Fractionating healthy weight\textsuperscript{1,2}

Stanley M Garn

ABSTRACT Any discussion of healthy weight necessarily starts with body composition and its relation to long-term mortality and morbidity and then goes on to consider the limited range of ages for which we have epidemiologic data, the time span involved, the criteria used to define “healthy,” and the possibility that a weight that is advantageous with respect to one outcome criterion may be disadvantaged for another. One may therefore ask, weight of what? healthy weight for whom? by what criteria? and question whether a simple weight-for-height ratio is sufficiently effective for the task. Am J Clin Nutr 1996;63(suppl): 412S–4S.

KEY WORDS Obesity, overweight, ponderal indexes, fat weight, lean body weight, mortality, morbidity, health outcomes, body build, running

INTRODUCTION

We are immediately challenged by the charge of this conference workshop having to do with healthy weight. We all appreciate that the term “weight” often is a euphemism for fat weight, though it is measured, and that each of its components can be independent risk factors for specific disabilities. We are also concerned separately with short-term and long-term risks, which may operate in opposite directions and not necessarily in a linear fashion (1, 2). For example, risks to the mother and her conceptus may have to be considered separately, for the long-term survival of the mother may compete with the short-term survival of the fetus. At most ages, the question of a healthy weight must be answered by still another question: healthy, when and how?

FRACTIONATING WEIGHT

Much of the time, “weight” is merely a synonym for fat weight or percentage fat, which are not the same (3). Conventionally, we assume that percentage of fat is the major risk factor for cardiovascular and renal diseases and diabetes, thus allowing a person with a large lean body mass (LBM) to carry more fat, but we are not completely sure of that assumption. Moreover, the size of the LBM itself is a separate risk factor for coronary artery disease and other disabilities, and these two risk factors often sum in their morbidity effects.

In recent years the weight-for-height ratio or body mass index (BMI) has been rediscovered (again) and used as a surrogate for weight, though the two are operationally nearly the same ($r > 0.9$ for adults of both sexes). Calculated as the BMI, weight itself is disproportionately weighted, and dividing it by height squared (or cubed) does not fully correct for leg length or body build (4, 5). Still, weight alone is so easy to measure and most fitness programs lack facilities for desitometry, $^{40}$K measurement, dual-photon absorptiometry, or bioimpedance measurement, or even simple skinfold calipers.

HEALTHY WHEN?

Out of long tradition and following practices of insurance companies, we have been most concerned with weight or relative weight at age 30 in relation to morbidity and mortality three or four decades later (2). Interestingly, however, we have come to extend our attention to both ends of the life span. We do not yet know whether adiposity in senior citizens is as morbidogenic as at younger ages. We also are unsure about the long-term consequences of adolescent obesity, in part because only a small proportion of the adolescent obese remain obese for decades. Adolescents are a particular investigative problem because they differ so much in maturational timing that one 14-y-old girl may be developmentally $< 12$ y and another (of the same age) developmentally $\geq 17$ y. Thus, for adolescents, developmental age should be used.

Although we may suggest a weight for optimal fitness now and for longevity in the long-run, there are situations in which the two optima contradict, as when pregnancy is contemplated or intended. Indeed, a weight deemed optimal for athletic performance and presumably optimal for longevity may be far too low for optimal pregnancy. Our data on 49 995 pregnancies showed far lower fetal and neonatal mortalities and far lower incidences of prematurity when the prepregnancy weight was closer to $\sim 73$ kg (160 lb) than the more stylish 60 kg (130 lbs).

Is dieting bad? Dieting during adolescence is common in girls today not just out of fashion but also because of the fashions girls elect. Sports-oriented boys also commonly diet simply “to make a weight,” for example, in a sport such as wrestling. There is much concern among many pediatricians that adolescent dieting may have adverse long-term consequences to LBM, particularly to skeletal mass or bone weight. Indeed, because bone tissue continues to be added throughout the ages of the 20s and 30s, there is a need to reconsider what weights and fat weights should be advocated for younger adults still short of their peak skeletal mass.

\textsuperscript{1} From the Center for Human Growth and Development, and the Nutrition Unit, School of Public Health, University of Michigan, Ann Arbor.

\textsuperscript{2} Address reprint requests to: SM Garn, Center for Human Growth and Development, University of Michigan, 300 North Ingalls Building, Ann Arbor, MI 48109-0406.

BODY BUILD COMPARED WITH BODY WEIGHT

As applied to individuals as apart from groups, differences in body proportions and body build also complicate our choices. Beyond differences in leg length, differences in LBM limit the utility of weight or relative weight alone. A University of Michigan football player averages in excess of 150% of standard weight, and stripped of fat, still weighs far more than the average male. So, some individuals of both sexes are scarcely obese despite a very high BMI, and some low-weight, low-BMI males and females are both excessively fat and underweight at the same time. The problem is how best to measure such differences in body build and what to do about them in this conference.

Failure to comprehend the two-component nature of weight, relative weight, or BMI complicates many data analyses, though Behnke et al (6, 7) explained it five decades ago. Using underwater weighing, Behnke showed why football players seemingly so "overweight" that they were draft-exempt could still stamp merrily on each others kidneys every weekend in the fall. More recently, individuals with a high BMI were claimed to have higher bone densities, not because they were obese (as assumed) but because close to one-third of individuals with a high BMI also had a large LBM—including muscle, viscera, and skeletal mass (8).

IS ADULT WEIGHT INCREASE NORMAL?

In the United States and other Westernized countries, average weight increases through the seventh decade in both sexes, even as lean body weight decreases. We are accustomed to think of this as normal and physiologic. However, not all adult Americans gain weight, and by the age of 50 y those who lose weight are as prevalent as those who gain weight. In fact, the gainers gain more weight than the losers lose, which is why the textbook averages climb. In many other parts of the world, however, adult weight gain is not the rule and actual weight loss may begin early in life. So there is reason to reconsider adult weight gain as an inevitable part of the human condition.

Interestingly enough, blood pressure does not go up (or up as much) in those populations in which fatness gain is not the rule. Because systolic blood pressure rises \( \approx 1 \) mm Hg per millimeter of triceps or subscapular skinfold thickness, there are good reasons to reconsider the notion that adult weight gain is physiologic and normal, or that the consequent gains in systolic and diastolic blood pressure are normal.

The smoothed age curves for weight not only obscure the existence of individual variance in both directions but also obscure the magnitude of such changes. Although some individuals are remarkably weight-constant (within 1–2 kg, which is well within the limits of measurement error and fecal retention) others cycle to a remarkable degree (\( \pm 10 \) kg and more) (9). Attention has been directed to weight cycling as an independent risk factor for atherosclerosis, but the reality may be simpler than that. Men and women with little fat do not cycle much, in part because they have so little to lose. However, the weights of high-weight, massively obese men and women fluctuate much more, so it is likely that the underlying obesity and not the associated weight fluctuation actually affects their duration of life.

CAN WE TRUST THE "NORMS"?

The purpose of this workshop is also complicated by the reference values commonly used, now three decades old for adolescents and adults in the first National Health and Nutrition Examination Survey (and the population is constantly changing in an upward direction). The data on infants and young children in the "new" growth charts from this survey are far older still; indeed, some of the original infants included in these standards are now receiving social security benefits! Moreover, the mixed-population sample included in the standards of the National Center for Health Statistics for adolescents and adults includes both black and white subjects, who differ both in the components of weight and in weight itself.

That body weight and components of weight are much influenced by socioeconomic level is well known (10–13). Women at the poverty level have a smaller lean body weight but a much larger fat weight and weigh more as a consequence (11). Should our reference population be the affluent women who are leaner and weigh less, or the poorer women who weigh more? Do we benefit from the use of a national probability sample, which is politically expedient but begs the question of what is truly healthy, politics aside? Granted that national probability samples have been blessed by a consensus conference, does that consensus meet our needs here?

ENERGY DYNAMICS OF WEIGHT

We have much to understand about the energy dynamics of a healthy weight. Although in a clinical research unit suitably policed we can manipulate the energy balance to our content and pleasure, in free-living ambulatory men and women it is even difficult to verify that bigger individuals eat more. Some of this difficulty is attributable to large individual differences in voluntary energy expenditure, even at nominal rest, which are not easily metered in a 5-min oxygen-intake sample, or in an extrapolation from 24-h heart rates. Much of this difficulty is exacerbated by self-reporting of food consumption, which is notably unreliable and systematically distorted as well. So it is that overweight and obese women generally report lower intakes of energy and nutrients and minerals—suggesting to the unwardy that such disabilities as hypertension are due to less sodium, potassium, magnesium, or calcium per day. Indeed, it might be (inaccurately) inferred from self-reported intake data that obesity is due to insufficient food, and that underweight stems from overeating.

ISSUES TO CONSIDER ABOUT HEALTHY WEIGHT

1) Healthy weight of what? Are we talking about the weight (or more specifically obesity tissue) or the weight of the LBM or some combination of the two? 2) Healthy weight for whom? Are we primarily restricted to the long-term mortality and morbidity of 30–40–y-old probands or are we in a position to suggest both immediate and long-term healthy weights for younger and older people? 3) Healthy weights for whom? Because existing insurance-derived mortality-for-weight statistics pertain to upper-income, white Americans, can these statistics be applied to lower-income men and women and to those of African, Asiatic, and Central American ancestry? 4) Is a healthy weight a stable weight? Alternatively, are the disadvan-
tages of marked weight fluctuations simply confounded by obesity? The answer to this question also bears on whether a higher but stable weight might be preferable to a lower weight with cycling of ± 10 kg. 5) Is the considerable adult weight gain normal and therefore healthy as some contend, or is this weight gain simply obesity tissue with all its disadvantages with respect to lipid concentrations, blood pressure, diabetes, and more?

CONCLUSION

The American Health Foundation has presented us with the challenge of healthy weight. This challenge comes from numerous directions, beginning with the very meaning of weight and its several components, the validity of the reference standards, and the samples used. We are challenged by the use of weight alone, or a simple weight ratio that is 99% weight. We are challenged by the fact that a given weight or body composition may not be equally healthy under all circumstances, and for all individuals and for all stages of life. And so we are convened at this Roundtable on Healthy Weight to address these challenges. Although we may not answer all the questions posed, they will assuredly provoke considerable and invaluable discussion.

REFERENCES