

Child stuntedness

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Abstract

Abstract goes here.

1. Stunting

1.1. Definition

According to [1], “Growth stunting is defined by comparing measurements of children’s heights to the NCHS¹ growth reference population: children who fall below the fifth percentile of the reference population in height for age are defined as stunted, regardless of the reason for their shortness. As an indicator of nutritional status, comparison of children’s measurements with growth reference curves may be used differently for populations of children than for individual children. The fact that an individual child falls below the fifth percentile for height for age on a growth reference curve may reflect normal variation in growth within a population: the individual child may be short simply because both his parents were short and not because of inadequate nutrition. However, if substantially more than 5% of an identified child population have height for age that is less than the fifth percentile on the reference curve, then the population is said to have a higher-than-expected prevalence of stunting, and inadequate nutrition is generally the first cause considered.”

1.2. Causes

Inadequate nutrition is just one of several causes of growth stunting. Other contributors to stunting include chronic or recurrent infections, sometimes in combination with intestinal parasites. The prevalence of growth stunting, particularly among children under two years of age, can also reflect the prevalence of low birth weight in a population. Finally, in rare cases, growth stunting may reflect extreme psychosocial stress without nutritional deficiencies.

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¹National Center for Health Statistics

The contributions of each of these causes to the growth stunting prevalence rate are only partly understood. One study concluded that from 20% to 40% of the prevalence of growth stunting in the first two years of life can be attributed to low birth weight. However, inadequate nutrition may still be implicated because some low weight births may be due to maternal nutritional deficiencies during pregnancy.

Just as low birth weight and nutritional deficiencies are interrelated, so also are inadequate nutrition and the chronic or recurrent infections that are believed to contribute to growth stunting. There is evidence that even mild nutritional deficits can alter the immune response in children, before clinical signs of malnutrition occur, and that nutritional deficiencies during pregnancy can impair the infant’s immune response after birth. Thus, the reasons for any given child’s growth impairment may be complex. However, inadequate nutrition is a common theme that suggests a key focus for a policy response to the problem of growth stunting.

1.3. Consequences

Children who suffer from growth retardation as a result of poor diets or recurrent infections tend to be at greater risk for illness and death. Stunting is the result of long-term nutritional deprivation and often results in delayed mental development, poor school performance and reduced intellectual capacity. This in turn affects economic productivity at national level. Women of short stature are at greater risk for obstetric complications because of a smaller pelvis. Small women are at greater risk of delivering an infant with low birth weight, contributing to the intergenerational cycle of malnutrition, as infants of low birth weight or retarded intrauterine growth tend to be smaller as adults.

1.4. Measuring stunting

Several important age-related differences and discontinuities in the reference growth curves are used to measure stunting. First, for children less than 24 months of age, growth is determined by measuring the length of a recumbent child. After 24 months, growth is determined by measuring the height of a standing child. Because length and height measurements are not equivalent, there is a natural

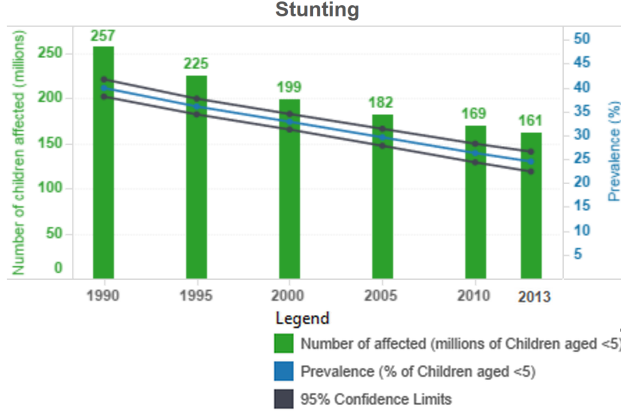


Figure 1. Child malnutrition trend for stunting (According to [2]).

discontinuity between growth curves for children below and above 24 months of age.

The WHO² uses to classify stunting as height for age < -2 SD³ of the WHO Child Growth Standards median (measurement charts of girls and boys are at the end of this document).

2. Problem statement

Using the statement described in [3], we have the goal to determine a combination of early measures that would be a good predictor for birth weight. In pursuit of this goal, we have collected time series data from ultrasounds on pregnant mothers. We would like you to use this data to predict a child's birth weight and birth date (days from pregnancy start).

For each fetus given sex, status, and multiple ultrasound measurements (columns 5-12) during the pregnancy (time being the variable $t_{ultrasound}$). The data from the repeated ultrasounds provides a small time series that can be used for predicting the birth weight and day.

For each prediction (b_i, w_i) , the error from the true birth date and birth weight will be measured as the squared Mahalanobis distance,

$$e_i = (b_i - b_{0i}, w_i - w_{0i})^T S^{-1} (b_i - b_{0i}, w_i - w_{0i})' \quad (1)$$

where S^{-1} is the inverse of the sample covariance matrix calculated on the complete dataset.

$$S^{-1} = \begin{pmatrix} 3554.42 & -328.119 \\ -328.119 & 133.511 \end{pmatrix} \quad (2)$$

Scores will be calculated as a generalized R^2 measure of fit. This is calculated as follows. The total sum of errors for the submission will be calculated as $SSE = \sum(e_i)$.

²World Health Organization

³standard deviations

A baseline sum of squared error will be calculated by predicting the sample means for each fetus, that is the mean values of b and w for the current training set,

$$e_{0i} = (\bar{b} - b_{0i}, \bar{w} - w_{0i}) S^{-1} (\bar{b} - b_{0i}, \bar{w} - w_{0i})' \quad (3)$$

$$SSE_0 = \sum(e_{0i})$$

3. Development: numbers, results and difficulties

The dataset given in [3] is composed by 5651 rows, with 14 columns each row, as shown in 3.

4. Further studies

There's a lot of

5. Charts

The charts below are from CDC⁴ website and given the default curves of growth for girls and boys from the birth to 24 months.

⁴Center for Disease Control and Prevention

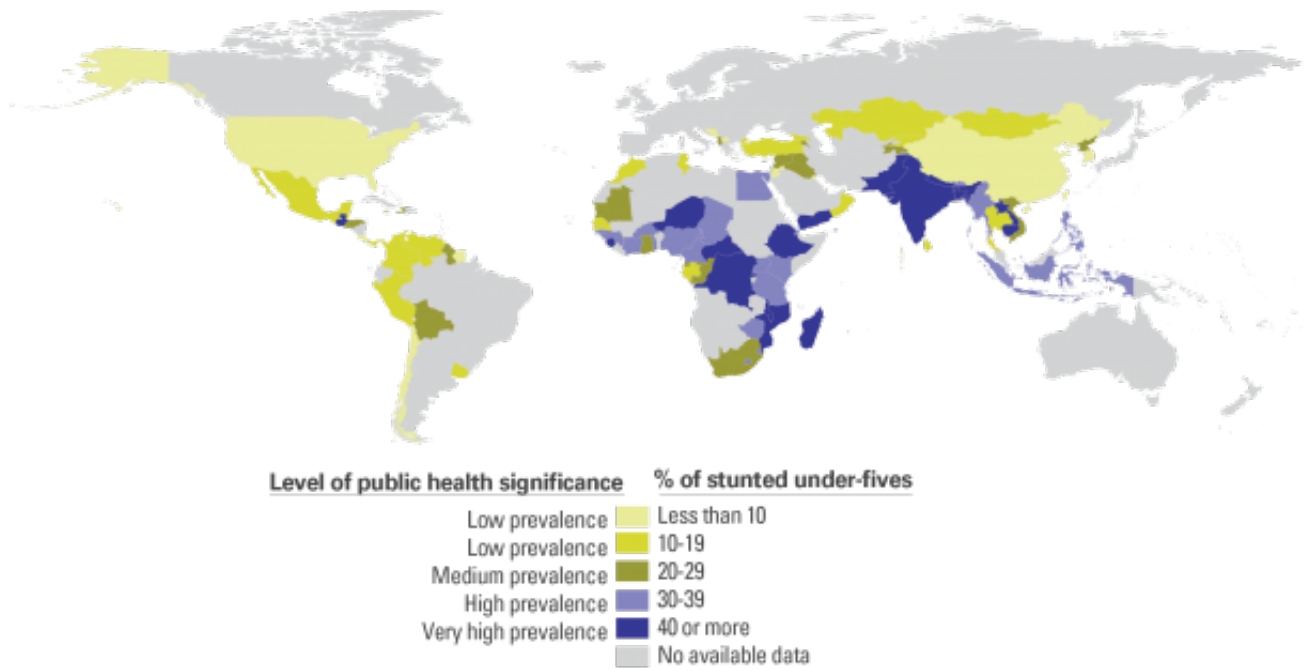


Figure 2. Undernutrition contributes to half of all deaths in children under 5 and is widespread in Asia and Africa Percentage of under-five children who are stunted, 2008 - 2013).

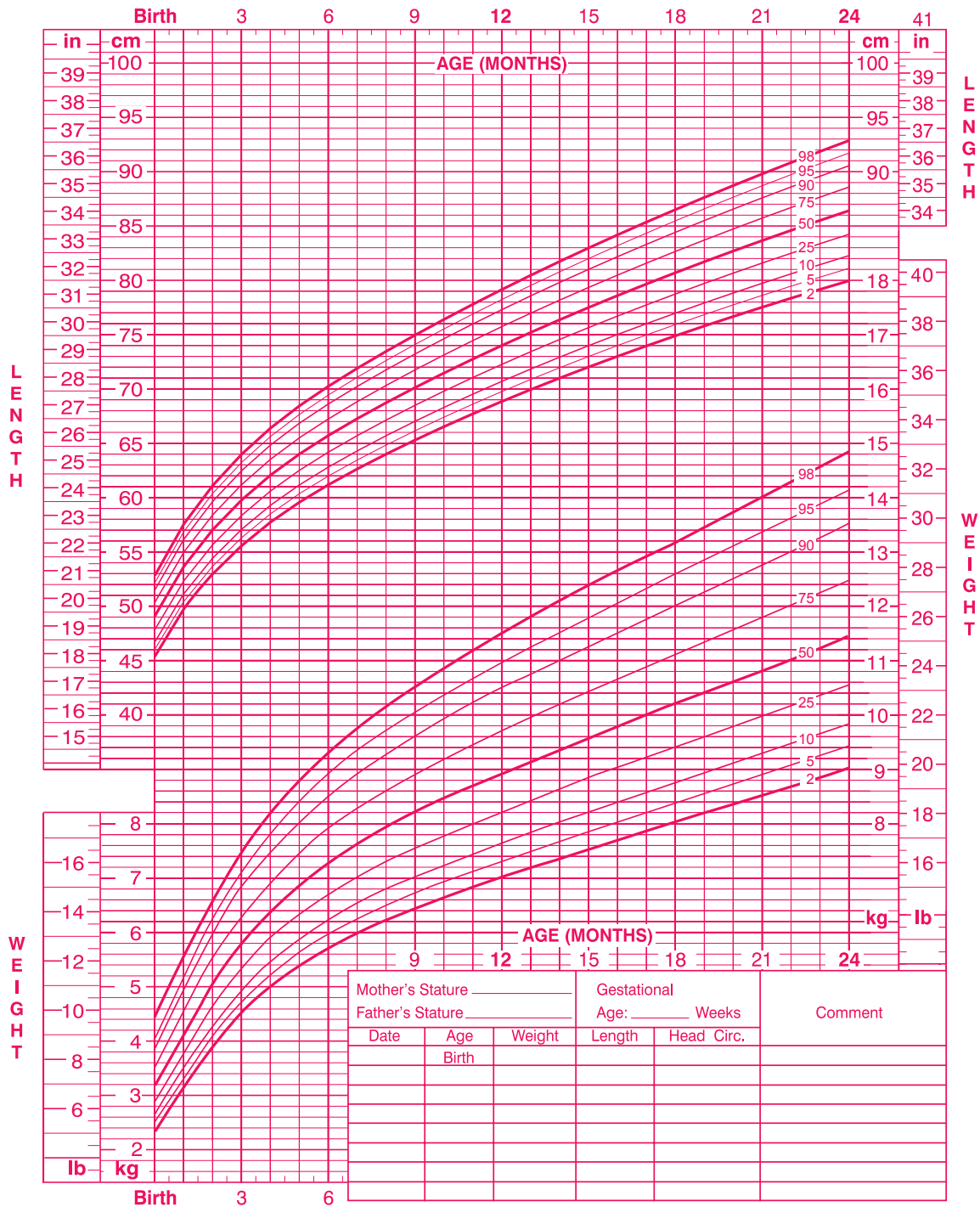
Column	Variable	Type	Label/Description
1	Id	int	Unique Fetus ID
2	t.ulsnd	float	Estimated fetus gestational age from last menstrual recall date
3	Sex	int	0 = Male, 1 = Female
4	Status	int	Maternal nutritional status (1 or 2)
5-12	Odv	float	Dependent variables: Ultrasound observed measurements
13	Birth Sz	float	Birth Weight (w)
14	Duration	float	Pregnancy Duration, or Birthday (b)

Table 1. Dataset definition (from [3])

Birth to 24 months: Girls
Length-for-age and Weight-for-age percentiles

NAME _____

RECORD # _____



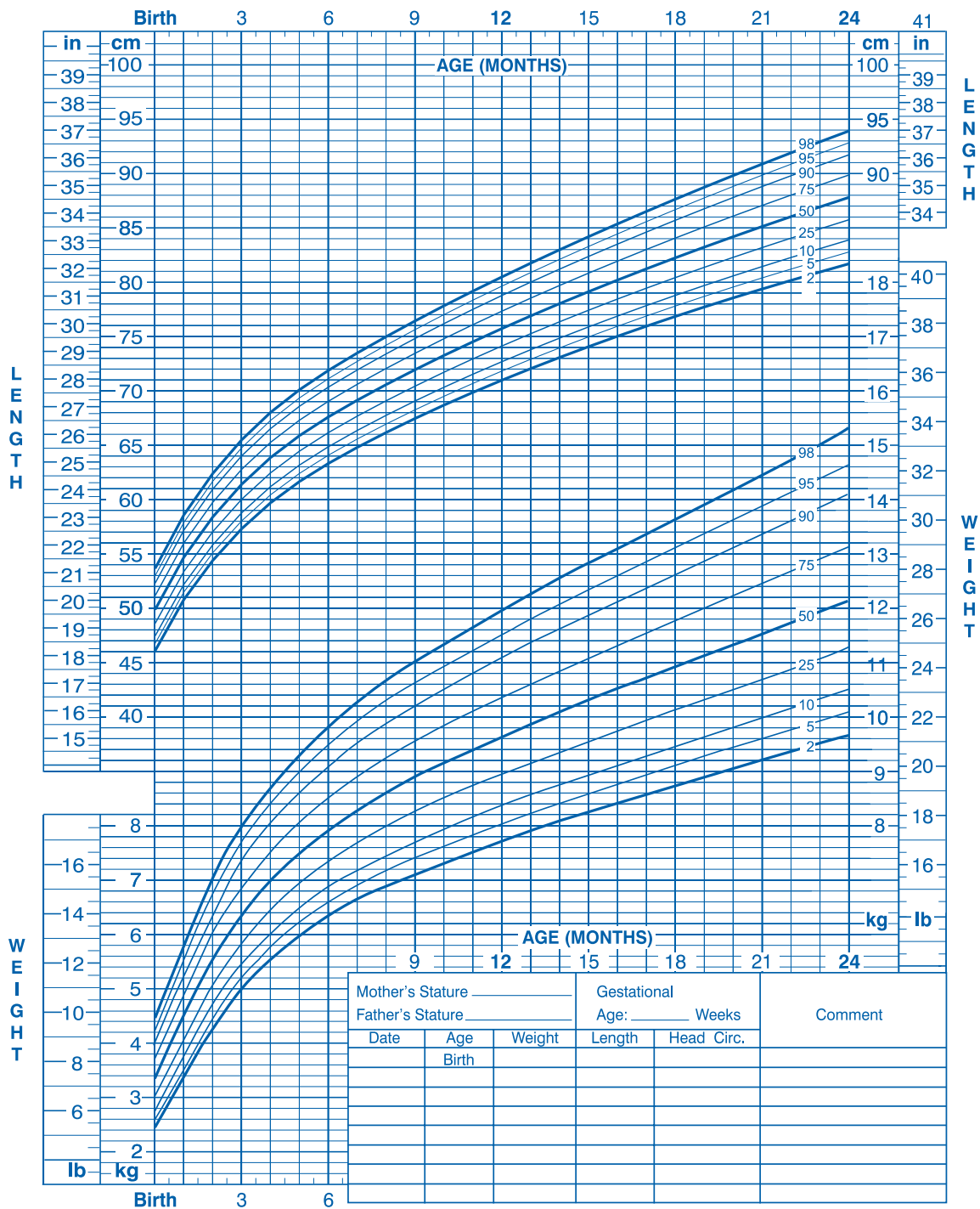
Published by the Centers for Disease Control and Prevention, November 1, 2009
 SOURCE: WHO Child Growth Standards (<http://www.who.int/childgrowth/en>)



Birth to 24 months: Boys
Length-for-age and Weight-for-age percentiles

NAME _____

RECORD # _____



Published by the Centers for Disease Control and Prevention, November 1, 2009
 SOURCE: WHO Child Growth Standards (<http://www.who.int/childgrowth/en>)

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- [2] UNICEF. Child nutrition interactive dashboard. <http://data.unicef.org/resources/2013/webapps/nutrition#>, 2014. [Online; accessed 15-November-2014]. **2**
- [3] TopCoder Team. Child Stuntedness. <http://community.topcoder.com/longcontest/?module=ViewProblemStatement&rd=16065&pm=13367>, 2014. [Online; accessed 11-October-2014]. **2, 3**
- [4] Sahilu Assegid Teshale Fikadu and Lamessa Dube. Factors associated with stunting among children of age 24 to 59 months in Meskan district, Gurage Zone, South Ethiopia: a case-control study. <http://www.biomedcentral.com/1471-2458/14/800>, 2014. [Online; accessed 29-November-2014].
- [5] World Health Organization. Nutrition Landscape Information System (NLIS). <http://apps.who.int/nutrition/landscape/help.aspx?menu=0&helpid=391&lang=EN>, 2014. [Online; accessed 05-December-2014].
- [6] Center for Disease Control and Prevention. WHO Growth Standards Are Recommended for Use in the U.S. for Infants and Children 0 to 2 Years of Age . http://www.cdc.gov/growthcharts/who_charts.htm#TheWHOGrowthCharts, 2014. [Online; accessed 05-December-2014].