

The WHO Multicentre Growth Reference Study (MGRS)

¹Sampriti Debnath

Abstract: The World Health Organization (WHO) Multicentre Growth Reference Study (MGRS) (1997-2003) was a community-based, multi-country project in collaboration with other institutions to formulate new growth references for infants and young children. This study was a combination of a longitudinal study and a cross-sectional study. The subjects had favourable socio-economic conditions to grow with low mobility. Other inclusion criteria were absence of health or environmental constraints on growth, absence of maternal smoking and breast fed children and adherence to the feeding recommendations by MGRS. Data was collected from 8,500 children from Brazil, Ghana, India, Norway, Oman and the United States of America. This study has published the standards which describe how healthy children should grow under optimal health and environmental condition. The growth charts formulated by the MGRS study are also known as WHO growth charts. The standards formulated by this study which are applicable to all the children worldwide irrespective of ethnicity, feeding practices and environmental diversity.

Keywords: Anthropometry, nutrition, growth charts, growth reference, growth standard, MGRS, WHO.

Introduction

Growth references is a valuable tool for assessing the general well-being of individuals, children, communities in which they live and for tracking progress in reaching a range of health and other, broader goals related to social equity (de Onis et al., 2004). It is also used as a common basis for purposes of comparison of growth (WHO Working Group on Infant Growth, 1995). According to Cameron (2002), a growth reference is essentially a database defining the statistical distribution of one or more measures of size or growth, indexed by sex, age and/or other factors.

According to the World Health Organization (WHO), the growth references formulated by NCHS (1977) and CDC (2000) did not represent the early childhood growth adequately because of some methodological problems later observed in these two references. Hence, formulation of new references became necessary. The use of a growth standard is more convenient than the use of a convenient scale for comparison. The growth standard implies a norm or desirable target and the basic concept of a standard is that environment has a greater effect on early childhood growth than genetics. Therefore, the growth pattern of young children reared in optimal conditions should represent a standard (Duggan, 2010).

The WHO, in collaboration with a number of institutions worldwide, subsequently conducted a community-based, multi country study and developed new growth references for infants

¹ UGC-Junior Research Fellow, Department of Anthropology, University of North Bengal, Raja Rammohanpur, Darjeeling-734013, West Bengal, In dia. Email: sampritidebnath@gmail.com

and young children. This is called the WHO Multicentre Growth Reference Study (MGRS) between 1997 and 2003. The MGRS formulated a growth standard for infants and children of less than 5 years of age. When the necessary aim of a study is to assess the nutritional well-being as a key outcome then it is necessary that numerous physiological processes must proceed normally and many needs must be fulfilled in foetal life and childhood if growth is to proceed normally. Therefore, to formulate a universally applicable growth reference these basic facts must be fulfilled by the reference population. These were taken into consideration in the MGRS. The MGRS considered the fact that all children grow very similarly for the first 5 years of life if their physiologic needs are met and the environments support their healthy development and nearly all inter-ethnic variability is probably a result of environmental affect.

Necessity of Developing the MGRS References

- There were many limitations of the earlier NCHS/WHO reference that was being used.
- Childhood obesity was increasing globally and to control the problem new references became necessary.
- WHO Department of Nutrition Working Group in 1994 noted a number of technical problems in the earlier NCHS/WHO international growth reference and concluded that these problems were sufficient to result in potentially harmful decisions in the nutritional management of individual infants and inaccurate population-based assessments (de Onis et al., 2004).
- Statistical techniques used in NCHS/WHO have some limited features and it became necessary to improve them.

Goal of WHO MGRS

The goal of MGRS was to provide an appropriate growth reference for the infant and young children growing in different regions around the world. The MGRS was designed to provide data that describe “*how children should grow on average, in all countries, when properly fed and cared for rather than merely describing how they grew at a particular time and place*” (WHO Multicentre Growth Reference Study Group, 2006). This was done by including in the selection criteria of the study specific behaviours that are consistent with current health promotion recommendations (e.g., breast-feeding norms, standard paediatric care, and non-smoking requirements) (Garza and de Onis, 2004).

The Unique Features of MGRS

1. In MGRS only healthy children living under conditions likely to favour the achievement of their full genetic growth potential were selected.
2. The study reduced the impact of environmental variation on growth by selecting the healthy and privileged population.
3. Mothers of the children selected were breastfeeding their infants and not smoking.
4. The study included children with ethnic and environmental diversity from a number of countries around the world (Brazil, Ghana, India, Norway, Oman and the U.S.).
5. The study has established the breast-fed child as the normative model for growth and development and identified breast-feeding as the biological norm.
6. The new MGRS standards included the scales for six main motor developmental milestones which were absent in the earlier international references.

The main hypothesis for developing the MGRS was that all young children have the potential to grow similarly, regardless of their ethnic group or place of birth, if they are in a

healthy environment and receive adequate nutrition. This hypothesis was subsequently confirmed.

Data Collection in MGRS

The primary growth data and related information were collected from 8,500 children from widely different ethnic backgrounds and cultural settings. The data was collected from Brazil, Ghana, India, Norway, Oman and the United States of America during the period from July 1997 to November 2003. The study included longitudinal follow-up of infants and young children (from zero to 24 months) and a cross-sectional survey involving children aged 18 to 71 months. The longitudinal study from birth to 2 years was with optimal infant-care practices (non-smoking mothers exclusively breast-feeding) and ongoing contact and support. The data collected on children aged 18 to 71 months were (in four of the six countries) based on single measurements and the technical methodology employed for sampling, anthropometry and analysis was 'state-of-the-art' and the database represents a 'standard' (Duggan, 2010). Only the children of mothers who complied with the MGRS feeding and with no-smoking criteria were included in the growth standards' sample (WHO MGRS GROUP).

The conditions for the selection of the reference population

- The study populations lived under socio-economic conditions favourable to growth
- Low mobility of the population
- Greater than 20 per cent of mothers were practising breast-feeding
- Growth was not environmentally constrained
- Socio-economic conditions were favourable to growth
- Low altitude of the residing area of the population
- Minimum of 20 per cent of the mothers were willing and able to follow specified infant feeding recommendations
- Existence of breast-feeding support system
- Local presence of qualified collaborative institutions
- Rate of hospital deliveries
- Sufficient number of eligible births
- Overall high parental education

Use of Anthropometry in MGRS

Anthropometry is a diagnostic tool for grading malnutrition (undernutrition and overnutrition). It has a long and honourable pedigree and it dates from Gomez' demonstration of the correlation between severity of weight-for-age and risk of death (Gomez et al., 1956; Duggan, 2010). It is a simple tool to assess nutritional status in individuals and communities. The anthropometric parameters used in MGRS to construct the growth reference were height, weight, arm circumference, head circumference, triceps skinfold and subscapular skinfold.

Data from India

The city of New Delhi, India was the Asian collection center of the WHO MGRS. A total of 58 affluent neighbourhoods in South Delhi were selected. At least one parent with 17 or more years of education of the selected child was the basic criterion which is the key for unconstrained growth of the child. The study started on January, 2000 and was completed towards the end of 2003. Over a period of 18 months a total of 111, 084 households were visited. To identify pregnant women whose new-borns were likely to be eligible for the longitudinal study were identified by a door to door survey conducted in the 58 selected neighbourhoods. For the cross sectional

study of children aged between 18 to 71 months were also identified by this survey for the inclusion in the MGRS cross-sectional component. Anthropometry and motor development sessions were conducted regularly. Standardization sessions for the new-borns were conducted in All India Institute of Medical Sciences (Bhandari et al., 2004).

Standards Obtained from MGRS

Before the MGRS, there were international references available only for attained length/height-for-age, weight-for-age and weight-for-length/height. The MGRS protocol was designed to approximate standards for these and several other attained anthropometric measurements: body mass index (BMI)-for-age, mid-upper-arm circumference-for-age, head circumference-for-age, triceps skinfold-for-age and subscapular skinfold-for-age. Additionally, velocity references were available for a number of growth parameters because of the longitudinal component of the MGRS (Garza and de Onis, 2004).

Difference from other International Growth References

The reference population in MGRS consist of participants from multiple countries with the variation in ethnicity and environmental situations. Unlike the NCHS/WHO international reference which was based solely on US children who as infants were predominantly formula-fed. In case of MGRS only the breast fed children with non-smoking mothers were taken into consideration. The study has explicitly identified breastfeeding as the biological norm and established the breastfed child as the normative model for growth and development. Therefore, the differences in the 2006 growth pattern from the previous reference for children of less than 5 years are attributed to differences in infant feeding (Duggan, 2010). The MGRS has given the standards rather than a reference.

Differences between Growth Patterns in the New Who 2006 and Previous Nchs/Who Studies

After the publication of the new WHO standard in 2006, differences have been reported in the median trajectories (growth curves) for height and weight for the age groups under study and the 1983 data set. These differences were attributed to the differences in infant feeding practices between the two cohorts (de Onis et al. 2006; Duggan, 2010). Moreover, the growth patterns in the multi-country study would differ from the US based sample and these can be summarised as: according to the growth curves of WHO 2006, the exclusively breast fed boy would be taller and heavier than the formula fed boy in NCHS/WHO during the first 1month to 6 months, but afterwards until he reaches 5 years he would be lighter than the NCHS/WHO reference counterpart. The WHO 2006 growth curves also showed that the boy slightly shorter than NCHS/WHO reference boy in late infancy overtook the NCHS/WHO reference boy during the second year and after that remains slightly taller and less bulky (Duggan, 2010). Another important difference in the growth patterns of these two are the spread of values in the data sets and it is narrower both for height and weight in the new study (WHO MGRS 2006).

Limitations of MGRS

In MGRS the study was limited to the children of zero to 5 years of age group therefore the standards established from this study published as WHO growth standards (2006) is not applicable for the children of higher age groups. Thereafter in 2007 WHO published a new data set for children of 5 years to 19 years.

Conclusion

The MGRS was an ambitious undertaking and the goals established on initiation of the study have been achieved successfully. The MGRS is unique in that it was purposely designed to produce a standard rather than a reference. The WHO charts are growth standards that describe how healthy children should grow under optimal environmental and health conditions. Use of the 2006 WHO international growth standard for the assessment of growth among all children aged less than 24 months, regardless of type of feeding or feeding practices, is recommended by WHO. When using the WHO growth charts, values of 2 standard deviations above and below the median, or the 2.3rd and 97.7th per centiles (labelled as the 2nd and 98th per centiles on the growth charts), are recommended for identification of children whose growth might be indicative of adverse health conditions. Growth of children, less than 5 years was recorded in MGRS and involved children from six countries. The MGRS therefore constitute a growth standard.

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