The Implications of Using the World Health Organization Child Growth Standards in Saudi Arabia

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The World Health Organization (WHO) has recently released a new child growth standard that it recommends for international use. The objective of this study was to demonstrate the differences and the implications of using the WHO child growth standards on Saudi children. The Saudi reference was based on a cross-sectional sample of the population of healthy children and adolescents from birth to 19 years of age. The WHO sample was selected from privileged households in some countries. Percentile construction and smoothing were performed using the lambda, mu, sigma (LMS) methodology in both studies. The data from the WHO study including the 3rd, 5th, 50th, 95th, and 97th percentiles were plotted on the Saudi charts for weight for age, height for age, and weight for height. There are major differences between the 2 studies. Compared with the Saudi charts, the WHO lower percentiles (third and fifth) are shifted upward, whereas the upper percentiles are shifted downward. The use of the WHO standards in Saudi Arabia and possibly in other countries of similar socioeconomic status increases the prevalence of undernutrition, stunting, and wasting, potentially leading to unnecessary referrals, investigations, and parental anxiety. Clear guidelines should be developed by WHO experts to guide clinicians in developing countries in the proper use

of the standards not only to determine prevalence but also in the daily clinical assessment of the growth of children.

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Growth parameters in the form of weight for age, height for age, and weight for height are important tools for the assessment of the nutritional status of children, and some countries have established their own reference growth charts for children and adolescents.^{1,2} The recognition of certain limitations of the National Center for Health Statistics (NCHS)/World Health Organization (WHO) reference led to a major revision addressing most of the deficiencies and resulting in the development and release of the Centers for Disease Control and Prevention (CDC)³ growth charts reference for the United States in 2002. In 1995, a WHO expert committee recommended the need for an international standard rather than a reference that reflects the growth potential of children.⁴ The study was implemented between 1997 and 2003, and the results were released in 2006 as the WHO child growth standards (the WHO standards) for children younger than 5 years and recommended for international use.⁵ In Saudi Arabia, previous reports on the growth of children pointed out important differences with the commonly used NCHS reference

growth charts that have been recommended for international use by the WHO.^{6,7} Accordingly, updated growth reference charts⁸ for healthy children and adolescents in Saudi Arabia from birth to 19 years of age were completed in 2005 and reported in 2007. Although reports comparing the new WHO standards with local references have been published,^{9,10} to our knowledge, there is no published information from countries in the Middle East. The objective of this report is to evaluate the difference between the WHO standards and the Saudi reference and the implications of using the WHO standards in Saudi Arabia and possibly in other developing countries of similar socioeconomic status.

Participants and Methods

The Saudi Study

The design and methodology have been reported in detail elsewhere.¹¹ Briefly, recommended guidelines and criteria were used for the determination of sample size.¹² The study sample was selected by multistage probability sampling procedure from a stratified listing based on the population census. Accordingly, the sample is representative of all the socioeconomic strata and consists of a majority of children with prolonged mixed breastfeedings. A pilot study was designed to test all components of the project before the data collection, and

Figure 1. Weight for age for boys. KSA indicates growth charts for Saudi children in 2005; WHO, WHO child growth standards in 2006.

workshop training for the members of the field teams was conducted in each of the 13 regions of the kingdom. Data collection was made through house-to-house visits where survey questionnaire, clinical examination, and body measurements were completed by primary care physicians and nurses. Data were analyzed after “cleaning” using the LMS methodology.^{13–15} The number of children younger than 5 years was 15,516, and 50.5% were boys.

The WHO Study

The details of participants and the methodology have been reported by WHO.⁵ Briefly, a multinational sample was selected from Muscat, Oman; Davis, California; Pelotas, Brazil; Oslo, Norway; selected affluent neighborhoods of Accra, Ghana; and South Delhi, India. The sample consisted of 2 components: 1 longitudinal from birth to 24 months and 1 cross-sectional from 18 to

71 months. The eligibility for entry in the longitudinal component included healthy families living in favorable socioeconomic conditions, nonsmoking mothers, exclusively or predominantly breastfeeding for at least 4 months, introduction of solids by 6 months of age, and continued breastfeeding for at least 12 months. Eligibility criteria for the cross-sectional component are the same, with an important exception of infant-feeding practices, although a minimum of 3 months of breastfeeding was required. The methodology of data collection and analysis are similar with those of the study in Saudi Arabia.

Weight for age, length/stature for age, and weight for length/stature were selected for comparison of the 3rd, 5th, 50th, 95th, and 97th percentiles. For simplification purposes, the term *height* will be used to refer to the length/stature; the higher percentiles, to the 95th and 97th; and the lower percentiles, to the 3rd and the 5th, throughout the article.

Figure 2. Weight for age for girls. KSA indicates growth charts for Saudi children in 2005; WHO, WHO child growth standards in 2006.

Results

Details of the socioeconomic status of the Saudi families in this study were reported elsewhere.^{6,9} In brief, 73% of the households in the study sample were in urban settlements. Most of the families (69%) live in owned houses. About 50% of the heads of households completed at least 12 years of education. The prevalence of consanguinity was 56%, and the first-cousin type was more common (33.6%) than all others (22.4%).

The gestational age of the children was estimated by history taken from mothers, and all children with gestational age below 8 months (0.9%) were excluded from body measurements. Similarly, low-birth-weight children below 2.5 kg (3.2%) were excluded. A history

of breastfeeding was positive in 91.6% of the children younger than 3 years, and the first breastfeeding was started between birth and 3 hours in 50.5% of the children. In addition to breastfeeding, bottle-feeding was started between 1 and 2 months in 52% of the children, and solid food was introduced between 4 and 6 months in 81.9% of the children. The Saudi study population seems to be more homogeneous than that of the WHO.

Comparison of the weight for age percentiles is depicted in Figures 1 and 2 for boys and girls, respectively. Compared with the WHO standards, the lower percentiles for boys in the Saudi chart have a similar position the first 2 months of age, followed by a gradual upward shift of the WHO curves that increases up to 60 months of age. However, the higher percentiles

Figure 3. Height for age for boys. KSA indicates growth charts for Saudi children in 2005; WHO, WHO child growth standards in 2006.

show overlap of the curves up to 6 months, then there is a shift of the WHO curves downward up to 24 months, after which the shift assumes an upward direction with a gap increasing gradually up to 60 months of age. The 50th percentile curves show overlapping during the first month of age, followed by a slight upward shift of the WHO curve until 9 months, then another overlap continues up to 21 months, after which there is a gradually increasing upward shift up to 60 months of age. The pattern of variation of the weight for age in the girls' chart is similar to that of the boys, but with a delayed onset of the gap.

The pattern of change in the height for age is presented in Figures 3 and 4 for boys and girls, respectively. For boys, there is an upward shift of the WHO lower percentiles starting early by the end of the first month of age and gradually increasing up to 60 months. The pattern in the higher percentiles indicates that after an

overlap during the first 3 months, a downward shift is noted to continue up to 52 months, where an overlap occurs again. The 50th percentile variations show a pattern, although to a lesser degree, similar to that of the lower percentiles. In the girls, the pattern of height for age variation is grossly similar, as shown in Figure 4.

Comparison of the weight for height is shown in Figures 5 and 6 for boys and girls, respectively. The curves for boys show a major upward shift of the WHO lower percentiles for all age groups. Regarding the higher percentiles; however, a downward shift occurs from a height of 55 to 105 cm, after which an overlap of the 2 curves continues up to 120 cm. The pattern in the 50th percentile indicates a clear upward shift of the WHO curve up to the height of 60 cm, after which an overlap continues up to a height of 90 cm, when another upward shift starts and continues to 120 cm. The pattern of

Figure 4. Height for age for girls. KSA indicates growth charts for Saudi children in 2005; WHO, WHO child growth standards in 2006.

Figure 5. Weight for height for age for boys. KSA indicates growth charts for Saudi children in 2005; WHO, WHO child growth standards in 2006.

weight for height variations for girls is similar to that of the boys.

Discussion

There are basically 2 types of charts used in the assessment of growth in children. By definition, a reference chart describes the pattern of growth of children in a given population, and the individual growth is assessed in relation to that of their peers of similar age and sex. Most of the growth charts, including the Saudi chart, are reference growth charts. By contrast, a standard describes the growth potential of children in ideal conditions with no or minimal constraints to growth, indicating a concept of a norm or target. Accordingly, the 2006 WHO growth charts are standards.

It is well known that the growth of children as assessed by anthropometric measurements is affected by a combination of genetic and environmental factors. Although studies suggest a minimal role of genetic factors,^{16–18} ethnic variations both between individuals and populations cannot be excluded.¹⁹ In most developing countries, it is thought that environmental factors in the form of frequent infections and inadequate food are the main causes of growth deficiency in children. However, in others, such as Saudi Arabia and an increasing number of developing countries, improvement in socioeconomic status over the last several decades has led to abundance of food and improvement of the health of the population in general, thereby minimizing the effects of environmental factors on the growth in these countries.

Figure 6. Weight for height for age for girls. KSA indicates growth charts for Saudi children in 2005; WHO, WHO child growth standards in 2006.

The feeding and nutritional history of young Saudi children indicates that most of the infants received combined breast and bottle milk and that solid food was started within the appropriate age.¹¹ The role of smoking in our society can be considered minimal, as smoking is extremely rare (<1%) in Saudi women of child-bearing age.²⁰

The quality of our sample has been evaluated, and all errors have been corrected or deleted before analysis. Summary statistics showed SDs of the 3 indices' Z score (weight for age, height for age, and weight for height) between 0.92 and 1.03, indicating high-quality data.^{21,22} Finally, the statistical methodology is similar in both studies, excluding any effect of statistical methods on the observed variations.

This report demonstrates the magnitude of the expected differences between the WHO standards and the Saudi reference that vary according to the age, the

growth indicator, and the percentile. The upward shift of the lower percentiles of the WHO standards was more expected than the downward shift of the higher percentiles. The latter possibly reflects the increasing overweight and obesity in our population probably as a result of a more sedentary lifestyle and poor dietary habits reported in children of some industrialized countries.

Comparison of the WHO standards with CDC and UK references has been reported. Comparison with the 2000 CDC reference indicated that the CDC sample was somewhat heavier and shorter than the WHO sample, implying lower rates of undernutrition (except during the first 6 months of life) and higher rates of overweight and obesity when based on the WHO standards.⁹ Another comparison was reported with the UK growth charts (UK 1990 reference) that indicated variations according to age with the UK populations appearing larger at birth

and showing apparent “catch-down” growth by around 1 centile band (SD, 0.67) during the first 2 to 4 months when using the WHO standards, but from 4 months old, the children in the UK 1990 reference were less likely to be classified as underweight and the proportion of UK infants classed as obese was higher. However, between ages 2 and 5 years, the UK growth references and WHO standards showed no important differences in height, and differences in weight SDs were less than those observed before 2 years.¹⁰ Such variations are different in type and magnitude from our findings described above. The differences between the WHO standards and those of other countries can be explained by the characteristics of the samples. The WHO sample was selected from privileged households, nonsmoking mothers, and predominantly breastfed children assumed to have minimal environmental constraints to the expression of full genetic potential for growth. This type of sample contrasts with that in most other studies, including ours, which is representative of all the socioeconomic strata of the population with variable percentage of breastfed infants, resulting in “reference” rather than “standard” growth charts.

Comparison with data from some developing countries has been reported. Field testing of the WHO standards indicated higher rates of stunting in Pakistan and Maldives than in Italy and Argentina.²³ Another report comparing Z scores of the weight for age, length for age, and weight for length of Gabonese children with the WHO standards, the 2000 CDC, and the NCHS 1978 growth charts indicated considerably different growth faltering pattern depending on the chart used.²⁴ The authors concluded that shifting to the WHO growth charts will have important implications for child health programs. Finally, the results of the use of WHO charts in 3 developing countries showed that wasting was more prevalent in India and Peru but less prevalent in Vietnam. In all 3 countries, a higher proportion of children were stunted and fewer children were classified as underweight.²⁵

The implications of using the WHO standards in Saudi Arabia and in other developing countries of similar status depend on the direction of the variations. The upward shift of the lower percentiles of the WHO standards, in the weight for age, height for age, and weight for height charts, is expected to result in increased prevalence of underweight, stunting, and wasting, respectively. Regarding the higher percentiles, the downward shift of the WHO curves for weight for age and weight for height is expected to increase the prevalence of obesity in Saudi children, whereas an upward shift, as observed in some age groups, leads to underestimation of obesity.

In conclusion, the use of the WHO standards in Saudi Arabia and possibly in other countries of similar socioeconomic status increases the prevalence of undernutrition, stunting, and wasting, potentially leading

to unnecessary referrals, investigations, and parental anxiety. Clear guidelines should be developed by WHO experts to guide clinicians in developing countries in the proper use of the standards not only to determine prevalence but also in the daily clinical assessment of the growth of children.

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Can't Chalk It Up to "Baby Fat"

Despite recent widespread media attention given to studies that have indicated that one-third of American children have a weight problem, a new study shows just one-third of children who are overweight or obese actually receive that diagnosis by a pediatrician. The study also stresses that this failure to diagnose seems to have the most impact on children who may most greatly benefit from early intervention.

Using electronic medical records, researchers reviewed body mass index (BMI) measurements recorded for 2- to 18-year-olds (N = 60,711) who had at least 1 well-child visit between June 1999 and October 2007. The BMI measurement showed that 19% (n = 11,277) of the children were overweight, 23% (n = 14,105) obese, and 8% (n = 4,670) severely obese. Researchers discovered that increasing BMI percentile increased the likelihood of a diagnosis. Although 76% of severely obese children

and 54% of obese children were diagnosed, only 10% of overweight patients received a proper diagnosis. (Overweight is defined as a BMI between the 85th and 95th percentile, obesity is defined as a BMI greater than 95th percentile, and severely obese is a BMI equal or greater to the 99th percentile.) Also, although the percentage of patients whose condition was diagnosed increased steadily over the study period until 2005, the diagnosis rate plateaued in 2006 and 2007, implying that the impact of publicity regarding weight problems may be reaching its peak. And despite adding an abnormal BMI flag in the electronic medical record system from 2004 to 2007, there was no evidence of increased diagnosis in that period. Despite having set pediatric BMI guidelines, there is a lot left to do, and this is wake-up call to pediatricians that as many as 90% of overweight children are not being properly diagnosed.

Source: *Pediatrics*