

UK-WHO chart source data

Charlotte M Wright
Professor of Community Child Health
Academic Lead RCPCH growth charts working group

Tim J Cole
Professor of Medical Statistics
Member of RCPCH growth charts working group

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Introduction

The UK-WHO 0-4 year old charts were officially launched on May 11th 2009. Any child born after that date should be plotted on a UK-WHO Growth chart. Children born before May 11th 2009 are already plotted on British 1990 (UK90) charts and subsequent measurements will continue to be plotted using those charts. There will be no switch over of existing children to the new UK-WHO Charts. After age 4 we will revert to using UK90 charts.

The source data for these charts are included in two spreadsheets as LMS tables. Together they define the UK-WHO growth charts, containing LMS values by age. If the data are needed in centile or SDS lookup format they can be accessed via the LMSgrowth Excel add in (see below). We have also included data not yet incorporated into a paper chart - for example BMI and head circumference beyond 2 years.

These data and the LMSgrowth software can be freely used without charge as long as their source is acknowledged in any publications or products using them. Users may not claim any IP rights over them, derive financial gain from supplying the data to others, seek to restrict use of the data by others or use them for the purposes of advertising or promoting other products. Notwithstanding this limited grant of rights, the original copyright notices must continue to be reproduced in any copies of these materials.

Data files

There are two data files, each made up of three sections: a birth section, based on UK90 reference data, a postnatal section from 2 weeks to 4 years copied from the WHO standard, and for completeness the 4-20 years section from the UK90 reference:

UK_WHO_term.xls

Average values at birth for weight, length and head circumference (not BMI) for all term births (gestations 37 to 42 weeks) computed from the UK90 reference data base.^{1,2}

Acknowledgement statements using these data should specify the data source as: "British 1990 reference data, reanalysed 2009"

This is combined with the WHO standard for weight, BMI and head circumference from 2 weeks to 4 years, for length 2 weeks to 2 years and height 2-4 years. It is shown by week to 13 weeks and then by calendar month. They are exactly the same data as the LMS tables accessed from the WHO website (<http://www.who.int/childgrowth/standards/>) except that the data from birth to 2 weeks are omitted.

Acknowledgement statements using these data should specify the data source as:
"WHO Child Growth Standards"^{3,4}

The British 1990 section runs from 4 to 20 years by month, and includes height, weight, BMI and head circumference (to 18/17 years in boys/girls).

Acknowledgement statements using these data should specify the data source as:
"British 1990 reference"²

UK_WHO_preterm.xls

Weight and head circumference at birth by gestation from 23 to 42 weeks and length at birth from 25 to 42 weeks, computed from the UK90 reference data base and shown by week^{1,2}.

Acknowledgement statements using these data should specify the data source as:
"British 1990 reference data, reanalysed 2009"

This is combined with the WHO standard from 2 weeks post-term, and the British 1990 reference from 4 years, as described above.

Use of data files

These files should be used as follows:

Term infants

= infants born at or beyond 37 completed weeks gestation. *UK_WHO_term.xls* should be used for all term infants, with no adjustment for gestation. Centiles should not be computed between birth and 2 weeks.

Preterm infants

= infants born before 37 weeks completed weeks gestation. *UK_WHO_preterm.xls* should be used for all preterm infants for birth and subsequent measurements, using gestationally corrected age.

Gestationally corrected age

= actual age – (40 - gestation at birth)

Note this age will be negative until EDD is reached

Use of LMSgrowth Software

This software can be used to access the above files and manipulate growth data as required.

Files required for this are downloadable from:

<http://www.healthforallchildren.co.uk/pro.epl?DO=USERPAGE&PAGE=lmsdownload>

Instructions on Installation of Excel add-in LMSgrowth

1. Copy the data files above to the Excel startup folder
 - a. c:\Program Files\Microsoft Office\Office\XLStart for Windows 2000/XP or earlier versions of Office
 - b. c:\Program Files\Microsoft Office\Office 10\XLStart for Office XP or /Applications/Microsoft Office/Office/Startup/Excel for Mac OS X
2. Copy growth.xla, growth.hlp and growth.cnt to another directory, e.g. c:\growth in Windows
3. Start Excel, click File|New, then click Tools|Add-ins|Browse to locate growth.xla and click OK to confirm.

The Growth Add-in program is then installed. You will see the LMSgrowth menu appear on the menu bar. Acknowledgement statements for this add in should read "LMSgrowth programme version x.xx, authors Huiqi Pan and Tim Cole, copyright MRC 2002-10"

What LMSgrowth does

For those wanting to reproduce the workings of LMSgrowth in software, its algorithm to convert measurements to z-scores is as follows:

1. Look up in the LMS table for the relevant measurement (height or weight etc) the age-sex-specific values of L, M and S for the child, using either linear or cubic interpolation to get the exact age.
2. To obtain the z-score, plug the LMS values with the child's measurement into the formula

$$z = \frac{\left[\left(\text{Measurement} / M \right)^L - 1 \right]}{L \times S}$$

3. If required, convert the z-score to a centile using normal distribution tables.

The algorithm for the reverse process, from z-score or centile back to measurement, is as follows:

4. Repeat step 1 to obtain the LMS values for the child's measurement, age and sex.
5. The z-score is then converted back to a measurement with the formula

$$\text{Measurement} = M (1 + L \times S \times z)^{1/L}$$

6. This conversion is useful for example to obtain centiles to plot growth charts, where each centile is defined by its corresponding z-score.

References

1. Cole TJ, Freeman JV, Preece MA. British 1990 growth reference centiles for weight, height, body mass index and head circumference fitted by maximum penalized likelihood. *Stat Med* 1998;17:407-29.
2. Cole TJ, Freeman JV, Preece MA. 1998. British 1990 growth reference centiles for weight, height, body mass index and head circumference fitted by maximum penalized likelihood. *Stat Med* 17(4):407-29
3. WHO Multicentre Growth Reference Study Group. WHO Child Growth Standards: Length/Height-for-age, Weight-for-age, Weight-for-length, Weight-for-height and Body Mass Index-for age. Methods and Development. 2006. ISBN 92 4 154693 X.
4. WHO Multicentre Growth Reference Study Group. WHO Child Growth Standards: Head circumference-for-age, arm circumference-for-age, triceps skinfold-for-age and subscapular skinfold-for age. Methods and Development. 2007. ISBN 978 92 4 154718 5.