UNIT NO. 1

CHILDHOOD OBESITY - DEFINITION, CLASSIFICATION, AND EPIDEMIOLOGY

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ABSTRACT

Childhood obesity is defined as excessive fat accumulation which presents a risk to health in a person under 18 years old. Measuring fatness is not easy and hence for practical reasons, indirect ways of measuring this using weight-and-height-based anthropometric indices are used e.g. percentage of ideal weight for height (PWH) or body mass index (BMI) as surrogate measures for adiposity. For screening, diagnosis, and monitoring childhood obesity, several countries have already developed country-specific age-and-sex-specific BMI reference charts for their own paediatric populations; these reference values are more sensitive (missing fewer true overweight or obese individuals) than those based on an "international" dataset such as the IOTF-BMI reference values. Diagnosis of obesity should use the BMI percentile with national reference data (e.g., BMI 95th percentile or greater). Epidemiologically, paediatric obesity should be considered a chronic disease with numerous possible co-morbidities. An optimal BMI needs to be aimed for control and prevention. Concerted social policies to promote physical activity and decrease excessive food intake are also needed.

SFP2009; 35(4): 11-13

INTRODUCTION

Childhood obesity is today a global health problem. (Wang & Lobstein, 2006; James, 2008)[1,2]. Concerted efforts by providers, parents and the children themselves are needed to control and prevent the problem from escalating. As a prelude to tackling childhood obesity we need to understand what constitutes obesity, how to classify it, and understand the impact of obesity on health.

DEFINITION

Childhood obesity is defined as excessive fat accumulation which presents a risk to health in a person under 18 years old.

Measuring fatness

Although defining obesity is relatively straightforward, measuring the degree of fatness is complicated by the fact that fatness is not easily measured directly. Table 1 shows the main methods of measuring fat.

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Indirect ways of measuring fatness

Since fatness is not easily measured directly, indirect ways of measuring this using weight-and-height-based anthropometric indices have long been in use as surrogate measures for adiposity namely, percentage mean weight for height and body mass index.

Percentage mean weight for height (PWH) is the simplest indirect measure for fatness. In 1977 a WHO bulletin noted that in undernourished populations, 80% median weight for height (which corresponds to approximately minus 2.0 standard deviations) was suitable for classifying malnourished children. Following this principle, it was suggested that 120% (or plus 2.0 standard deviations) could be used in populations where over-nutrition was a problem (Sweeting, 2007; Waterlow et al, 1977)[3,4]. PWH has been used as an indirect measurement of fatness in Singapore studies on childhood obesity.

Body mass index (BMI) is the most frequently used measure of weight in relation to height. It has been described as "the backbone of the obesity classification system and surveillance statistics… an immensely valuable tool" (Sweeting, 2007; Prentice & Jebb, 2001)[3,5].

BMI however has several disadvantages as a surrogate measure for fatness. (Sweeting, 2007)[3]. First, BMI varies between males and females and according to age and level of maturity. Thus, while male and female BMIs tend to be similar in childhood, they are higher among females in adolescence. In respect of age, BMI increases from birth to around one year, then declines to around age six, then increases through the remainder of childhood and adolescence. Such variations mean that among children and adolescents, the significance of any particular BMI is more difficult to determine than within adult populations.

A second, and related limitation of BMI, is that it reflects both fat and fat-free components of body weight. Also, there are population differences. For example, among children with the same BMI, fat measurements are higher for whites than blacks, and higher for Asians than whites.

A third disadvantage of BMI is that since one of the components is height, the index also varies according to height, and this association in turn varies according to sex and age. Its relationship to height means that BMI is also affected by relative leg length.

A further disadvantage is that since BMI does not measure fat directly, there is no consensus about which cut off to use in order to define obesity in children and adolescents. Nonetheless, many countries are adopting age-and-sex-specific BMI charts for their paediatric populations, and overweight is defined as a BMI between 85th to 94th percentiles, while obesity is defined as a BMI at or more than the 95th percentile for age. (Speiser,

Table 1. Main methods of measuring fat

Method of measuring fatness	General principle and methodology	Remarks
Density-based methods		
• Hydrodensitometry (underwater weighing (UWW)	Determine the density of the person by weighing in water and weighing in air. Knowing the density, the proportion of fat and fat free mass can be estimated using an equation.	Often described as the gold standard. Is limited to use in research setting.
Scanning methods		
• Computerised tomography; magnetic resonance imaging (CT; MRI)	Assesses overall fat mass as well as its regional distribution.	Expensive, limited to research setting.
• Dual Energy X-ray absorptometry (DEXA or DXA)	Can be used to calculate the fat and fat free mass, total and regional body composition in subjects over a wide range of ages and body sizes.	Use limited to research setting.
Bioelectrical impedence methods		
Bioelectrical impedence analysis (BIA)	The resistance between the conductors attached to the subjects body provides a measure of body fat.	Some analysers are portable, inexpensive, quick to use and reasonably accurate. Can be used in the field and work with large numbers of subjects.
Anthropometric methods		
Skin fold measurements (SF)	Subcutaneous fat is measured using calipers. This is an indicator of total fat.	Cheap and fairly simple. Difficult to measure reproducibly if the subject is fat. Also need to partially undress subject.
Waist circumference (WC)	WC reflects total and abdominal fat levels and is an indicator of adiposity not greatly influenced by height.	WC centiles for children have been developed in a in a number of countries. Ratio of WC to height could be used as rapid screening tool.
Waist-hip ratio (WHR)	A larger WHR in adults indicates relatively larger amounts of abdominal fat. Some evidence it is a poorer measure of body fat distribution in children.	Infrequently used in studies of children and adolescents.

Source: Sweeting, 2007

BMI and overweight/obesity – where to draw the line?

Now, if the aim is to track levels of obesity over time, or to compare populations, the BMI centile values defining obesity must be fixed. The question is not only which centile they should be fixed at, but also which population (and so at which point of time) should be used as the basis for the calculations. The solution is several countries e.g. United States, UK, France, Germany and Denmark have developed BMI-for-age-and-sex-specific reference charts for their paediatric populations. Similarly, Singapore is developing its set of charts too.

What about a BMI centile values using an international dataset?

This was the idea behind the International Obesity Task Force BMI reference values that ideally should be representative of the world's population. Data from 6 countries collected 1963-93, including Singapore, were pooled and in 2000, centile curves were published that passed through the points of 25 kg/m2 and 30 kg/m2 (reflecting WHO recommended definitions of adult overweight and obese) at age 18. (Sweeting, 2006; Cole et al, 2000)[3,8].

It has been found that whilst the IOTF-BMI curves were specific it was not sensitive enough so that the true prevalence of high levels of body fat content in the tested population will be underestimated. This was found to be so when the IOTF-BMI figures were compared against the population specific data of a Singapore population, and an UK population respectively. (Deurenberg-Yap et al, 2009; Reilly, 2005)[9,10].

CLASSIFICATION

For adults who have attained their maximal height, the WHO has delineated BMI cutoff of 25 and 30 kg/m2 as "overweight" and "obese", respectively. (Kimm, 2002)[11].

In children, the situation is more complex. In the child, BMIs exhibits non-linear variation during growth. To deal with, this percentile curves that apply to different ages of childhood utlising BMI, sex, and age-specific growth charts have been developed in several countries for their paediatric patients e.g. in the United States, and also in the UK, to mention two countries.

Cutoffs have also been established to define what is "healthy weight", "overweight" and "obese". Overweight is defined as a BMI between the 85th to 94th percentiles, while obesity is defined as a BMI at or more than the 95th percentile for age as has been pointed out earlier. (Loke, 2009; Speiser et al, 2005)[6,7].

EPIDEMIOLOGY

Worldwide trends in childhood overweight and obesity

The arrival of the obesity epidemic took some time for the world to recognize its presence. Only in 1997 did WHO accept that obesity was a major public health problem. (James, 2008)[2]. A study by Wang and Lobstein of the trends of childhood overweight and obesity among school-age children for 2006 in some 60 countries, using IOTF criteria as far as these are available, showed that the prevalence of childhood overweight had increased in almost all countries for which data was available. Exceptions were found among school-age children in Russia and to some extent Poland during the 1990s. Exceptions were also found among infant and pre-school children in some lower-income countries. Obesity and overweight has increased more dramatically in economically developed countries and in urbanized populations. (Wang & Lobstein, 2006)[1].

North America, Europe, and parts of the Western Pacific had the highest prevalence of overweight among children (approximately 20-30%). Parts of South East Asia and much of sub-Saharan Africa appeared to have the lowest prevalence.

South and Central America, Northern Africa and Middle Eastern countries fell in between. (Wang & Lobstein, 2006)[1].

Based on the trends found and assuming they continued on a linear basis, the authors estimated that over 46% of school-age children would be overweight (using IOTF criteria) in the Americas by 2010; along with approximately 41% of children in the Eastern Mediterranean region, and 38% of children in the European region (which included the countries of the former Soviet Union); 27% in the Western Pacific region, and 22% in South East Asia. (Wang & Lobstein, 2006)[1].

Singapore growth trends

In Singapore, the growth trends of Singapore children spanning 5 decades were reviewed by Loke et al based on 8 anthropometric studies from 1957 to 2002. The data showed that the heights of pre-schoolers and children have optimized according to their genetic potential. The weights of the children on the other hand still appear to be increasing from 6 to 18 years for both sexes; the body mass indices also appear to be increasing in tandem with this trend in weight increase. (Loke et al, 2008)[12].

The roots of the childhood obesity epidemic

What has started the childhood obesity epidemic? It now seems clear that the removal of the need for physical activity to earn our living and hence a decreased need for big meals was the start. The expansion of the food industry on the other hand flooded the market place with food to create an environment 'toxic' to healthy living. Overweight and obesity are the result.

Consequences of obesity

The consequences of obesity are both psychological and medical. This are covered in Unit 2 of this skills course (Loke, 2009)[6].

New understanding

It is now recognized that the optimum population BMI is less than 21 and this is particularly true in Asia and Latin America where the populations are very prone to developing abdominal obesity, type 2 diabetes and hypertension. There are substantial numbers of cohort studies showing that, for individuals, the lowest risk of diabetes, hypertension, and other conditions may be at BMIs less than 21. (James, 2008)[2].

New evidence from studies in India suggests that insulin resistance at birth seems linked to low birth weight and a higher proportion of body fat with selective B12 deficiency and abnormalities of one carbon pool metabolism potentially responsible and affecting 75% of Indians and many populations in the developing world. Biologically there are also adaptive biological mechanisms which limit weight loss after weight gain and thereby in part account for the continuing epidemic despite the widespread desire to slim. (James, 2008)[2].

Substantial changes in urban planning and diet are needed to counter the removal of any every day need for physical activity and the decades of misdirected food policies which with free market forces have induced our current 'toxic' environment. Countering this epidemic requires concerted policy initiatives. (James, 2008)[2].

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LEARNING POINTS

- **Childhood obesity is defined as excessive fat accumulation which presents a risk to health in a person under 18 years old.**
- **Fatness is measured indirectly e.g., percentage weight for height, body mass index.**
- **Country-specific age-and-sex specific BMI charts should be used for screening, diagnosis and monitoring childhood obesity.**
- **Epidemiologically, paediatric obesity should be considered a chronic disease with numerous possible co-morbidities. An optimal BMI needs to be aimed for control and prevention.**
- **Concerted social policies to promote physical activity and decrease excessive food intake are also needed.**