Growth charts on postage stamps

Rachel Braun
2107 Spencer Road
Silver Spring, MD 20910
rachelbraun@verizon.net

https://www.rachelbraun.net
https://www.rachelbraun.net/statistical-graphics-on-postage-stamps

Among my collection of statistical graphics on postage stamps are three pages devoted to children's growth charts. These are graphs of anthropometric measurements of childhood development, such as height, weight, and head circumference, sorted by centiles. An example of a growth chart is found on this Nicaraguan stamp, depicting a growth curve of infant weights. In this article, I'll discuss how centile growth charts are created, and we'll look at examples of them on postage stamps around the world.



This stamp, Nicaragua CB1 (1973), was overprinted with nutritional information on the reverse, an example of countries using postal designs for health information. It is the first value of a set of eleven air post semi-postals, whose purchase included a surtax for a hospital building fund.

What are centiles? Well, if you've ever taken a child to a pediatrician for a well-visit, you've probably heard the doctor identify the child's 'percentile' for weight or height for her age. ("Centiles' is the alternate, more typically academic term when referring to growth charts.) Tracking the consistency of percentiles as the child grows and comparing percentiles for height and weight are both important ways that pediatricians monitor the healthy growth of children. How do they arrive at those numbers?

A percentile (also called a cumulative relative frequency) is usually defined to be the data value at-or-below-which the percentage of the population lies. In notation, we'd say that the percentile value $F_x(X)$ for any probability density function f(x) may be given as

(if x is a discrete random variable, such as SAT scores): $F_x(x) = P(X \leq x)$ and

(if x is a continuous random variable, such as weight): $F_x(x) = \int_{-\infty}^{x} f(x)\,dx$

For example, a twelve-month old American female who weighs 8 kilograms (about 17 pounds) would be considered at the 5th percentile for weight, meaning only 5% of American baby girls weigh 17 pounds or less at 12 months of age. In contrast, she would be in the 95th percentile for 12-month-old baby weight at 11.4 kg (roughly 25 pounds). Another way of stating that is, a 25 pound, 12-month-old baby girl would weigh more than approximately 95% of her peers, while roughly 5% of similarly aged girls weigh more than her.

A more precise weight value may be determined by scouring the data tables issued by the Center for Disease Control. Their publication, *2000 CDC Growth Charts for the United States: Methods and Development*, includes both data tables and growth curves. A pediatrician might refer to a growth curve from that report while evaluating a patient. I've reproduced such a page below, for baby and toddler girls. In an office visit, the doctor reads the age of the girl on the horizontal axis and her weight along the vertical axis. Once the doctor locates that (age, weight) point, the doctor identifies the percentile curve (labeled 5, 10, 25, 50, 75, 90, 95 along the curves) to which that point is closest, or perhaps interpolates in between.

The first known growth curve (this one for height) was sketched 250 years ago by Count Philibert de Montbeillard (1720-1785). I have not found de Montbeillard pictured on a postage stamp. But two other important contributors to the development of growth charts have appeared on postage stamps. Count George de Buffon (1707-1788) published de Montbeillard's curve in his important work *Histoire Naturelle*. Adolphe Quetelet (1796-1874) was a prolific Belgian statistician who applied the newly characterized normal distribution to techniques of anthropometry (measurement of human physical traits).



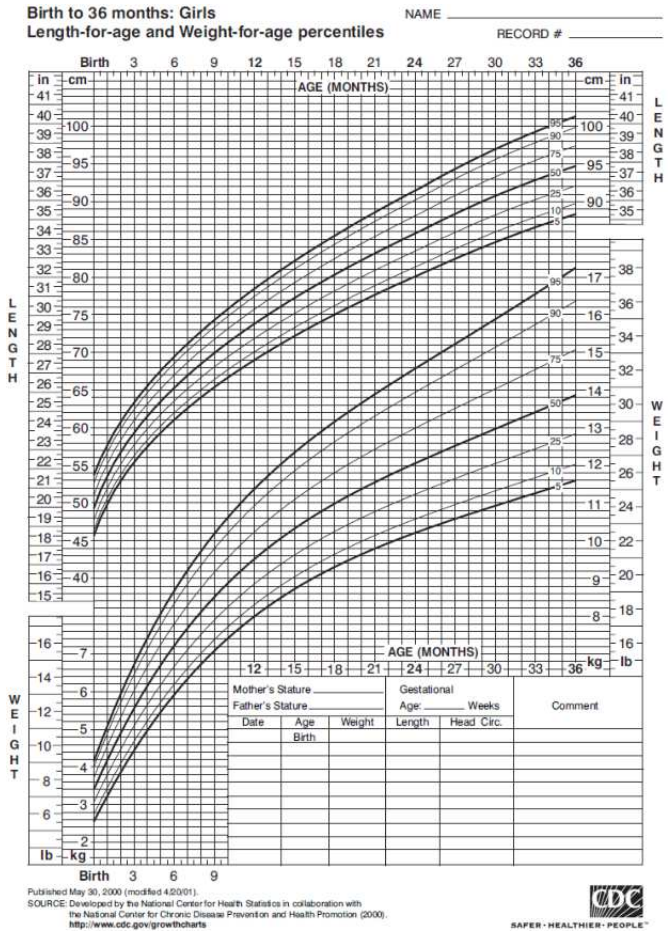
France 1949 Scott B241



Belgium 1973 Scott 885

("Scott" refers to the numbering system of the Scott Catalogues of postage stamps.)

The shape of the curves on a growth chart reveals much about child growth. The rate of growth ('growth velocity,' just as velocity is the first derivative of position) can be inferred from their curvature. Curves for babies and toddlers in the US have the characteristic shape seen in the CDC chart. Weight and height gain is most rapid in the earliest months of a child's life. Charts that track children through adolescence often have a point of inflection at the years near puberty, when growth rates accelerate.



http://www.cdc.gov/growthcharts/data/set1clinical/cj41l018.pdf (Dept of Health and Human Services, Center for Disease Control, National Center for Health Statistics, *Vital and Health Statistics* Series 11, number 246, May 2002)

Babies whose weights remain on the same centile curve over time are said to grow at average velocity, while 'centile crossing' – moving down or up to a different centile curve -- may be cause for concern or relief. Doctors and health workers tracking individual children look for inconsistencies in centile status for height and weight, as well as 'centile loss' – movement over time from a higher centile category to one lower. The World Health Organization provides guidelines to health workers around the world to detect growth deficiencies revealed by such monitoring.

I have found fourteen growth charts depicted on postage stamps. All appear as one or two values on a multi-value set, with core health behaviors for child survival illustrated within the

set. (Interesting aside: in the literature for public health professionals, many articles discuss the role of postage stamps in providing health education to a population.) Many of the stamps were issued in the mid- to late 80's, honoring the fortieth anniversary of UNICEF and the 1988 UN Child Survival campaign.

To enable you to see the health education effect of these stamp programs, I show two full sets below, one from St. Vincent and one from Rwanda.

The St. Vincent issue of 1987 was printed twice (Sc 997-1000 and Sc 1040-1043), the second time with an overprint marking the world having reached a population of 5 billion on (approximately) July 11th. Four health themes, clearly marked on the stamps reading from the left, are growth monitoring (with the growth chart as a background shape and a line graph tracking growth for a particular child), oral rehydration, breast feeding, and immunization.



Rwanda (Scott 1274-1277) issued UNICEF-themed stamps in 1987, denoted 'revolution pour la survie des enfants' – revolution for child survival. The 70F value pictures a growth chart under the caption 'nutritional surveillance'. The same four core health behaviors are promoted within the set. In the early 80s, those four interventions (GOBI) were being promoted by UNICEF as "selective primary health care" (as opposed to the more political "primary health care" promoted in 1978 in the Alma Ata Declaration).



The stamps below feature single values from each of their respective sets on the theme of child survival, selecting for stamp(s) that depict growth curves.



Bangladesh 1985 Sc 258



Sri Lanka 1985 Sc 763



Liberia 1988 1074



Ethiopia 1986 Sc 1169



Sudan 1988 Sc 359



Ghana 1985 Sc 1000



Indonesia 1986 Sc 1288



United Arab Emirates 1987 Sc 25



India 1988 Sc 1132



Tanzania 1986 Sc 324

A few notes about these issues:

- I love seeing the clear graph paper on the Bangladeshi issue, but consider the stylized curve on the Sri Lankan stamp, with a child forging forward over it, a compelling design.
- The growth chart on the Liberian value is somewhat confusing, as the fourth value, honoring growth monitoring, includes a growth curve that reverses half way across the design. There are indeed 'survival curves' (reverse cumulative frequency curves) that note the declining representation of a trait in a population; I'm not sure which variable is represented on the Liberian stamp in the declining portion of the graph.
- Note that Sudan's issue likely includes a longer age span on the x-axis, as a point of inflection is apparent, signaling an increase in growth rate in teenage years.
- As an English reader and data wonk, I especially like the Indian stamp, as the axes are clearly marked with age and kilogram values.

With these stamps, countries and their postal authorities are acknowledging ideas dear to the hearts of nutritionists, but also statisticians: that truth can be teased out with numbers, that statistics both guide and describe the wellbeing of a country; and that the presentation of statistics, especially with graphics, provides a narrative of human and national life. For collectors, these stamps remind us that on a tiny slip of paper, postal and health authorities express shared national values, as well as confidence in citizens, in our ability to receive and process information presented on the most minute of spaces.

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