ELSEVIER

Obesity: The Worldwide Epidemic

PHILIP T. JAMES, CBE, MD, DSc

Abstract. *Over the last decade, the prevalence of obesity in Western and Westernizing countries has more than doubled. A standardized classification of overweight and obesity, based on the body mass index now allows a comparison of prevalence rates worldwide for the first time. In children, the International Obesity Taskforce age, sex, and BMI specific cut-off points are increasingly being used. BMI data are being evaluated as part of a new analysis of the Global Burden of Disease. Prevalence rates for overweight and obese people are very different in each region with the Middle East, Central and Eastern Europe and North American having higher prevalence rates. Obesity is usually now associated with poverty even in developing countries. Relatively new data suggest that abdominal obesity in adults, with its associated enhanced morbidity, occurs particularly in those who had lower birth weights and early childhood stunting.*

Obesity is the accumulation of adipose tissue to excess and to an extent that impairs both physical and psychosocial health and well-being. The prevalence of obesity in Western and westernizing countries has doubled over the past decade, with 20% of males and 25% of females now classified as obese in the United States.[1] Up to double these numbers of the American adult population are overweight. An estimated 315 million people worldwide are obese.

The World Health Organization (WHO) recently published its Expert Technical Consultation on Obesity, held in Geneva in June 1997.[2] Before this, the International Obesity Task Force (IOTF) had developed a comprehensive analysis of the obesity problem, with a draft report as the basis for the WHO technical report. Previously the WHO had been almost exclusively concerned with nutrition matters related to breast-feeding, protein-energy malnutrition, and micronutrient deficiencies; this was the first time that it considered overnutrition as a health issue. An earlier WHO report on physical anthropometry[3] had considered overweight and obesity, but this publication focused on the measurement requirements, the definition of normal weight, and how to ensure appropriate analysis of a nation's prevalence of underweight or overweight in both children and adults.

Defining Overweight and Obesity

It is possible to measure body fat directly; but, although accurate, these methods are expensive, time-consuming, and unsuited to fieldwork and most clinical work. Body mass index (BMI), defined as {weight (kg)/height (m)^2}, is the accepted measure of obesity in populations and in clinical practice. A height-independent measure of weight, BMI is a robust but indirect measure of body fatness that provides more reliable results than "ideal weight" estimations or other ratios of weight to height. Exceptions to the BMI's reliability are in persons with extremes of age, very muscular builds (overestimates obesity), and extreme height. The power of height for women ideally might be better set at 1.6 rather than its present 2.0, but in the interest of simplicity the same BMI expression is used for all persons of both sexes aged 18 years and older. In 1995 the lower number for the normal adult BMI range was changed from 20.0 to 18.5, and the full normal range was set at 18.5 to 24.9 BMI. Some experts have argued for an age-related increase in this upper limit, but this view has not yet been adopted. For persons younger than 18 years, there has been far more concern with how best to express underweight, which is defined on an arbitrary basis as a weight for height of $<$2 standard deviations (SDs) of the normal weight for height for children of the same age and sex. Applying the same arbitrary categorization to overweight in children would define overweight as $\geq$2 SDs of the normal weight for height.

The 2000 WHO report is concerned with the health hazards of overweight and obesity and the issues of how best to prevent excessive weight gain and treat different degrees of overweight and obesity. Table 1 gives the consensus definition of different degrees of overweight and obesity in adults. The additional categories of extreme BMIs, based on cutoff points of 35 and 40, were chosen to aid in the development of treatment strategies. These cutoff points are somewhat arbitrary, because the relationships between BMI and morbidity and mortality vary between ethnic groups and with body fat distribution (see later). BMI categories are thus used to develop plans for clinical management, to depict changes in the obesity epidemic, and to present comparative data from different countries. In fact the prevalence of obesity is crucially dependent on the shift in the distribution of the whole population.[4] Thus modest shifts in the mean of the BMI distributions will cause substantial and predictable increases in the prevalence

From the International Obesity Task Force, London, United Kingdom.
Address correspondence to Dr. Philip T. James, International Obesity Task Force, 231 North Gower Street, London NW1 2NS, UK.
E-mail address: jeanhjames@aol.com.

360 Park Avenue South, New York, NY 10010
0738-081X/04/$–see front matter
doi:10.1016/j.clindermatol.2004.01.010

Table 1. WHO classification of obesity

Classification	BMI	Risk of comorbidities
Underweight	<18.5	Low (but risk of other clinical problems increased)
Normal range	18.5–24.9	Average
Overweight	≥25	
Pre-obese	25.0–19.9	Increased
Obese class 1	30.0–34.9	Moderate
Obese class 2	35.0–39.9	Severe
Obese class 3	≥40.0	Very severe

	Waist circumference	
	Women	Men
Above action level 1	≥ 80 cm	≥ 94 cm
Above action level 2	≥ 88 cm	≥ 102 cm

of obesity. The implications of such analysis are that total population strategies should be the primary focus of obesity prevention schemes and that a mean population BMI of <23 is needed if the prevalence of obesity (BMI ≥30) is to be decreased.

BMI and Obesity Comorbidities

The health hazards of different degrees of weight are not substantially changed at any particular BMI cutoff point. There are age-dependent changes in the relationship of BMI to total mortality.[5] The comorbidities intrinsically linked to high BMI, including diabetes, hypertension, gallstones, and coronary heart disease, are linearly related to BMI from a BMI nadir of about 19 or 20 in prospective studies in both men and men and women.[5] Thus the choice of an upper normal value of 24.9 for individuals is very generous and quite different from the optimum population mean BMI, which, as in the latest WHO report, should be between 21.0 and 23.0. Nonsmoking individuals are likely to have an optimum life expectancy and disability-free life by maintaining BMI at about 20 throughout life.

Obesity in Special Population Groups

Spurred by concerns about the high prevalence of diabetes and hypertension in Asian populations at very modest increases in BMI,[6] some Asian investigators recently proposed an alternative classification system (Table 2). In this system the BMI cutoff point of 25 signifies obesity, and the upper limit of normal is 22.9.

Such ethnically based differences are generally seen by most investigators as indicative of genetic factors, but research suggests that environmental factors are of great importance. In an analysis of the relationship between birth weight and the prevalence of adult hypertension, a clear inverse relationship between the two was found in the majority of more than 80 studies reported from all over the world.[7,8] Analyses from Japan, China, and India suggest that the increased prevalence of hypertension and diabetes at any BMI level in Asian populations relates to the impact of early programming events with hypertension, particularly related to birth weight and diabetes being predicted both from birth weight and the mother's BMI during pregnancy. A correlate of this amplified risk is the increased susceptibility of those born small to the selective deposition of excess fat in the truncal region and particularly within the abdomen.

Body Fat Distribution

Central or visceral obesity is associated with a greater prevalence of metabolic disease, including type 2 diabetes and dyslipidemia.[9] Numerous studies now show that the waist circumference is a useful measure of increased intra-abdominal fat. Magnetic resonance imaging or computed tomograpgy scans can provide more objective measures of central fat accumulation, but are not of general clinical or field relevance. Thus the WHO report[1] suggests waist circumference cutoff points that not only crudely predict whether people were overweight or obese, but also signify their propensity to hypertension and dyslipidemia, particularly low levels of high-density lipoprotein cholesterol (Table 1). Recent data from Guatemala suggest a clear relationship between the prevalence of stunting (which in turn is related to low birth weight) and the selective accumulation of abdominal body fat.[10] Lower waist circumference cutoff values have been suggested for Asians,

Table 2. Comorbidity risk associated with different levels of BMI and suggested waist circumference in adult Asians[6]

		Risk of comorbidities	
		Waist circumference	Waist circumference
Classification	BMI	< 90 cm (men) < 80 cm (women)	≥ 90 cm (men) ≥ 80 cm (women)
Underweight	< 18.5	Low (but increased risk of other clinical problems)	Average
Normal range	18.5–22.9	Average	Increased
Overweight	≥ 23		
At risk	23–24.9	Increased	Moderate
Obese I	25–29.9	Moderate	Severe
Obese II	≥ 30	Severe	Very severe

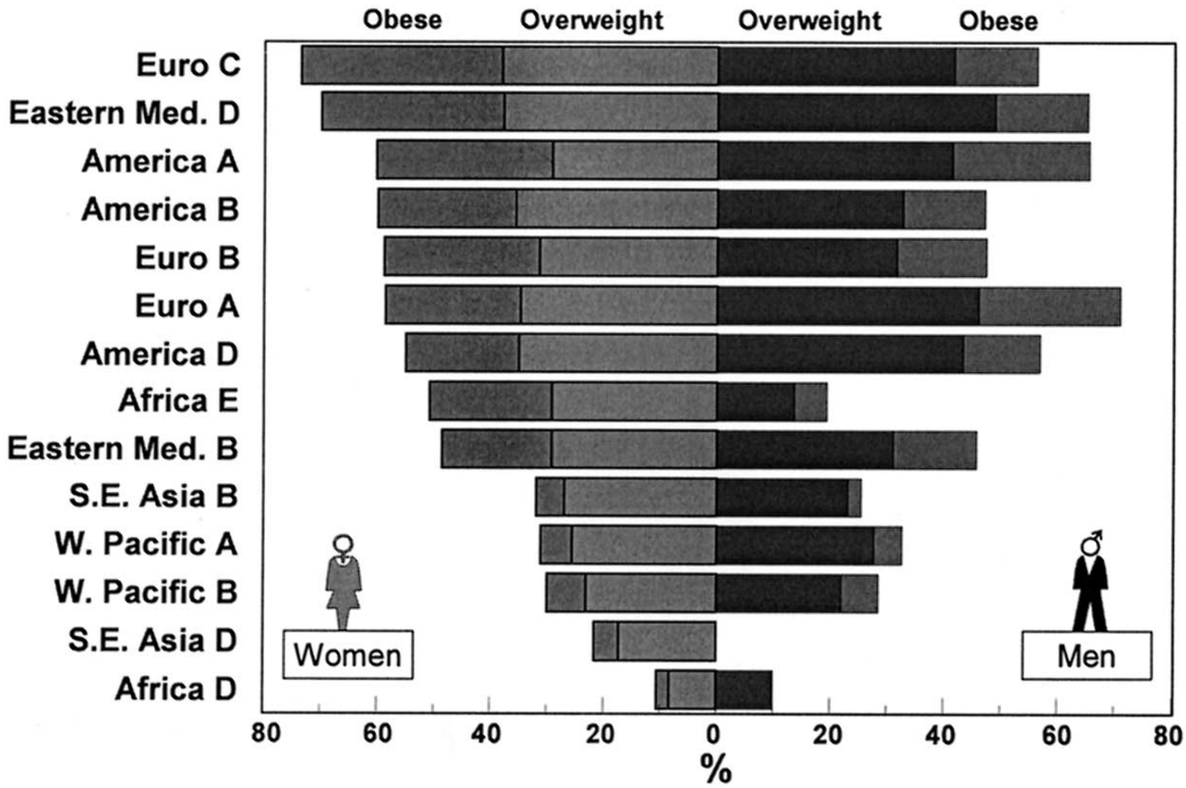

Figure 1. *Preliminary estimates of the prevalence of overweight and obesity in persons age 45–59 in different parts of the world. A total of 191 countries are included in the subregional groupings, which have been constructed on the basis of observed infant mortality rates and life expectancies. To illustrate the nature of the regions specified, the three countries with the largest populations in each subregion are listed below:*
Africa D: Nigeria, Algeria, and Ghana
Africa E: Ethiopia, Congo, and South Africa
America A: United States, Canada, and Cuba (all of the countries in the region)
America B: Brazil, Mexico, and Colombia
America D: Peru, Ecuador, and Guatemala
Eastern Med B: Iran, United Arab Emirates, and Saudi Arabia
Eastern Med D: Pakistan, Egypt, and Sudan
Euro A: Germany, France, and the United Kingdom
Euro B: Turkey, Poland, and Uzbekistan
Euro C: Russian Federation, Ukraine, and Kazakhstan
S.E. Asia B: Indonesia, Thailand, and Sri Lanka (all of the countries in the region)
S.E. Asia D: India, Bangladesh, and Myanmar
W. Pacific A: Japan, Australia, and Singapore
W. Pacific B: China, Vietnam, and the Philippines

because although Asians have an increased propensity to abdominal obesity, they still have an absolute increase in risk at any particular waist measurement (Table 2).

It thus seems likely that the WHO classification scheme will continue to be used for worldwide data analyses, but in clinical practice and preventive strategies we will choose different approaches targeted to specific segments of society and to the many countries worldwide where many children are born disadvantaged.

Prevalence of Overweight and Obesity

Figure 1 shows recent estimates of the different prevalence rates of overweight and obesity in middle-aged men and women (age 45–59 years) throughout the world. As shown these rates range from 5% in parts of Africa to nearly 80% in Eastern Europe. These rates are being used in a new analysis of the "global burden of disease," which was first presented by Murray and Lopez more than 10 years ago.[11] This reanalysis seeks for the first time to look systematically at the principal risk factors contributing to the major diseases leading to early death and disability throughout the world. Lopez's colleagues in Australia have already undertaken preliminary assessments of the burden of disease attributable to overweight and obesity and have shown that the maximum impact, in terms of years of life lost and years of life with disability, is in men age 55–64 years.[12] Women have the most disabled and limited years from 55 years onward. Despite halving the estimated risks of obesity to take into account possible confounding factors, such as physical inactivity, this Australian analysis found that in both sexes more than 4% of total disability and life years lost (DALYs) are due to overweight and obesity.

There is a remarkable variation in the prevalence of both overweight and obesity between the sexes worldwide. Obesity is clearly more prevalent in women. These differences are probably biologically based and relate to men's ability to deposit more lean (muscle) than fat tissue when energy imbalance occurs with weight gain.[13] Lean tissue is metabolically active and increases the basal metabolic rate in men, in part compensating for the discrepancy between intake and output. Women have more fat mass and less lean mass than men, and thus would need to gain far more weight to gain the additional lean tissue needed to provide the adaptive gain in basal metabolism to match any excessive intake. Bray and Popkin[14] have shown that the prevalence of obesity relates not only to the gross national product of a country, but also, and more specifically, to the fat intake estimated (albeit crudely) from Food and Agricultural Organization food balance sheets. Economic development tends to bring a progressive reduction in the demands for physical activity; it seems clear that this interaction between a readily available energy-dense, high-fat diet and increasingly sedentary lifestyles is a major factor in the development of obesity worldwide.

Detailed studies from various countries, including the United States, England, Brazil, and Japan, demonstrate a progressive increase in obesity rates in all, although these rates vary widely among countries. In most countries a clear inverse relationship is seen between education level/socioeconomic status and obesity prevalence. Thus obesity is increasingly seen as a feature of the poor.[15] Again, this may relate to social circumstances and cultural differences that alter behavior. The choice of an energy-dense diet may be determined by the relative cheapness of processed foods in which energy is derived predominantly from fats and sugars. The ready availability of these foods, the constant stream of food advertising, the provision of large portion sizes as a marketing technique, and the immediate and widespread availability of "fast foods" all mean that individuals have to be constantly on guard against the natural tendency to eat. The poor and less educated may also gain more enjoyment from watching television. This sedentary activity is less expensive and requires less initiative than various other social and leisure activities that require more resources and energy. It is perhaps not unexpected that as societies develop, it is the more disadvantaged who prove particularly prone to obesity.

Obesity in Children

BMI is lower in children and adolescents than in adults, and adult BMI cutoff points are not applicable in children. Recently the IOTF proposed a new classification system for overweight and obesity in children for research purposes.[16] This approach marries the childhood and adult definitions by taking, at age 18 years, those percentiles that corresponded to BMIs of 25 and 30 and using these same percentiles throughout the age range for specifying overweight and obesity in childhood in girls and boys separately. The IOTF chose data from six countries (the original NHANES I data from the U.S., UK data, and surveys from the Netherlands, Hong Kong, Singapore, and Brazil). This choice could have been improved by the inclusion of data on well-fed children of Indian and African origin, but suitable data were not available. The composite percentile cutoff points chosen from the six datasets are now being used in many parts of the world.

In clinical practice, age-related BMI percentiles are routinely used in many regions, including Europe, North America, Japan, Australia, and the Middle East, to distinguish obese and overweight children from normal-weight children.[17] There is some variation in whether the 90th, 95th, or 97th percentile is used as the discriminator; only Australia uses the 85th percentile as a cutoff point.[18]

Tracking Body Fat and BMI Into Adult Life

The usefulness of the age- and sex-specific BMI cutoff points in the IOTF reference values and the adult BMI cutoff points of 25 and 30 would be amplified if there were good percentile tracking of both body fat and BMI through childhood into adult life. Guo and Chumlea[19] reported that based on longitudinal studies in the United States, the probability of children with high BMI still being overweight and obese at age 35 rises markedly throughout childhood. Systematic reviews of attempts to predict adult obesity from childhood weight have not found much evidence supporting the value of selective monitoring in the prepubertal phase for predicting the emergence of obesity, particularly if based on analysis of weight rebound, that is, when the child first starts to move upward over BMI percentiles.[20,21] Power et al[22] demonstrated that the older the children studied, the greater the risk of their continuing to be obese in adult life. After age 5, being obese incurs a great risk of persistent obesity throughout adulthood. This observation has important implications for both prevention and intervention.

Conclusions

Given the rising prevalence of obesity with age in both childhood and adulthood, and although the prevalence of adult obesity cannot be predicted from childhood data, childhood obesity heralds a greater health burden in adult life. It is clear that obesity represents a cost burden to the community; most currently published figures are probably underestimates, because the methodology used does not take into account the indirect costs of obesity.[23] These indirect costs include money spent on commercial weight loss programs, reduced quality of life and lower earnings, and greater use of social services. The increasing prevalence of obesity and the associated increasing health costs for the community have focused attention on the economic burden of obesity. The cost of obesity-related medical care in the United States has been estimated at 5–7% of overall health spending. Thus as the epidemic of childhood obesity emerges throughout the globe and the prevalence of adult obesity continues to rise alarmingly, it can be confidently predicted that the health impact of excess weight gain will continue to be amplified in the coming years. Consequently, we can expect more systematic epidemiologic surveys conducted worldwide as governments confront what is already seen by the WHO as the world's greatest unrecognized public health problem.

References

1. Caterson ID, Gill TP. Obesity: epidemiology and possible prevention. Best Pract Res Clin Endocrinol 2002;16:595–610.
2. World Health Organization. Obesity: preventing and managing the global epidemic. WHO obesity technical report series 2000, no. 894. Geneva, Switzerland: World Health Organization, 2000.
3. World Health Organization. Physical status: the use and interpretation of anthropometry. Technical report series 1995, no. 854. Geneva, Switzerland: World Health Organization, 1995.
4. Rose G. Population distributions of risk and disease. Nutr Metab Cardiovasc Dis 1991;1:37–40.
5. Willett WC, Dietz WH, Colditz GA. Guidelines for healthy weight. N Engl J Med 1999;341:427–34.
6. WHO/IASO/IOTF. The Asia-Pacific perspective: redefining obesity and its treatment. February 2000. Available at http://www.idi.org.au/obesity_report.htm.
7. Law CM, Shiell AW. Is blood pressure inversely related to birth weight? The strength of evidence from a systematic review of the literature. J Hypertens 1996;14:935–41.
8. Huxley RR, Shiell AW, Law CM. The role of size at birth and postnatal catch-up growth in determining systolic blood pressure: a systematic review of the literature. J Hypertens 2000;18:815–31.
9. Montague C, O'Rahilly S. The perils of portliness: causes and consequences of visceral adiposity. Diabetes 2000;49: 883–8.
10. Schroeder DG, Martorell R, Flores R. Infant and child growth and fatness and fat distribution in Guatemalan adults. Am J Epidemiol 1999;149:177–85.
11. Murray CJ, Lopez AD. Global and regional cause-of-death patterns in 1990. Bull World Health Organ 1994;72:447–80.
12. State of Victoria burden of disease study: morbidity. Melbourne, Victoria, Australia: Department of Human Services, Public Health Division, 1999.
13. James WPT, Reeds PJ. Nutrient partitioning. In: Bray GA, Bouchard C, James WPT, editors. Handbook on obesity. New York: Marcel Dekker, 1997:555–571.
14. Bray GA, Popkin BM. Dietary fat intake does affect obesity rate. Am J Clin Nutr 1998;68:1157–73.
15. Peña M, Bacallao J. Obesity and poverty. Washington: Scientific publication no. 576. Pan American Health Organization, 2000, 41–49.
16. Cole TJ, Bellizzi MC, Flegal KM, et al. Establishing a standard definition for child overweight and obesity worldwide: international survey. BMJ 2000;320:1240–3.
17. Must A, Dallal GE, Dietz WH. Reference data for obesity: 85th and 95th percentiles of body mass index (wt/ht^2) and triceps skinfold thickness. Am J Clin Nutr 1991;53:839–46.
18. Guillaume M. Defining obesity in childhood: current practice. Am J Clin Nutr 1999;70(suppl):126S–30S.
19. Guo SS, Chumlea WC. Tracking of body mass index in children in relation to overweight in adulthood. Am J Clin Nutr 1999;70(suppl):145S–8S.
20. Power C, Lake JK, Cole TJ. Measurement and long-term health risks of child and adolescent fatness. Int J Obes 1997;21:507–26.
21. Parsons TJ, Power C, Logan S, et al. Childhood predictors of adult obesity: a systematic review. Int J Obes 1999; 23(suppl):S1–S107.
22. Barlow SE, Dietz WH. Obesity evaluation and treatment: expert committee recommendations. Pediatrics 1998;102: 1–11.
23. Thompson D, Wolf AM. The medical care cost burden of obesity. Obes Rev 2001;2:189–97.