

THE NEW WHO CHILD GROWTH STANDARDS

MERCEDES DE ONIS*

The origin of the WHO Child Growth Standards dates back to the early 1990s and a meticulous evaluation of the NCHS growth reference, which had been recommended for international use since the late 1970s. The review documented the deficiencies of the reference and led to a plan for developing new growth charts that would depict how children should grow in all countries rather than merely describing how they grew at a particular time and place. The outcome of this plan was the WHO Multicentre Growth Reference Study (1997-2003), which applied rigorous methods of data collection and serves as a model of collaboration for conducting international research. The study provides a solid foundation for developing a standard because the sample is based on healthy children living under conditions likely to favor achievement of their full genetic growth potential. Furthermore, the mothers of the children selected for the construction of the standards engaged in fundamental health-promoting practices, namely breastfeeding and not smoking. Other important features of the study are that it included children from a diverse set of countries (Brazil, Ghana, India, Norway, Oman and USA) and explicitly identified breastfeeding as the biological norm and established the breastfed child as the normative model for growth and development. By replacing the NCHS reference, which is based on children from a single country, with one based on an international group of children, the new standards recognize that children the world over grow similarly when their health and care needs are met. The WHO Child Growth Standards provide a technically robust tool for assessing the well-being of infants and young children. The standards depict normal growth under optimal environmental conditions and can be used to assess children everywhere, regardless of ethnicity, socioeconomic status and type of feeding.

Descriptors: GROWTH STANDARDS, OVERWEIGHT, OBESITY, UNDERWEIGHT, STUNTING, WASTING

Introduction

Adequate nutrition during the early years of life is of paramount importance for growth, development and long-term health through adulthood. It is during infancy and early childhood that irreversible faltering in linear growth and cognitive deficits occur (1, 2). Poor nutrition during this critical period contributes to significant morbidity and mortality (3). Similarly, the increasing prevalence of childhood obesity worldwide is associated with an increased risk of unfavorable health outcomes later in life and decreased longevity (4, 5). Apart from

contributing positively to child survival, therefore, the quality of infant and young child feeding is fundamental for achieving optimal growth and development. Pediatricians rely largely on the assessment of children's growth status to determine whether or not infant and young child nutrition is adequate. Growth charts are thus essential items in the pediatric toolkit for evaluating the degree to which physiological needs for growth and development are being met. However, the evaluation of child growth trajectories and the interventions designed to improve child health are highly dependent on the growth charts used.

references and alternative approaches to developing new tools to assess growth (8). The WHO standards were developed to replace the National Center for Health Statistics (NCHS)/WHO international growth reference, whose limitations have been described in detail elsewhere (9-11). The purpose of this paper is to provide the background and rationale of the WHO Child Growth Standards, describe how the charts were developed, and outline the main innovative aspects they provide.

Rationale for developing new child growth standards

The origin of the new standards dates back to the early 1990s when WHO initiated a comprehensive review of the uses and interpretation of anthropometric references and conducted an in-depth analysis of growth data from breastfed infants. This analysis showed

*Department of Nutrition
World Health Organization

Address:
Mercedes de Onis, MD, PhD
Department of Nutrition
World Health Organization
1211 Geneva 27, 20 Avenue Appia
Switzerland
E-mail: deonism@who.int

In April 2006 the World Health Organization (WHO) released new standards for assessing the growth and development of children from birth to five years of age (6, 7). The standards are the product of a detailed process initiated in the early 1990s involving various reviews of the uses of anthropometric

that the growth pattern of healthy breastfed infants deviated to a significant extent from the NCHS/WHO international reference (12, 13). The review group concluded from these and other related findings that the NCHS/WHO reference did not adequately describe the physiological growth of children and that its use to monitor the health and nutrition of individual children or to derive estimates of child malnutrition in populations was flawed. The group recommended the development of new standards, adopting a novel approach that would describe how children should grow when free of disease and when their care follows healthy practices such as breastfeeding and non-smoking (14).

This approach would permit the development of a standard as opposed to a reference merely describing how children grew in a particular place and time. Although standards and references both serve as a basis for comparison, each enables a different interpretation. Since a standard defines how children should grow, deviations from the pattern it describes are evidence of abnormal growth. A reference, on the other hand, does not provide as sound a basis for such value judgments, although in practice references often are mistakenly used as standards. Following a resolution from the World Health Assembly endorsing these recommendations, the WHO Multicentre Growth Reference Study (MGRS) was launched in 1997 to collect primary growth data that would allow the construction of new growth charts consistent with "best" health practices (15, 16).

Design of the WHO Multicentre Growth Reference Study

The goal of the MGRS was to describe the growth of healthy children. Implemented between 1997 and 2003, the MGRS were a population-based study conducted in six countries from diverse geographical regions: Brazil, Ghana, India, Norway, Oman and the USA (16). The study combined a longitudinal follow-up from birth to 24 months with a cross-sectional component of children aged 18-71 months. In the longitudinal component, mothers and newborns were

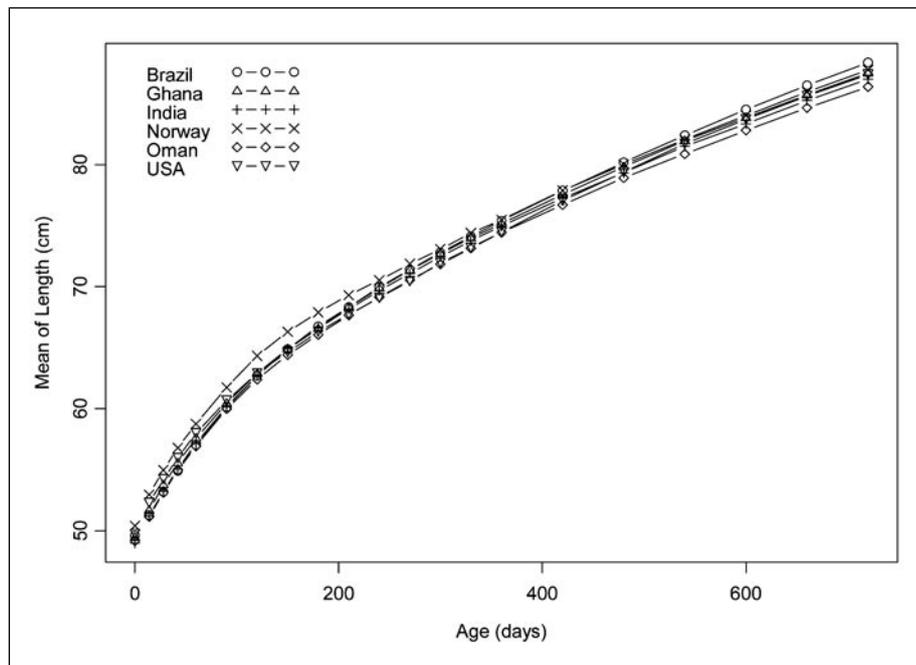


Figure 1
Mean length (cm) from birth through two years for each of the six study sites

Slika 1.
Srednja duljina (cm) od rođenja kroz dvije godine za svaku od 6 studijskih država.
Na osi x je dob (u danima), a na osi y je srednja duljina u cm

enrolled at birth and visited at home a total of 21 times at weeks 1, 2, 4 and 6; monthly from 2-12 months; and bimonthly in the second year.

The study populations lived in socioeconomic conditions favorable to growth. The individual inclusion criteria were: no known health or environmental constraints to growth, mothers willing to follow MGRS feeding recommendations (i.e. exclusive or predominant breastfeeding for at least 4 months, introduction of complementary foods by 6 months of age, and continued breastfeeding to at least 12 months of age), no maternal smoking before and after delivery, single term birth, and absence of significant morbidity. Term low-birth-weight infants were not excluded.

Eligibility criteria for the cross-sectional component were the same as those for the longitudinal component with the exception of infant feeding practices. A minimum of three months of any breastfeeding was required for participants in the study's cross-sectional component. Rigorously standardized methods of data collection and procedures for data management across sites yielded exceptionally

high-quality data. A full description of the MGRS and its implementation in the six study sites is found elsewhere (16).

The length of children was strikingly similar among the six sites (Figure 1), with only about 3% of variability in length being due to inter-site differences compared to 70% for individuals within sites (17). The striking similarity in growth during early childhood across human populations means either a recent common origin as some suggest or a strong selective advantage associated with the current pattern of growth and development across human environments (18).

Construction of the WHO Child Growth Standards

Of 1743 mother-child dyads enrolled in the MGRS longitudinal sample, 882 complied fully with the study's infant-feeding and non-smoking criteria and completed the follow-up period of 24 months. This sample was used to construct the WHO standards from birth to 2 years of age combined with 6669 children from the cross-sectional sample from age 2-5 years (19). Data from all sites were pooled to construct the standards (17). The

generation of the standards followed state-of-the-art statistical methodologies that are described in detail elsewhere (7, 20).

Weight-for-age, length/height-for-age, weight-for-length/height, and body mass index-for-age percentile and z-score values were generated for boys and girls aged 0-60 months. The concordance between the smoothed curves and observed or empirical percentiles was excellent and free of bias at both the median and the edges, indicating that the resulting curves are a fair description of physiological growth of healthy children (7). Detailed results of the MGRS study and the construction of the growth standards are available elsewhere (6, 7). The full set of tables and charts is presented on the WHO website (www.who.int/child-growth/en), together with tools such as software for PC and PDA and training materials that facilitate their application.

Windows of achievement for the six gross motor milestones collected in the MGRS (i.e. sitting without support, hands-and-knees crawling, standing with assistance, walking with assistance, standing alone and walking alone) are also available in a published paper and on the website (21). Standards for a second set of anthropometric variables (i.e. head circumference, mid-upper arm circumference, and triceps and subscapular skinfolds) were released in 2007; and growth velocity standards for weight, length, and head circumference will be made available in 2008 (22).

Innovative aspects of the new standards

The WHO Child Growth Standards were derived from children who were raised in environments that minimized constraints to growth such as poor diets and infection. In addition, their mothers followed healthy practices such as breastfeeding their children and not smoking during and after pregnancy. The standards depict normal human growth under optimal environmental conditions and can be used to assess children everywhere, regardless of ethnicity, socioeconomic status and type of feeding.

Another key characteristic of the new standards is that they explicitly identify breastfeeding as the biological norm and establish the breastfed child as the normative model for growth and development. As an advocacy tool for the protection and promotion of breastfeeding, the new standards have the potential to significantly strengthen health policies and public support for breastfeeding.

Third, the pooled sample from the six participating countries allowed the development of a truly international reference that underscores the fact that child populations grow similarly across the world's major regions when their health and care needs are met. It also provides a tool that is timely and appropriate for the ethnic diversity seen within countries and the evolution towards increasingly multiracial societies in the Americas and Europe as elsewhere in the world.

Fourth, the wealth of data collected allows not only the replacement of the current NCHS international references on attained growth (weight-for-age, length/height-for-age, and weight-for-length/height) but also the development of new standards for triceps and subscapular skinfolds, head and arm circumferences, and body mass index. These innovative references allow for more specific nutritional assessment of aspects of body compositions and are thus particularly useful for monitoring the increasing epidemic of childhood obesity.

Fifth, the study's longitudinal nature also allows the development of growth velocity standards. Pediatricians will not have to wait until children cross an attained growth threshold to make the diagnosis of undernutrition or overweight since velocity standards will enable the early identification of children in the process of becoming undernourished or overweight. Lastly, the development of accompanying motor development reference data will provide a unique link between physical growth and motor development. Although WHO issued guidelines in the past concerning attained physical growth, it has not previously made recommendations for assessing motor development.

To complement the growth standards for children under-five years of age, WHO recently developed a growth reference for school-aged children and adolescents (23). These curves are closely aligned with the WHO Child Growth Standards at 5 years, and the recommended adult cut-offs for overweight and obesity at 19 years. They fill the gap in growth curves and provide an appropriate reference for the 5 to 19 years age group. The full set of clinical charts and tables displayed by sex and age are available on the WHO website (www.who.int/growthref/en).

Conclusions

The WHO standards provide an improved tool to monitor the rapid and changing rate of growth in early infancy (24). They also demonstrate that healthy children from around the world who are raised in healthy environments and follow recommended feeding practices have strikingly similar patterns of growth (17). The ancestries of the children included in the WHO standards were widely diverse. They included peoples from Europe, Africa, the Middle East, Asia and Latin America. In this regard they are similar to growing numbers of populations with increasingly diverse ethnicities. The growth of the children in the various sites was very similar because their environments were similarly healthy. This indicates that we should expect the same potential for growth in any country. It also implies that deviations from this pattern must be assumed to reflect adverse conditions that require correction, e.g. lack of breastfeeding, nutrient-poor or energy-excessive complementary foods, unsanitary environments, deficient health services and/or poverty.

Since the WHO standards were released in 2006, numerous countries using the NCHS reference and others that have been using their own national charts, have adopted the new WHO standards, and many other countries are in the process of doing so. The shift in growth charts provides a unique opportunity to underscore the importance and utility of monitoring child growth; to rethink and redesign surveillance systems so

that they are more useful in decision-making and less burdensome in terms of data collection; and, most importantly, to promote infant and young child nutrition within the context of broader efforts that encompasses maternal and child health, full immunization, and adequate attention to physical, motor and cognitive development.

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Sažetak

NOVI STANDARDI SVJETSKE ZDRAVSTVENE ORGANIZACIJE ZA PROCJENU RASTA DJECE

M. de Onis

Svjetska zdravstvena organizacija (SZO) izradila je standarde za procjenu rasta djece ranih 90-ih godina prošlog stoljeća uz već postojeće pomno evaluirane referentne vrijednosti za rast dobivenih od Nacionalnog Centra za Zdravstvenu Statistiku (engl. NCHS) koji su u internacionalnoj uporabi od kasnih 70-ih godina. Pregledni članak ukazuje na manjkavosti postojećih standardnih krivulja i referentnih vrijednosti, i potrebu razvoja novih krivulja rasta koje bi se mogle koristiti za praćenje djece u svim zemljama radije nego samo za praćenje djece koja žive u pojedinim državama ili vremenu. Rezultat ovog plana i potreba za novim standardima bila je Multicentrična Studija SZO za razvoj referentnih vrijednosti rasta (1997. do 2003.) u kojoj su se primijenile stroge metode prikupljanja podataka, a koja je poslužila i kao model za suradnju u izvođenju internacionalnih istraživanja. Studija je dala čvrste temelje za razvoj standarda jer je uzorak temeljen na zdravoj djeci koja su živjela u takvim životnim uvjetima koji su omogućavali potpuno postizanje genetskog potencijala rasta. Dalje, majke djece selektirane za konstrukciju ovakvih standarda bile su angažirane oko osnovnih aktivnosti vezanih uz promociju zdravlja, a to su dojenje i ne pušenje. Druge važne osobine studije su da su bila uključena djeca iz različitih zemalja (Brazil, Gana, Indija, Norveška, Oman i SAD) te da se dojenje eksplicitno definiralo kao biološka norma, a da je dojeno dijete normativni model za rast i razvoj. Tako umjesto NCHS referentnih vrijednosti za rast temeljenih na djeci iz jedne države, koriste se referentne vrijednosti dobivene istraživanjem djece iz internacionalne grupe. Novi standardi upućuju da djeca iz cijelog svijeta rastu identično kada su zadovoljeni uvjeti za postizanje zdravog rasta i razvoja. Novi standardi SZO za procjenu rasta djece su tehnički gledano robusna metoda za određivanje dobrobiti dojenčadi i male djece. Standardi opisuju normalan rast pod optimalnim okolišnim uvjetima i mogu biti korišteni za procjenu rasta djece svugdje u svijetu, bez obzira na etnicitet, socioekonomski status i vrstu hranjenja.

Deskriptori: STANDARDI ZA PROCJENU RASTA, PREKOMJERNA TJELESNA TEŽINA, DEBLJINA, SMANJENA TJELESNA TEŽINA, ZASTOJ RASTA, GUBITAK NA TEŽINI