DEPARTMENT OF **HEALTH AND COMMUNITY SERVICES**

DISCUSSION PAPER

Child Growth Charts
In the Northern Territory 08

Northern Territory Government

Child Growth Charts In the Northern Territory

Discussion Paper

Consideration of the 2006
WHO growth standards

Discussion and Recommendations

March 2008

This document may be found online at:
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Introduction

The purpose of this paper is to provide information about the new World Health Organisation (WHO) growth standards and growth references to help inform the decision about which growth reference is most appropriate for use in the Northern Territory (NT).

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The authors would like to acknowledge the Discussion Paper *Towards a Queensland Health Position on the use of Child Growth Standards (April 2007)* by Queensland Health in the preparation of this paper.[1]

Background

National Centre for Health Statistics (NCHS) growth references have been in use since the late 1970's. Centre for Disease Control (CDC) in the United States of America, revised these references and released new charts in 2000 that are based on 5 national surveys.

In 2006 the WHO released a new set of growth standards and charts, based on data from the Multi-centre Growth Reference Study (MGRS).[2] The WHO recommends the application of these standards for all children worldwide, regardless of ethnicity, socioeconomic status and type of feeding.[3] A large number of countries have officially adopted the new standards and many others are in the process of doing so.

In 2002 the Australian National Health and Medical Research Council (NHMRC) recommended the use of the CDC 2000 growth standards[4] and most states and territories have, or are in the process of implementing this recommendation. The NHMRC does not currently plan to consider the WHO growth standards. However, there has been strong support for the WHO charts by various bodies and one of the earlier criticisms that they were only available for children from age 0-5 years is now invalid, with the release of growth references for children 5-19 years of age. The growth charts and background information are available at www.who.int/childgrowth/en/

Use of Growth Charts

Currently growth reference data and growth charts are used in a number of ways.

1. as a surveillance tool to monitor the pattern of an individual child's longitudinal growth. Aiming to identify growth faltering which may indicate underlying physical ill-health, deprivation or neglect and allow early intervention,
2. as a screening test at a single point of time to indicate possible abnormalities, eg short stature may indicate investigation for Turners Syndrome,
3. as an eligibility criteria for growth hormone replacement,
4. as a surveillance tool for individual children aiming to identify early features of obesity and allow intervention to occur and
5. for analysis and reporting of population growth data and trends.

Recently growth monitoring has come under scrutiny, and has been criticised as a waste of valuable time and a cause of unnecessary parental anxiety. A Cochrane review concluded there was insufficient evidence that routine growth monitoring is of benefit to child health in either developing or developed countries.[5] A review of the evidence concerning growth monitoring and surveillance could find little evidence for monitoring weight beyond 12 months[6].

There is however a strong support for monitoring growth using growth charts. The National Aboriginal Community Controlled Health Organisation (NACCHO) recommends growth monitoring, as a minimum, to coincide with the routine immunisation schedule because of high rates of growth failure in Aboriginal and Torres Strait Islander children[7]. Programs of growth monitoring and intervention occur throughout urban and remote services in the NT. There is a concern about increasing prevalence of overweight and obesity in children and adolescents in Australia and references are needed both for assessment and monitoring of individual children and of populations. Growth charts are used universally in paediatric care[8].

Growth references and standards

NCHS (1977)

The National Centre for Health Statistics / WHO growth reference has been in use to chart children's growth since the 1970's.[9] This reference was produced using cross-sectional data from the United States National Health Examination Survey (NHES II, 1963-65 for ages 6-11 years, NHES III. 1966-70 for ages 12 -17 and National Health and Nutrition Examination Survey NHANES I, 1971-74 for ages 4 -17 years). Data for birth to 3 years of age was obtained from a longitudinal growth study of the Fels Institute in Yellow Springs Ohio, of mostly formula fed, Caucasian, middle class infants from a small geographic area of Ohio between 1929 and 1974. In 1978 the WHO produced a normalised chart allowing expression of measurements in Z scores. In 1991 BMI for age reference was developed but only covered the age groups above 9 years. The major concern about the NHCS growth charts is that the data was obtained from an unrepresentative group of infants who were mostly artificially fed, and that measurements were made infrequently.

CDC (2000)

In 2000, the Centre for Disease Control, Atlanta (CDC) produced a revised set of reference growth curves. These are based on more recent data solely collected from the USA National Health and Nutrition Survey (NHANES) program.[10] Data collection took place between 1963 and 1994 in 5 cross sectional, nationally representative health examination surveys. Exclusions from the survey were made for: (1) very low birth weight infants (birth weight <1500g) as these infants are known to grow differently from normal birth weigh babies, (2) data from NHANES III (1988-94) for children 6 or older because their inclusion would have significantly increased the cut-offs for overweight, (3) infants whose recumbent length and standing height differed by more than 5 cm (11 children) and (4) data from 2 children because a measurement was extreme.

The data from the 5 surveys was combined with a target sample size of 400-500 at each age group in order to generate precise percentile lines. Statistical methods were applied to obtain smooth curves. The population used to generate these charts is considered to be racially and ethnically diverse, and a better representative sample of the US population than the NHCS (1977) charts. Additional growth curves based on Body Mass Index (BMI) and weight for height are available.

NHCS and CDC growth curves are similar with some minor differences seen for infants. CDC describes the chart as a growth reference, which is defined as a tool enabling comparisons to be made.

Criticisms of the CDC growth charts include (1) that the infants were still predominantly artificially fed. Only about half of NHANES III mothers initiated breast feeding and only 21% exclusively breast fed for 4 months, (2) that sample size is small especially in the first 6 months (<100 per age group), (3) that there is a skew towards higher weight especially in the older age groups probably because of increasing rates of obesity, and (4) that variability is high probably due to the combining of a number of data sets.

WHO (2006)

The WHO, in collaboration with a number of academic institutions worldwide, undertook a Multi-centre Growth Reference Study (MGRS), a community-based, multi-country project to develop new growth standards for infants and young children[11] [12]. The study involved children from 6 countries representing different regions of the world: Brazil, Ghana, India, Norway, Oman and the United States. Criteria for inclusion of study sites included socioeconomic status that does not constrain growth, indicated by low infant mortality rates, and rates of stunting wasting and underweight < 5% at 12-23 months of age. Other characteristics of sites included altitude < 1500 metres above sea level, low mobility of the population to allow follow-up, at least 20% of mothers willing to follow the feeding recommendations, and existence of breastfeeding support services. Eligibility criteria for individual mothers and children included: (1) no health, environmental, economic constraints on growth (local criteria based on parent income or education were developed), (2) willingness of the mother to follow feeding recommendations which included exclusive or predominant breast feeding for the first 4 months*, starting complementary food by 6 months and continuing breast feeding to at least 1 year, (3) single birth, (4) absence of significant morbidity (a list of diagnosis was developed) and (5) absence of maternal smoking before and after delivery.

Total sample size was about 8500 children consisting of a longitudinal cohort of 1743 children followed from birth until 24 months, and a larger cross-sectional sample for the older age groups. Of the 1743 children followed longitudinally, there were 882 who complied with the constraints of the study. Between 67 and 220 infants from each of the 6 participating countries were included and the sample size was 238 boys and 454 girls for the infancy portion of the study. Data collection took place between 1997 and 2003.

In addition to weight and length measures, the new growth charts include motor developmental milestones, which were also monitored in the survey. A further set of charts comprising: mid upper arm circumference-for-age, head circumference-for-age, subscapular skin fold-for-age and triceps skin fold-for-age were released early in 2007[13].

**After the Multicentre Growth Reference Study commenced, the WHO changed infant feeding guidelines to recommend exclusive breastfeeding to 6 months of age. Infant feeding guidelines in Australia are consistent with this recommendation* [29].

WHO describes the growth charts for 0-5 years as growth standards describing 'normal' child growth under optimal environmental conditions. In other words, describing how children should grow, rather than measuring how child populations are growing.

Growth charts for children over 5 years were released in mid 2007 [14]. A decision was made that a multi-centre study similar to that used for under 5s was not feasible, because it would not be possible to control for environmental factors which may interfere with growth. It was also recognised that using a descriptive sample of a current population may not be appropriate because of the secular trend towards overweight. This would lead to upward movement of the growth reference and result in an underestimate of obesity and an overestimate of undernutrition.

Therefore a growth reference was constructed from existing historical data. After reviewing 115 available data sets from 45 countries, the NCHS/WHO 1977growth reference based on a non-obese sample was reconstructed. Sample size was 22,917. Outliers both for height and weight for age and BMI for age were removed from the data set (2.8% of boys and 3% of girls) to avoid the influence of unhealthy weights for height. Data was merged with the under 5's growth standards data and smooth growth curves generated. BMI charts were created for 5 – 19 year olds, the +1 SD at 19 years are equivalent to the overweight cut off for adults (25 kg/m^2) and +2 SD equivalent to the adult cut off for obesity (30 kg/m^2) [15]. WHO describes the charts for 5-19 year olds as a growth reference.

Criticisms of these charts mostly relate to the fact that they were produced from a highly selected group of children who are not representative of the real world, a point that could also be seen as strength.

Available charts

All WHO[16] and CDC[17] data are available as percentile charts for both males and females. CDC[17] data only provides tables to calculate Z scores, whereas Z scores from the WHO dataset are available as a chart (Table 1). Available software is shown in (Table 2).

Table 1 – Available charts

	WHO (percentiles and Z scores)	CDC (percentiles only)
Weight for age	0-6 months 0-2 years 6 months – 2 years 2 – 5 years 0-5 years 5-10 years	0-3 years 2-20 years
Length/ height/ stature for age	0-6 months 0-2 years 6 months – 2 years 2 – 5 years 0-5 years 5-19 years	0-3 years 2-20 years
Weight for length/ height /stature	0-2 years 2-5 years	0-3 years(45-103 cm) 2-5 years (77-121 cm) 2-20 years
BMI for age	0-2 years 2-5 years 5-19 years	2-20 years
Head Circumference for age	0-13 weeks 0-5 years	0-3 years
Others	• Mid upper arm circumference for age 3 months-5 years • Subscapular skinfold for age 3 months-5 years • Triceps skinfold for age 3 months – 5 years • Development gross motor milestones	
Under development	Weight, length and head circumference growth velocity standards.	

Table 2 - Available computer software

WHO[18]		CDC	
Software	**Description**	**Software**	**Description**
WHO Anthro 2005	Incorporates growth standards. Includes anthropometric calculator, individual assessment and nutritional survey tools.	Epi Info™	Includes NutStat which calculates percentiles and z-scores using either the 2000 CDC or the 1978 CDC/WHO growth reference
Macros	Available for SAS, S-Plus, and STATA.	SAS program	Generates a dataset that contains indices of the anthropometric status of children from birth to 20 years of age based on the 2000 CDC growth charts.
WHO Anthro mobile devices	Software for use on mobile devices running MS PocketPC 2003 or MS Windows Mobile 5.0	STAT Growth BP	Program for Palm OS or Windows Mobile Pocket PC[19]

Comparing WHO and CDC datasets[20]

1. **Weight for age.** (figures 1 and 2)
   Differences in weight for age curves are most marked in infancy. Children in the WHO standards grow faster and have higher mean weights than the CDC children in the first few months of infancy. At around 6 months the lines cross and children in the WHO study are on average lighter than the CDC children from 6-32 months after which the medians are similar to 60 months. Comparing the -2 SD cut offs for underweight there would be more children classified as underweight in the first 6 months of life using the WHO chart but less in the rest of childhood.

2. **Length and height for age** (figure 3)
   Length or height for age show similar shaped curves. On average WHO children are slightly taller than the CDC children. The WHO curves have much tighter variability and stunting rates would be higher for all age groups using the WHO charts.

3. **Weight for length and weight for height** (figure 4)
   The CDC children are on average heavier, so rates of overweight are higher when using the WHO standard, and rates of wasting lower.

4. **BMI for age** (figure 5)
   The curves are quite different reflecting obesity in the CDC sample. The +1 SD and +2 SD at 19 years of age match the adult cut-off points of BMI 25 (overweight) and 30 (obesity).

Figure 1:

Comparison of the WHO and CDC weight-for-age Z-score **curves for boys.**[20]

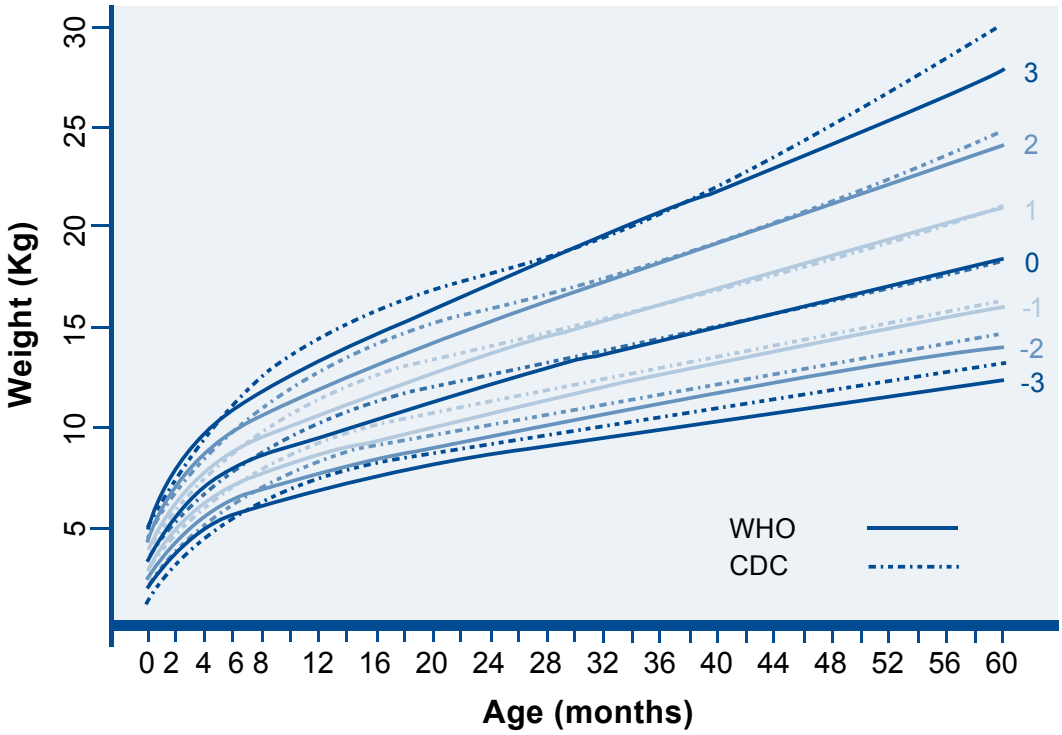


Figure 2:

The plots represent the 50th percentile line from the WHO chart, placed on the currently used Road to Health Chart (based on NCHS data)

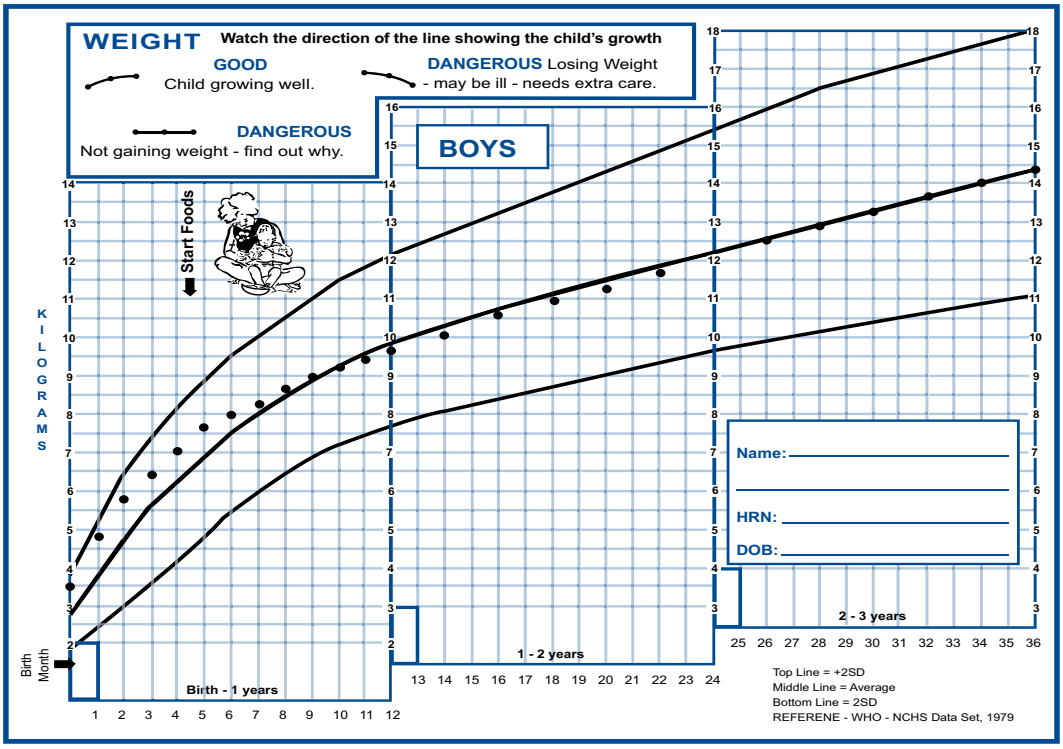


Figure 3:

Comparison of the WHO and CDC length/height-for-age Z-score curves for boys.[20]

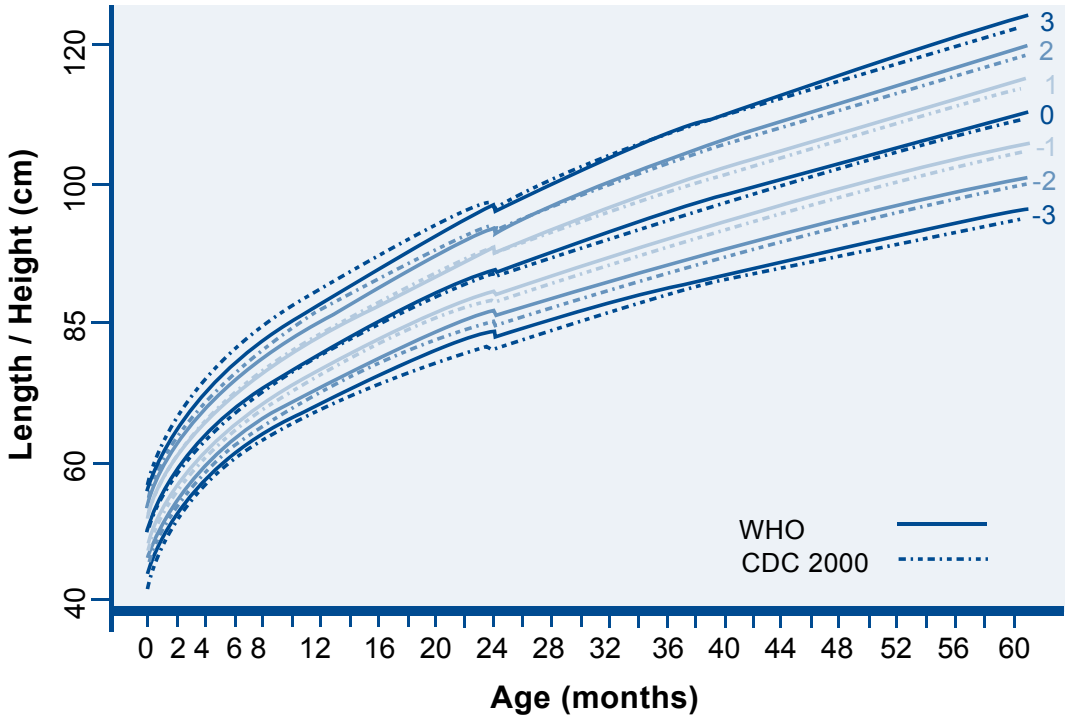


Figure 4:

Comparison of the WHO and CDC weight-for-length Z-score curves for boys.[20]

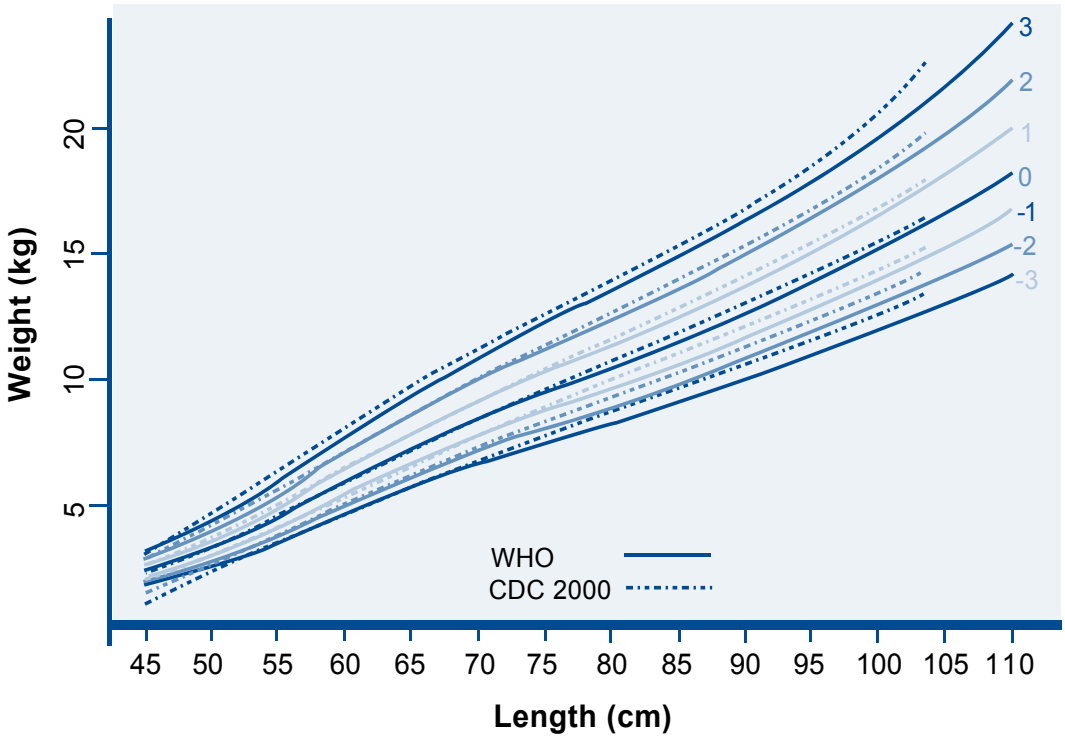
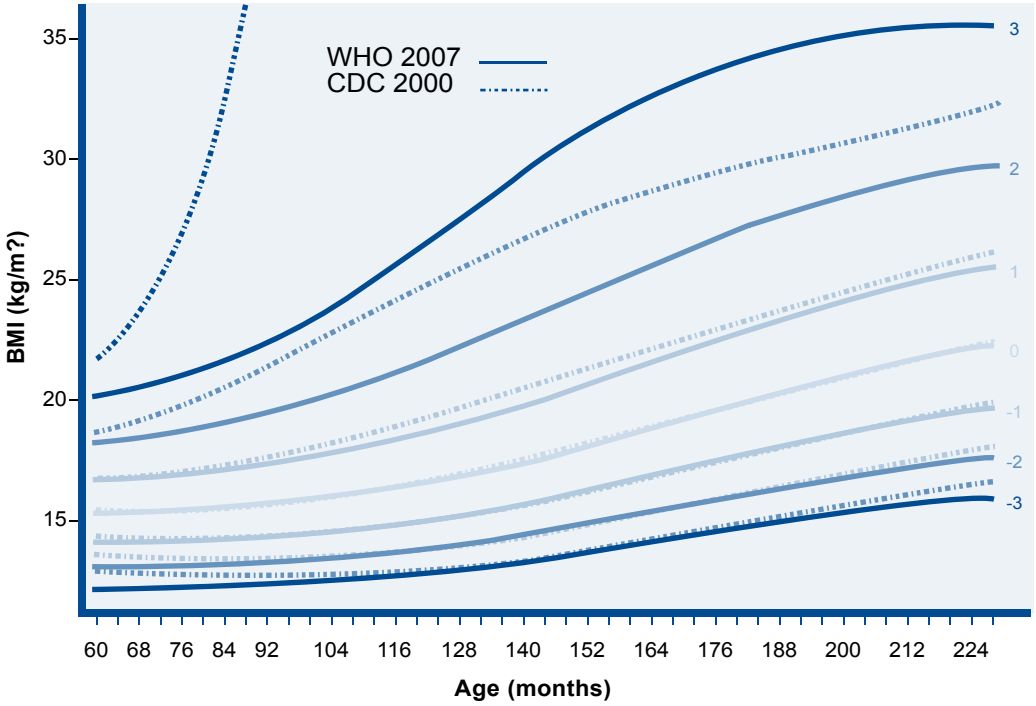


Figure 5:

Comparison of the WHO and CDC BMI Z-score **curves for boys 5-19years.**[21]



Use of growth charts

Internationally

The WHO recommends the application of their standards for all children worldwide, regardless of ethnicity, socioeconomic status and type of feeding. Many countries have officially adopted WHO growth standards, or are in the process of doing so [22]. In Latin America all countries except Cuba and Venezuela have decided to adopt them and are at various stages of implementation. Many countries in Asia (Bangladesh, Bhutan, Cambodia, India, Indonesia Laos, Malaysia, Mongolia Sri Lanka and Vietnam), the Middle East (Iran, Oman, Palestine and Yemen), and the Pacific (Fiji and New Zealand), are also at different stages of implementation. In New Zealand the WHO standard has recently been endorsed for the growth charts within the Well Child / Tamariki Ora Parent health record book, by the New Zealand Ministry of Health [23]. In Europe and North America, there has also been considerable interest in the new WHO growth standards. Canada, USA, UK, Denmark, France, Italy, Norway, Sweden and a number of Eastern European countries have undertaken formal reviews and will make public their decision soon.

WHO standards have been endorsed by a number of international bodies including the International Paediatric Association, the International Union of Nutrition Sciences (IUNS), and the United Nations Standing Committee on Nutrition (SCN).

Australia

The CDC growth standards have been widely implemented across Australia based on recommendations from the National Health and Medical Research Council (NHMRC) and the Australasian Paediatric Endocrinology Group [4]. These charts have been reproduced for the Australian market and are now available from Pfizer Australia, replacing the previous NCHS charts.

However, there has been strong support for the WHO charts by the Australian Medical Association (AMA), the Australian Breastfeeding Association, and the Public Health Association[24]. One of the recommendations arising from a Parliamentary Enquiry into the Health Benefits of Breastfeeding is that “the Minister of Health and Ageing, in consultation with state and territory health ministers, decide on a standard infant growth chart to be used in all states and territories”[25] Queensland Health has developed a discussion paper on the child growth standards and is currently developing a final position on this issue following consultation[1].

In Australia, most states include growth charts in hand held child health records given to parents at the birth of their child. Hospital paediatricians, general practitioners and medical services routinely use growth charts as part of the assessment of children referred to their services. Children with various chronic medical problems, including

endocrine problems are monitored using growth charts. Obesity in children and adolescents is becoming a great concern, and assessment tools are needed for both individuals and for populations. Professor Colin Binns, Co-Director Western Australia Centre for Health Promotion Research and lead author of Infant Feeding Guidelines and Dietary Guidelines for Australia (NHMRC), expressed concern about a change to WHO charts. He feels that the charts might actually discourage some women from breast feeding if their baby is not achieving the rapid weight gain indicated on the WHO charts in the first few months of life [25].

The Northern Territory

Remote indigenous children represent a significant proportion of the NT population. Data from Indigenous children in remote communities, and some urban communities show high rates of growth faltering in the first few years of life. Growth monitoring programs with intervention for children failing to thrive are in operation. Monitoring and accurately identifying individual children who are not growing normally is important, as is having the best population data about rates of inadequate growth. The accurate and early identification of overweight is also important because of the prevalence of obesity, early onset of type 2 diabetes and other chronic diseases.

Growth charts

For many years, growth charts based on the NCHS (1977) data set have been used for individual growth monitoring in the NT. Urban Community Health Centres and Hospitals have been using the Pharmacia charts (based on NCHS data). However, the Pharmacia charts have been discontinued and Pfizer have recently produced charts based on the CDC 2000 reference. In most remote communities the Road to Health Chart (based on the NCHS (1977) dataset) continues to be used.

With the recent upgrade of the Department of Health and Community Services Community Care Information System (CCIS) electronic charts have been developed based on the CDC 2000 dataset. There are a number of commercial computerised patient record management systems that have the facility to plot measurements on a growth chart. For example, Communicare, used by many Aboriginal Medical Services have used growth data from the WA Health Department. The source is unreferenced and unknown but looks like NCHS data.[26] [27] Ferret and Medical Director, used in many general practices have charts based on the CDC 2000 reference. NT government managed remote health centres will change to the electronic system, Primary Care Information System (PCIS) over the next few years. Programmers from PCIS and Communicare are awaiting guidance as to which charts are to be used in the NT.

Population Reporting

Unlike other jurisdictions, the NT has a population growth monitoring and reporting system. The Growth Assessment and Action (GAA) Program includes collection and analysis of routine growth measurements from government and non-government service providers and generates individual community reports as well as district and NT reports on stunting (<-2SD height-for-age), wasting (<-2SD weight-for-height), underweight (<-2SD weight-for-age) and anaemia (<11g/dl). In 2004 a report was also produced from routine growth measurements for indigenous and non-indigenous children attending urban Community Care Centres. This also included BMI for 4-6 year olds, and will become routine reporting practice in the future. Key performance indicators for primary health care developed via the NT Aboriginal Health Forum (Aboriginal Medical Services Alliance NT, Department of Health and Community Services and Office of Aboriginal and Torres Strait Islanders Health) include the proportion of children under five years who are underweight (<-2SD weight for age).

GAA reporting commenced in 1998 using the NCHS (1977) data set as the reference. Following the recommendations from NHMRC in 2002, the data set changed to CDC 2000 and previous data was reanalysed. This change resulted in an increase in the reported level of underweight and wasting. Table 3 shows the NT population rates of underweight, wasting and stunting using CDC and WHO datasets.

Table 3:
Comparison of rates of wasting, stunting and underweight in 0-5 year old children living in remote and urban NT communities using WHO and CDC data.

	Wasted		Stunted		Underweight		
	WHO	CDC	WHO	CDC	WHO	CDC	Source
Remote	4.1%	8.9%	17.6%	11.1%	8.1%	14.3%	GAA October 2004
Urban Indigenous	1.6%	3.9%	5.2%	3.0%	4.2%	6.0%	CCIS 2004
Urban Non-Indigenous	1.9%	4.1%	2.4%	1.3%	2.1%	3.6%	CCIS 2004

GAA - Growth Assessment and Action dataset (remote)
CCIS - Community Care Information System (urban)

Discussion

The most common and important reason to use a growth chart in the NT is for monitoring of a young child or infant's growth or as part of a health assessment. The WHO data set appears to have significant advantages especially in the 0-5 year age groups. The fact that the data is derived from a world population of infants who are receiving optimal nutrition and exclusively breast fed for the first 4 months, and that the chart can be used as a growth standard makes the WHO data set the preferred choice for use in the NT. We do not believe that the relatively rapid rise in weight in the first few months on these new standards will lead to unnecessary intervention. This is the pattern that we usually see in breast fed infants, and those infants whose growth is falling away from the growth percentile may well have issues which need intervention[28].

Apparent growth faltering in the second six months of life is seen when many healthy babies particularly Aboriginal infants, are plotted on the CDC or NHCS charts. The use of WHO charts will reduce this unnecessary anxiety and workload.

In the older children differences in BMI between the 2 data sets probably reflects the fact that the CDC sample is overweight. WHO data will identify more children who are overweight beyond infancy. Early identification of overweight and interventions need to be based on the best assessment tool.

There is a strong argument for consistency. Children frequently move from one health service to another, from one location to another and between community and hospital services. The use of different charts by different service providers will create confusion and reduce confidence in any chart as a tool for assessment of a child's growth. The need for consistency is great within the NT; consistency between States is also important but probably less so. Even so, either chart can be used to plot a growth curve for an individual child: looking at a longitudinal picture of the child's growth will to some extent overcome deficiencies of either chart.

Recommendations

We recommend that the NT should:

1. Adopt the use of WHO growth standards and references in all health services, for the following reasons:

    a. The data is derived from an internationally representative sample of infants and young children who received optimal nutrition including exclusive breastfeeding until at least 4 months of age*.

    b. The charts can be used as a growth standard from 0-5 years.

    c. The relatively rapid rise in growth in the first few months is what we see in exclusively breast fed infants and will not lead to unnecessary intervention.

    d. Overweight children will be identified earlier and more accurately allowing interventions to be made.

    e. The charts can be used as a growth reference for children 5-19 years who still require growth monitoring.

    f. There is a strong argument for consistency in use of charts between health services.

2. Report on growth data using WHO references.

3. Support a national approach to adopting a national standard growth chart to be used by all States and Territories.

**After the Multicentre Growth Reference Study commenced, the WHO changed infant feeding guidelines to recommend exclusive breastfeeding to 6 months of age. Infant feeding guidelines in Australia are consistent with this recommendation* [29].

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