Obesity in humans came to be recognised as a serious public health concern during the 1960’s, when several national and international obesity societies were founded. But the focus was initially on adults, and it took a further 30 years for the concern to extend to children. This was because obesity is to some extent an inter-generational condition, with fat parents begetting fat children, so it took time - more than a generation - for the levels of obesity in children to rise sufficiently to cause alarm. Once the danger was recognised, researchers from all over the world rushed to carry out prevalence studies to quantify the scale of the problem, and many such studies were published during this time.

However there was a serious problem - nobody could agree on how to define child obesity. As a result each study used its own definition, with the unfortunate consequence that the methods were incompatible and the prevalence rates could not be compared across studies. This highlighted the need for a unified international definition that all could use, which would allow the effort being put into measuring child obesity prevalence to be properly harnessed.

The International Obesity Task Force (IOTF) was another reflection of the rising concern about obesity. It was set up in 1994 by Philip James as a policy and advocacy think tank, and its initial action was to prepare what became the first scientific report on the global epidemic of obesity, published as a WHO expert technical report in 2000. This work highlighted the lack of a proper definition for child obesity, and a second IOTF initiative was to convene a workshop on child obesity in Dublin in June 1997 to address the deficiency. The purpose and summary of the workshop were later published (Dietz and Bellizzi 1999, Bellizzi and Dietz 1999). The primary outcome of the workshop was a definition of childhood obesity that appeared in the BMJ (Cole et al. 2000), a paper which has since been cited 5,391 times by Web of Science (an average of 350 citations per year) and 10,125 times by Google Scholar (as of 8 May 2014).

Obesity is more complicated to diagnose in children than in adults, because children increase in height, weight and body fat naturally as they grow. The difficulty is to decide when the pattern of growth is excessive. So to define child obesity requires three components: a measure to define the amount of body fat; a reference population to define the distribution of the body fat measure by age and sex, and a centile cut-off to define the point in the body fat measure distribution corresponding to obesity. For historical reasons there were in fact two cut-offs, one for obesity and a less extreme one for overweight. The workshop agreed to use body mass index (BMI or weight/height 2) as the measure of body fat, an uncontroversial choice as it matched the usage in adults. However the other two
components of the definition were novel: large nationally representative samples of children from Brazil, Great Britain, Hong Kong, the Netherlands, Singapore and USA (n = 192,727) that were used to establish the distribution of BMI internationally; and (my idea) centile cut-offs of BMI chosen to match the universally accepted adult cut-offs of BMI 25 (overweight) and BMI 30 (obesity) at age 18 years. This ensured that the child and adult definitions were consistent with each other, a notable advance on previous definitions.

Centile charts are widely used to assess growth in paediatric practice, and previous obesity definitions had used the 85th and 95th centiles of BMI as overweight and obesity cut-offs. The shapes of the centile curves on the chart can be estimated with a statistical technique called the LMS (λ-μ-σ) method which I developed with Peter Green (Cole and Green 1992). LMS allows one to construct any required centiles, in particular those that pass through BMI 25 and 30 at age 18. The calculations were done for each of the six samples separately, and the cut-offs were then averaged.

One indicator to justify the approach taken was to see how close to each other the centiles based on the separate samples were. It turned out that the Singapore cut-offs were a different shape from all the others, the Singaporean children being relatively fatter in early puberty (Cole et al. 2000), and the first version of the paper excluded the Singapore cut-offs on that basis. However the BMJ reviewers said they should be retained, and in retrospect this was a wise decision - the anomalous pattern of BMI change with age seen in the Singapore sample has since been seen in other datasets too.

Another early intention of the authors was to develop cut-offs to identify underweight as well as overweight, based on the same BMI reference data. Child malnutrition is as big a public health problem as obesity in many parts of the world, and cut-offs based on BMI would have advantages over the weight-for-height cut-offs then in use. However it proved to be too ambitious at the time, and only in 2007 was the follow-up paper published (Cole et al. 2007). It has been cited 580 times to date. More recently the underlying methodology has been overhauled, and it is now possible to present the information in the form of a BMI growth chart (Cole and Lobstein 2012).

It is interesting to speculate as to why the 2000 paper was such a runaway success. The first ingredient was its authors: Bill Dietz and Katherine Flegal were both well-known and respected obesity researchers from the US Centers for Disease Control and Prevention, which encouraged the paper's take-up in the USA. Mary Bellizzi was Secretary of the IOTF, and this emphasised the international nature of the definition. I provided the statistical framework on which the work was based. The second ingredient was the wide variety of countries providing data, giving reassurance to researchers that the cut-offs were indeed international and could be applied with confidence to children from their own country. By contrast the World Health Organization (WHO) international growth reference was at that time based on US data, and this was politically uncomfortable in parts of the world where the pattern of child growth was clearly different from that in the USA.

A third ingredient was the way the cut-offs were constructed, linked to the widely used adult definition. This provided reassurance that the cut-offs were not just a statistical artefact but were based on existing practice. And finally the paper's publication in the BMJ, a general medical journal with very broad reach, ensured that it received widespread publicity from day one. The BMJ itself was impressed by the high citation rate of the paper, and used it as the example in a discussion piece about how the internet was altering the nature of literature citations (Delamothe 2002).

Overall the paper's timeliness was the key - it addressed a problem that researchers worldwide were struggling with, while at the same time providing them with psychological and political reassurance that it was valid to use. This was confirmed by an exhaustive IOTF review of child obesity published in 2004 which quoted many studies with prevalence rates based on the definition (Lobstein, Baur, and Uauy 2004). As the Abstract Conclusion of the 2000 paper concisely summarised it,

"The proposed cut off points, which are less arbitrary and more internationally based than current alternatives, should help to provide internationally comparable prevalence rates of overweight and
obesity in children.”

REFERENCES


