Adopting the WHO growth standard – lessons learned in the UK and beyond

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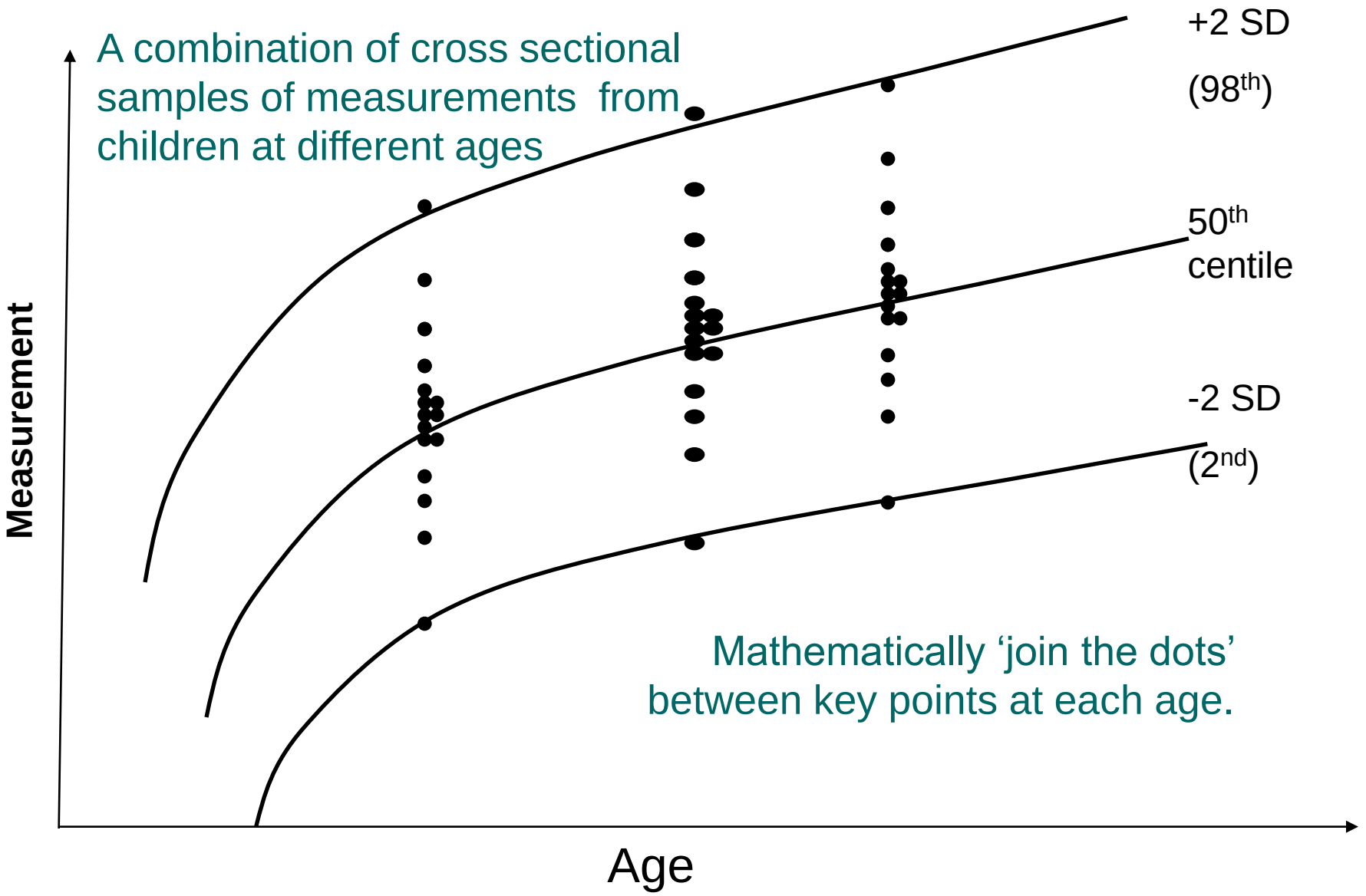
Summary

- How were the WHO growth charts made?
- How did the UK decide to adopt them?
- Validity for Hong Kong?
- How did the UK go about implementation?

How are growth charts made?

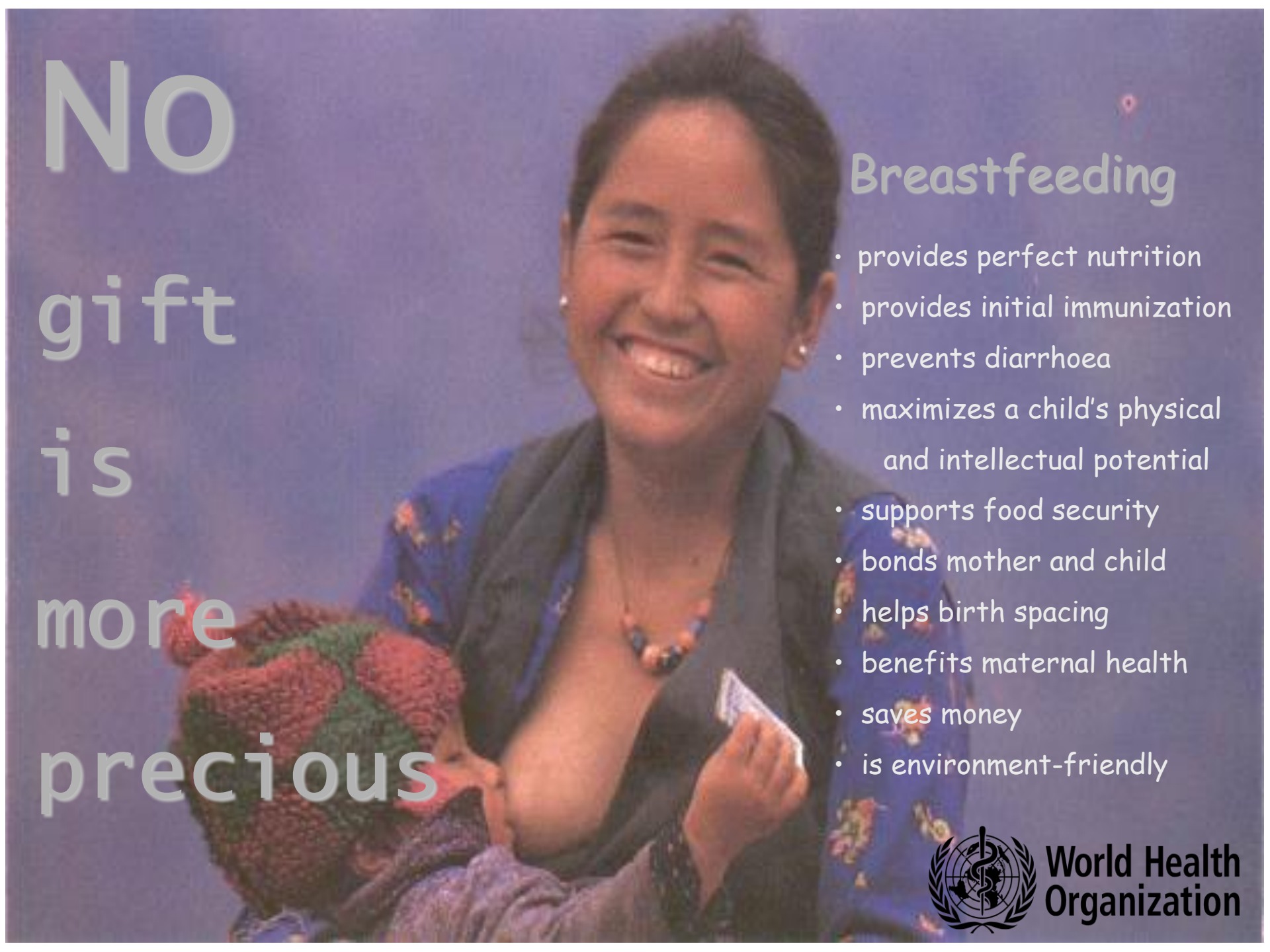


What should be the norm for comparison?

- A growth **reference** tells you how children compare to population patterns when the data were collected
  - Always out of date
  - Not necessarily healthy
- Only comparison to a growth **standard** can inform whether growth is healthy
  - Based on ideal or optimal population

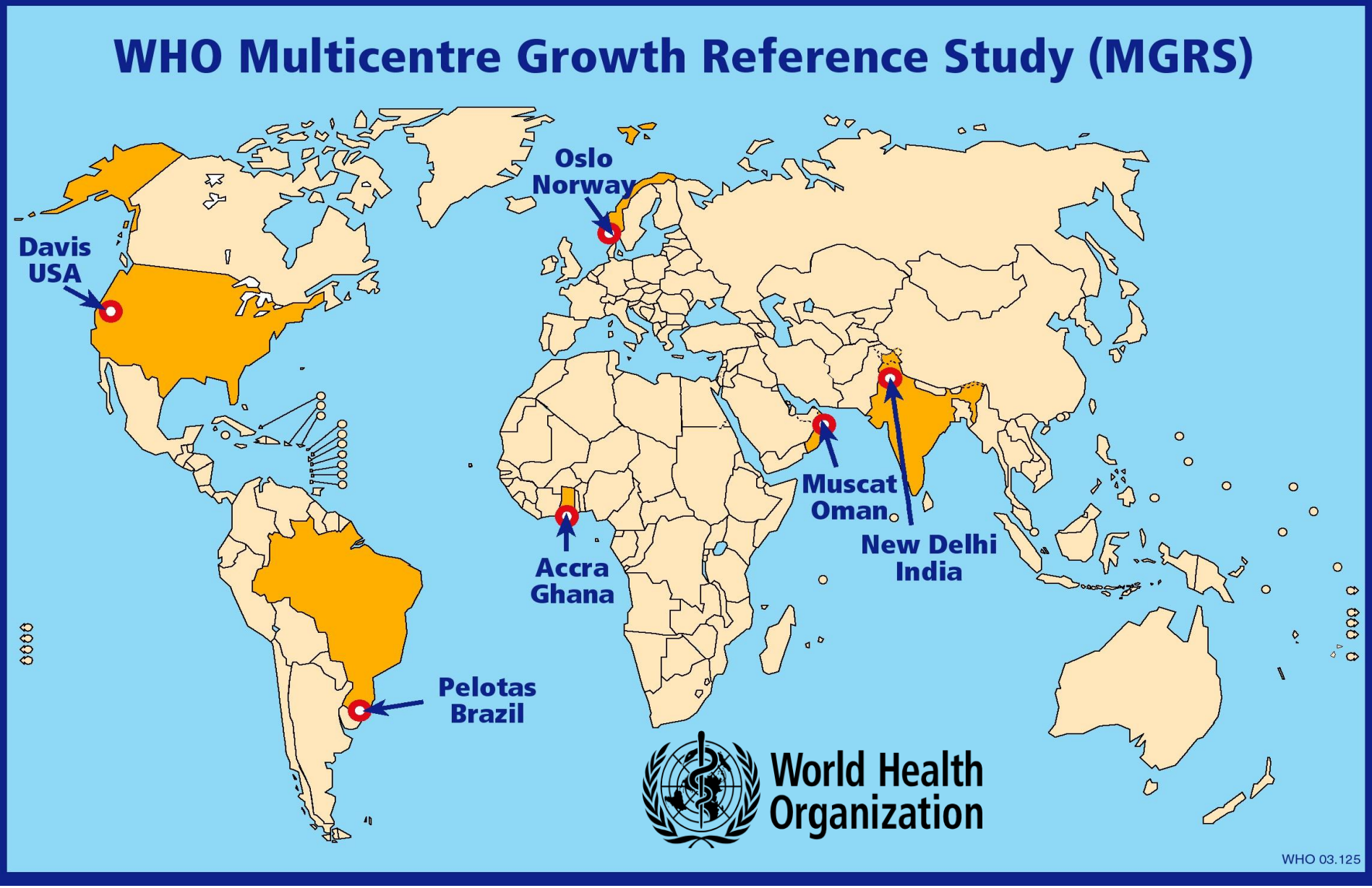
Ethnic variation in growth?

- Ethnic differences in stature appear to be largely environmental
  - Disappear after migration to more affluent countries
  - Secular trends to increased height with increasing affluence
- Growth in infancy remarkably similar throughout the world where children are breast fed and healthy
  - All growth charts prior to 2006 based mostly on formula fed infants


NO
gift
is
more
precious
Breastfeeding
• provides perfect nutrition
• provides initial immunization
• prevents diarrhoea
• maximizes a child's physical and intellectual potential
• supports food security
• bonds mother and child
• helps birth spacing
• benefits maternal health
• saves money
• is environment-friendly
World Health Organization

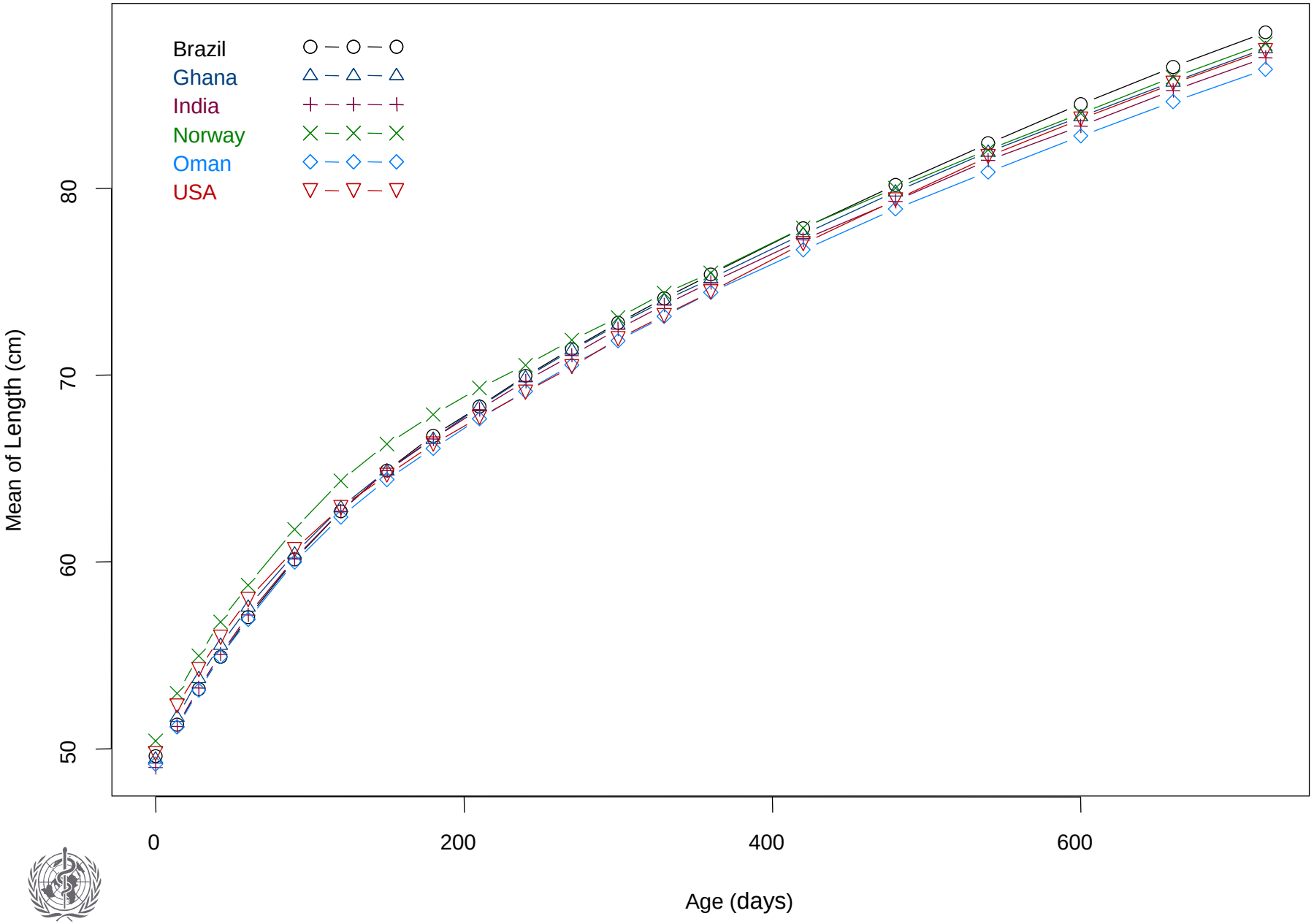
WHO MGRS programme

- 15 year programme to establish **standard** for healthy infancy growth
  - Derived only from optimally nourished children
  - Designed specifically to allow optimal chart construction
- Once established should never need to be re-made
- Assumes great similarity in growth world wide



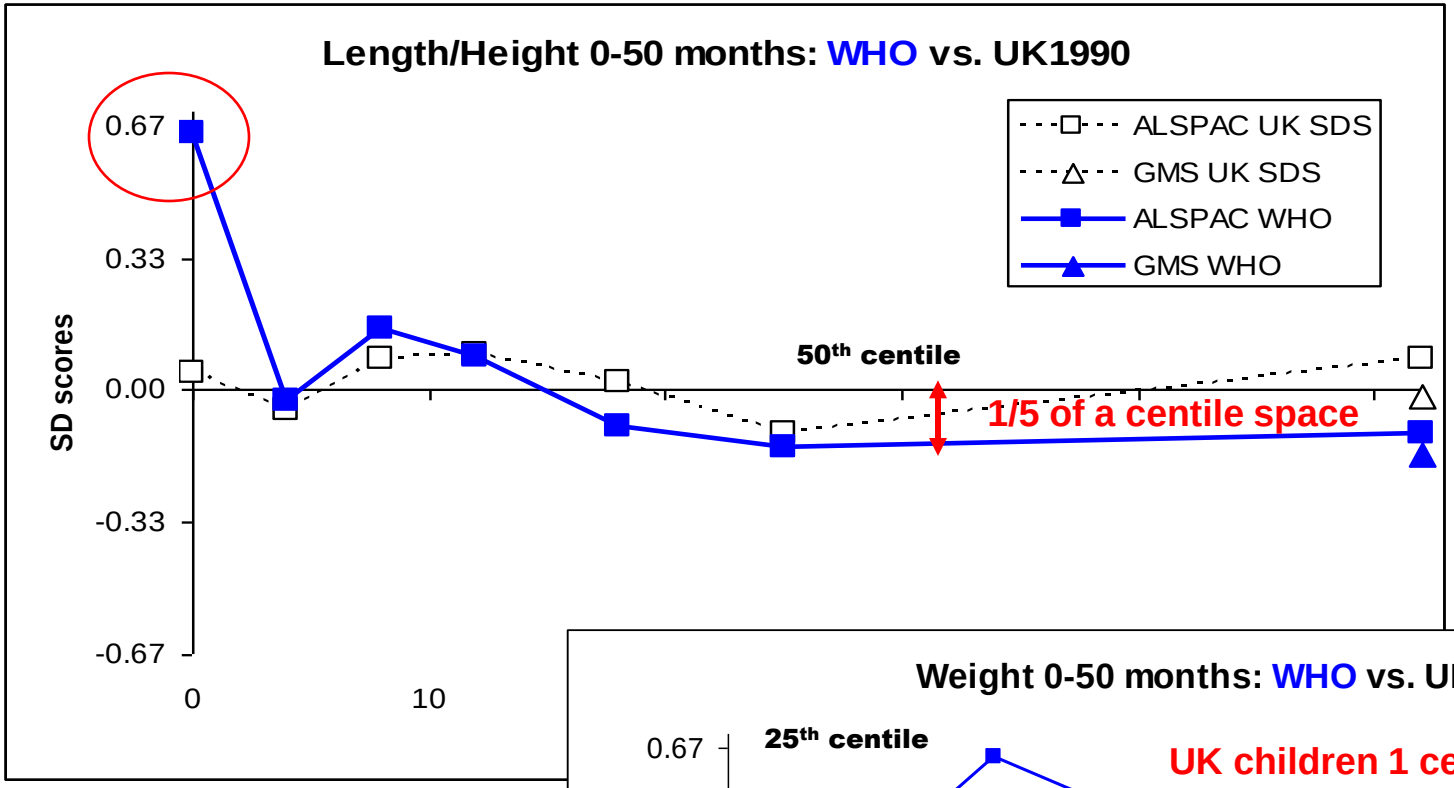
882 subjects: term, healthy, exclusively breast fed children of non smoking, non deprived mothers;

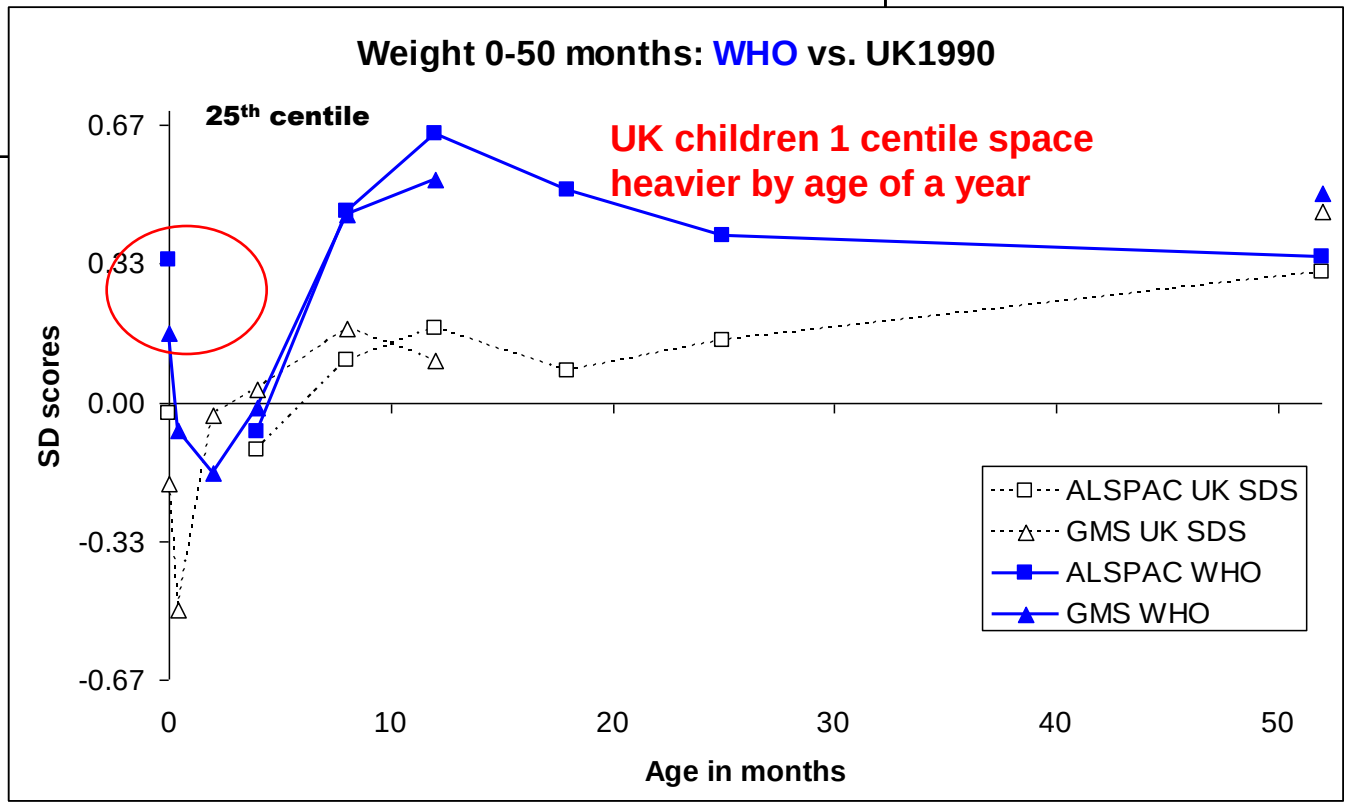
Mean length from birth to 24 months for the six MGRS sites



UK Scientific Advisory Committee on Nutrition (SACN) considered

- Are WHO Standards
  - Robust?
  - Valid for use in UK?
- What would be the implications (risks) of adopting them?
  - Growth patterns
  - Clinical thresholds


Length/Height 0-50 months: WHO vs. UK1990
0.67
0.33
0.00
-0.33
-0.67
SD scores
0
10
50th centile
1/5 of a centile space
ALSPAC UK SDS
GMS UK SDS
ALSPAC WHO
GMS WHO


Weight 0-50 months: WHO vs. UK1990
25th centile
UK children 1 centile space
heavier by age of a year
0.67
0.33
0.00
-0.33
-0.67
SD scores
0
10
20
30
40
50
Age in months
ALSPAC UK SDS
GMS UK SDS
ALSPAC WHO
GMS WHO

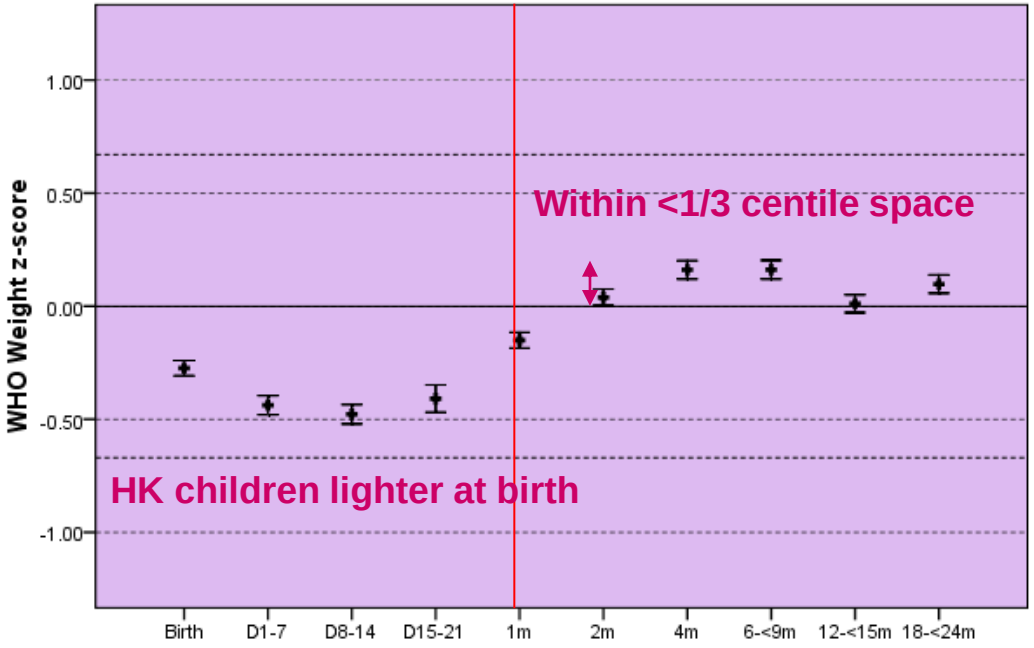
Why did the UK adopt?

- Sets the breast fed child as physiological norm
  - Powerful social marketing
- Cuts through arguments about ethnic variation and secular trends
- Sets lower norm for infancy weight gain
  - Obesity prevention
  - Reduces unnecessary worries about mild weight faltering

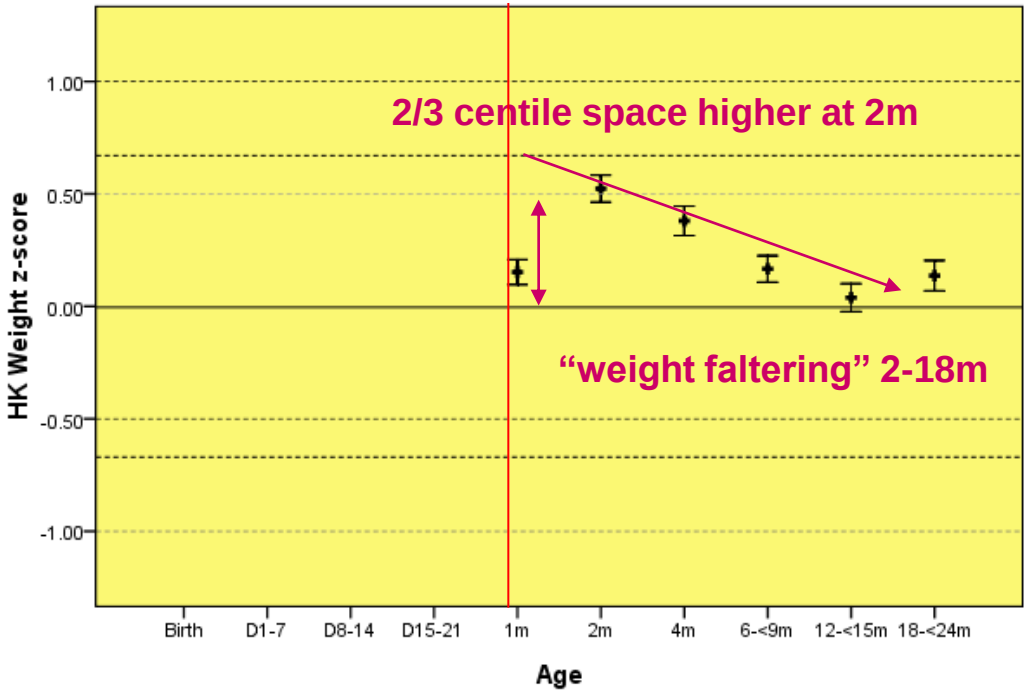
Hong Kong data

with thanks to
Eva WY Luk and
Shirley Leung

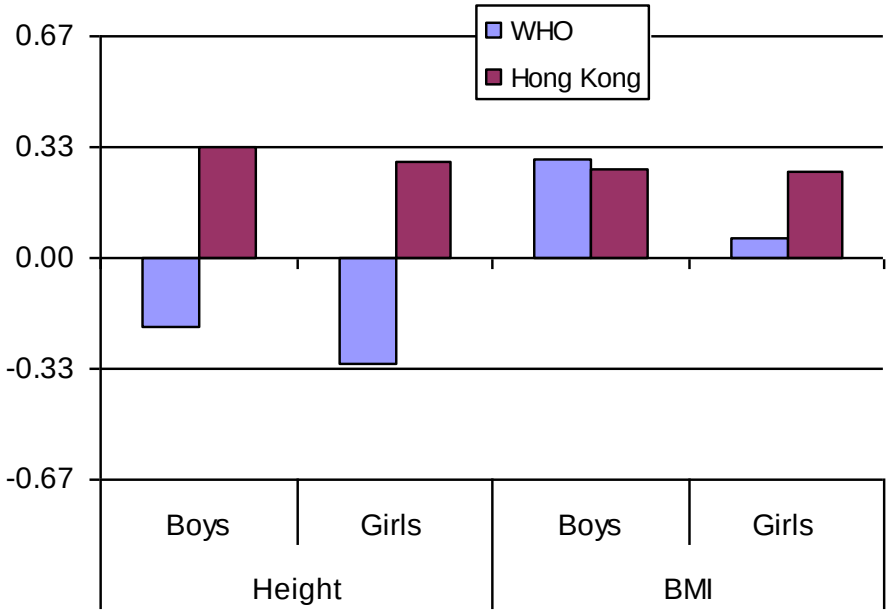
WHO



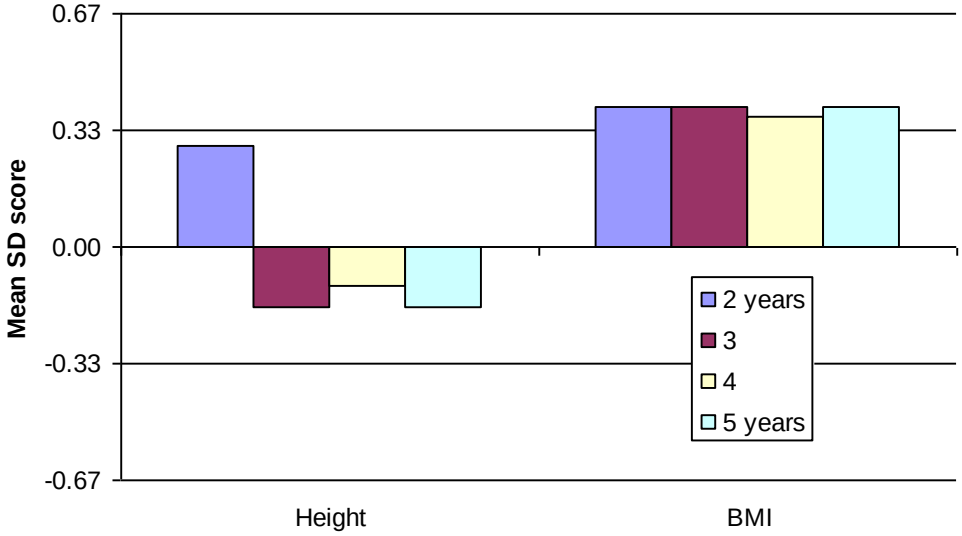
HK 1993



48-60 month old children born in 2006 attending maternal and child health centres in Hong Kong



S Korean data compared to WHO (with thanks to Jin Soo Moon)



What would be the implications (risks) of changing from HK 1993 reference to WHO standard?

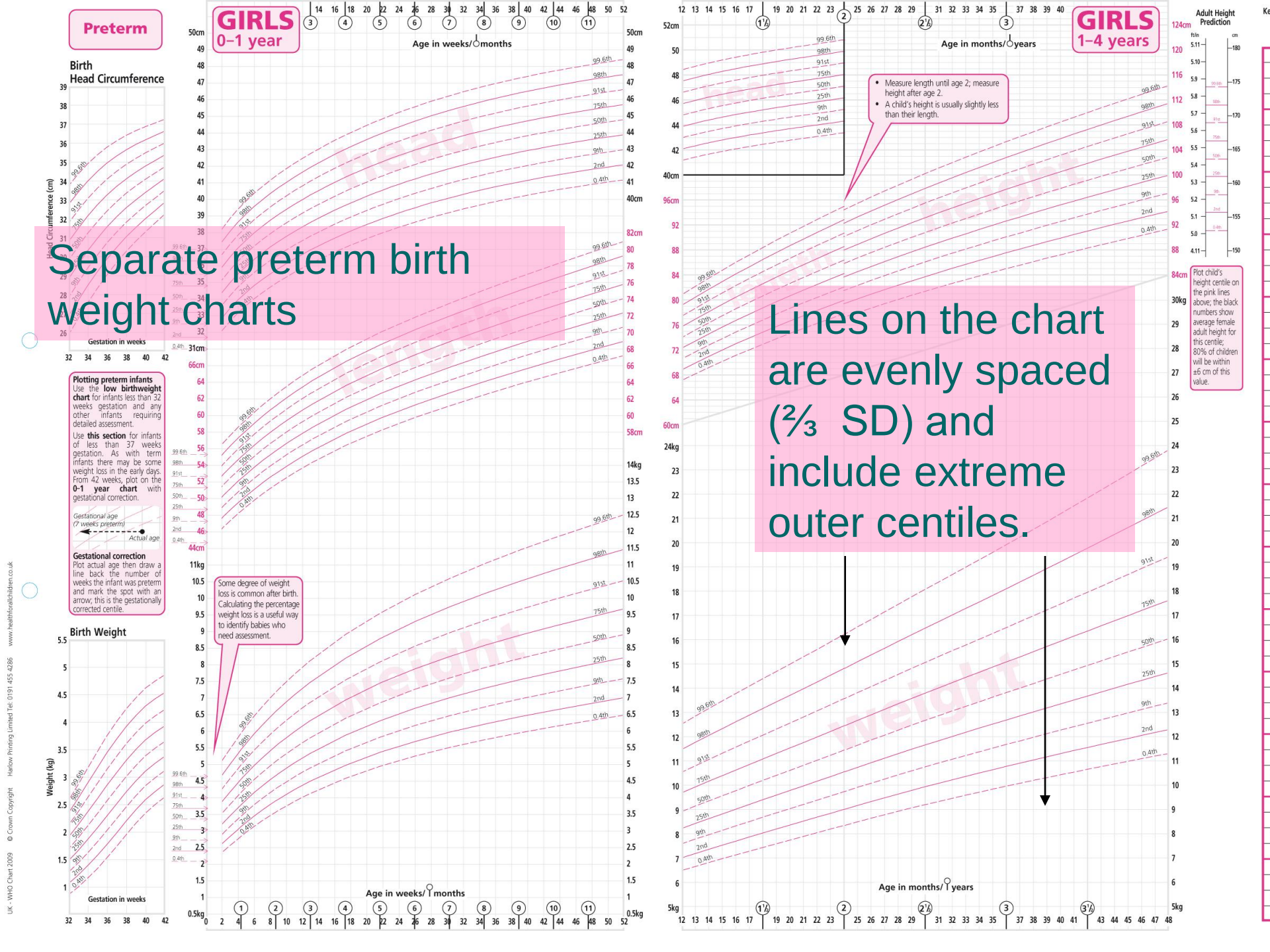
- Infants will appear relatively light at birth and in first month, but after that fit WHO standard for weight well
- More short stature (compared to HK 1993)
  - Change referral criteria?
- No effect on overweight

UK recommendations on implementation

- Adopt WHO from age 2 weeks to 4 years
  - Keep UK 1990 birth reference including preterm data
  - Restart UK 1990 at age 4 to avoid confusion at school entry check (age 4.5 to 5.5 years)
- Design
  - New charts
  - Supporting educational materials

Design process

- Expert team convened
  - Statistician, qualitative researcher, nurses, paediatricans
  - Designers appointed
- Concurrent evaluation
  - Initial parental consultation
  - Design questions tested with initial professional focus groups
  - Resulting prototypes and instructions tested with 7 further focus groups
- Stakeholder consultation


Preterm
GIRLS
0–1 year
Age in weeks/months
Birth
Head Circumference
Gestation in weeks
Head Circumference (cm)
Plotting preterm infants
Use the low birthweight chart for infants less than 32 weeks gestation and any other infants requiring detailed assessment.
Use this section for infants of less than 37 weeks gestation. As with term infants there may be some weight loss in the early days. From 42 weeks, plot on the 0–1 year chart with gestational correction.
Gestational age (7 weeks preterm)
Actual age
Gestational correction
Plot actual age then draw a line back the number of weeks the infant was preterm and mark the spot with an arrow; this is the gestationally corrected centile.
Birth Weight
Weight (kg)
Some degree of weight loss is common after birth. Calculating the percentage weight loss is a useful way to identify babies who need assessment.
Head
Weight
Age in weeks/months
GIRLS
1–4 years
Age in months/years
Measure length until age 2; measure height after age 2.
A child's height is usually slightly less than their length.
Adult Height Prediction
Plot child's height centile on the pink lines above; the black numbers show average female adult height for this centile; 80% of children will be within ±6 cm of this value.
Separate preterm birth weight charts
Lines on the chart are evenly spaced (⅔ SD) and include extreme outer centiles.
UK - WHO Chart 2009 © Crown Copyright Harlow Printing Limited Tel: 0191 455 4286 www.healthforallchildren.co.uk

GIRLS UK–WHO
Growth Chart 0–4 years

Department of Health · Royal College of Paediatrics and Child Health · World Health Organization

Please place sticker (if available) otherwise write in space provided.

Name: _____

NHS/CHI No: | | | | | | | | | | |

Hospital No: | | | | | | | | | | |

Date of Birth: | | | / | | | / | | | | |

Who should use this chart?

Anyone who measures a child, plots or interprets charts should be suitably trained, or be supervised by someone qualified to do so. For further information and training materials see www.growthcharts.rcpch.ac.uk

Growth charts for all children

The UK–WHO growth chart combines World Health Organization (WHO) standards with UK preterm and birth data. The chart from 2 weeks to 4 years of age is based on the WHO growth standard, derived from measurements of healthy, non-deprived, breastfed children of mothers who did not smoke.[1] The chart for birth measurements (32–42 weeks gestation) is based on British children measured around 1990.[2] The charts depict a healthy pattern of growth that is desirable for all children, whether breast fed or formula fed, and of whatever ethnic origin.[3]

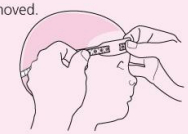
Weighing and measuring

Weight: use only class III clinical electronic scales in metric setting. For children up to 2 years, remove all clothes and nappy; children older than 2 years should wear minimal clothing only. Always remove shoes.

Length: (before 2 years of age): proper equipment is essential (length board or mat). Measurers should be trained. The child's shoes and nappy should be removed.

Height: (from 2 years): use a rigid rule with T piece, or stadiometer; the child's shoes should be removed.

Head circumference: use a narrow plastic or paper tape to measure where the head circumference is greatest. Any hat or bonnet should be removed.



When to weigh

Babies should be weighed in the first week as part of the assessment of feeding and thereafter as needed. Recovery of birthweight indicates that feeding is effective and that the child is well. Once feeding is established, babies should usually be weighed at around 8, 12 and 16 weeks and 1 year at the time of routine immunisations. If there is concern, weigh more often; however, weights measured too close together are often misleading, so babies should be weighed no more than once a month up to 6 months of age, once every 2 months from 6 to 12 months of age, and once every 3 months over the age of 1 year. However, most children do not need to be weighed this often.

When to measure length or height

Length or height should be measured whenever there are any worries about a child's weight gain, growth or general health.

Plotting measurements

For babies born at term (37 weeks or later), plot each measurement on a relevant chart by drawing a mark at where a vertical line through the child's age crosses a horizontal line through the measured value. The lettering on the charts ('weight', 'length' etc.) sits on the 50th centile, providing orientation for ease of plotting.

Plot birth weight (and, if measured, length and head circumference) at age 0 on the 0–1 year chart. The coloured arrows at age 0 represent UK birth weight data and show the child's birth centile.

Weight gain in the early days varies a lot from baby to baby, so there are no lines on the chart between 0 and 2 weeks. However, by 2 weeks of age most babies will be on a centile close to their birth centile.

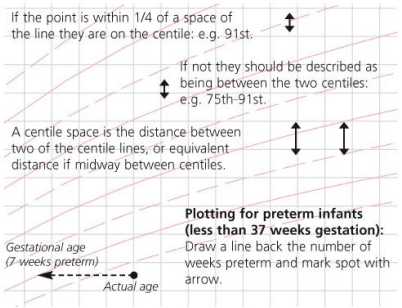
For **preterm infants** a separate low birth weight chart is available for infants of less than 32 weeks gestation and any other infant requiring detailed assessment. For healthy infants born from 32 weeks and before 37 weeks, plot all measurements in the preterm section (to the left of the main 0–1 year chart) until 42 weeks gestation, then plot on the 0–1 year chart using gestational correction, as shown below.

The preterm section can also be used to assess the relative size of infants at the margin of 'term' (e.g. 37 weeks gestation), but these measurements should also be plotted at age 0 on the 0–1 year chart.

Gestational correction

Plot measurements at the child's actual age and then draw a line back the number of weeks the infant was preterm. Mark the spot with an arrow (see diagram): this is the child's gestationally corrected centile. Gestational correction should continue until at least 1 year of age.

Centile terminology



Interpreting the chart

Assessing weight loss after birth

Most babies lose some weight after birth but 80% will have regained this by 2 weeks of age. Fewer than 5% of babies lose more than 10% of their weight at any stage; only 1 in 50 are 10% or more lighter than birth weight at 2 weeks.

Percentage weight loss can be calculated as follows:

$$\text{Weight loss} = \text{current weight} - \text{birth weight}$$

$$\text{Percentage weight loss} = \frac{\text{Weight loss}}{\text{Birth weight}} \times 100\%$$

For example, a child born at 3.500kg who drops to 3.150kg at 5 days has lost 350g or 10%; in a baby born at 3.000kg, a 300g loss is 10%.

Careful clinical assessment and evaluation of feeding technique is indicated when weight loss exceeds 10% or regain of birth weight is slow.

What do the centiles mean?

These charts indicate a child's size compared with children of the same age and maturity who have shown optimum growth. The chart also shows how quickly a child is growing. The centile lines on the chart show the expected range of weights and heights (or lengths); each describes the number of children expected to be below that line (e.g. 50% below 50th, 91% below the 91st). Children come in all shapes and sizes, but 99 out of 100 children who are growing optimally will be between the two outer lines (0.4th and 99.6th centiles); half will lie between the 25th and 75th centile lines.

Being very small or very big can sometimes be associated with underlying illness. There is no single threshold below which a child's weight or height is definitely abnormal, but only 4 per 1000 children who are growing optimally are below the **0.4th centile**, so these children should be assessed at some point to exclude any problems. Those above the **99.6th centile** for height are almost always healthy. Also calculate BMI if weight and height centiles appear very different.

What is a normal rate of weight gain and growth?

Babies do not all grow at the same rate, so a baby's weight often does not follow a particular centile line, especially in the first year. Weight is most likely to track within one centile space (the gap between two centile lines, see diagram). In infancy, acute illness can lead to sudden weight loss and a weight centile fall but on recovery the child's weight usually returns to its normal centile within 2–3 weeks. However, a sustained drop through two or more weight centile spaces is unusual (fewer than 2% of infants) and should be carefully assessed by the primary care team, including measuring length/height.

Because it is difficult to measure length and height accurately in pre-school children, successive measurements commonly show wide variation. If there are worries about growth, it is useful to measure on a few occasions over time; most healthy children will show a stable *average* position over time.

Head circumference centiles usually track within a range of one centile space. After the first few weeks a drop or rise through two or more centile spaces is unusual (fewer than 1% of infants) and should be carefully assessed.

Why do the length/height centiles change at 2 years?

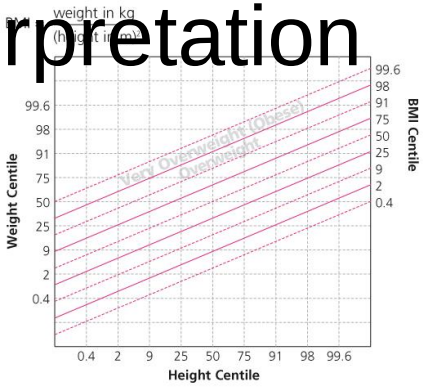
The growth standards show length data up to 2 years of age, and height from age 2 onwards. When a child is measured standing up, the spine is squashed a little, so their height is slightly less than their length; the centile lines shift down slightly at age 2 to allow for this. It is important that this difference does not worry parents; what matters is whether the child continues to follow the same centile after the transition.

Predicting adult height

Parents like to know how tall their child will be as an adult. The child's most recent height centile (aged 2–4 years) gives a good idea of this for healthy children. Plot this centile on the adult height predictor to the right of the height chart to find the average adult height for children on this centile. Four out of five children will have adult heights that are within 6cm above or below this value.

Weight–height to BMI conversion chart

BMI indicates how heavy a child is relative to his or her height and is the simplest measure of thinness and fatness from the age of 2, when height can be measured fairly accurately. This chart[4] provides an approximate BMI centile, accurate to a quarter of a centile space.



Date:				
Age:				
BMI Centile:				

Instructions for use

1. Read off the weight and height centiles from the growth chart.
2. Plot the weight centile (left axis) against the height centile (bottom axis) on the chart above.
3. If between centiles, read across in this position.
4. Read off the corresponding BMI centile from the slanting lines.
5. Record the centile with the date and child's age in the data box.

Interpretation

In a child over 2 years of age, the BMI centile is a better indicator of overweight or underweight than the weight centile; a child whose weight is average for their height will have a BMI between the 25th and 75th centiles, whatever their height centile. BMI above the 91st centile suggests that the child is overweight; a child above the 98th centile is very overweight (clinically obese). BMI below the 2nd centile is unusual and may reflect undernutrition.

References

1. www.who.int/childgrowth/en
2. 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.
3. www.sacn.gov.uk/reports_position_statements/index.html
4. Cole TJ. A chart to link child centiles of body mass index, weight and height. Eur J Clin Nutr 2002;56:1194-9.

Measuring, plotting, terminology, interpretation

Educational materials

- All free to download at www.growthcharts.rcpch.ac.uk
  - Powerpoint presentations
  - Quiz and plotting activities
  - Fact sheets
  - Directed at staff and student learners
- Train the trainer sessions

Summary

- WHO 2006 provides standard of how children ***should*** grow
  - Sets breast fed child as physiological norm
  - Constructed with highest quality data and statistical approaches
  - Avoids need for new growth charts as countries develop, allows inter country comparison
- Countries who adopt need to
  - Understand how their children match the chart and what that means in terms of thresholds
  - Ensure that chart designs are robust and easy to use