

The "Dynamic Epidemiology" of Obesity: Knowledge to Help Improve Our Ability to Manage the Condition

by Steven Jonas, M.D., M.P.H., M.S.

American Medical Athletics Association Journal, Summer, 2004 (Slightly edited version, Oct., 2004)

Introduction

As is well known, the growing epidemic of overweight/obesity (O/O) in the United States has become an increasingly serious health and health care problem over the last 20 years. Long-term, the answer is of course prevention. However, in the meantime much work needs to be done in order to bring the epidemic under control using treatment and management interventions, now and for the foreseeable future. The science of epidemiology, that is the study of the distribution of disease and negative and positive states of health in populations, can be very helpful in this regard.

At present, a good deal is known about what can be termed the "static" epidemiology of obesity: what the overweight population looks like at a given point in time in terms of demographic and health-related characteristics. However, little is known about the patterns of weight gain and loss over time in individuals and populations, what might be termed the "dynamic" epidemiology of the condition. Who gains, how and why? Who is at risk for weight gain in the first place? Who isn't? What are the several different weight-gain patterns? Why does one person gain weight one way at one time in life and another way at another time in life?

On the other side of the ledger, what are the factors in weight loss success and failure? It is well-known that the success rate for losing weight and keeping it off is low; however, some people are successful in losing weight and keeping it off over time. Knowledge of the similarities and differences between those overweight persons who are successful in losing weight and those who are not, in both their individual health and demographic and their weight-gain and weight-loss pattern characteristics, is also limited. This paper addresses these issues and in so doing, offers a research agenda for elucidating them.

The Shape of the Problem

The epidemic of O/O in the United States has gathered momentum over the last 25 years, has been known to exist for quite some time and appears to be continuing unabated (19, 21, 2, 8, 13, 22, 14, 27, 29, 7, 23, 10, 11, 26, 4, 9, 20, 17, 18). O/O has very serious negative effects for our society. It is estimated that about 400,000 deaths annually are attributable to it and its stable mate, sedentary lifestyle (4). In addition, it has been estimated that the health-related costs of O/O and its negative health outcomes are associated with approximately 10% of national health care expenditures (16).

There are numerous approaches to weight management and weight loss. Some of them work for at least some of those who try them: the person is able to lose weight and keep it off. Healthy eating combined with regular exercise has been established as the scientifically sound approach to weight loss and does appear to be the approach most commonly used by those who are successful in losing weight and keeping it off (5). However, no single program works for everyone who tries it, and many don't work for anyone who tries them. Obviously, one size does not fit all when it comes to weight loss, or weight maintenance for that matter. Finding answers to the many still unanswered questions could be of great assistance in developing a better approach to weight management and loss.

Definitions of Overweight and Obesity

Traditionally, "overweight" has been defined as excess body weight in relation to observed norms in the population by age, sex, and height (28). Traditionally, the term "obesity" has been defined as an excess proportion of body fat in relation to observed norms in the population by age, sex, and height, regardless of weight. That is, a person of normal weight carrying a higher than normal proportion of body fat would have been characterized as "obese." In the

current era, somewhat different definitions of the two terms are being used (19, 21). Rather than referring independently to excess body weight and excess body fat, presently the definitions of both conditions refer to an elevation in an individual's body mass index (BMI), which measurement comprehends both weight and height. Thus, the two terms now simply represent different degrees of excess. Presently the term "overweight" refers to a BMI of 25 through 29 and "obesity" to a BMI of 30 or more. Since "obesity" is now used simply to refer to a higher degree of the generic condition "overweight," in this paper the combined term "overweight/obesity" is used. As noted above, the term is abbreviated as "O/O."

The Elements of the Dynamic Epidemiology of Obesity

Going beyond the well-understood "static epidemiology" of O/O consider the following. Over time, just who gets heavy and why? For example, why do some pregnant women gain a very significant amount of weight and then do not or cannot lose it, while others gain but are successful in weight loss, while still others do not gain any much weight at all during pregnancy and stay that way afterwards? How does adult weight gain differ, over time, from childhood weight gain? Are weight gain and weight loss simply related to the calories-in/calories-out balance/imbalance? Alternatively, is there a role played, in certain people at least, by the characteristics of individual metabolism and its possible variation from person to person? Are there variations over time in the way a given person gained weight that affects the probability of success or failure using a given weight loss program at a given point in time? In a person with O/O, does previous dieting history have an impact, positive or negative, on current weight loss attempts? Does metabolism -- that is, active metabolism, not just resting metabolic rate -- vary significantly among people of normal weight and also among the overweight and obese? If so, are there also variations between the several groups, over time? Further, what are the epidemiological characteristics of the several groups?

These are all versions and elements of the question: Why might it be important to gain an understanding of the -dynamic epidemiology" of O/O? The answer to this question forms the basis for the position taken here. It may well be that just how a particular person with particular demographic, eating, metabolic, and weight loss and dieting history characteristics gains -- and in some instances, successfully loses -- weight over time is rather different from how another person gains and loses. If two or more patterns can be identified, people exhibiting them will obviously coalesce into groups. These patterns and the characteristics of the people exhibiting them could then be studied over time, using the tools of "dynamic epidemiology." It could be very helpful for weight loss/management program design to have developed epidemiologic "movies" of people over time as they gain weight, maintain it, try to lose it, lose it and so forth, with of course detailed records of their various demographic, health and other characteristics. As noted above, some people are indeed successful (5, 2 5). It would be very useful to know how they did it, what their dynamic weight-related characteristics are, and how those factors differ, if they do, from those who are unsuccessful.

For example, suppose that in a random sample survey (the sample for the Consumer Reports 2002 study referenced above [5] was not randomly selected) of people trying the same weight loss program, the successful differed from the unsuccessful in how they had gained weight in the first place, or in what their earlier weight loss and dieting history had been before starting the new regimen. That finding would be very instructive. Further, it could be determined if there were physical, pathogenetic, morbid or psycho emotional co-factors for both success and failure. If identifiable groups of people gain weight differently and then lose it differently, does that mean that different approaches to weight loss/management should be designed to deal with possibly different pathways to and from O/O? For example, as stated above, nutritionists know that the healthiest way to lose weight and keep it off is through a reasonably low-fat, lowered caloric-intake diet combined with regular exercise. This program apparently works for many of those who try it and are able to stick with it. However, the much-hyped highfat/high-protein/low-carb ("Atkins") diet also works over the long run for certain users. Is this just a chance occurrence or, in terms of weight gain and dieting history, and metabolic functioning, is it possible that there are two or more different types of people here?

Research Topics: Toward a General Theory of O/O

It would appear obvious that part of the proposed research effort must focus on the how and the why of weight gain, that is, its "natural history." it may come as a surprise to know that this is something not well-understood. Developing such an understanding could be very helpful, just as an understanding of the natural history of diseases and negative health conditions ranging from cholera and cigarette smoking to heart disease and sedentary lifestyle has lead to

many advances in the prevention and/or treatment/management of them. The first defined arena proposed for research is in what might be called the "General Theory of Overweight/Obesity." The question in its simplest form is: Is overweight the simple product of too-many-calories-in/too-few-calories-out, or is there possibly a third factor in the equation, possibly variations in individual metabolism? Perhaps illustrating the difficulties afoot in answering this question, a Report of the Council on Scientific Affairs of the American Medical Association at different points in the text took each position.

Under "definitions of overweight and obesity," the report states (6):

"Excess body fat results from an imbalance between energy intake and energy expenditure."

This is the old theory: "If you eat more than you need to, you will get fat." However, later in the report this statement appears:

"Increasing evidence suggests that obesity is not a simple problem of willpower or self control [in eating and physical activity] but is a complex disorder involving appetite regulation and energy metabolism that is associated with a variety of co-morbid conditions."

If this latter statement is correct, then one might conclude that the accumulation of excess body weight/fat results from an imbalance among three factors: energy intake, energy metabolism, and energy expenditure.

Perhaps, then, weight gain is also significantly influenced by the presence or absence of other negative-health conditions. Suppose, for example, that weight gain is indeed the product of a three-factor equation (calories-in/calories-out/metabolic-profile), not just the two-factor calories-in/calories-out. In any given adult, is the major variable then overeating as a child, or as an adult? If overeating, what kind: excess carbohydrates (beer), or excess fat (meat), both (rich desserts), or just excess calories of any type? Or is the major variable primarily inactivity rather than over- or otherwise unhealthy eating? In addition, just how do these various factors affect metabolism?

A better understanding of the role of energy metabolism and its variants in facilitating or inhibiting weight loss could also be useful. Important aspects in this arena are better to understand: how energy metabolism possibly varies between individuals; how energy metabolism varies within individuals over time, especially after they have been overweight for some time; and how energy metabolism varies over time in persons who have made one or more unsuccessful attempts to lose weight. Concerning this aspect of the natural history of 0/0 there is also a need for research into a question raised in the AMA/CSA Report concerning the role of "co-morbidity" in weight gain, 0/0 maintenance, and weight loss (6). Consider briefly two current hypotheses on the natural history of weight gain.

Some time ago, I developed one I called "The Four Pathways" hypothesis (15). It postulates that there is not just one, but rather at least four distinct pathways from normal weight at some time in life to 0/0 at another. Briefly, they are:

1. High-calorie overweight: adult onset overeating/under-exercising, pure and simple.
2. Family-induced overweight: 0/0 commences in childhood through eating/exercise patterns established in the family.
3. Genetically-predisposed overweight: a genetic anomaly leads to a metabolic imbalance.
4. Diet-induced low-calorie overweight: the result of the negative impact on resting metabolic rate of the sudden-calorie-restriction "weight-loss" diets that are so popular in this country.

If this hypothesis were correct, its application would have a major impact on the approach to both weight gain and weight loss. It would also have a major impact on the development of obesity prevention programs. For example, it would indicate that when doing studies of intervention programs for persons with 0/0 it is vital to know by which pathway they have come to 0/0 status, so that one would not be comparing apples and oranges. Exploring this hypothesis, using historical, epidemiologic, and metabolic tools, would therefore be useful.

The "it's all in the genes" hypothesis concerning the natural history of weight gain has been around for quite some time (7). However, as Koplan and Dietz point out (16): "Genes related to obesity are clearly not responsible for the epidemic of obesity because the gene pool in the United States did not change significantly between 1980 and 1994." In other words, while there is clearly a genetic pathway operative in some individuals, given the rapidity of the development, of the modern obesity epidemic the incidence of this pathway to O/O is probably the least frequent. But perhaps there are one or more variants of long-standing genetic predisposition which, when exposed to the enormous caloric overload with which the U.S. population is bombarded (30) lead more easily to O/O. Again, gaining a better understanding of the dynamic epidemiology of weight gain would help us to develop a better understanding of the role of genetic composition in O/O, at least in certain persons.

Research Topics: The Management of O/O

Although no controlled studies on the subject have been done, as noted it does appear that persons who try to lose weight on their own, not in a group program of any kind, are the most successful (5). One study found that 60% of persons attempting independently to lose weight succeeded (25). Successful weight loss requires ongoing motivation mobilization and self-discipline. It is thus logical to conclude that persons who can take control of their lifestyles and attempt to lose weight on their own would be more successful than persons needing outside assistance for one reason or another. The latter would most likely need a group program for support. As to the specifics of success rates in group programs (e.g., Weight Watchers, Diet Centers, Jenny Craig), since few if any of them publish their results, little is known.

Since those who lose weight and keep it off on their own seem to have a higher success rate than those who use organized programs, another major arena for research in effective weight loss methods would be better to understand just what characteristics, both of the methods that work and of the people using them, lead to that success. Since exercise does seem to be central here (6, 5, 7, 24, 25), its role should perhaps receive special attention (16). As weight loss authority and Chair of the NHLBI Expert Panel Dr. F. X. Pi-Sunyer said some time ago (12):

"Exercise is extraordinarily important, not so much for the number of calories it expends but it seems to keep a person focused. Physical activity keeps an individual motivated to maintain the dietary discipline that is required in weight control. Persons who exercise are much more likely to successfully manage their weight than those who don't."

Conclusion

To repeat what was said at the outset, the ultimate answer to the epidemic of O/O is of course prevention (16, 1); however, success in that arena is a long way off. If the U.S. population is not to be overwhelmed by O/O and its negative effects, more effective ways of treating and managing this negative health condition must be developed. It is suggested that a series of research projects in the natural history and "dynamic epidemiology" of O/O and its treatment/management, designed to answer the questions posed above and to be sure, others as well, could be very helpful in developing more and more effective interventions with which to deal with the epidemic.

REFERENCES

1. American Association of Clinical Endocrinologists, American College of Endocrinology, "Position statement on the prevention, diagnosis, and treatment of obesity (revision)." Endocrinology Practice 1998; 4:299-350.
2. Allison DB, et al. "Annual Deaths Attributable to Obesity in the United States." Journal of the American Medical Association 1999; 282:1530-1538.
3. Barlow S, Dietz WH. "Obesity Evaluation and treatment: expert committee recommendations." Pediatrics 1998; 102:29.
4. Centers for Disease Control and Prevention, "Fact Sheet: Actual Causes of Death in the United States," 2000, www.cdc.gov/nccdphp/factsheets/death-causes2000.htm.
5. "The Truth About Dieting." Consumer Reports 2002; June:26-31.
6. Council on Scientific Affairs. "Obesity as a Major Public Health Problem" (Resolution 423, A-98). Chicago, IL: American Medical Association, CSA Report A-99, Feb. 1, 1999.
7. Expert Panel on the Identification, Evaluation, and Treatment of Overweight and Obesity in Adults. "Clinical Guidelines on the Identification, Evaluation, and Treatment of Overweight and Obesity in Adults - the Evidence Report." Bethesda, MD: National Institutes of Health/National Heart, Lung, and Blood Institute, NIH Pub. No. 98-4083, Sept. 1998.
8. Flegal EM, Carroll MD, Ogden CL, Johnson CL. "Prevalence and Trends in Obesity Among US Adults 1999-2000." Journal of the American Medical Association 2002; 288:1723-1727.
9. Fontaine KR, Redden DT, Wang C, et al. "Years of Life Lost Due to Obesity." Journal of the American Medical Association 2003; 289:187-193.
10. Fontanarosa PB. "Patients, Physicians, and Weight Control." Journal of the American Medical Association 1999; 282:1581-1582.
11. Fontanarosa PB. "Obesity Research: A Call for Papers." Journal of the American Medical Association 2002; 288:1772.
12. An interview with Dr. Pi-Sunyer: "Obesity Trends." Food Insight 1994; March/April, No. 2.
13. Freedman DS, Khan IS, Serdula MK, et al. "Trends and Correlates of Class 3 Obesity in the United States from 1990 through 2000." Journal of the American Medical Association 2002; 288:1758-1761.
14. Hill JO, Peters JC. "Environmental Contributions to the Obesity Epidemic." Science 1998; 280(29):1371.
15. Jonas S. (and the Editors of Consumer Reports Books). Take Control of Your Weight. Yonkers, NY: Consumer Reports Books, 1993.
16. Koplan JP Dietz WEL "Caloric Imbalance and Public Health Policy." Journal of the American Medical Association 1999; 282:1579-1581.
17. Lambert C. "The Way We Eat Now." Harvard Magazine 2004; May/June:50.
18. Lemonick, MD. "How We Grew So Big." Time 2004; June 7:59.

19. Mokdad AL, et al. "The Spread of the Obesity Epidemic in the United States." Journal of the American Medical Association 1999; 282:1519-1522.
20. Manson JE, Basic SS. "Obesity in the United States: A Fresh Look at its High Toll." Journal of the American Medical Association 2003; 289:229-230.
21. Must A. "The Disease Burden Associated with Overweight and Obesity." Journal of the American Medical Association 1999; 282:1523-1529.
22. Ogden CL, Flegal KM, Carroll MD, Johnson CL. "Prevalence and Trends in Overweight Among US Adults, 1999-2000." Journal of the American Medical Association 1999; 288:1728-1732.
23. Schoenborn CA, Adams PE Barnes PM. "Body Weight Status of Adults: United States, 1997-98." Advance Data 2002; Vol. 330.
24. Serdula, MK, et al. "Prevalence of Attempting Weight Loss and Strategies for Controlling Weight." Journal of the American Medical Association 1999; 282:1353-1358.
25. Stem J, et al. "Obesity: Does Exercise Make a Difference?" In Recent Advances in Obesity Research, Vol. 5, Berry, EM, et al, Eds., London (Eng.): John Libby & Co., 1987.
26. Stolberg SG. "Fat Chance," AARP Bulletin 2003; March /April:04-70.
27. Taubes G. "As Obesity Rates Rise, Experts Struggle to Explain Why." Science 1998; 280(29):1367.
28. USDA/USDHHS: Dietary Guidelines for Americans, 3rd ed., Washington, DC: Government Printing Office, 1990.
29. Wickelgren I. "Obesity: How Big a Problem?" Science 1998; 280(29):1364.
30. Nestle, M. Food Politics: How the Food Industry Influences Nutrition and Health. University of California Press, 2003.