

Original Article

Body mass index as an indicator of obesity

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Undernutrition and hunger have always formed the foundation of the Food and Agriculture Organisation's (FAO) mandate. Working in collaboration with the International Dietary Energy Consultative Group (IDECG), FAO began to examine both appropriate cut-off points of the body mass index (BMI) at the lower end of the spectrum and the functional consequences of low BMI (<16.0 = Category III Chronic Energy Deficiency (CED); 16.0 – 16.9 = Category II CED; 17.0 – 18.4 = Category I CED). Over the past decade FAO has recognized the growing obesity epidemic occurring not only in the developed world but also among all income and socio-economic groups of the developing world. In response, FAO and the World Health Organization (WHO) have collaborated together in joint initiatives. Following the WHO 1998 Obesity Consultation on Preventing and Managing the Global Epidemic, a number of regions examined their individual situation regarding obesity. In looking at the BMI risk-based cut-off points, there appeared to be need for a tailoring of the cut-off points for Asia. The publication *The Asia-Pacific Perspective: Redefining Obesity and its Treatment (2000)* proposed area-specific cut points. While such efforts to individualize reference values to a region or situation are attractive and even commendable, there is always the danger of creating confusion particularly if later these figures are changed. It is very important that before values are promulgated, a thorough review is conducted and full confidence can be placed on them.

Key words: Asia, body mass index, chronic energy deficiency, consequence, Food and Agriculture Organization, obesity, overweight.

Introduction

From the earliest days of its founding in 1946, FAO's mandate has been defined as focussing on undernutrition, hunger and related agriculture policies. The first task of FAO and partially the impetus behind its creation was the urgent need to address the food shortages and hunger in postwar Europe. Later its geographical focus and geopolitical demands shifted the attention to the food inadequacy and malnutrition prevalent in the newly independent countries and the developing world in general. As a technical backup to addressing these nutritional issues a review of micro- and macro-nutrient requirements was initiated as well as the introduction of nutrition considerations and interventions into the development process. In 1948, the newly established FAO Standing Advisory Committee considered that 'the problem of assessing the calorie and nutrient requirements of human beings, with the greatest possible degree of accuracy, is of basic importance to FAO.'¹ (During the early years of FAO and within the general scientific community, energy was referred to as 'calorie', the unit then applied to expressing energy. In fact, the correct unit is 'kilocalorie' and increasingly the convention is to use kilojoules (KJ) where 1 kilocalorie equals 4.1868 KJ.)

Although undernutrition was the primary concern when formulating the requirements, recognition was given early on to the consequences of excess energy balance, that is, overweight and obesity. The first committee on calories offered the very practical rule of thumb that if the person 'is in good health

and *calorie balance*, that is, neither over nor underweight, then he or she is consuming food according to his or her calorie requirements.'¹ The early committees had the insight of adding the notion of maintaining an adequate level of energy expenditure, thus recognizing that leisure activities and health promoting activities were important and that the requirements were not equated with a minimum, survival level.²

BMI as an indicator of undernutrition or Chronic Energy Deficiency (CED)

The 1981 Joint FAO/WHO/UNU Expert Consultation on Energy and Protein Requirements was a turning point in the determination of energy requirements. With the exception of children under 10 years of age due to limitations of energy expenditure data, energy requirements were based on estimates of energy expenditures, rather than energy intakes. In applying this methodology, knowledge was required of ideal and actual body weights, while the Body Mass Index facilitated the determination of an ideal weight at any given height.

As a result of working with the BMI as a nutritional indicator, attention was turned to better assessing and expressing adult nutritional status, again with emphasis on low body weight. Nutritional status based on anthropometry

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had been limited almost entirely to children less than five years of age, and yet there was increasing evidence that the nutritional status of adults may better reflect the food accessibility situation than anthropometric indicators for children. Working in collaboration with the International Dietary Energy Consultative Group (IDECG), Professors WPT James, A Ferro-Luzzi and JC Waterlow, FAO began to examine both appropriate cut points of the BMI at the lower end of the spectrum and the functional and health related consequences of low BMI.³ Following two working group meetings on this subject its conclusions were presented in a publication detailing three classes of Chronic Energy Deficiency (CED): <16.0 BMI = CED grade III; 16.0–16.9 BMI = CED, grade II and 17.0–18.4 BMI = CED, grade I. A BMI of 18.5 and above but less than 25.0 was considered normal. However, in presenting a final classification system, the authors combined the three CED grades with energy expenditure levels above and below a 1.4 Physical Activity Level (PAL) × Basal Metabolic Rate (BMR). A PAL of 1.4 was selected since at that time it was considered to be the level compatible with health or an acceptable maintenance level. The Working Group felt that both body weight and physical activity should be included so as not to incorrectly classify those with a low BMI but performing at a satisfactory energy expenditure level. The different categories proposed by the IDECG Working Group are shown in Table 1.

Additional research and discussions were carried out on the most appropriate, yet simple, way of presenting CED. Eventually it was realized that although purer in concept, it is unrealistic to propose the global development of activity monitoring as an aid to the assessment of undernourished adults.⁴ In addition, the original concern that the developing countries may have large numbers of thin but very athletically fit individuals was discounted. This allowed for the full reliance on any direct assessment of the nutritional status to be based solely on a simple anthropometric measure of

body weight and height, i.e., the BMI. Thus, a simplified scheme was proposed, shown in the first part of Table 2, but cut-off points were also established for the upper end of the BMI spectrum, which were identical to Garrow's risk-based categories of obesity.⁵

Subsequent research was carried out in a collaborative effort between FAO and the Rowett Research Institute, examining in detail data from Burundi, Brazil and Tunisia. Changes in the BMI distribution of the population over time were examined in addition to differences in the distribution according to income class. Where data permitted, the functional consequences of low BMI were examined, looking at reported days of morbidity and incidence of mortality. This work culminated with the convening of an IDECG workshop at FAO in Rome from 4 to 6 November 1992, on 'The Functional Significance of Low Body Mass Index', the proceedings of which were published in the *European Journal of Clinical Nutrition*.⁶ As a means of disseminating this information and the concept of low BMI and its consequences to workers in the field, FAO commissioned in 1993 a publication on 'Body Mass Index: A measure of chronic energy deficiency in adults', authored by Shetty and James.⁷

Convinced of the importance of collecting more adult BMI data, FAO arranged in 1990 through a contract with Macro International for the collection of mothers' BMI in approximately 12 countries during the next round of the Demographic and Health Surveys (DHSII). The contract was supported by funding from both FAO and the United States Agency for International Development (USAID) and subsequently resulted in the routine inclusion of mothers' BMI in future DHS surveys. (FAO had originally proposed that the height and weight data of all adults from families surveyed in the DHSII round be collected but reduced this request to only the collection of mothers' data due to the cost implications.) These BMI data have proved crucial not only in monitoring the degree of undernutrition but also the levels of overweight and obesity.

Table 1. Epidemiological diagnosis of CED as proposed by an IDECG Working Group

BMI	< 16.0	16.0–16.9	17.0–18.5	> 18.5
≥ 1.4 PAL	CED Grade III	CED Grade I	Normal	Normal
< 1.4 PAL	CED Grade III	CED Grade II	CED Grade I	Normal

BMI, body mass index; CED, chronic energy deficiency; IDECG, international dietary energy consultative group; PAL, physical activity level.

Table 2. IDECG BMI categories for under/overweight and obesity

BMI (kg/m ²)	Classification	
< 16.0	Category III	} Category of Undernutrition/CED
16.0–16.9	Category II	
17.0–18.4	Category I	
18.5–24.9	Normal	
25.0–29.9	Category I obesity	} A Garrow's risk-based category of obesity
30.0–39.9	Category II obesity	
≥ 40.0	Category III obesity	

BMI, body mass index; CED, chronic energy deficiency; IDECG, international dietary energy consultative group.

The obesity epidemic

In the mid-1990s, WHO responded to the growing obesity epidemic throughout the world. Preparations began for conducting an expert consultation on obesity, which drew in part on the work of the International Obesity Task Force (IOTF) for the preparation of the background documents and material. The Consultation was held in June 1997 in Geneva and the report published in 1998.⁸ Although the prevalence and causes of obesity were reviewed for all regions of the world, the North American and European populations dominated the analysis. The BMI cut-off points are well known and were based on risk of chronic diseases, albeit from largely a North American and European population (Table 3). The one unique aspect of these classifications was the reduction of 'Normal' to a BMI of 18.5 as opposed to 20.0.

In the aftermath of the WHO 1997 Obesity Consultation, a number of regions examined their individual situation regarding obesity and comorbidities. Asia appeared to present a particularly unique situation. The Asian population has always been characterized as 'small' or 'lean'. However, the populations of the Asian region are not homogeneous. In looking at possible BMI risk-based cut-off points, the prevalence of overweight and obesity appeared to be lower than elsewhere in the world. However, obesity and related diseases are growing in the region. When including the Pacific region as a result of its geographical proximity, the situation is further complicated. This phenomenon suggested the need for a tailoring of the cut-off points for Asia.

In collaboration with the WHO Western Pacific Regional Office, the International Obesity Taskforce turned its attention to the Asian-Pacific region in its publication *The Asia-Pacific Perspective: Redefining obesity and its treatment*.⁹ The resulting classifications, which were presented as proposals and provisional, were assigned a unique terminology and lowered the cut-off points for obesity (Table 4).

Over the past decade, the Food and Nutrition Division of FAO has also recognized the growing obesity epidemic occurring not only in the developed world but also among all income and socio-economic groups of the developing world. Whereas traditionally FAO has addressed primarily the issues of hunger and the rural farmer, it recognized the links between malnutrition and obesity and the increasing prevalence of the double burden of disease that many of the poorest countries were experiencing. The issue became even more relevant to FAO's work in light of the growing evidence that undernutrition during foetal development (particularly exhibited by thinness at birth) and early childhood led to an enhanced tendency to obesity and the related chronic diseases later in life, particularly the metabolic syndrome (central obesity, glucose intolerance, insulin resistance, dyslipidemia and hypertension).¹⁰ This issue has been thoroughly reviewed and summarized by WHO.¹¹

In late January 2002 WHO and FAO convened a Joint WHO/FAO Expert Consultation on Diet, Nutrition and the Prevention of Chronic Diseases at the WHO Headquarters in Geneva. Expanding on previous examinations of this topic, enhanced emphasis was placed on the complete lifestyle

Table 3. WHO 1998 classification of BMI categories for Europeans

BMI (kg/m ²)	Classification
< 18.5	Underweight
18.5–24.9	Normal
25.0–29.9	Pre-obese
30.0–34.9	Obese I
35.0–39.9	Obese II
≥ 40.0	Obese III

BMI, body mass index; WHO, World Health Organization.

Table 4. IOTF-proposed classification of BMI categories for Asia

BMI (kg/m ²)	Classification
< 18.5	Underweight
18.5–22.9	Normal
23.0–24.9	At-risk of obesity
25.0–29.9	Obese I
≥ 30.0	Obese II

BMI, body mass index; IOTF, International Obesity Taskforce.

impact of this phenomenon, particularly reduced levels of activity.

The BMI cut points recommended from the 1998 WHO Consultation on Obesity were the first such cut-off points at the international level. Although they have been generally accepted, a number of countries and regions have questioned the relevance of the public health cut-off points to their respective situations. This has been particularly so in the Asia and Pacific regions. It has been amply demonstrated that Asians in general, although not consisting of a homogeneous population, have a higher percent body fat at a given BMI than Caucasians. They also have a higher waist-to-hip ratio than Caucasians and a more centralized distribution of body fat. Perhaps of most concern, morbidity and mortality among Asians are occurring in people with lower BMIs and smaller waist circumference. On the other hand, Pacific Islanders tend to be larger and more muscular, with less body fat at higher BMI levels.

Increasingly, the appropriateness of the WHO BMI cut-off points for Asians are being questioned.¹² For those countries with a sufficient data base, country-specific values have been developed. Data from Japan¹³ and China¹⁴ have resulted in the Japanese defining obesity as a BMI of 25 or more and the Chinese as using a BMI of 24 and 28 as markers for overweight and obesity, respectively.

The attractiveness and even urgency felt for setting country-specific cut-off points for both BMI and waist circumference is understandable. A country can look at the population anthropometric profile and chronic disease experience and note with alarm the large numbers that will be excluded from intervention as a result of screening using the international cut-off levels. However, it is important that the short-term gains that might be foreseen from setting and

adopting country-specific cut-off points do not overshadow the longer term disadvantages that may result. Environmentally determined factors can be unstable over time and in their association with various sectors of the populations and selected ethnic groups. Whereas a population-specific cut-off point may prove ideal at one point of time, over time the evidence may dictate the need for changes. Such changes may confuse the public and raise havoc with any attempts at trend analysis. Thus, a thorough, data-based review must accompany any process to change the adopted cut-off points for overweight and obesity.

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