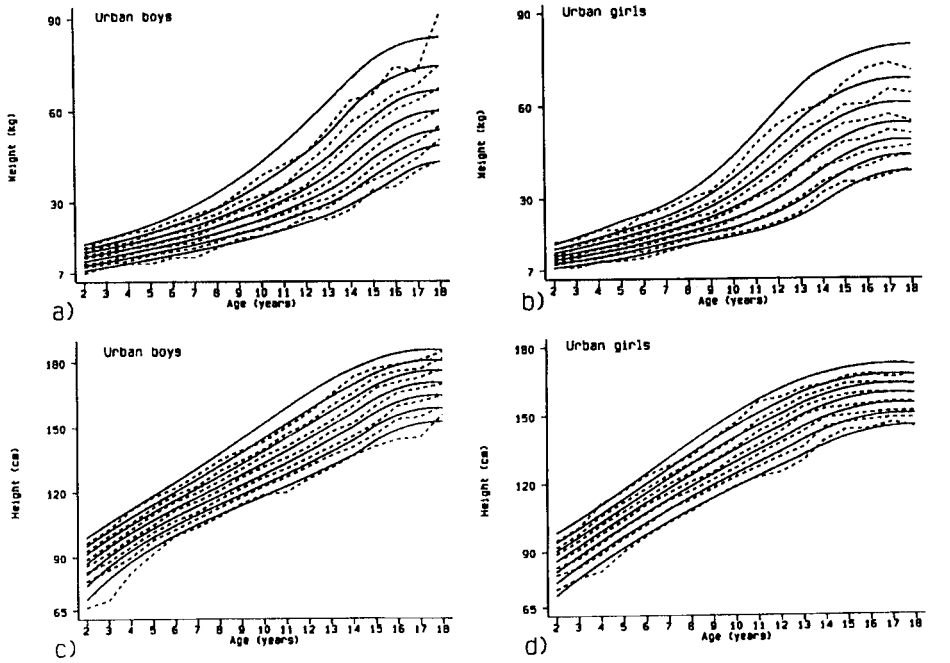


Figure 4. Raw centiles for heights and weights of boys and girls in urban Iran (excluding Tehran) compared with centiles of charts based on children in Tehran. The standard 3rd, 10th, 25th, 50th, 75th, 90th, and 97th centiles are shown.

Figures 5a–d compare for rural children the appropriate raw to the corresponding smooth centiles. Figures 5a and b show that the first three raw and smooth centiles for weight are generally close. However, for boys all seven raw centiles show a check at about 30 kg in weight and thereafter the raw centiles fall below the smooth centiles although they tend to catch up at later ages. For girls the 62nd, 88th, 96th and 99th raw centiles are below the corresponding chart centile after the age of 13. For both boys and girls the 99th raw centiles are above the 97th chart centile in the youngest age groups. In contrast, figures 5c and d show that for heights of rural children the corresponding raw and smooth centiles fit well.

3.4. Comparison with NCHS standards

The proposed growth charts for urban Iran are compared with the NCHS standards. The NCHS reference centiles (Hamill, Drizd, Johnson, Reed, Roche and Moore 1979) have been recommended by WHO (1986) to be used worldwide, and in most developing countries, as in Iran, these charts are widely used in health fields (PHC). But due to differences in genetics and environmental factors, in different parts of the world children grow differently. So the application of these standards can be misleading. As an example, the proposed growth chart for weights of Iranian girls is compared with the corresponding NCHS references in figure 6. According to the figure 6 median weights of urban Irani girls up to the age of 13 years old are below the 25th centiles of NCHS standards, and the 25th centiles of girls' weights are about the 3rd centile of the NCHS reference. After the age of 13 years there is a catch up in the weight of Iranian girls, and their centiles start to cross the NCHS centiles

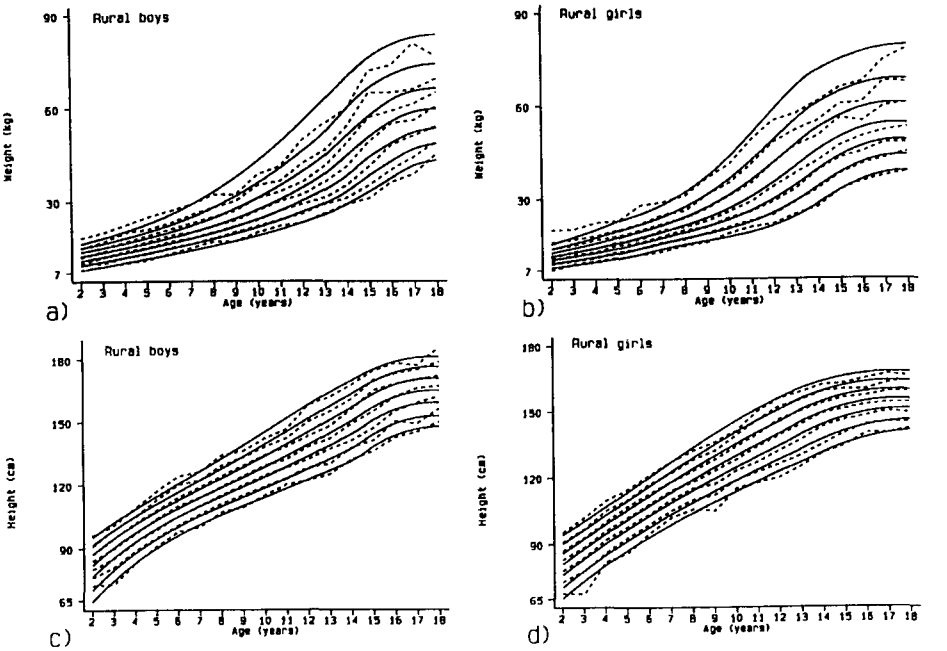


Figure 5. Smooth centiles 3rd, 10th, 25th, 50th, 75th, 90th, 97th for weight of boys and girls, and 1st, 3rd, 10th, 25th, 50th, 75th, 90th for height of boys and girls in urban Tehran with the corresponding average raw centiles for the rural areas of Iran. (a) Rural boys' weights, 5.5th, 17th, 38th, 66th, 85th, 95th, 99th raw percentiles; (b) Rural girls' weights, 5.6th, 18th, 40th, 62nd, 88th, 96th, 99th raw percentiles; (c) Rural boys' heights, 4th, 9th, 24th, 50th, 76th, 91st, 97th raw percentiles and, (d) Rural girls' height, 3rd, 8th, 25th, 51st, 78th, 92nd, 97th raw percentiles.

but the whole set of centiles are still substantially below the corresponding NCHS data.

Analytically, by entering the NCHS centile data into this study's model of weight for girls, it was found that up to the age of 13 the 3rd, 10th, 25th, and 50th centiles of the NCHS standards correspond on average to the 28th, 51st, 69th and 84th centiles of the Iranian charts.

Alternatively the proportion of urban Tehrani children aged 2–9 years old with NCHS *Z*-scores below −2 as computed by EPINUT (WHO 1996), averages 23.3%. The percentages by age from 2 to 9 are 25.6, 27.9, 30.9, 26.6, 21.9, 19.0, 17.1, and 17.9.

4. Discussion

There has been considerable discussion as to whether developing countries need their own growth charts (Goldstein and Tanner 1980). It is accepted by WHO (1986) that there are genetic differences between groups, just as there are between individuals, but for practical purposes they are not considered large enough to invalidate the general use of NCHS data both as a reference and as a standard. In the absence of local data, the Road to Health charts (Morley 1973) certainly provide a general indication as to whether a child is growing satisfactorily, but give no indication as to whether a child is within the normal range for children in the area. The findings of this study agree with those of Ayatollahi's survey in Shiraz (Ayatollahi and

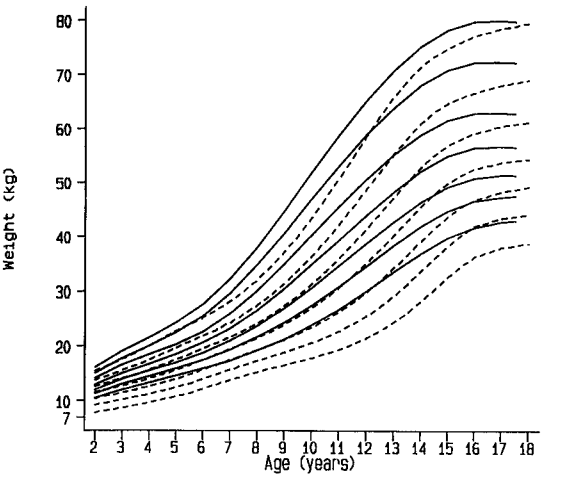


Figure 6. Comparison of NCHS and Iranian charts for girls' weight. Solid line NCHS; broken line Iranian: centiles are 3rd, 10th, 25th, 50th, 75th, 90th, 97th.

Carpenter 1991) that Iranian children are substantially smaller than children in the US. The 3rd centile on the NCHS weight charts approximately corresponds to the 28th centile on the proposed charts for Iran.

At first sight these findings imply that children in Iran are generally seriously malnourished, however, a comparison of this study's centiles for weight and height with NCHS centiles in figure 6 shows a general shift downward but little change in the spread of the centiles in each age group. If serious malnourishment were present in a proportion of the population the upper centiles could be normal and the lower centiles would be relatively much lower than expected. The general shift of the centile suggests either that the usual diet of Iranian children does not promote growth as much as the usual diet of US children or that there are genetic differences between the populations. Either way the NCHS reference is too high for identification of the nutritional status of an Iranian child relative to its compatriots.

It will also be noted that, in the above comparisons, standards for urban Iran were compared with the NCHS reference standard. If data from rural Iran had been compared with this reference the differences would have been bigger, and larger percentages of children than presented above would have been classified as malnourished. These findings clearly imply the need for locally based charts for any clinical judgement that goes beyond the crudest assessment of growth.

Freeman, Cole, Chinn, Jones, White and Preece (1995) found that growth data from different surveys in England had to be 'adjusted' before the data could be pooled to form new national charts. Recently differences of 17% (0.5 kg) have been reported between average normal birth weights in Hungary and Norway (ECAS 1997). Previously, Clements and Pickett (1957) reported that weights of army recruits in 1941 were 4 kg heavier in Northern Scotland than in the Liverpool region and that average heights differed by 2.7 cm from the North to the South of England. Thus the provincial variation in mean weights and heights observed here is not altogether implausible.

However, the National Health Survey of Iran was the first of its kind and weights and heights of children comprised only a small fraction of the data. With all the other work, it is possible that the calibration of the measuring equipment may have been overlooked. Thus, at least part of the differences between provinces may be due to calibration bias. The finding that differences between provinces show little tendency to change with age, as shown in figure 3, supports this view. Differences in growth attributable to genetic or social factors would be expected to increase with age, as for example differences between urban and rural children shown in figure 2. The latter differences, like the differences between the growth of girls and boys persist across all provinces and are undoubtedly real.

The differences between the provinces raise problems when constructing growth charts. Standard charts for the whole country are clearly desirable, and we have chosen the data for Tehran as a *homogeneous* subset from which to construct standards. Other data sets might have been used but none would be entirely satisfactory. In the event, figures 4a–d show that the all important lower chart centiles correspond closely to the raw centiles in all other urban districts of Iran taken together, and that the higher chart centiles are somewhat too high in the older age groups, probably because of the greater growth of children in better off homes in the capital city. These findings are in line with observations by Preece (personal communication 1994) that, in the developing world, capital cities tend to include people drawn from all parts of the country and consequently they often can be used as a representative population for growth studies.

For rural children, the 3rd and 10th weight chart centiles correspond approximately to the 6th and 17th or 18th centiles. For heights, the 50th raw centile is close to the 25th chart centile, with corresponding adjustments to the other centiles as shown on the charts presented in the companion paper. With these modifications the weight charts are reasonable and the height charts work well.

Any calibration differences that occurred in the survey are likely to be similar to those occurring in routine measurements of children. Consequently, in so far as differences between provinces are due to such errors, these differences will be covered by using the proposed standard as described. Further research, using more precise measurements made, preferably with self calibrating equipment, is required to determine the precise extent of regional variations in growth. With such information, it may be possible to recommend adjustments that should be made to the charts when applied in a particular province. But for general clinical work, especially when this involves the interpretation of repeated measurements, the proposed standard charts should be satisfactory when interpreted as described.

The National Health Survey did not include data on weights and heights of children under the age of two. The results of this study suggest that this gap might be filled, at least in the first instance, by a survey of children up to 2 years of age living in Tehran, coupled with data on measurements at birth of infants from urban and rural areas born in other provinces. Such data would require far fewer resources to collect than a full scale sample survey of all young children in Iran.

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Address for correspondence: R. G. Carpenter, Medical Statistics Unit, London School of Hygiene and Tropical Medicine, London, WC1E 7HT, England, UK

Zusammenfassung. Es werden Körperhöhen- und Körpergewichtsdaten von 22 349 Kindern und Jugendlichen aus dem Iran im Alter von 2 bis 18 Jahren vorgestellt. Die Daten wurden im Rahmen des in den Jahren 1990–1992 durchgeführten National Health Survey erhoben, in dem mittels einer geclusterten Zufallsstichprobe 1 aus 100 Familien in allen iranischen Provinzen ausgewählt wurde. Multilevel-Modelle, die dem Untersuchungsdesign Rechnung tragen ergaben signifikante Unterschiede zwischen den Provinzen sowie zwischen Kindern städtischer und ländlicher Herkunft. Unterschiede zwischen Kindern aus städtischen und ländlichen Gebieten sowie Unterschiede zwischen Jungen und Mädchen ließen sich in allen Provinzen nachweisen und sind sicher real existent. Unterschiede zwischen den Provinzen können z.T. durch Unterschiede in der Kalibrierung bedingt sein. Charts, die auf einer homogenen Teilstichprobe Teheraner Kinder basieren, können für alle städtischen Kinder und in modifizierter Form auch für alle ländlichen Kinder verwendet werden. Alle Perzentile der Charts liegen beträchtlich unter denen der NCHS Charts. Die Streuung ist jedoch ähnlich, so daß es keinen Anhaltspunkt dafür gibt, daß die Unterschiede aus der Prävalenz grober Unterernährung resultiert. Die Unterschiede zeigen, daß die Verwendung lokaler Charts für die Bewertung des Wachstums von Kindern im Iran von großer Bedeutung ist.

Résumé. On expose les poids et statures de 22 349 enfants et adolescents iraniens âgés de 2 à 18 ans. Ces données proviennent de l'enquête Nationale de Santé de 1990–1992, constituée à partir d'un échantillonnage aléatoire de 1/1000 familles dans toutes les provinces de l'Iran. Des modèles de niveaux multiples prenant en compte les caractéristiques de l'enquête, révèlent des différences significatives entre les provinces ainsi qu'entre les enfants ruraux et urbains. Les différences entre enfants ruraux et urbains comme les différences entre filles et garçons, s'imposent dans toutes les provinces et sont certainement réelles. Les différences entre provinces peuvent être pour une part dues à des différences de calibration. Des graphiques établis à partir de sous-échantillons homogènes d'enfants vivant dans la ville de Téhéran peuvent être utilisés pour tous les enfants urbains et sous une forme modifiée pour tous les enfants ruraux. Les centiles

de ces graphiques sont nettement inférieurs à ceux des standards NCHS mais leur allure est semblable, si bien qu'il n'apparaît pas probable que les différences expriment la prévalence d'une forte malnutrition. La différence montre que l'utilisation des courbes de croissance établies localement, est essentielle pour le suivi de la croissance des enfants en Iran.