119 Redrawing the Model of the Exercising Human in Exercise Prescriptions

From Headless Manikin to a Creature with Feelings

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Please answer this simple pop-quiz question. Exercise and physical activity should be (a) effective in promoting health, (b) as safe as possible, (c) pleasant and enjoyable, (d) a and b, or (e) a, b, and c. If you answered (e), you might be surprised to learn that, according to the logic behind most of the contemporary exercise prescription guidelines and physical activity recommendations, your answer would be incorrect; the "correct" answer is (d). At least in the United States, such guidelines and recommendations have traditionally been developed based on a biomedical model, focusing strictly on effectiveness and safety and incorporating little or no evidence from psychology, behavioral economics, marketing, or the behavioral sciences in general.

The history of exercise science over the second half of the twentieth century is filled with spectacular triumphs but also some epic failures. The successes consist in discovering a wealth of scientific evidence supporting the beneficial effects of physical activity on health and raising the awareness not only of the medical community but also of the public at large. The failures are the result of the inability to raise the rates of physical activity participation, which remain discouragingly low in most industrialized countries. This chapter will specifically focus on the possible role played by exercise prescription guidelines and physical activity recommendations in these failures. These documents are criticized for lacking an overarching philosophy, containing numerous inconsistencies and conflicting messages, and having persistently neglected the importance of how exercise is experienced. Finally, a proposal is put forth for considering pleasure as a fundamental criterion when exercise is prescribed or physical activity is recommended. Ensuring that exercise and physical activity are not just effective and safe but also pleasurable can increase the chances that these behaviors will become lifelong habits. In turn, this may help the field of exercise science succeed in its central mission of promoting human health by increasing the number of people who have permanently integrated exercise and physical activity into their lives.

SPECTACULAR TRIUMPHS

A perusal of the medical literature over the past 60 years offers some perspective on the colossal attitudinal shift that has occurred in the biomedical community with respect to the public health value of exercise. The first substantial scientific evidence supporting a role of physical activity in health came from a series of studies conducted by the epidemiologist Jeremy Morris with British civil servants. Perhaps cognizant that they were addressing a skeptical readership, Morris et al.[1] were extremely circumspect in their analyses and interpretations, emphasizing that "we are dealing with what is still hypothesis rather than established fact" (p. 1120). They showed that "bus conductors (on double-decker vehicles) were found to have less coronary heart-disease than bus drivers, and postmen less than telephonists, executive officers, and clerks"; and on the basis of these findings, they proposed that "men in physically active jobs have a lower incidence of coronary heart disease in middle age than have men in physically inactive jobs" (p. 1120). In the following years, despite additional data, the hypothesis that physical activity may have a cardioprotective effect was viewed as a marginal and odd idea. Its impact on research was minimal and, on medical practice, practically nonexistent. Following another

publication by Morris' group in the early 1970s, the famous mile-runner and neurologist Roger Bannister[2] wrote a letter to *The Lancet* expressing his frustration: "Perhaps instead of reaching for the prescription pad we should help to swing our patients over to a more positive view of health so that they change their life style to include sufficient exercise" (p. 613).

In the United States, a landmark report published in 1970 by the Inter-Society Commission for Heart Disease Resources, entitled *Primary Prevention of the Atherosclerotic Diseases*,[3] included "sedentary living" among a list of possible secondary risk factors but stressed that the evidence linking it to coronary heart disease was "not entirely consistent" and that "the apparent impact… observed in some studies is less than that for the major risk factors" (p. A-71). Along the same lines, an additional statement that "exercise … may have a role to play in the prevention of atherosclerotic diseases" was immediately juxtaposed with the warning that "exercise is not free of danger both to the musculoskeletal and the cardiovascular systems" (p. A-89). This view remained prominent during the 1970s. Discussing data from the Framingham study, for example, Kannel and Sorlie[4] commented: "It has not yet been convincingly or consistently established that physical activity is an important determinant of the degree to which the major risk factors exist in the general population. Nor has it been conclusively shown that the protective role of physical activity found by some is the result of a favorable influence on the established major cardiovascular risk factors" (p. 860). Furthermore: "It does not seem likely that exercise programs can make as great an impact on incidence of cardiovascular disease as can control of blood pressure, the cigarette habit, obesity, or hyperlipemia" (p. 860). Echoing an argument that was commonly expressed at the time, Kannel and Sorlie[4] alerted physicians to the fact that "data from eastern Finland, where physical activity levels are high, record an incidence of ischemic heart disease that is the highest observed anywhere" (p. 860).

Reading these passages today, one cannot but be amazed by how parochial or even shortsighted they seem. In 1992, a committee of the American Heart Association[5] first declared that "inactivity is recognized as a risk factor for coronary artery disease" (p. 340). This was followed in 1995 by the first physical activity recommendations specifically developed for health promotion, published jointly by the Centers for Disease Control and Prevention and the American College of Sports Medicine (ACSM).[6] In 1996, the U.S. Department of Health and Human Services published a landmark Surgeon General's report[7] on the relationship between physical activity and health. Conducted by a panel of internationally recognized experts, this thorough analysis of the epidemiologic and experimental evidence led to the conclusion that "physical activity of the type that improves cardiorespiratory endurance reduces the risk of developing or dying from cardiovascular disease (coronary heart disease in particular), hypertension, colon cancer, and non-insulin-dependent diabetes mellitus and improves mental health" (p. 149). Furthermore, according to the report, the "findings are highly suggestive that endurance-type physical activity may reduce the risk of developing obesity, osteoporosis, and depression and may improve psychological well-being and quality of life" (p. 149).

In 2003, a report[8] developed by a committee of the American Health Association, entitled *Exercise and Physical Activity in the Prevention and Treatment of Atherosclerotic Cardiovascular Disease*, stated, in no uncertain terms, that habitual physical activity "prevents the development of coronary artery disease (CAD) and reduces symptoms in patients with established cardiovascular disease. There is also evidence that exercise reduces the risk of other chronic diseases, including type 2 diabetes, osteoporosis, obesity, depression, and cancer of the breast and colon" (p. 3109). Referring specifically to atherosclerosis, the committee declared:

> The data satisfy the criteria required to infer a causal relationship from epidemiological evidence. The results are strong, with the most physically active subjects generally demonstrating CAD rates half those of the most sedentary group. The data demonstrate a graded relationship of decreasing CAD rates with increasing levels of activity… Physical activity both prevents and helps treat many established atherosclerotic risk factors, including elevated blood pressure, insulin resistance and glucose intolerance, elevated triglyceride concentrations, low high-density lipoprotein cholesterol concentrations, and obesity (p. 3110).

Interestingly, the committee also encouraged physicians to "personally engage in an active lifestyle to… set a positive example for patients and the public" and recommended that information about the importance of physical activity for health "be incorporated into the education of physicians and other medical professionals" (p. 3114). In 2007, for the first time, the American Heart Association published physical activity guidelines[9] jointly with the ACSM, emphasizing that "frequent physical activity is an important behavior for individual and population health" (p. 1431). The culmination of more than five decades of research came with the publication of the first *Physical Activity Guidelines for Americans* by the U.S. Department of Health and Human Services in 2008.[10]

Besides these undeniable triumphs on the scientific front, there have also been some notable advances in communicating the message about the healthful effects of physical activity to the public. Of the 2002 U.S. adults surveyed by Morrow et al.,[11] representing the 48 contiguous states and the District of Columbia, 84% knew that physical inactivity was related to the development of heart disease. Furthermore, 97% identified physical inactivity as a health risk factor, with 52% rating it as "very important," 37% as "important," and 8% as "somewhat important."[12] Analyses of media coverage of stories about the effects of physical activity on health in western countries have shown that the topic receives some prominence, even if the journalistic quality of the articles is less than optimal[13] or if physical activity is allotted less space than other lifestyle factors, such as obesity or smoking.[14]

EPIC FAILURES

One might have expected that the staggering accumulation of scientific evidence over the past 60 years and the heightened awareness of the health benefits of physical activity among health care providers and the public would have begun to influence the rates of participation in physical activity. Unfortunately, this has not happened. Discovering and disseminating information, which is an intervention strategy credited with success in promoting other health behaviors (e.g., greatly reducing the rates of cigarette smoking or containing the HIV/AIDS epidemic), appears to have been largely ineffective in the case of physical activity.

A few years ago, an analysis of data from the Behavioral Risk Factor Surveillance System (BRFSS), which is a nationwide survey conducted by telephone, gave the impression that there might be some cause for optimism, showing that "from 2001 to 2005, the prevalence of regular physical activity increased by 8.6% (from 43.0% to 46.7%) among women overall and by 3.5% (from 48.0% to 49.7%) among men" (p. 1210).[15] The exuberance, however, was short lived. The final progress review of the Healthy People 2010 program,[16] which was based on data from the National Health Interview Survey (NHIS), collected from in-home (face-to-face) interviews, stated that "individual physical activity behaviors for adolescents and adults are essentially unchanged since baselines were established" (p. 2). Specifically, the percentage of adults who reported no participation in any leisure-time physical activity was 40% in 1997 and 39% in 2006.

As sobering as these statistics might seem, the problem of physical inactivity in the United States was shown to be significantly more severe when data from the 2003–2004 National Health and Nutritional Examination Survey (NHANES), in which physical activity was measured objectively by accelerometry ($N = 6329$), were analyzed.[17] Among adults between the ages of 20 and 59 years, only 3.5% (3.8% of men, 3.2% of women) participated in bouts of at least moderate-intensity physical activity totaling at least 30 min/day on at least 5 days/week. For those over the age of 60 years, the percentage was even lower, at 2.4% (2.5% of men, 2.3% of women). A latent class analysis[18] of the same data set showed that, when every minute of activity was considered, 78.7% of the population was included in two least active classes (33.6% averaging 5.3 min and 45.1% averaging 21.0 min of moderate-to-vigorous physical activity per day). When only activity performed in bouts of at least 10 min was considered (during which at least 70% of the counts were above the threshold for moderate-to-vigorous activity), 93.5% of the population was included in the two least active classes (56.1% averaging nearly zero and 37.4% averaging 10.3 min of moderate-to-vigorous physical activity per day). The data for vigorous activity were even more disconcerting. In 91.1% of all days, participants accumulated less than 1 min of vigorous physical activity. Of 3462 participants who provided valid data for at least 3 days, only 23 registered 20 min of vigorous physical activity on at least 3 days/week.

Although there is still no systematic study of objectively assessed rates of physical activity within special populations, data derived from self-reports suggest that individuals who face physical or psychological challenges tend to be even less active than the general population. A case in point is obesity, a condition for which regular physical activity would be of great benefit. According to data[19] from the 2000 BRFSS, 59.9% of overweight women and 35.9% of overweight men (i.e., with a body mass index (BMI) ≥ 25 kg/m^2) as well as 70.0% of obese women and 62.8% of obese men (i.e., with a BMI ≥ 30 kg/m^2) reported trying to lose weight. Approximately two-thirds of them reported using physical activity as part of their weight-loss efforts. However, only 19.8% of the overweight women and 22.8% of the overweight men reported combining a reduction in caloric intake and at least 150 min/week of physical activity (approximately five 30 min sessions/week). The numbers were even lower for obese individuals, with 15.9% of women and 21.3% of men reaching at least 150 min/week. Similarly, according to data[20] from the 1999–2002 NHANES, 44.7% of the overweight respondents and 61.8% of those who were obese reported trying to lose weight. However, only 30.0% of those who were overweight and 21.6% of those who were obese reported that their physical activity participation reached 600 min and 20 sessions/month or approximately five 30 min sessions/week.

Importantly, however, current recommendations for weight management set the minimum duration of daily physical activity at 60 min, twice the duration recommended for health promotion in the general population. According to data[19] from the 2000 BRFSS, only 4.1% of overweight women, 3.0% of obese women, 6.9% of overweight men, and 6.4% of obese men trying to lose weight reported reaching 420 min of activity weekly (or 60 min daily) besides restricting their caloric intake. Even in a study[21] in which participants knew that their activity was being monitored since they volunteered to wear accelerometers for 7 days, only 13% of the overweight or obese individuals accumulated 60 min of daily activity.

It is crucial to point out that the problem of physical inactivity is not merely the result of people's unwillingness to become physically active. To a large extent, it is also the result of discontinuation or "dropout." The exact magnitude of this problem is unknown. A statistic frequently reported in the literature is that 50% of those who start an activity program drop out within the first 6 months.[22] However, this number is somewhat deceptive for two reasons. First, this estimate is derived from published clinical trials, most of which include some intervention component designed to improve adherence and retention (e.g., anything from one-on-one counseling, goal-setting, social support, or efficacy-building approaches to provision of monetary incentives, free transportation, or childcare). Clearly, such benefits are absent outside the context of well-funded clinical trials. Second, the 50% figure is merely an average, which conceals the great variation that exists between studies. Dropout rates from individual published studies have ranged from a low of 9% to a high of 87%.[23]

It could be argued that the problem of dropout represents an even greater failure for exercise science and practice compared to the low rates of initial engagement. Although the responsibility for disseminating the message of physical activity is arguably shared among many stakeholders (including the media, national and state health agencies, health educators, and health care providers), the responsibility of designing and delivering exercise or activity programs that people want to incorporate into their lives on a permanent basis is primarily the responsibility of exercise scientists and practitioners.

Overall, the physical activity participation data paint a very disconcerting picture, one that stands in stark contrast to the remarkable successes on the scientific front. Exercise science has managed to uncover a wealth of evidence supporting the beneficial effects of exercise on human health and has, to a large extent, succeeded in publicizing, and even popularizing, these discoveries. On the other hand, no progress has been made in capitalizing on these remarkable scientific findings by changing behavior at the population level. For the most part, this is not due to an unwillingness to undertake policy initiatives or a lack of funds channeled into research and community outreach programs (although most researchers and practitioners would probably argue that more funds would be desirable). The culprit for the massive failure should probably be sought in an unsuccessful communication strategy and an inability to adequately prepare practitioners for their challenging mission. Addressing the problem of physical inactivity represents one of the greatest challenges in public health. Based on substantial epidemiologic evidence from the Aerobics Center Longitudinal Study that low cardiorespiratory fitness is a stronger predictor of mortality than "traditional" risk factors like hypertension, cholesterol, obesity, or smoking, Blair[24] proclaimed that physical inactivity should be recognized as "the biggest public health problem of the 21st century" (p. 1).

EXERCISE IS MEDICINE BUT WHAT SHOULD BE IN THE PRESCRIPTION?

Exercise prescription guidelines were first developed by the ACSM in the 1970s. From the beginning, the development of guidelines was driven by two main considerations: (a) maximizing the training effect, defined primarily as an increase in cardiorespiratory fitness (VO_2max) and (b) reducing the risk of adverse cardiac, skeletal, or muscular events, especially among individuals exercising in clinical or rehabilitation settings (e.g., pre- or postinfarct cardiac patients). Issue (a) pertains to cardiac, respiratory, and muscular (energy-system) adaptations and, thus, falls within the area of expertise of exercise physiologists, many of whom have backgrounds in sport and human performance. Issue (b) pertains to pathology and is, thus, within the purview of physicians. Four decades after the development of the first guidelines, the panel of experts convened by the ACSM to update the guidelines reportedly took into account the same two considerations: (a) "the dose that induces the greatest health benefit" and (b) "the potential risk in a particular population" (p. 133).[25]

As the aforementioned participation and dropout data illustrate, however, a program that is effective and safe may not necessarily be one that people want to follow. This brings up the crucial, yet seldom discussed, issue of the philosophy undergirding exercise prescriptions and physical activity recommendations. What should be the prime objective of such prescriptions or recommendations? What the public or each individual client is advised might differ, perhaps considerably so, if the prime objective, for example, is to stimulate the largest possible gain in cardiorespiratory fitness (or any other beneficial physiological adaptation) in the shortest amount of time compared to instilling a lifelong habit of physical activity. In the former case, developing a prescription based on the traditional bipartite rationale of effectiveness and safety could be sufficient. However, in the latter case, incorporating some additional considerations, beyond just effectiveness and safety, would probably be necessary. Although it is becoming increasingly clear that views on this subject within the field of exercise science diverge, an open debate has yet to take place.

The absence of a consistent guiding philosophy is evident in the guidelines issued by most scientific and professional organizations. It is interesting, for example, that a statement favoring behavior change as the prime objective of exercise prescriptions in the seventh edition of the ACSM guidelines[25] ("the most appropriate exercise prescription … is the one that is most helpful in achieving… behavioral change" [p. 136]) was edited out in the eighth edition.[26] Although a clear statement of philosophy is also missing from the guidelines[27] issued by the British Association of Sport and Exercise Sciences, it is reassuring to note that this document at least acknowledges some of the challenges faced by beginner exercisers, including the fact that the exercise may be too "demanding" (p. 585). Along the same lines, it is striking that, although activity guidelines for overweight and obese participants calling for at least 60–90 min of daily activity had been criticized as "too daunting" (p. 769)[28] and "too ambitious" (p. 2264),[21] the latest ACSM[29] and European College of Sport Science[30] position stands contain no mention of this challenge or the shockingly low participation rates among overweight and obese individuals. Likewise, several scientific groups have concluded that "adherence is lower with higher-intensity exercise programs" (p. 142)[25] and that "moderate-intensity physical activities are more likely to be continued than are high-intensity activities" (p. 243).[31] Nevertheless, in recent years, several authors have advocated higher intensities for cardiac adaptations,[32] weight management,[33] and health in general,[34,35] without addressing the implications of their suggestions for long-term motivation and adherence.

Presumably, guideline documents are revised following extensive debate among experts. So, an inspection of historical trends may be a good basis for deciphering the changing conceptual and philosophical undercurrents in this field. An analysis of the eighth edition of the ACSM guidelines[26] would suggest a resistance to the idea that exercise prescriptions may have to involve creative combinations of art and science. Furthermore, the notion that the ultimate goal of the

guidelines is to facilitate the instillation of a lifelong activity habit, a goal that necessitates input from psychology, is apparently viewed with ambivalence. It would be wonderful if the maximization of effectiveness, the ascertainment of safety, and the promotion of lifelong activity could all be accomplished within the same prescription. However, in many cases, this might not be feasible. This is why a clear philosophical stance on what the prime objective should be is of such fundamental importance. If we cannot accomplish all three objectives simultaneously, then having a crystalized consensus on a prime, overarching objective is the only way to develop a workable solution. Dishman[36] recognized this challenge approximately 30 years ago, when he wrote that "although exercise prescriptions based strictly on objective thresholds of energy demand or heart rate may optimize physiological adaptations, they may also minimize the chances that certain individuals will adhere to that prescription" (p. 174). He urged exercise scientists and practitioners to seek "some compromise between the ideal physiological prescription and a manageable behavioral prescription … to allow adherence to be sufficient for desired biological changes to occur" (p. 248).[37] Decades later, very limited progress appears to have been made on this front.

EXERCISE PRESCRIPTIONS AS A MOTIVATIONAL (AND DEMOTIVATIONAL) FORCE

In an exceptionally insightful review of the history of exercise prescriptions and physical activity recommendations in the United States, Blair et al.[38] offer a rare glimpse into the "battle of paradigms" that has taken place within the field. They identify the early 1990s as a turning point, at which the first realization was made that guidelines, besides serving as a technical aid to practitioners worldwide, also function as a communication and marketing apparatus whose echoes can influence public behavior. By specifying the minimum recommended dose of activity, the guidelines let the public make important judgments that have direct impact on behavioral decision making. These include, for example, whether the recommended dose is attainable or unrealistic, or whether exercising for a given amount of time or up to a given intensity is "worth doing."

According to Blair et al.,[38] a sense began to develop that the ACSM guidelines "led to somewhat regimented thinking about how much exercise should be recommended, … [causing] most persons to think that exercise not meeting these specific criteria would be of limited or no value" (p. 915S). In particular, exercise intensity emerged as a possible culprit, responsible for intimidating large segments of the sedentary public. This was first expressed in the 1990 ACSM position stand[39] on *The Recommended Quantity and Quality of Exercise for Developing and Maintaining Cardiorespiratory and Muscular Fitness in Healthy Adults*, which stated that the "ACSM recognizes the potential health benefits of regular exercise performed more frequently and for a longer duration, but *at lower intensities* than prescribed in this position statement" (p. 266, emphasis added).

Along similar lines, the fifth edition of the ACSM guidelines[40] was prefaced with the statement: "It is increasingly clear that less regimented approaches are needed in community health and activity promotion efforts. The vast majority of physically active adults are not involved in structured, formal exercise programs, nor do they need to be" (p. 3). The 1995 physical activity recommendations[6] by the Centers for Disease Control and Prevention and the ACSM, the first that introduced the idea that "moderate-intensity," ordinary lifestyle activities like fishing, home care, or lawn mowing can be beneficial for health, were explicitly aimed "to encourage increased participation in physical activity" (p. 402). The preface to the seventh edition of the ACSM guidelines[25] included the following acknowledgment: "Because Americans are highly sedentary … persuading sedentary individuals to become physically active is more likely to be successful when the target level of physical activity is moderate, rather than the traditional higher-intensity level" (pp. 5–6). These statements illustrate that, over time, the leaders in the field of exercise science became sensitized to the fact that exercise prescription guidelines and physical activity recommendations were not just that; they also played a central role in the ongoing social marketing campaign to promote physical activity to larger segments of the public. In the mid-1990s, with the advent of the simpler and less intimidating message[6] of "30 minutes or more of moderate-intensity physical activity on most, preferably all, days of the week," most exercise professionals were anticipating a significant shift in physical activity behavior. However, more than a decade and a half later, it is clear that, contrary to expectations, the new approach has not been any more successful than the previous approaches in increasing the number of people who are active enough to benefit their health.

IF THE PRODUCT IS SO GOOD, WHY ARE WE STILL FAILING IN MARKETING IT?

It seems that, more than 35 years after the first exercise prescription guidelines and with no visible improvement in the rates of physical activity participation in industrialized countries, it is time for reflection and a reconsideration of the operational plan. Clearly, there are failures in the system that must be identified and corrected. The list of systemic failures is probably long and impossible to cover in a comprehensive manner. So, emphasis here is placed on just one: confusion. There is hardly a greater impediment to the success of a marketing campaign than message confusion, and there is hardly a more potent cause of confusion than inconsistency. On this issue, the failure is pervasive, persistent, and absolute. One would be hard pressed to find another health behavior for which more sets of guidelines and recommendations have been issued, by a larger array of scientific and professional bodies, or with so many revisions and updates. Marketing experts warn that social marketing campaigns have reduced chances of success if they are subject to "contradictory counter-marketing" or the concurrent exposure

of the target market to conflicting or inconsistent messages. The social marketing of exercise and physical activity faces contradictory counter-marketing from both external and internal sources.

Examples of contradictory counter-marketing messages from sources outside of exercise science abound. Following the recommendations by the ACSM and the Centers for Disease Control and Prevention,[6] as well as the Surgeon General's report[7] extolling the virtues of moderate-intensity physical activity, a best-selling book[41] by a well-known trainer to the stars asserted that people should exercise "at the highest intensity that is safe" (p. 108). According to the same source, the appropriate intensity is one that induces "a definite feeling of fatigue" (p. 113) and takes people "past [their] level of comfort" (p. 115). Presumably, this book was read by a much larger number of people than those who turned to credible scientific sources.

One illustrative example of a contradictory message from within the domain of public health was the call by the Institute of Medicine[42] in 2002 for 60, as opposed to 30, min of daily physical activity. In a draft report that received extensive media attention, the Institute of Medicine noted that "30 minutes per day of regular activity is insufficient to maintain body weight … and achieve all the identified health benefits fully." Thus, the institute recommended that "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" should be performed. In the days that followed the release of the report, news articles were as critical of the 60 min figure, which was portrayed as exorbitant, as they were of the inconsistency. A search of the news archives for September 2002 shows that, in several of the articles, the focus was not on the contents of the report as much as it was on the fact that researchers cannot agree ("How much time does it take to stay healthy? Even the experts don't agree" read one headline). An article in a major newspaper on September 30 opened with the sentence "Millions of Americans are thrown into a tizzy of confusion" and proceeded with statements from an exerciser who said that the report was "confusing" and she was "unclear about what constituted 'moderately intense' exercise." In another major newspaper, on October 7, a journalist wrote that "the recent call for 60 minutes of daily exercise has sparked plenty of confusion among consumers and heated debate among fitness experts." In an interview, a member of the public said that she "[did] not know what to think anymore… It's confusing because you hear different schools of thought all the time … You don't know what to believe."

In August 2007, the joint recommendation[9] by the ACSM and the American Heart Association specified that each American adult should "perform moderate-intensity aerobic (endurance) physical activity for a minimum of 30 min on five days each week or vigorous-intensity aerobic activity for a minimum of 20 min on three days each week" (p. 1431). Thus the minimum recommended duration per week amounted to 150 min of moderate or 60 min of vigorous activity. Only 14 months later, in early October 2008, the Department of Health and Human Services published the first *Physical Activity Guidelines for Americans*.[10] Although the minimum recommended duration of moderate activity per week was also 150 min (2 h and 30 min), the minimum recommended duration for vigorous activity was not 60 but 75 min/week (1 h and 15 min).

Confusion can even be generated within the same document, by statements that do not appear to be entirely consistent. For example, in the physical activity recommendations[10] for adults issued by the ACSM and the American Heart Association, the purpose of which reportedly was to clarify some of the inconsistencies and confusing aspects of previous recommendations, some points seem hard to reconcile. On the one hand, the document advises the public that "individuals should start at the lower end of this range when beginning an activity program" (p. 1428) and warns that, by exceeding the minimal recommendations, the "musculoskeletal health risks are increased as well, possibly negating some of the added benefit" (p. 1430). On the other hand, the public is also advised that adults who "wish to improve their personal fitness or further reduce their risk for premature chronic health conditions and mortality related to physical inactivity *should* exceed the minimum recommended amounts of physical activity" (p. 1426, emphasis added). It is also noteworthy that issues of adherence and dropout are not addressed anywhere in this document, which is strictly based on a consideration of effectiveness and risk.

Moreover, confusion can be generated by a lack of specificity. For example, in exercise prescription guidelines, the standard approach since the 1970s has been to recommend a broad range of frequencies, durations, and intensities. These ranges are reportedly "intentionally broad" (p. 141)[25] in order to accommodate the widest possible array of individual capabilities and preferences. However, finding the level that is appropriate for each individual is left on the individual and his or her advisors (health care provider, exercise leader, or rehabilitation specialist). The guidelines do not (and perhaps could not) provide specific guidance. So, an interesting question to ponder is whether recommending such broad ranges ultimately serves to exacerbate the confusion and uncertainty that the guidelines were developed to alleviate in the first place. The current ACSM guidelines,[26] for instance, specify that the range of effective and safe intensity extends from a low of 40% of oxygen uptake reserve or heart rate reserve (or 64% of maximal heart rate) to a high of 85% of oxygen uptake reserve or heart rate reserve (or 94% of maximal heart rate). For most individuals, these intensities encompass a very broad range of activity modalities, from a slow to moderately paced walk to a fairly hard run. Similarly, the descriptors "moderate" (i.e., 3–6 metabolic equivalent units or 10.5–21.0 $mL \cdot kg^{-1} \cdot min^{-1}$) and "vigorous" (i.e., more than 6 metabolic equivalent units or 21.0 $mL \cdot kg^{-1} \cdot min^{-1}$), which are used in current physical activity recommendations,[10] are also essentially all-encompassing. According to a widely used compendium, examples of activities that correspond to 3.0 metabolic equivalent units include putting away household items, washing the car or windows, fishing while

standing, and dressing a child. On the other hand, activities that correspond to 9.0 metabolic equivalent units include cross-country running or skiing, playing football competitively, and climbing hills with a 42+ pound load. For adults returning to physical activity after decades of sedentary living, with no experience of how a severely deconditioned body responds to physical challenges, this array of options, all sanctioned as effective and safe, may be bewildering. It is also important to point out that, within these recommended ranges, there are intensities that will leave some individuals unchallenged or bored, as well as intensities that may cause overexertion, discomfort, exhaustion, pain, and even fear or embarrassment. All of these intensities might have been judged by experts to be effective and safe, but whether they are truly appropriate for a given individual is not always easy for a novice to decide.

Confusion can also be the unintended consequence of a seemingly mundane process, such as the periodic update and revision of guidelines. For example, the ACSM has revised the recommended ranges of intensity and duration for the development and maintenance of cardiorespiratory fitness several times since 1975 and has also varied these ranges for special populations, such as people with heart disease, hypertension, diabetes, or obesity (see Figure 119.1). Experts in physiology or medicine might argue that frequent updates are a necessity and a direct consequence of a rapidly evolving literature. On the other hand, a marketing or communications expert would probably claim that, if one considers the promotion of physical activity as a prime objective, then maintaining a consistent message should be seen as of overriding importance. From this point of view, a 5% upward or downward adjustment in the guidelines probably does more harm than good. One reason is that, in the eyes of the public and even of professionals in a wide range of health care-related fields, constant changes are more likely to be interpreted as a sign of an immature and unreliable knowledge base than a sign of a field striving to bring the latest scientific information to the forefront. Furthermore, the changes are so many that, outside of a dedicated core of specialists, keeping up with the new sets of numbers becomes a nearly impossible task. The challenge becomes even more difficult due to the fact that, in some cases, the changes may have more to do with transient trends than a clearly identifiable scientific rationale. As one example, the term "moderate intensity" was defined as extending from 60% to 79% of maximal heart rate in the fifth edition of the ACSM guidelines, from 55% to 69% in the sixth edition, and from 64% to 76% in the seventh and eighth editions.

The result of this stream of inconsistent messages over many years, not surprisingly, has been widespread confusion, not only among the public but also among health care providers, as documented in a growing number of studies. One of the goals set in the precursor to the Healthy People program in 1980 was that, by 1990, the proportion of adults who would be able to accurately identify the dose of exercise thought to promote cardiovascular fitness most effectively would be higher than 70%. At that time, this "most effective"

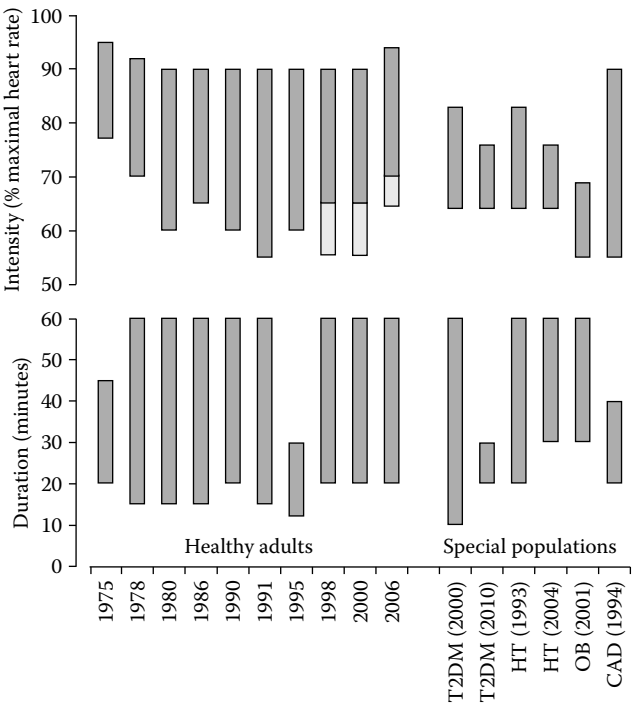

FIGURE 119.1 Changes in the lower and upper limits of the recommended range of exercise intensity (top panel) and daily duration (bottom panel), according to the American College of Sports Medicine. The figures for healthy adults are drawn from *ACSM's Guidelines for Exercise Testing and Prescription* and Position Stands on the *Recommended Quantity and Quality of Exercise for Developing and Maintaining Cardiorespiratory and Muscular Fitness in Healthy Adults*. The lighter gray part of the bars refers to recommendations in which the lower limit of intensity was specified as a range, as opposed to a single level (e.g., 64%–70% of maximal heart rate). T2DM, type 2 diabetes mellitus; HT, hypertension; OB, obesity; CAD, coronary artery disease.

dose was believed to be at least 20 min, on ≥3 days/week, and an intensity of at least 60% of an individual's cardiorespiratory capacity. Caspersen et al.[43] analyzed the responses of more than 170,000 adults from the 1985 NHIS. They reported that 37.9% of respondents could not choose the correct answer from a list of options for any of the three questions (pertaining to frequency, duration, and intensity, respectively). Another 33.6% selected one correct answer and 23.5% selected two. However, only 5.1% of respondents selected all three answers correctly. Even when more relaxed criteria were used (considering any answer above the minimum recommended threshold as correct), the percentage of respondents answering all three questions "correctly" was 63.7%.

Morrow et al.[44] surveyed a random nationwide sample of 2002 individuals. Most respondents answered correctly that it is "true" that "Everyone should get 30 minutes of moderate physical activity most days of the week" (87.7%), that it is "false" that "Moderate levels physical activity do NOT provide any health benefits" (86.7%), and that it is "false" that "Vigorous levels of physical activity are necessary to provide a health benefit" (64.2%). On the other hand, more than

half (57.1%) of the respondents answered (incorrectly) that it is "false" that "Ten minutes physical activity three times per day provide the same health benefits as a single session of 30 minutes." Similarly, when asked in an open-ended fashion to specify "What is the minimum length of time (in minutes) one needs to be physically active throughout a typical day in order to achieve a health benefit," more than half (52.9%) gave answers other than "30 minutes."

Bennett et al.[45] analyzed data from 2381 participants in the 2005 Health Information National Trends Survey. When asked in an open-ended fashion, most participants responded correctly that the frequency of physical activity should be at least 5 days/week (57%) and the duration should be at least 30 min (86%), although any number over 5 days and 30 min was considered correct. However, only 33% of respondents gave correct answers to both questions. Importantly, 74.5% of respondents agreed (either "somewhat" or "strongly") that "there are so many different recommendations about physical activity or exercise that it's hard to know which ones to follow."

One might argue that the uncertainty and confusion reflected in public surveys might be due not to the flaws of the marketing message itself (i.e., inconsistencies and contradictions) but rather due to deficiencies in the preparation of the public to process the subtleties of the message (e.g., lack of specialized training and exposure to original research, lack of comprehension of important distinctions, such as between "exercise" and "physical activity"). The data, however, indicate that the confusion also extends to physicians and other health care professionals, to whom these limitations presumably do not apply.

Petrella et al.[46] surveyed 27,980 primary care physicians in Canada. Only 15.8% of them reported providing their patients with written exercise prescriptions, a finding that the authors attributed to "inadequate knowledge, skills, and tools needed to write exercise prescriptions" (p. 1779).

Allen et al.[47] surveyed 175 family physicians and 31 cardiologists in Canada. On a scale ranging from 1 (no knowledge) to 5 (strong knowledge), the family physicians rated their knowledge for prescribing exercise for two hypothetical cases (a patient with stable angina and a patient 2 weeks after discharge for an uncomplicated myocardial infarction) as 2.5 on average, with the cardiologists scoring just one point higher. To put these figures in perspective, the family physicians rated the knowledge needed in order to provide appropriate exercise prescriptions as 1.7 points higher than their perceived current level of knowledge. For family physicians, inadequate knowledge of safe levels of exercise was by far the most frequently reported barrier to prescribing exercise. In focus groups, physicians indicated that, although they are capable of providing general advice (i.e., that one should undertake physical activity), they did not know how to provide specific advice (i.e., cite specific figures for frequency, duration, intensity, and progression).

Essentially, the same finding was reported by Bull et al.[48] based on survey data from 789 family practitioners in Australia. Although nearly all (91.3%) physicians reported that they felt capable of providing general advice on physical activity, fewer than half felt capable of providing specific advice (45.5%; 51.4% of men, 31.7% of women).

Douglas et al.[49] studied 757 general practitioners, nurses, and health visitors in Scotland. The majority reported that they felt they had "sufficient knowledge to advise patients about physical activity" (66% of general practitioners, 71% of nurses, and 80% of health visitors either "agreed" or "strongly agreed"). However, when asked, only 13% of general practitioners, 7% of nurses, and 9% of health visitors correctly described the current recommendations (i.e., accumulation of at least 30 min of moderate activity, 5 days/week). The numbers of those who thought that the current recommendations call for 20 min, three times per week were larger (18% of general practitioners, 10% of nurses, and 12% of health visitors).

Daley et al.[50] surveyed 138 general practitioners in England. Almost two-thirds (64.5%) knew the "minimum amount of moderate-intensity physical activity that adults should aim to achieve each day for health benefits." On the other hand, only about a third (32.6%) knew the recommended minimum number of days per week and one-tenth (10.9%) knew how many minutes of moderate physical activity is recommended for the prevention of obesity.

One factor that may explain the relatively low level of knowledge of physicians and other health care professionals regarding exercise prescriptions is that such information is typically not offered as part of their formal education. According to a questionnaire survey[51] of 72 deans of medical schools and directors of medical education from the United States, even though almost half of them (47.2%) felt that being able to design an exercise prescription is "highly important," only 10.0% believed that students graduating from their programs were "highly competent" in doing so. Therefore, it seems that physicians, like the rest of the public, have to track down, read, and decode this information on their own. The fact that many, if not most, fail to do so effectively, despite their background, is an indication of the difficulty of this task.

PLEASURE AS THE MISSING ESSENTIAL INGREDIENT

At present, an exercise prescription or physical activity recommendation is considered successful if, within a relatively short period of time (i.e., usually that employed in experimental studies, such as 2–4 months), the exercise or physical activity is shown to produce statistically significant beneficial changes in the outcome variables without causing adverse events. This, however, is a dubious criterion of success since all short-term exercise- or activity-induced adaptations are reversible once the exercise or activity is discontinued. Therefore, although effectiveness and safety are obviously essential considerations, they may become meaningless unless participation is continued over the long haul, ideally for a lifetime. This fundamental principle implies that, ultimately, the prime objective of exercise prescriptions and

physical activity recommendations must be the instillation of a sustainable activity habit. If this principle is endorsed by exercise scientists and practitioners, it has the potential to act as a catalyst in reshaping the entire field. The development of instructions about what one *should* do without taking into account what one *can* do or *is willing* to do must become a thing of the past. Furthermore, shifting the focus to long-term maintenance as the prime objective could potentially unburden guidelines and recommendations from the massive confusion and marketing failures that have plagued them over the past four decades.

Certainly, instilling a lifelong activity habit is more easily said than done. The contributing variables are probably numerous, they may interact in complex ways, they are likely to vary from one individual to the next, and they remain mostly beyond the reach of our current understanding. Thus, the development of a comprehensive model that can serve as the basis of interventions that can be delivered by practitioners in the field is still a long way from becoming a reality. So, the position advanced here focuses specifically on one variable, namely pleasure.

This variable is selected for the following important reasons. First, the strong link between pleasure and human motivation for action has been known since antiquity. An emerging literature now suggests that the pleasure experienced during bouts of physical activity predicts subsequent physical activity participation. For example, Williams et al.,[52] using a single-item rating scale, measured pleasure at a "moderate" level of intensity (64% of age-predicted maximal heart rate) from a sample of formerly sedentary adults. These ratings were found to be significantly correlated with self-reported levels of physical activity 6 and 12 months later. Each one-unit increase on the 11-point rating scale of pleasure that was used was associated with 38 additional minutes of at least moderate-intensity physical activity per week at 6 months and 41 min/week at 12 months. Similarly, Schneider et al.[53] collected pleasure ratings from 124 adolescents as they cycled on an ergometer for 30 min at a moderate intensity (80% of the workload corresponding to their ventilatory threshold). After controlling for aerobic capacity and gender, each one-unit increase on the 11-point rating scale of pleasure was associated with 4.18 min of additional daily moderate-to-vigorous physical activity, assessed by accelerometer. For many exercise practitioners, the link between pleasure and subsequent exercise behavior is something they have learned from experience. Cardiac rehabilitation specialists have noted that "[managing] anxieties from the fear of overexertion causing an event, and attaining enjoyment from the exercise" are crucial contributors to adherence. Unless these are addressed, "the required longer-term changes of behavior for maintaining physical activity at appropriate levels are less likely" (p. 48).[54] Likewise, physical therapists working with individuals with chronic pain or fatigue use the construct of "kinesiophobia" to describe the fear that some of their patients have that exercise may exacerbate their symptoms. Once this fear develops, it tends to predict reduced physical activity participation.[55,56]

Second, when individuals who manage to remain active are asked in an open-ended fashion about the reasons behind their adherence; variants of pleasure (such as enjoyment, energy, relaxation, or pride) are among the most commonly reported factors. Conversely, variants of displeasure (such as exhaustion, pain, disappointment, or embarrassment) are ubiquitous in the reports of those who have dropped out. For example, Hendry et al.[57] interviewed patients with osteoarthritis about their exercise habits. Among the themes that most strongly distinguished those who were consistently active from those who had given up on exercise were statements related to pleasure versus displeasure or enjoyment versus aversion. Those in the former category used statements such as "I really do enjoy the gym; I look forward to going." Those in the latter category used statements such as "I can't enjoy exercise because it's so painful." According to a review of this literature,[58] constructs such as fun and enjoyment (or lack thereof) "were reported more often as predictors of participation and non-participation than perceived health benefits" (p. 832).

Third, several studies, particularly during the last decade, have examined the relationship between the dose characteristics of physical activity and the degree of pleasure that participants report. This research has shown that relative intensity, in particular, seems to exert a strong influence on pleasure. To illustrate this close linkage, Lind et al.[59] designed a study to simulate a scenario in which an exercise professional prescribed a level of intensity that was just 10% higher than that which participants would have selected if given this option. A sample of middle-aged women who were exercising for the first time in at least a year (but, in many cases, much longer) reached 84.17% ± 12.86% of their peak heart rate at the end of a 20 min treadmill bout, with the range recommended by the ACSM[26] extending from 64% to 94%. In contrast, imposing a treadmill speed that was just 10% faster than the self-selected caused the women to reach 91.14% ± 13.83% of their peak heart rate. Although both intensities were within the ACSM-recommended range, ratings of pleasure remained positive and stable during the bout at self-selected intensity but declined continuously and significantly when the speed was raised by just 10%. In this study, the women spontaneously selected an intensity that did not differ significantly from their ventilatory threshold (reached 98.07% ± 24.79% at the 20th min). In contrast, when the speed was raised by 10%, the women significantly exceeded their ventilatory threshold (115.40% ± 31.04%). In general, when adults are allowed to self-select their intensity, in most cases, they choose levels well within the range recommended by the ACSM for the development and maintenance of cardiorespiratory fitness. Furthermore, ratings of pleasure tend to remain stable and positive.[60]

Such findings support a reconceptualization of the constructs of "exercise prescription" and "physical activity recommendation." Instead of constantly revising the boundaries of the recommended heart rate range and risking massive confusion, it might be more effective to prescribe or recommend activity based on a constant and easy-to-understand reference

criterion: the intensity should be such that it does not cause a significant decrease in pleasure. Although this may sound simplistic, it represents an evidence-based approach to reaching the "compromise between the ideal physiological prescription and a manageable behavioral prescription" that was envisioned decades ago by Dishman[37] (p. 248). An intensity that does not induce a decrease in pleasure is, in most cases, close to the ventilatory threshold.[60] Such an intensity allows the maintenance of a physiological steady-state and can thus be continued over a prolonged period of time. Furthermore, since the ventilatory threshold typically occurs at approximately 50%–60% of maximal aerobic capacity in healthy nonathletic adults,[61,62] this intensity is within the range currently recommended by the ACSM.[26] Therefore, maintaining a steady level of pleasure during exercise can benefit motivation without compromising effectiveness or safety.

Calling for the maintenance of pleasure as a central consideration does not mean that monitoring intensity by objective means should be eliminated. The relationship between intensity and pleasure varies between, and even within, populations of exercisers with different physiological and psychological characteristics. It is also subject to situational influences, such as the perceived features of the social environment in which the exercise or physical activity takes place (e.g., whether the individual appraises the context as threatening by emphasizing competition or evaluation).

The presence of interpopulation and interindividual variability presents challenges and necessitates some radical changes in the way that exercise practitioners are trained (e.g., educational curricula will have to place at least as much emphasis on the psychology of exercise and physical activity as they do on the physiology). Furthermore, there is a need to direct resources toward a broad research agenda. The range of research topics that will have to be investigated in the years ahead includes (a) population-specific variations in the relationship between intensity and pleasure-displeasure responses (e.g., among individuals who are overweight or obese, patients with various exercise-limiting conditions), (b) physiological and psychological bases of interindividual differences in pleasure–displeasure responses, (c) the link between pleasure and exercise behavior (e.g., what aspects of pleasure–displeasure experiences may be more strongly predictive of subsequent behavior), (d) the mechanisms underlying pleasure–displeasure responses during exercise, and (e) the effectiveness and limitations of interventions aimed at increasing pleasure or decreasing displeasure during exercise.

AN ILLUSTRATIVE EXAMPLE: THE BOOM–BUST HYPOTHESIS OF EXERCISE BEHAVIOR IN OBESITY

Although the majority of the population in many industrialized countries is presently overweight or obese, how overweight or obese individuals feel when they exercise remains largely unexplored. Perhaps not coincidentally, the failure to increase physical activity among obese individuals has been nearly absolute. As noted earlier, according to data from the 2000 BRFSS, only 3.0% of obese women and 6.4% of obese men trying to lose weight report averaging 60 min of physical activity daily,[19] which is the minimum amount recommended by most agencies for effective weight management. As was also mentioned earlier, position statements by European and American scientific societies address how much exercise people should be doing for weight management but make no mention of the fact that the vast majority of people cannot or do not follow these guidelines.[29,30]

The ACSM[26] recommends that, initially, training intensity for obese individuals should be "moderate," defined as 40%–60% of oxygen uptake or heart rate reserve, with eventual progression to 50%–75%. This intensity should be maintained initially for 30–60 min and eventually for at least 60 min, with the option of performing the activity intermittently, as long as each period is at least 10 min long. If weight loss is desired (which is the case for the majority of obese women and men), then 60–90 min/day is deemed necessary.

To put these figures into perspective, a group of obese and sedentary, but otherwise healthy, middle-aged women reached 61% of their maximal oxygen uptake after walking at a relatively slow speed (2.50 miles/h, corresponding to approximately 3.0 metabolic equivalent units) for only 2 min.[63] A group of more active and fit obese women reached 56.0% of their maximal oxygen uptake after walking at a similar speed (2.65 miles/h) for only 4 min.[64] These figures illustrate that, at least when walking is chosen as the mode of physical activity, it may be impossible to maintain intensity within the recommended range of 40%–60% of maximal oxygen uptake for more than a few minutes. The challenge of accumulating 60–90 min of activity daily under these circumstances should become evident.

Studies have also shown that, unlike normal-weight individuals who typically show significant declines in pleasure at intensities that exceed the ventilatory threshold, obese individuals feel worse across most of the range of intensity.[63] Furthermore, obese participants may exhibit an attenuated "rebound" in pleasure (typically experienced as an increased sense of energy and reinvigoration) after exercise is stopped.[63]

Taken together, these data compose a likely scenario that could shed some light on the reasons behind the low levels of physical activity participation among obese individuals. It appears that many obese individuals, because of low cardiorespiratory fitness relative to body mass, need to raise intensity to fairly high percentages of maximal capacity in order to perform activities that may appear to be fairly "manageable" on paper (such as walking at 2.50 miles/h). This entails that most activities, at least after the first few minutes, would require effort that exceeds the ventilatory threshold. Because of the inability to maintain a physiological steady-state, these activities cannot be continued over extended periods of time, making the accumulation of 60–90 min on a daily basis a very challenging undertaking. Because initial attempts are likely to produce decreases in pleasure that are essentially unavoidable, giving up after a few trials is a phenomenon that should be considered predictable. This pattern can be

described as a series of "boom–bust" cycles that eventually serve to associate the idea of physical activity with displeasure. Because it is inherent in human nature to gravitate toward pleasant options and avoid unpleasant ones, activities associated with displeasure are avoided.

While this "boom–bust" hypothesis certainly requires considerable empirical testing and theoretical elaboration, it is interesting to use it as a possible frame of reference in evaluating recent calls for high-intensity exercise not only for weight management[33] but also for health promotion in general.[34,35] The main argument in support of these proposals is that, by using high intensity, the same fitness and health benefits can be accomplished within a shorter period of time compared to exercise of lower intensity. Although this argument may seem reasonable, it ignores some important empirical observations. First, with weekly energy expenditure fixed, given a choice between higher intensity or longer duration as a method of facilitating adherence, more obese individuals chose a reduction in intensity and a prolongation of duration.[65] Second, with daily duration fixed at 30 min, higher intensity was negatively associated with adherence (proportion of prescribed activity that was completed), whereas higher frequency (and, therefore, additional overall time investment) was not.[66] Third, higher intensity (specifically, intensity above the ventilatory threshold) produced a significant reduction in pleasure, whereas longer duration did not.[67]

Considering the persistent failure to promote physical activity to a larger segment of the public, it seems reasonable to suggest that prescriptions or recommendations for a given dose of exercise or physical activity should be accompanied by careful consideration of the possible impact on pleasure and adherence. The model of the exercising human without a head and without feelings is a relic of the dualistic past of biomedicine. The pressure to solve the problem of physical inactivity should accelerate its long-overdue decline into obsolescence.

With this in mind, the latest *Quantity and Quality of Exercise for Developing and Maintaining Cardiorespiratory, Musculoskeletal, and Neuromotor Fitness in Apparently Healthy Adults*,[68] issued by ACSM, should be considered a development of historical significance. According to this position stand, "moderate-intensity exercise and exercise that is enjoyable can enhance the affective responses to exercise, and may improve exercise adherence" (p. 1335). Moreover, "limited evidence suggests that pleasant affective responses to exercise (i.e., how enjoyable or pleasant is the exercise) may enhance future exercise behavior and vice versa" (p. 1347).

REFERENCES

1. Morris, J.N., Heady, J.A., Raffle, P.A.B. et al. 1953. Coronary heart-disease and physical activity of work. *Lancet* 265: 1111–1120.
2. Bannister, R. 1973. Vigorous exercise and coronary heart-disease. *Lancet* 301: 613.
3. Inter-Society Commission for Heart Disease Resources. 1970. Primary prevention of the atherosclerotic diseases. *Circulation* 42: A55–A95.
4. Kannel, W.B., Sorlie, P. 1979. Some health benefits of physical activity: The Framingham study. *Arch Intern Med* 139: 857–861.
5. Fletcher, G.F., Blair, S.N., Blumenthal, J. et al. 1992. Statement on exercise: Benefits and recommendations for physical activity programs for all Americans. *Circulation* 86: 340–344.
6. Pate, R.R., Pratt, M., Blair, S.N. et al. 1995. Physical activity and public health: A recommendation from the Centers for Disease Control and Prevention and the American College of Sports Medicine. *JAMA* 273: 402–407.
7. United States Department of Health and Human Services. 1996. *Physical Activity and Health: A Report of the Surgeon General*. Atlanta, GA: United States Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion.
8. Thompson, P.D., Buchner, D., Pina, I.L. et al. 2003. Exercise and physical activity in the prevention and treatment of atherosclerotic cardiovascular disease: A statement from the Council on Clinical Cardiology. *Circulation* 107: 3109–3116.
9. Haskell, W.L., Lee, I.M., Pate, R.R. et al. 2007. Physical activity and public health: Updated recommendation for adults from the American College of Sports Medicine and the American Heart Association. *Med Sci Sports Exerc* 39: 1423–1434.
10. United States Department of Health and Human Services. 2008. *Physical Activity Guidelines for Americans*. Washington, DC: United States Department of Health and Human Services.
11. Morrow, J.R. Jr., Jackson, A.W., Bazzarre, T.L. et al. 1999. A one-year follow-up to physical activity and health: A report of the Surgeon General. *Am J Prev Med* 17: 24–30.
12. Martin, S.B., Morrow, J.R. Jr., Jackson, A.W. et al. 2000. Variables related to meeting the CDC/ACSM physical activity guidelines. *Med Sci Sports Exerc* 32: 2087–2092.
13. Faulkner, G., Finlay, S.J., Roy, S.C. 2007. Get the news on physical activity research: A content analysis of physical activity research in the Canadian print media. *J Phys Act Health* 4: 180–192.
14. Chau, J., Bonfiglioli, C., Chey, T. et al. 2009. The Cinderella of public health news: Physical activity coverage in Australian newspapers, 1986–2006. *Aust N Z J Public Health* 33: 189–192.
15. Kruger, J., Kohl, H.W. III, Miles, I.J. 2007. Prevalence of regular physical activity among adults: United States, 2001 and 2005. *MMWR* 56: 1209–1212.
16. United States Department of Health and Human Services. 2008. *Healthy People 2010 Progress Review: Physical Activity and Fitness*. Washington, DC: United States Department of Health and Human Services.
17. Troiano, R.P., Berrigan, D., Dodd, K.W. et al. 2008. Physical activity in the United States measured by accelerometer. *Med Sci Sports Exerc* 40: 181–188.
18. Metzger, J.S., Catellier, D.J., Evenson, K.R. et al. 2008. Patterns of objectively measured physical activity in the United States. *Med Sci Sports Exerc* 40: 630–638.
19. Bish, C.L., Blanck, H.M., Serdula, M.K. et al. 2005. Diet and physical activity behaviors among Americans trying to lose weight: 2000 Behavioral Risk Factor Surveillance System. *Obes Res* 13: 596–607.

20. Kruger, J., Yore, M.M., Kohl, H.W. III. 2007. Leisure-time physical activity patterns by weight control status: 1999–2002 NHANES. *Med Sci Sports Exerc* 39: 788–795.
21. Davis, J.N., Hodges, V.A., Gillham, M.B. 2006. Physical activity compliance: Differences between overweight/obese and normal-weight adults. *Obesity* 14: 2259–2265.
22. Dishman, R.K., Buckworth, J. 1996. Increasing physical activity: A quantitative synthesis. *Med Sci Sports Exerc* 28: 706–719.
23. Marcus, B.H., Williams, D.M., Dubbert, P.M. et al. 2006. Physical activity intervention studies: What we know and what we need to know. *Circulation* 114: 2739–2752.
24. Blair, S.N. 2009. Physical inactivity: The biggest public health problem of the 21st century. *Br J Sports Med* 43: 1–2.
25. American College of Sports Medicine. 2006. *ACSM's Guidelines for Exercise Testing and Prescription* (7th edn.). Philadelphia, PA: Lippincott Williams & Wilkins.
26. American College of Sports Medicine. 2010. *ACSM's Guidelines for Exercise Testing and Prescription* (8th edn.). Philadelphia, PA: Lippincott Williams & Wilkins.
27. O'Donovan, G., Blazevich, A.J., Boreham, C. et al. 2010. The ABC of physical activity for health: A consensus statement from the British Association of Sport and Exercise Sciences. *J Sports Sci* 28: 573–591.
28. Hill, J.O., Wyatt, H.R. 2005. Role of physical activity in preventing and treating obesity. *J Appl Physiol* 99: 765–770.
29. Donnelly, J.E., Blair, S.N., Jakicic, J.M. et al. 2009. Appropriate physical activity intervention strategies for weight loss and prevention of weight regain for adults. *Med Sci Sports Exerc* 41: 459–471.
30. Fogelholm, M., Stallknecht, B., Van Baak, M. 2006. ECSS position statement: Exercise and obesity. *Eur J Sport Sci* 6: 15–24.
31. National Institutes of Health Consensus Development Panel on Physical Activity and Cardiovascular Health. 1996. Physical activity and cardiovascular health. *JAMA* 276: 241–246.
32. Wisløff, U., Ellingsen, Ø., Kemi, O.J. 2009. High-intensity interval training to maximize cardiac benefits of exercise training? *Exerc Sport Sci Rev* 37: 139–146.
33. Phelan, S., Roberts, M., Lang, W. et al. 2007. Empirical evaluation of physical activity recommendations for weight control in women. *Med Sci Sports Exerc* 39: 1832–1836.
34. Gibala, M.J. 2007. High-intensity interval training: A time-efficient strategy for health promotion? *Curr Sports Med Rep* 6: 211–213.
35. Gibala, M.J., McGee, S.L. 2008. Metabolic adaptations to short-term high-intensity interval training: A little pain for a lot of gain? *Exerc Sport Sci Rev* 36: 58–63.
36. Dishman, R.K. 1982. Health psychology and exercise adherence. *Quest* 33: 166–180.
37. Dishman, R.K. 1982. Compliance/adherence in health-related exercise. *Health Psychol* 1: 237–267.
38. Blair, S.N., LaMonte, M.J., Nichaman, M.Z. 2004. The evolution of physical activity recommendations: How much is enough? *Am J Clin Nutr* 79(Suppl.): 913S–920S.
39. American College of Sports Medicine. 1990. The recommended quantity and quality of exercise for developing and maintaining cardiorespiratory and muscular fitness in healthy adults. *Med Sci Sports Exerc* 22: 265–274.
40. American College of Sports Medicine. 1995. *ACSM's Guidelines for Exercise Testing and Prescription* (5th edn.). Philadelphia, PA: Lippincott Williams & Wilkins.
41. Greene, B. 2002. *Get with the Program! Getting Real about Your Weight, Health, and Emotional Well-Being*. New York: Simon & Schuster.
42. Institute of Medicine. 2005. *Dietary Reference Intakes for Energy, Carbohydrate, Fiber, Fat, Fatty Acids, Cholesterol, Protein, and Amino Acids*. Washington, DC: National Academies Press.
43. Caspersen, C.J., Christenson, G.M., Pollard, R.A. 1986. Status of the 1990 physical fitness and exercise objectives: Evidence from NHIS 1985. *Public Health Rep* 101: 587–592.
44. Morrow, J.R. Jr., Krzewinski-Malone, J.A., Jackson, A.W. et al. 2004. American adults' knowledge of exercise recommendations. *Res Q Exerc Sport* 75: 231–237.
45. Bennett, G.G., Wolin, K.Y., Puleo, E.M. et al. 2009. Awareness of national physical activity recommendations for health promotion among US adults. *Med Sci Sports Exerc* 41: 1849–1855.
46. Petrella, R.J., Lattanzio, C.N., Overend, T.J. 2007. Physical activity counseling and prescription among Canadian primary care physicians. *Arch Int Med* 167: 1774–1781.
47. Allen, M., Mann, K., Putnam, W. et al. 2000. Prescribing exercise for cardiac patients: Knowledge, practices, and needs of family physicians and specialists. *J Cardiopulm Rehabil* 20: 333–339.
48. Bull, F.C.L., Schipper, E.C.C., Jamrozik, K. et al. 1997. How can and do Australian doctors promote physical activity? *Prev Med* 26: 866–873.
49. Douglas, F., Torrance, N., van Teijlingen, E. et al. 2006. Primary care staff's views and experiences related to routinely advising patients about physical activity: A questionnaire survey. *BMC Public Health* 6: 138.
50. Daley, A.J., Bassi, S., Haththotuwa, H.R. et al. 2008. "Doctor, how much physical activity should I be doing?" How knowledgeable are general practitioners about the UK Chief Medical Officer's (2004) recommendations for active living to achieve health benefits? *Public Health* 122: 588–590.
51. Connaughton, A.V., Weiler, R.M., Connaughton, D.P. 2001. Graduating medical students' exercise prescription competence as perceived by deans and directors of medical education in the United States: Implications for Healthy People 2010. *Public Health Rep* 116: 226–234.
52. Williams, D.M., Dunsiger, S., Ciccolo, J.T. et al. 2008. Acute affective response to a moderate-intensity exercise stimulus predicts physical activity participation 6 and 12 months later. *Psychol Sport Exerc* 9: 231–245.
53. Schneider, M., Dunn, A., Cooper, D. 2009. Affect, exercise, and physical activity among healthy adolescents. *J Sport Exerc Psychol* 31: 706–723.
54. Buckley, J. 2006. Exercise physiology and monitoring of exercise in cardiac rehabilitation. In *Exercise Leadership in Cardiac Rehabilitation: An Evidence-Based Approach*, ed. M.K. Thow, pp. 47–95. Chichester, U.K.: John Wiley & Sons.
55. Elfving, B., Andersson, T., Ja Grooten, W. 2007. Low levels of physical activity in back pain patients are associated with high levels of fear-avoidance beliefs and pain catastrophizing. *Physiother Res Int* 12: 14–24.
56. Nijs, J., De Meirleir, K., Duquet, W. 2004. Kinesiophobia in chronic fatigue syndrome: Assessment and associations with disability. *Arch Phys Med Rehabil* 85: 1586–1592.
57. Hendry, M., Williams, N.H., Markland, D. et al. 2009. Why should we exercise when our knees hurt? A qualitative study of primary care patients with osteoarthritis of the knee. *Fam Pract* 23: 558–567.

58. Allender, S., Cowburn, G., Foster, C. 2006. Understanding participation in sport and physical activity among children and adults: A review of qualitative studies. *Health Educ Res Theory Pract* 21: 826–835.
59. Lind, E., Ekkekakis, P., Vazou, S. 2008. The affective impact of exercise intensity that slightly exceeds the preferred level: "Pain" for no added "gain." *J Health Psychol* 13: 464–468.
60. Ekkekakis, P. 2009. Let them roam free? Physiological and psychological evidence for the potential of self-selected exercise intensity in public health. *Sports Med* 39: 857–888.
61. Jones, A.M., Poole, D.C. 2005. Introduction to oxygen uptake kinetics and historical development of the discipline. In *Oxygen Uptake Kinetics in Sport, Exercise and Medicine*, eds. A.M. Jones and D.C. Poole, pp. 3–36. London, U.K.: Routledge.
62. Meyer, T., Lucía, A., Earnest, C.P. et al. 2005. A conceptual framework for performance diagnosis and training prescription from submaximal gas exchange parameters: Theory and application. *Int J Sports Med* 26 (Suppl. 1): S38–S48.
63. Ekkekakis, P., Lind, E., Vazou, S. 2010. Affective responses to increasing levels of exercise intensity in normal-weight, overweight, and obese middle-aged women. *Obesity* 18: 79–85.
64. Mattsson, E., Larsson, U.E., Rössner, S. 1997. Is walking for exercise too exhausting for obese women? *Int J Obes* 21: 380–386.
65. Fogelholm, M., Kukkonen-Harjula, K., Nenonen, A. et al. 2000. Effects of walking training on weight maintenance after a very-low-energy diet in premenopausal obese women: A randomized controlled trial. *Arch Int Med* 160: 2177–2184.
66. Perri, M.G., Anton, S.D., Durning, P.E. et al. 2002. Adherence to exercise prescriptions: Effects of prescribing moderate versus higher levels of intensity and frequency. *Health Psychol* 21: 452–458.
67. Kilpatrick, M.W., Kraemer, R.R., Bartholomew, J.B. et al. 2007. Affective responses to exercise are dependent on intensity rather than total work. *Med Sci Sports Exerc* 39: 1417–1422.
68. American College of Sports Medicine. 2011. Quantity and quality of exercise for developing and maintaining cardiorespiratory, musculoskeletal, and neuromotor fitness in apparently healthy adults: Guidance for prescribing exercise. *Med Sci Sports Exerc* 43: 1334–1359.