Physical activity considerations for the treatment and prevention of obesity\(^1\)\(^–\)\(^4\)

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ABSTRACT
Overweight and obesity present significant public health concerns because of the link with numerous chronic health conditions. Excess body weight is a result of an imbalance between energy intake and energy expenditure. Physical activity is the most variable component of energy expenditure and therefore has been the target of behavioral interventions to modify body weight. It appears that physical activity is an important component on long-term weight control, and therefore adequate levels of activity should be prescribed to combat the obesity epidemic. Although there is evidence that 30 min of moderate-intensity physical activity may improve health outcomes, the amount of physical activity that may be necessary to control body weight may be >30 min/d. There is a growing body of scientific literature suggesting that at least 60 min of moderate-intensity physical activity may be necessary to maximize weight loss and prevent significant weight regain. Moreover, adequate levels of physical activity appear to be important for the prevention of weight gain and the development of obesity. Physical activity also appears to have an independent effect on health-related outcomes when compared with body weight, suggesting that adequate levels of activity may counteract the negative influence of body weight on health outcomes. Thus, it is important to target intervention strategies to facilitate the adoption and maintenance of an adequate amount of physical activity to control body weight. *Am J Clin Nutr* 2005;82(suppl):226S–9S.

KEY WORDS Exercise, physical activity, energy expenditure, obesity, weight control

INTRODUCTION
It is estimated that in excess of 65% of adults are classified as overweight (body mass index \(\geq 25.0\, \text{kg/m}^2\)), with \(\approx 30\%\) of adults classified as obese (body mass index \(\geq 30\, \text{kg/m}^2\)) (1). These prevalence rates of overweight and obesity reflect a significant increase in these prevalence rates over the past few decades. These increasing rates of overweight and obesity are of concern because of the demonstrated association with numerous chronic conditions, which include cardiovascular disease, diabetes, and various forms of cancer (2). Therefore, it is critical to develop and implement effective interventions for the prevention and treatment of excess body weight.

WHAT IS THE ROLE OF PHYSICAL ACTIVITY IN WEIGHT LOSS?
The key to managing body weight is energy balance. When energy expenditure is equal to energy intake, theoretically body weight will be maintained, which should be the goal for prevention of initial weight gain or prevention of weight regain after weight loss. However, to promote weight loss, it is necessary to create an energy imbalance that elicits an energy deficit. Physical activity in the form of structured exercise contributes to the creation of an energy deficit by increasing total energy expenditure, and this can promote weight loss. However, although exercise is an important component of weight loss interventions, it is important to understand the magnitude of the contribution of exercise to weight loss within clinical interventions.

Short-term interventions, which are typically 6 mo or less in duration, have examined the effect of exercise alone and in combination with reductions in energy intake on changes in body weight. When compared, these studies have demonstrated that reductions in energy intake (eg, diet) have a greater impact on body weight than changes in energy expenditure via exercise, with the combination of diet plus exercise having the greatest impact on weight loss. For example, Hagan et al (3) reported reductions in body weight of 11.4, 8.4, and 0.3% in males participating in 12 wk of diet plus exercise, diet alone, or exercise alone, respectively. A similar pattern of weight losses of 7.5, 5.5, and 0.6% was observed in women engaging in the same interventions. The more recent review of the literature conducted as part of the clinical guidelines developed by the National Heart, Lung, and Blood Institute has consistently identified a similar pattern of results in numerous short-term studies of diet plus exercise, diet alone, and exercise alone (2).

Despite the results of clinical intervention studies that demonstrate that changes in energy intake may have a greater impact on body weight than exercise alone, there are studies that suggest that exercise can be as effective as diet for precipitating initial weight loss. For example, Ross et al (4) compared the effect of a 700 kcal/d energy deficit on 3 mo weight loss when produced via reduction in energy intake versus an increase in energy expenditure (exercise). The investigators reported comparable weight losses of 7.6 kg in the energy restriction and energy expenditure

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groups, respectively. These results provide some evidence that exercise can be as effective as changes in diet for producing weight loss. However, it should be noted that a 90.7 kg (200 lb) individual would need to engage in \( \approx 115.7 \) min/d (1 h 57 min/d) of brisk walking (four metabolic equivalents) to expend 700 kcal/d in exercise to produce this magnitude of weight loss. These data highlight why clinical interventions typically report greater initial weight loss with changes in diet versus changes in exercise, because most overweight and obese individuals may be unlikely to engage in sufficient levels of exercise to produce the magnitude of weight loss typically observed with reductions in energy intake.

The benefits of exercise for weight control may be best observed when exercise continues as part of the treatment plan beyond the initial weight loss period, which is typically 6 mo in duration. Studies have demonstrated that exercise alone can have a significant impact on body weight when maintained for \( \geq 12 \) mo (5, 6). Moreover, it has been shown that exercise may contribute to additional weight loss beyond the weight reduction observed within the initial 6 mo of treatment (7). Of greater importance is the observation that individuals who are capable of maintaining their weight loss long term also report engaging in exercise as part of their behavioral treatment program (7–9). An interesting observation in a study conducted by McGuire et al (10) was that individuals in the National Weight Control Registry who reduced their level of leisure-time physical activity also reported weight regain across a 1-y period. Thus, for exercise to be effective long term, it will be important to implement strategies that will facilitate the maintenance of the exercise behavior long term in overweight and previously overweight individuals.

Another important consideration is that exercise does not operate in isolation to enhance long-term maintenance of weight loss. Rather, exercise functions in concert with other important behaviors to contribute to the successful maintenance of weight loss. For example, Jakicic et al (11) reported that exercise is one behavior in a constellation of behaviors that contributes to long-term maintenance of weight loss. Across an 18-mo intervention, it was reported that individuals who maintained a greater magnitude of weight loss were engaging in both adequate amounts of exercise and healthy eating behaviors associated with weight control. Thus, the maintenance of weight loss may be a result of a constellation of behaviors, of which exercise is one of the important behaviors.

WHAT IS THE ROLE OF PHYSICAL ACTIVITY IN THE PREVENTION OF WEIGHT GAIN?

Because of the impact on energy balance, physical activity may contribute to the prevention of weight gain, which may slow the increasing prevalence rates of obesity in the United States. Data from observation studies support the potential importance of exercise in the prevention of weight gain. DiPietro et al (12) reported that a modest increase in fitness, which most likely reflects regular participation in exercise, prevented weight gain across a 4-y period in adults. Similarly, Sherwood et al (13) reported that exercise may have contributed to the prevention of weight gain in the Pound of Prevention Study. There are ongoing clinical trials to further examine the dose of physical activity to prevent weight gain. However, the currently available data provides initial support for the inclusion of exercise in efforts to curtail the increase in body weight that has been observed over the past few decades and has contributed to the obesity epidemic.

Of interest is the effect of interventions on the prevention of weight gain. Data from the recently completed STRIDDE study reported that control subjects gained weight, whereas those who participated in exercise had modest decreases in body weight and measures of body fatness, and this appears to occur in a dose-response manner (14). Regardless of these results, the optimal magnitude of exercise that is most effective for prevention of weight gain is still being debated. Therefore, it may be advantageous to initially target 150 min/wk of exercise, because this is the minimal recommended level of physical activity to promote improvements in health and to increase levels of exercise as needed to promote the prevention of weight gain.

ARE THERE HEALTH BENEFITS FOR OVERWEIGHT ADULTS INDEPENDENT OF BODY WEIGHT?

There is a growing body of knowledge to support the independent effects of physical activity and improvements in cardiorespiratory fitness on health-related outcomes (15, 16). It is important to acknowledge that overweight and obese adults may realize significant improvements in health-related outcomes independent of weight loss (17–19). Wei et al (19) reported that cardiorespiratory fitness was a significant predictor of cardiovascular disease and all-cause mortality across categories of normal weight, overweight, and obese men. Similar findings have been reported for women, with low levels of cardiorespiratory fitness being a stronger predictor than body mass index of all-cause more mortality (19). This pattern of results has been confirmed in a recent study of women in the Women’s Ischemic Syndrome Evaluation study, which reported lower coronary artery disease risk factors, angiograph coronary artery disease, and cardiovascular events with increasing levels of cardiorespiratory fitness, with no independent effect of body weight on these outcomes (20). These findings support the importance of improving physical activity and cardiorespiratory fitness in overweight and obese adults, and this should be one of the focal points of interventions for individuals in this population.

WHAT IS THE DOSE OF PHYSICAL ACTIVITY TO MAXIMIZE WEIGHT CONTROL?

To realize the benefits of physical activity for weight control, individuals need to participate in adequate levels of physical activity. It is commonly accepted that the equivalent of at least 150 min/wk of moderate-intensity physical activity is necessary to realize improvements in health-related outcomes (16, 21). However, higher levels of physical activity may be necessary to improve long-term weight loss outcomes. For example, in two separate studies, Jakicic et al (7, 22) have reported that long-term weight loss was improved in overweight and obese women with the addition of 200–300 min/wk of physical activity. These findings are similar to the results reported by Schoeller et al (23) who demonstrated that weight loss maintenance was improved when individuals engaged in the equivalent of \( \approx 65 \) min/d of moderate-intensity physical activity. It has also been demonstrated that \( \geq 2000 \) kcal/wk of physical activity may improve long-term weight loss outcomes (9, 24). Thus, although there may be health-related benefits associated with at least 150 min/wk of moderate-intensity physical activity (16, 21), there is a growing
body of knowledge to support higher levels of physical activity for improving long-term weight loss outcomes. Blair et al (25) have concluded recently that, although 30 min/d of moderate-intensity physical activity may provide substantial health benefits, “this dose of exercise may be insufficient to prevent an unhealthy weight gain for some persons who need additional exercise or caloric restriction to minimize the likelihood of additional weight gain.” Thus, encouraging levels of physical activity greater than the minimum public health recommendation (150 min/wk) may be necessary for improving long-term weight loss outcomes, and this is supported by the physical activity recommendations of the Institute of Medicine (26), American College of Sports Medicine (27), and the International Association for the Study of Obesity (28).

**ADDITIONAL PHYSICAL ACTIVITY CONSIDERATIONS**

**Resistance exercise**

Research has continued to focus on the potential benefits of resistance exercise for overweight and obese individuals. Unfortunately, it does not appear that resistance exercise has clear advantages over other forms of exercise for enhancing weight loss outcomes, and this is supported in a recent review of the literature conducted by Donnelly et al (29). Interventions that have combined dietary energy restriction with resistance exercise have shown no clear weight loss advantage when compared with energy restriction combined with other forms of exercise. A potential limitation of these studies is the relatively short-term intervention periods, with most not exceeding 6 mo in duration. However, in one of the few long-term studies to examine the effect of resistance exercise on weight loss, Wadden et al (30) reported no improvement in weight loss across a 40-wk intervention period with the inclusion of resistance exercise. Donnelly et al (29) also concluded that resistance exercise in the absence of restriction in energy intake has minimal impact of changes in absolute body weight, which may be partially explained by modest increases in fat-free mass combined with modest reductions in fat mass.

The advantage of including resistance exercise in interventions for the prevention and treatment of overweight and obesity may be the known benefits of resistance exercise on muscular strength. This may prove to be advantageous for improving function and the ability to perform activities of daily living in overweight and obese individuals. For example, the ability to lift one’s own body weight may facilitate opportunities for physical activity in these individuals, which may improve physical activity levels and/or enhance function, which results in improvement in quality of life. Thus, the addition of resistance exercise may prove beneficial for overweight and obese adults for reasons other than the impact of this form of exercise on weight loss.

**Intermittent exercise**

Perceived lack of time is a commonly reported barrier to participation in physical activity. However, there is some evidence that recommending the accumulation of physical activity across multiple intermittent periods throughout the day should be considered as an alternative intervention approach to facilitate the adoption of physical activity in previously sedentary overweight adults (22, 31). Jakicic et al (22, 31) reported that the strategy to include intermittent periods of physical activity throughout the day was effective for improving physical activity participation in overweight women across a 20-wk behavioral weight loss program, and this may have contributed to a trend for improved weight loss when compared with continuous periods of physical activity (ie, 40 continuous minutes). However, despite initial improvements in physical activity, to date this strategy has not been shown to improve long-term physical activity participation in overweight adults when compared with continuous exercise (22, 32). Therefore, this strategy may be most effective for improving the initial adoption of physical activity in overweight and obese individuals. This should be considered as an alternative strategy that may facilitate participation in physical activity during periods when there are barriers to participation in more traditional periods of physical activity (ie, 30–60 continuous minutes).

**Lifestyle approaches to increasing physical activity**

An additional alternative to tradition forms of exercise may be lifestyle approaches to physical activity. This approach emphasizes seeking opportunities in one’s lifestyle to engage in physical activity. An example of a lifestyle physical activity is to use walking rather than motorized alternatives (ie, automobiles, elevators, and escalators) for the purpose of transportation and mobility. It has been reported that lifestyle approaches to physical activity may result in cardiorespiratory fitness and body weight changes that are similar to what is observed with more traditional forms of exercise (33, 34). However, despite investigators describing the intervention that was prescribed to participants in these studies, the actual mode, duration, and intensity of the lifestyle activity in which the participants engaged has not been reported. Therefore, it is difficult to determine whether a lifestyle approach to physical activity resulted in varying patterns of physical activity that is significantly different from what is commonly observed with more traditional approaches to exercise. Thus, additional research may be necessary to understand the true impact of specific forms and patterns of lifestyle physical activity on body weight, cardiorespiratory fitness, and additional health-related outcomes in overweight adults.

There is an increasing use of pedometers to promote the increase in steps walked, and promoting lifestyle forms of physical activity may enhance the accumulation of steps. Currently, it is suggested that the accumulation of at least 10 000 steps per day may be associated with improvements in health-related parameters (35). Assuming that the average adult accumulates 2000 steps for walking 1 mile, the average adult would need to add at least 2 miles of walking per day to their current level of physical activity to achieve the goal of 10 000 steps per day (35). This is consistent with current public health recommendations to increase physical activity by at least 30 min/d (16, 21). However, it has been suggested that progressing to a higher step goal, or concurrent reductions in energy intake, may be necessary to reduce body weight in overweight and obese adults (36).

**SUMMARY**

Obesity is a significant public health problem that requires the development and implementation of effective interventions for both prevention and treatment. Physical activity appears to be an
important behavior that may prevent weight gain and significantly contribute to enhancing long-term weight loss and reducing health-risks associated with numerous chronic health conditions. There is strong scientific support for physical activity to be combined with modifications to energy intake as the most effective behavioral approach for addressing the obesity epidemic. Moreover, although 30 min/d of moderate-intensity physical activity may result in significant improvements in health, it appears that progressing to at least 60 min of physical activity may be necessary for enhancing long-term weight loss outcomes. Thus, it is important to target interventions to improve physical activity participation in overweight and obese individuals to maximize weight control and corresponding improvements in health-related outcomes.

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