The evolution of physical activity recommendations: how much is enough?[1–4]

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ABSTRACT
Physical inactivity is a major public health problem, and compelling evidence suggests that it is a contributing factor in several chronic diseases and conditions. Recognition of the health and functional hazards of a sedentary way of life has led numerous groups to promulgate public health recommendations for physical activity. In this report, we review the evolution of physical activity recommendations, discuss reasons for differences in the recommendations, and provide a summary recommendation in an attempt to harmonize existing differences. Current public health recommendations for physical activity are for 30 min of moderate-intensity activity each day, which provides substantial benefits across a broad range of health outcomes for sedentary adults. This dose of exercise may be insufficient to prevent unhealthful weight gain for some persons who may need additional exercise or caloric restriction to minimize the likelihood of further weight gain. Persons who get 30 min of moderate-intensity exercise per day are likely to achieve additional health benefits if they exercise more. In addition to aerobic exercise, people should engage in resistance training and flexibility exercises at least twice a week, which will promote the maintenance of lean body mass, improvements in muscular strength and endurance, and preservation of function, all of which enable long-term participation in regular physical activity and promote quality of life. *Am J Clin Nutr* 2004;79(suppl):913S–20S.

KEY WORDS Physical activity, fitness, public health, disease prevention, weight management

INTRODUCTION

There is compelling evidence that an active and fit way of life has many important health benefits and that sedentary habits are associated with an increased risk of numerous chronic diseases and decreased longevity (1–3). Although a consensus is growing on the importance of the relation between physical activity and health and wellness, the specific dose of physical activity necessary for good health remains unclear (4). Continued debate as to how much, what type, how often, what intensity, and how long the physical activity dose should be and how this dose should be quantified and disseminated has led to the promulgation of numerous different public health and clinical recommendations. Some of the inconsistency among physical activity recommendations is due simply to the inherent uncertainties of biomedical science, augmented by methodologic differences in collecting and interpreting the extant data. Some is due to a focus on different health outcomes by different groups.

How the specific outcome of interest can result in different interpretations and applications of existing physical activity data in the context of developing public health guidelines may best be illustrated by contrasting the recommendations of several evidence-based consensus reports on physical activity and health that were promulgated in the mid-1990s (1–3) with the recent recommendation from the Institute of Medicine (IOM) panel report on dietary reference intakes released in 2002 (5). The 1995 report from the Centers for Disease Control and Prevention and the American College of Sports Medicine (CDC/ACSM) recommended that "every US adult should accumulate 30 minutes or more of moderate-intensity physical activity on most, preferably all, days of the week" (2). Reports from a National Institutes of Health consensus conference, the US Surgeon General, and the American Heart Association presented very similar recommendations in 1996 (1, 3, 6). In contrast, the IOM report included the comment that "30 minutes per day of regular activity is insufficient to maintain body weight in adults in the recommended body mass index range of 18.5 up to 25 kg/m^2 and [to] achieve all the identified health benefits fully. Hence, to prevent weight gain as well as to accrue additional, weight-independent health benefits of physical activity, 60 minutes of daily moderate intensity physical activity (eg, walking/jogging at 4 to 5 mph) is recommended."

In this report, we review factors leading up to the development of these divergent health-related physical activity recommendations, evaluate the scientific foundations of these recommendations, and discuss how the recommendations can be harmonized. The focus will be on how much activity is needed to avoid the adverse health consequences of a sedentary lifestyle. Some authors differentiate between physical activity, defined as "any bodily movement," and exercise, defined as "a subset of physical activity that is characterized by planned and purposeful training" (7). In this report we will use physical activity and exercise interchangeably because some of the documents to which we will refer use the term exercise and others use the term physical activity without clearly delineating a difference as noted above.

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EVOLUTION OF EXERCISE RECOMMENDATIONS

Systematic research on the relation between exercise or physical activity and health began only in the second half of the 20th century. The purpose of this section is to review the historical foundations of exercise science research as they relate to improving health and to quantifying the physiologic adaptations to exercise training. There are 2 principal research streams relevant to this review: *1*) epidemiologic studies, in which the relation of exercise to health outcome is evaluated, and *2*) exercise training studies in a controlled laboratory environment, in which a physiologic variable, such as aerobic power, is the outcome.

Physical activity and health

Jeremy Morris, in London, is credited with carrying out the first systematic investigations of the health hazards associated with a sedentary lifestyle, the outcome of which was coronary heart disease (CHD). In seminal reports from prospective investigations of London transport workers and British civil servants, Morris et al (8–10) documented higher rates of CHD in men who were sedentary on the job or during leisure-time than in men who had higher levels of job or leisure-time physical activity. These observations have been confirmed and extended by others, notably Paffenbarger et al (11–14). At present there are dozens, if not hundreds, of published reports in the peer-reviewed literature documenting the health hazards of an inactive way of life and the benefits of being physically active (3, 4). Until the mid-1980s, epidemiologic studies used self-reported occupational or leisure-time physical activity as the exposure variable. Because self-reports of complex and repetitive lifestyle behaviors are, of necessity, crude and imprecise, it is difficult to specify with confidence the exact dose of exercise, in terms of type, amount, and intensity, that is associated with observed health benefits. Later studies used cardiorespiratory fitness, an objective and reproducible index of recent physical activity habits, as the exposure in studies of the relation of exercise to health outcomes (15–22). Although these latter investigations had the advantage of an objective measure of exposure and generally showed stronger associations with health outcomes than did studies with self-reported physical activity as the exposure, they are not definitive in describing the specific amounts and types of regular physical activity required to produce protective levels of cardiorespiratory fitness.

Exercise training studies

Karnoven et al (23) are generally credited with having carried out the first controlled exercise training experiment by evaluating the effects of 2 different intensities of exercise on adaptations in exercise capacity. In that classic study, 7 male medical students completed a 4-wk training period, with some training at 60% of their heart rate reserve [0.6 (maximal heart rate − resting heart rate) + resting heart rate] and others training at ≥70% of their heart rate reserve. Those who trained at ≥70% of their heart rate reserve showed greater improvement in physical work capacity than did those who trained at 60%.

Many other investigators, notably Michael Pollock, conducted controlled exercise training studies over the next few decades. These studies provided the quantification of the dose of exercise that was required to improve physical work capacity. A 1978 ACSM position stand, written by a committee chaired by Pollock, summarized these studies and presented recommendations for the type and amount of exercise needed to improve fitness (24). A common finding among the studies was that higher-intensity exercise produced greater gains in fitness. However, there was a fundamental design flaw in most of these studies, as we discussed previously in detail (25, 26). A typical design might have all study participants exercising for 5 d/wk for 30 min at each session. However, one group would exercise at a high intensity and another at a moderate intensity. In this situation, the total dose or volume of work done was higher for those exercising at a higher intensity because they worked at a higher intensity for the same number of min/wk as those working at a lower intensity for an equivalent amount of time. Thus, studies with this design were unable to isolate the effects of 2 different exercise intensities at a fixed volume of exercise. Indeed, the results of these studies reinforced the notion that relatively high intensity exercise was required for physiologic adaptations to occur. What was overlooked in these studies was that those in the moderate-intensity training groups also improved work capacity, although often not as much as those in the high-intensity groups. A reevaluation of the exercise training studies took place in the 1990s and ultimately led to the conclusion that moderate amounts and moderate intensities of exercise produced important physiologic adaptations.

Space precludes an exhaustive review of studies on various exercise intensities and volumes in relation to improvements in cardiorespiratory fitness and other health outcomes. Here we present a few examples of controlled exercise training trials that have investigated these issues. King et al (27) conducted a 12-mo exercise training program with 165 women and 197 men aged 50–65 y. Participants were assigned to a no-exercise condition or to 1 of 3 exercise training groups. Two of the groups were assigned to train for 40 min/d on 3 d/wk at an intensity of 73–88% of their peak exercise heart rate. One of these groups trained under supervision at a community center, and the other followed the same training program on their own at home. The third exercise group trained at home for 30 min/d on 5 d/wk and at 60–73% of their peak exercise heart rate. The 12-mo changes in maximal oxygen consumption ($\dot{V}O_2$max) for the 4 study groups are shown in **Figure 1**. Relative to that in the nonexercising control group, $\dot{V}O_2$max increased in all exercise groups ($P <$ 0.03); however, the changes in $\dot{V}O_2$max did not differ significantly among the exercise groups.

Asikainen et al (28) conducted a randomized clinical trial of different doses and intensities in a group of 121 postmenopausal women aged 48–63 y. The women were assigned to a no-exercise control group or to 1 of 4 exercise groups. Women in the exercise groups participated in walking on 5 d/wk, 2 d at the research center under supervision and 3 d on their own, for 24 wk. Two of the exercise groups expended 1500 kcal/wk in walking (≈8.5 km) and the other 2 groups expended 1000 kcal/wk (≈7 km). Within the 1500 and 1000 kcal/wk categories, 1 group of women exercised at 55% of maximal capacity and the other group exercised at 45% of capacity. All 4 exercise groups had significant improvements in $\dot{V}O_2$max (**Figure 2**), when compared with women in the no-exercise control group, and there were no statistically significant differences in $\dot{V}O_2$max changes among the 4 exercise groups.

Both of the studies reviewed briefly here had large samples, excellent methods, and few persons lost to follow-up. It is clear that moderate intensity exercise at the physical activity dose described in the consensus public health physical activity rec-

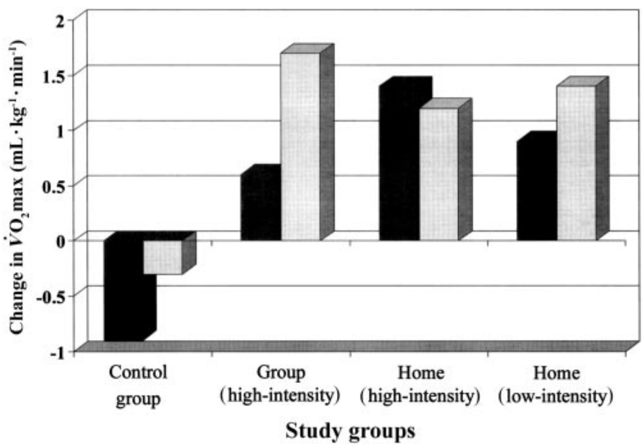

FIGURE 1. Changes in maximal oxygen consumption ($\dot{V}O_2$max) in women (■) and men (▨) assigned to the control group or to 1 of 3 exercise groups. The persons assigned to the group condition exercised under supervision at a community center. Those assigned to the home-based condition exercised on their own. The high-intensity groups exercised for 40 min at 73–88% of their members' peak exercise heart rate, and the low-intensity group exercised for 30 min at 60–73% of its members' peak exercise heart rate. After 12 mo of exercise training, all exercise groups significantly improved ($P < 0.03$) $\dot{V}O_2$max relative to those in the control group. However, the changes in $\dot{V}O_2$max did not differ significantly among the 3 exercise groups. Adapted from reference 27.

ommendations (1–3) produces significant improvements in work capacity, and that exercising at higher intensities or volumes has only modest additional effects.

Comparison of the 2 approaches

The 2 research streams briefly described here provided the scientific foundations for exercise recommendations that began to appear in the 1970s. In general, epidemiologic research provided the rationale for developing health-related activity recommendations, whereas exercise training research was used to quantify the frequency, intensity, and duration or the dose of activity recommended. The general consistency with which higher levels of physical activity are associated with improved physiologic functioning and lower disease risk, according to observations drawn from controlled experimental trials and population-based epidemiological studies, respectively, illustrates the complementary nature of different types of scientific research. It is difficult, however, to develop a broad public health recommendation for physical activity that precisely matches individual responses to a given exercise dose from controlled laboratory studies in small samples of people with the very general free-living physical activity patterns that are associated with improved health outcomes in population studies.

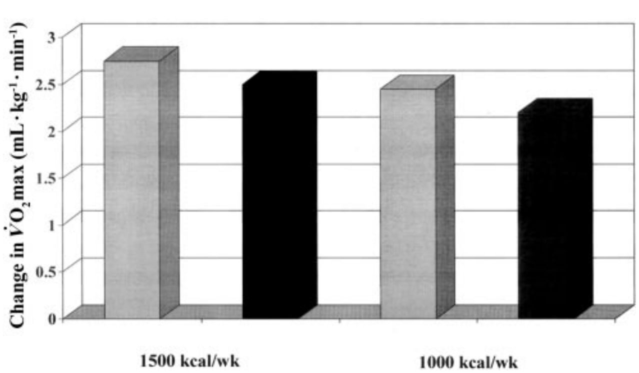

FIGURE 2. Changes in maximal oxygen consumption ($\dot{V}O_2$max) over 24 wk in 121 women assigned to a no-exercise (control) group or to 1 of 4 exercise groups. The changes in $\dot{V}O_2$max reported in the exercise groups were adjusted for the change in $\dot{V}O_2$max in the control group. Women were assigned to exercise at 55% (▨) or 45% (■) of their maximal capacity for a total of 1500 or 1000 kcal/wk. Adapted from reference 28.

TABLE 1
Dose of aerobic physical activity recommended in the American College of Sports Medicine's *Guidelines for Graded Exercise Testing and Exercise Prescription*, 1975–2000[1]

Objective and year of edition	Activity		
	Frequency	Duration[2]	Intensity
	d/wk	*min/d*	*% HRR*
Cardiorespiratory fitness			
1975 (29)	3–5	20–45	70–90
1980 (30)	3–5	15–60	50–85
1986 (31)	3–5	15–60	50–85
1991 (32)	3–5	15–60	40–85
1995 (33)	3–5	20–60	40–85
Health promotion			
2000 (34)	7	≥20	40–85

[1] HRR, heart rate recovery.
[2] Continuous activity except for recommendation from reference 34, which was for cumulative totals, with a minimum of 10 min of activity per session.

EARLY EXERCISE RECOMMENDATIONS

The ACSM was an early leader in providing specific exercise recommendations. The publication in 1975 of *Guidelines for Graded Exercise Testing and Exercise Prescription*, and its subsequent revised editions, had a major influence on the fields of exercise science and clinical and rehabilitation medicine (29–34). This book served as the foundation for development of the ACSM certification program that was designed for clinicians primarily working in cardiac rehabilitation settings. The recommendations for the frequency, intensity, and duration of exercise specified in the guidelines and the modifications of these recommendations in subsequent editions of the book are shown in **Table 1**.

An ACSM development that was parallel to the guidelines process was the publication of recommendations on the amount of exercise required to improve and maintain physical fitness (24). A summary of these recommendations and of the revisions published in 1990 (35) and 1998 (36) is presented in **Table 2**.

The exercise recommendations of the ACSM briefly reviewed above were quite specific and led to somewhat regimented thinking about how much exercise should be recommended. These highly structured exercise recommendations caused most persons to think that exercise not meeting these specific criteria would be of limited or no value. The 1990 ACSM position stand, however, may be seen as the beginning of a shift away from an exclusively "performance-related fitness" paradigm to one that includes activity recommendations for both performance and health-related outcomes: "ACSM recognizes the potential health benefits of regular exercise performed more frequently and for longer duration, but at lower intensities than prescribed in this position statement" (35).

TABLE 2
Dose of aerobic physical activity recommended in the American College of Sports Medicine's Position Stands, 1978–1998[1]

Objective and year of publication	Activity		
	Frequency	Duration[2]	Intensity
	d/wk	*min/d*	*% HRR*
Cardiorespiratory fitness, 1978 (24)	3–5	15–60	50–85
Cardiorespiratory fitness and body composition			
1990 (35)	3–5	20–60	50–85
1998 (36)	3–5	≥20	40–85

[1] HRR, heart rate recovery.
[2] Continuous activity except for recommendation from reference 36, which was for cumulative totals, with a minimum of 10 min of activity per session.

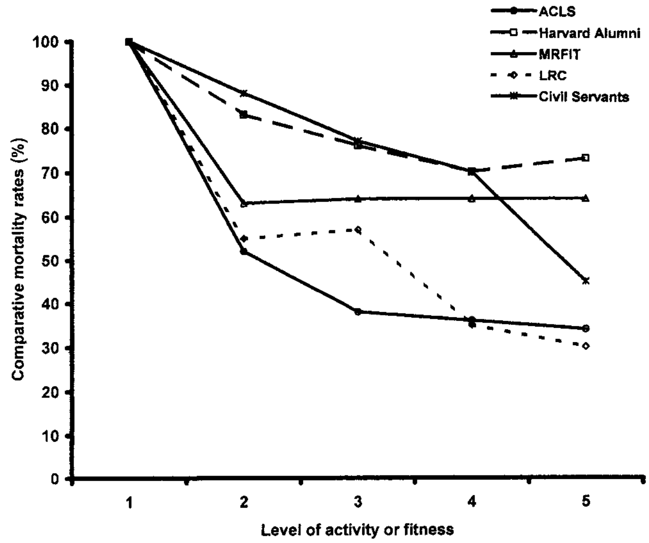

FIGURE 3. The association between self-reported physical activity [Harvard Alumnus Health Study (Harvard Alumni), Multiple Risk Factor Intervention Trial (MRFIT), and British Civil Servants Health Study (Civil Servants)] or cardiorespiratory fitness [Aerobics Center Longitudinal Study (ACLS) and Lipid Research Clinics Mortality Follow-up Study (LRC)] and cardiovascular disease mortality in 5 large prospective studies. Adapted from reference 2.

A NEW PARADIGM: PUBLIC HEALTH RECOMMENDATIONS FOR PHYSICAL ACTIVITY

The compelling evidence for the benefit of regular exercise in preventing several health problems (notably CHD) that had accumulated by the beginning of the last decade of the 20th century led the American Heart Association to release a report in 1992 that identified physical inactivity as the fourth major modifiable CHD risk factor, joining smoking, hypertension, and dyslipidemia (37). An important feature of this report was recognition of the health value of moderate amounts and intensities of exercise. Evidence cited in the report supported the conclusion that there was an inverse and graded dose-response association between exercise and CHD, and that high levels of exercise training were not required for a person to gain much of the health-related benefit of exercise.

The next major development in public health recommendations for physical activity was the CDC/ACSM report published in 1995 (2). The specific recommendation (noted in the first section of this report) emphasizing the accumulation of ≥30 min of moderate-intensity physical activity each day received much attention and has been highly influential, with ≈1000 citations appearing in the scientific literature by 2003. As stated earlier, similar recommendations by others, such as the US Surgeon General (3), the National Institutes of Health (1), and the World Health Organization (38), soon followed. The principal recommendation that persons accumulate ≥30 min of moderate-intensity physical activity/d was largely directed at the 40–50 million US adults who are sedentary and who account for much of the public health burden of chronic disease (39). Because these persons are unlikely to have the physical capacity to engage in greater quantities of high-intensity physical activity, and because compelling evidence shows health benefits can be accrued with even moderate amounts and intensities of regular exercise, the CDC/ACSM report recommended a dose of physical activity that would likely be achievable by the primary target population and that was supported by a large evidence base as being efficacious for disease risk reduction among most persons. The report also stated that persons meeting the basic recommendation could gain additional health benefits by doing more exercise, perhaps including some higher-intensity activities. Implicit in the CDC/ACSM recommendation is that exercise is similar to other therapeutic agents with dose-response characteristics of which a minimal dose that has proven efficacy and safety is typically prescribed as the initial dose. Interindividual response characteristics and differences in the severity and specificity of the risk factor or outcome being addressed often dictate that the dose of the therapeutic agent be titrated to maximize its effectiveness. Clearly, recommending a single absolute dose of physical activity to address a broad spectrum of disease intermediates and outcomes would be minimally effective and unacceptable in public health and clinical practice.

Determining the minimal dose of exercise on which to base a public health recommendation is a difficult process. Consistent data from randomized controlled clinical trials are a major requirement for establishing the dose profile of pharmacologic agents. Ethical and feasibility issues preclude the use of this research design to establish the specific health-related dose profile for physical activity. Therefore, the public health recommendation in the CDC/ACSM report was based mostly on a large volume of epidemiologic data that showed a very consistent pattern of a graded inverse association between physical activity and the risk of several disease intermediaries and outcomes. The general findings of several large, prospective, primary prevention studies on the relation between physical activity or fitness and cardiovascular disease risk are summarized in **Figure 3**. The overall pattern of a decline in disease risk that is associated with higher levels of activity or fitness indicates that there is a dose-response gradient with a large difference in the degrees of risk between the least active or least fit persons and those who are only modestly more active or fit. Collectively, these data suggest that relatively small changes in activity or fitness on the part of sedentary persons might produce large reductions in disease risk at the population level. This observation has been made for other chronic disease exposures and has been the basis for the development of several intensive primary prevention programs (40, 41).

Methodologic variations in quantifying and reporting the physical activity exposure in these epidemiologic studies make it difficult to clearly identify the specific physical activity dose characteristics of mode, frequency, duration, and intensity that could serve as the basis of a public health recommendation. However, as experts reviewed the extant data, it was evident that, in general, the expenditure of ≈1000 kcal/wk (150–200 kcal/d for most days standardized to a 70-kg person) in moderate to vigorous intensity activity was desirable (10, 11). Furthermore, participation in a wide variety of aerobic activities related to housecare, occupation, leisure-time, conditioning, and sports at a frequency of ≥5 d/wk and a duration of ≥30 min/d not only met or exceeded the 1000 kcal/wk threshold, but characterized persons who were within the activity category in which a large reduction in risk was observed relative to the risk among persons in the least active category (42–47). For example, Stofan et al (48) observed that men and women whose moderate levels of cardiorespiratory fitness are associated with significant reductions in all-cause mortality reported weekly physical activity of 130–150 min walking, 90 min jogging, or an intermediate number of minutes of performing aerobics. Hakim et al (42) reported significantly lower all-cause death rates among older men who walked an average of 1.5 miles/d (or 2.4 km/d) than among sedentary men, and that dose of exercise is consistent with the consensus public health recommendation for physical activity. Leon et al (49) updated follow-up results in the Multiple Risk Factor Intervention Trial study and showed significantly lower all-cause mortality beginning with men reporting an average volume of 23 min/d in activities that were largely of moderate intensity. The results summarized in the preceding examples are consistent with the physical activity specifications reported in a comprehensive review showing that moderate amounts of physical activity or fitness are related to significantly lower all-cause mortality (50). On the basis of data similar to those shown in Figure 3 and those described above, the CDC/ACSM report provided a public health recommendation for physical activity that, if followed, would be expected to substantially reduce morbidity and mortality from chronic diseases, particularly among the sedentary fraction of the population.

THE INSTITUTE OF MEDICINE RECOMMENDATION

The IOM Committee on Dietary Reference Intakes released a report in 2002 that included a chapter on physical activity (5). The specific recommendation is given in the first section of this report, and the fundamental issue is that it calls for 60 min activity/d and tends to dismiss as inadequate the consensus public health recommendation of 30 min activity/d.

Four features of the IOM recommendation are troubling. First, the statement that "some benefits" accrue in response to 30 min of moderate-intensity physical activity understates the substantially lower morbidity and mortality seen in moderately active adults than in those who are sedentary (Figures 1–3). For example, our own work on cardiorespiratory fitness and mortality has shown repeatedly that moderately fit women and men have mortality rates that are ≈50% lower than those of their unfit peers (15–17, 20, 51–53). Moderate fitness, as defined in our research, can be attained by meeting the consensus recommendation of 30 min of moderate-intensity physical activity on ≥5 d/wk (48, 54–56). The IOM's dismissal of earlier recommendations also fails to acknowledge that these prior recommendations all clearly state that obtaining >30 min activity/d provides additional benefits.

TABLE 3
BMI and physical activity level (PAL) for normal-weight and overweight or obese men and women in 3 age groups[1]

	Normal-weight[2]		Overweight or obese	
	BMI	PAL[3]	BMI	PAL
	kg/m²		*kg/m²*	
Men				
19–30 y	22.02	1.74	29.62	1.85
31–50 y	22.55	1.81	30.82	1.85
51–70 y	22.95	1.63	29.55	1.72
Women				
19–30 y	21.42	1.80	29.82	1.77
31–50 y	21.64	1.83	31.91	1.79
51–70 y	22.18	1.70	30.37	1.59

[1] All values are $\bar{x}$.
[2] BMI of 18.5–25.
[3] Expressed as total energy expenditure as a multiple of resting metabolic rate over 24 h.

Second, the statement that 30 min of activity is insufficient to affect weight control is speculation and is counter to some existing data (57, 58).

Third, the description of activities such as walking or jogging 4–5 miles/h (6.4–9.0 km/h) as moderate-intensity activities indicates a poor understanding of several issues. Physical activity at this specified level requires 4–8 multiples of resting energy metabolism (METs). This range of energy expenditure extends beyond that typically considered to be of moderate intensity on an absolute basis (eg, 3–6 METs) and far exceeds moderate intensity on a relative basis (eg, 40–75% maximal functional capacity), especially for older or unhealthy persons (3, 59).

Fourth, the major flaw in the logic of the IOM report is in the panel's interpretation of the doubly labeled water data presented. Whereas the panel performed a useful task in assembling data on doubly labeled water studies from several laboratories, they used this information inappropriately to draw inferences about how much activity is required to prevent unhealthful weight gain. First, it seems hazardous to rely on cross-sectional data for a major public health recommendation. Second, the data do not support the conclusion reached by the report's authors. The mean BMIs and physical activity levels (PAL) found among normal-weight or overweight or obese men and women in 3 age groups are shown in **Table 3**. There are sizable differences in the mean BMIs in the 2 weight groups among both men and women, but there is little difference, except perhaps among the women aged 51–70 y, between the PALs in normal-weight or overweight or obese persons. Thus, the claim that people who maintain normal weight are physically active for 60 min/d more than are overweight or obese persons is not supported by the currently available doubly labeled water data on energy expenditure.

HOW MUCH PHYSICAL ACTIVITY IS REQUIRED TO PREVENT UNHEALTHFUL WEIGHT GAIN?

It is extremely important to recognize that the CDC/ACSM report focused on recommending a dose of physical activity that would likely reduce the morbidity and mortality risk of several chronic diseases, rather than solely addressing the issue of weight management. The amount of activity required to prevent unhealthful weight gain appears to be a major rationale of the IOM recommendation for physical activity. Because of the cross-sectional design and the similarities in PAL between normal-weight and overweight or obese persons, we do not believe that the total energy expenditure data presented in the report justify the conclusion that 60 min activity/d is required to prevent unhealthful weight gain. In population-based observational studies with long-term follow-up, more modest levels of activity have been found to prevent substantial weight gain (57, 58, 60). The activity levels found to be protective against weight gain in these studies varied and cannot be directly compared across studies because of different methods, but it is clear that those levels are well below 60 min of daily activity.

The issue of preventing unhealthful weight gain is very complicated, and we believe that more data are necessary for a definitive conclusion. However, personal observations should remind us that some people appear to be able to regulate their weight over the long term without being physically active. Other persons seem to be relatively active, but they still gain weight over the years. We should not be surprised by these apparently contradictory observations. Like everything else we measure in humans, the ability to regulate and match energy intake to energy expenditure is in all likelihood affected by a person's genetic background, as well as by behavioral determinants. In summary, some persons manage to regulate their weight within narrow limits, even in the current environment of readily available food and little need for energy expenditure to get through the day, whereas others find it difficult to remain in energy balance even while trying to restrict intake and be physically active. These concepts are illustrated in **Figure 4**.

The International Association for the Study of Obesity organized a seminar in 2002 to discuss the question of how much activity is required to prevent unhealthful weight gain. The consensus statement from that meeting (61) agreed with a 1999 ACSM consensus in acknowledging the important contributions that 30 min of moderate daily exercise makes to health, even among persons who are overweight and obese (62). The International Association for the Study of Obesity report also presented the conclusion that, given current environmental factors, 30 min of moderate daily exercise may be insufficient for many persons to maintain weight. For those who find that 30 min of activity/d does not prevent weight gain, additional exercise is recommended (61). The importance of the International Association for the Study of Obesity's statement is that individual differences—that some persons have more trouble with weight regulation than do others—are recognized.

HARMONIZING THE DISPARATE RECOMMENDATIONS

The CDC/ACSM and IOM physical activity recommendations are similar in that they attempt to prescribe a physical activity dose for public health and clinical applications. However, because the 2 reports focus on different health outcomes, the resulting recommendations appear to be substantially different. After the release of the IOM report, headlines and articles in the popular press focused on "twice as much exercise as before." Scientific conflict can lead to confusion among clinicians and members of the public and thus to inaction in the acceptance and implementation of sound public health practices. Fortunately, we believe that there are basic points of similarity between the CDC/ACSM and IOM reports, which may allow for harmonization of the recommendations, and, in summary, we propose the following advice.

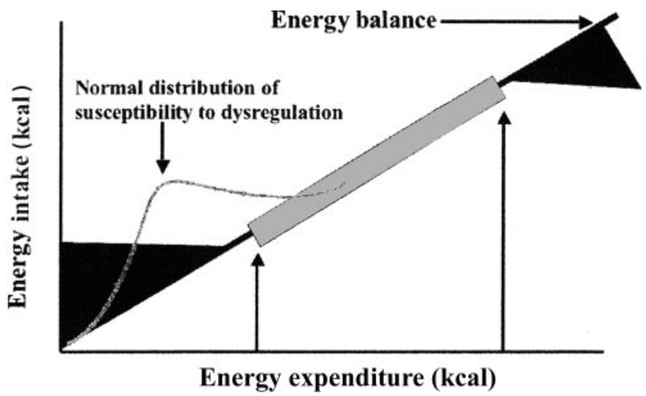

FIGURE 4. A hypothetical expression of several factors related to energy balance and weight maintenance. The kcal values on the horizontal and vertical axes are not intended to indicate any specific energy intake or expenditure but are intended to represent a range of values from low to high. The diagonal line represents energy balance, the status in which energy intake equals energy expenditure and thus in which weight is stable. The rectangular box in the middle of the diagonal line is intended to indicate that energy balance, and thus weight stability, occurs across a wide range of energy balance levels. The hypothesis is that built-in regulatory mechanisms match energy intake with energy expenditure across a wide range. We further hypothesize that, at low levels of average daily energy turnover, it becomes difficult for many persons to match energy intake with energy expenditure, especially in an environment with readily available food. The inability to match intake with expenditure puts these persons into positive energy balance and leads to weight gain. The triangle in the lower left of the figure is meant to suggest that weight gain is likely at low levels of daily energy balance because of dysregulation leading to a positive energy balance. This dysregulation probably is genetically influenced, and the superimposed normal curve in this part of the graph is meant to suggest that different persons come into a zone of dysregulation at different gradations of daily energy turnover. The triangle at the upper right part of the graph illustrates the phenomenon of difficulty in maintaining body weight at very high levels of energy expenditure, when many people may have difficulty taking in enough calories to remain in energy balance. Some of the concepts for this figure are derived from personal communications from JO Hill and RR Pate.

Current public health recommendations for physical activity are for 30 min of moderate-intensity activity/d, which provides substantial benefits across a broad range of health outcomes for sedentary adults. This dose of exercise may be insufficient to prevent unhealthful weight gain for some, perhaps many, but probably not all, persons. For persons who are exercising 30 min/d and consuming what appears to be an appropriate number of calories, but are still having trouble controlling their weight, additional exercise or caloric restriction is recommended to reach energy balance and minimize the likelihood of further weight gain. For persons exercising 30 min/d who are weight stable, we recommend that they try to build up to 60 min activity/d, which will provide additional health benefits. In addition to aerobic exercise, it is desirable that people engage in activities that build musculoskeletal fitness, such as resistance training and flexibility exercises, at least twice a week. These additional exercises will promote maintenance of lean body mass, improvements in muscular strength and endurance, and preservation of function, all of which enable long-term participation in regular physical activity and promote quality of life.

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