Appropriate Physical Activity Intervention Strategies for Weight Loss and Prevention of Weight Regain for Adults

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Abstract

Overweight and obesity affects more than 66% of the adult population and is associated with a variety of chronic diseases. Weight reduction reduces health risks associated with chronic diseases and is therefore encouraged by major health agencies.

Guidelines of the National Heart, Lung, and Blood Institute (NHLBI) encourage a 10% reduction in weight, although considerable literature indicates reduction in health risk with 3% to 5% reduction in weight.

Physical activity (PA) is recommended as a component of weight management for prevention of weight gain, for weight loss, and for prevention of weight regain after weight loss.

In 2001, the American College of Sports Medicine (ACSM) published a Position Stand that recommended a minimum of 150 min·wk^{-1} of moderate-intensity PA for overweight and obese adults to improve health; however, 200-300 min·wk^{-1} was recommended for long-term weight loss. More recent evidence has supported this recommendation and has indicated more PA may be necessary to prevent weight regain after weight loss.

To this end, we have reexamined the evidence from 1999 to determine whether there is a level at which PA is effective for prevention of weight gain, for weight loss, and prevention of weight regain.

- Evidence supports **moderate-intensity PA between 150 and 250 min·wk^{-1} to be effective to prevent weight gain.** Moderate-intensity PA between 150 and 250 min·wk^{-1} will provide only modest weight loss.
- **Greater amounts of PA (>250 min·wk^{-1}) have been associated with clinically significant weight loss**.
- **Moderate-intensity PA between 150 and 250 min·wk^{-1} will improve weight loss in studies that use moderate diet restriction but not severe diet restriction.**
- Cross-sectional and prospective studies indicate that after weight loss, **weight maintenance is improved with PA >250 min·wk^{-1}**. However, no evidence from

well-designed randomized controlled trials exists to judge the effectiveness of PA for prevention of weight regain after weight loss.

- **Resistance training does not enhance weight loss but may increase fat-free mass and increase loss of fat mass and is associated with reductions in health risk.**
- Existing evidence indicates that **endurance PA or resistance training without weight loss improves health risk**.
- There is inadequate evidence to determine whether PA prevents or attenuates detrimental changes in chronic disease risk during weight gain.

This document is an update of the 2001 American College of Sports Medicine (ACSM) Position Stand titled "Appropriate Intervention Strategies for Weight Loss and Prevention of Weight Regain for Adults" ([68]). This Position Stand provided a variety of recommendations such as the identification of adults for whom weight loss is recommended, the magnitude of weight loss recommended, dietary recommendations, the use of resistance exercise, the use of pharmacological agents, behavioral strategies, and other topics. The purpose of the current update was to focus on new information that has been published after 1999, which may indicate that increased levels of physical activity (PA) may be necessary for prevention of weight gain, for weight loss, and prevention of weight regain compared to those recommended in the 2001 Position Stand. In particular, this update is in response to published information regarding the amount of PA needed for weight management found in the National Weight Control Registry ([155]) and by the Institute of Medicine ([67]).

This update was undertaken for persons older than 18 yr who were enrolled in PA trials designed for prevention of weight gain (i.e., weight stability), for weight loss, or prevention of weight regain. Investigations that include older adults (i.e., older than 65 yr) are not abundant. Some concerns exist for the need for weight loss in older adults and for loss of fat-free mass and potential bone loss. This review considers the existing literature as it applies to the general population. However, it is likely that individuals vary in their response to PA for prevention of weight gain, for weight loss, and for weight maintenance. Successful results will also depend on energy intakes [Weight management. *J Am Diet Assoc*. 2009;109(2):330-46]. Trials with individuals with comorbid conditions that acutely affect weight and trials using pharmacotherapy were not included (i.e., acquired immunodeficiency syndrome, type 1 diabetes). Trials using individuals with medication and comorbid diseases, such as hypertension, cardiovascular disease (CVD), and type 2 diabetes, were included because these individuals are very prevalent in the United States (US) and individuals with these conditions are frequently in need of weight loss. Throughout this paper light-intensity activity is defined as 1.1 to 2.9 METS, moderate-intensity activity is 3.0 to 5.9 METS, and vigorous activity is $\geq$ 6 METS (U.S. Department of Health and Human Services Website [Internet]. Washington, DC: 2008 Physical Activity Guidelines for Americans; [cited 2008 Nov 17]. Available from http://www.health.gov/PAGuidelines.) The Evidence Categories of the National Heart, Lung, and Blood Institute (NHLBI) were used to evaluate the strength of the literature and to support recommendations

RATIONALE FOR WEIGHT MANAGEMENT

Overweight and obesity are defined by a body mass index (BMI) of 25 to 29.9 $kg \cdot m^{-2}$ and 30 $kg \cdot m^{-2}$ or greater, respectively. Together, overweight and obesity are exhibited by approximately 66.3% of adults in the US ([107]). Both overweight and obesity are characterized by the accumulation of excessive levels of body fat and contribute to heart disease, hypertension, diabetes, and some cancers as well as psychosocial and economic difficulties ([55,97,99,147]). The cost of treatment of weight reduction is now estimated to exceed $117 billion annually ([135]). Reduction in the prevalence of obesity was among the major aims of Healthy People 2000 ([147]), although it is now apparent that this goal was not achieved ([148]). Reduction in obesity remains a major aim of Healthy People 2010 ([146]) and of other major health campaigns (i.e., Steps to a HealthierUS Initiative, http://www.healthierus.gov/steps/; Make Your Calories Count, http://www.cfsan.fda.gov/□dms/hwm-qa.html; We Can! http://www.nhlbi.nih.gov/health/public/heart/obesity/wecan/). Management of overweight and obesity is considered an important public health initiative because numerous studies have shown the beneficial effects of diminished weight and body fat in overweight and obese individuals. These beneficial effects include an improvement in CVD risk factors such as decreased blood pressure ([85,102,137]), decreased LDL-C ([24,85,151]), increased HDL-C ([24,151]), decreased triglycerides (TG) ([24,43,151]), and improved glucose tolerance ([30,45]). Weight loss has also been associated with a decrease in inflammatory markers, such as C-reactive protein ([60,81,139]), which have also been associated with the development of CVD ([118,119]). The NHLBI Guidelines ([101]) recommend a minimum weight loss of 10%. However, there are also numerous studies that show beneficial improvements in CVD risk factors when weight loss is less than 10% ([16,38,56,80,114,150]). In fact, beneficial improvements in chronic disease risk factors have been reported with as little as 2-3% of weight loss

PA Will Promote Clinically Significant Weight Loss.

A negative energy balance generated by PA will result in weight loss, and the larger the negative energy balance, the greater the weight loss. Extreme amounts of PA found with military training ([104]) or mountain climbing ([116]) may result in substantial weight loss; however, it is difficult for most individuals to achieve and sustain these high levels of PA. Few studies with sedentary overweight or obese individuals using PA as the only intervention result in ≥3% decreases of baseline weight. Therefore, most individuals who require substantial weight loss may need additional interventions (i.e., energy restriction) to meet their weight loss needs.

Several studies that targeted <150 $min \cdot wk^{-1}$ of PA resulted in no significant change in body weight ([10,14,27,98]). Donnelly et al. ([33]), targeted 90 min of continuous moderate-intensity PA (30 min, 3 $d \cdot wk^{-1}$) compared to 150 min of moderate-intensity intermittent

PA (30 min, 5 d·wk^{-1}) in women for 18 months. The continuous group lost significantly greater weight than the intermittent group (1.7 vs 0.8 kg), yet neither group lost ≥3% of baseline weight.

Garrow et al. ([53]) and Wing ([154]) have reviewed the literature for the effects of PA for weight loss and concluded that weight loss is typically 2 to 3 kg; however, the level of PA was not well described. Interestingly, well-controlled laboratory studies generally find greater levels of weight loss in response to PA. This may reflect a greater amount of PA that is targeted in laboratory studies compared to outpatient studies and verification that participants achieved the targeted amount. **For example, Ross et al. ([121]) showed that men and women who experienced a 500- to 700-kcal·d^{-1} deficit for 12 wk had weight loss of 7.5 kg (8%) and 5.9 kg (6.5%), respectively.** Donnelly et al. ([32]), used a randomized, controlled trial of 16 months duration that provided 225 min of moderate-intensity PA with a targeted energy equivalent of □400 kcal·d^{-1}, 5 d·wk^{-1}, and verified all sessions of PA in a laboratory. The difference in weight between experimental and controls at 16 months was -4.8 kg for men and -5.2 kg for women. However, these differences were achieved differently. Men who received PA lost weight compared to controls who maintained weight. Women who received PA maintained weight compared to controls who gained weight. These findings may suggest a potential gender difference in response to PA. However, other investigations ([134]) have not found differences, and further investigation for gender differences seems warranted.

It is likely that **any increase in PA has the potential for weight loss; however, it seems that PA <150 min·wk^{-1} results in minimal weight loss compared to controls, PA > 150 min·wk^{-1} results in modest weight loss of □2-3 kg, and PA between 225 and 420 min·wk^{-1} results in 5- to 7.5-kg weight loss.** Thus, a dose effect is apparent for PA and weight loss, and higher doses are capable of providing 3% or greater weight loss from initial weight.

PA Will Prevent Weight Regain after Weight Loss. Evidence Category B.

It is **generally accepted that most individuals can lose weight but cannot maintain weight loss.** PA is universally promoted as a necessity for weight maintenance ([67,68,101]). Indeed, PA is often cited as the best predictor of weight maintenance after weight loss ([78,138]). A systematic review of PA to prevent weight regain after weight loss was completed by Fogelholm and Kukkonen-Harjula ([47]). The majority of studies were observational studies and studies of individuals who were randomized at baseline to exercise or no exercise, or to different levels of PA. Follow-up varied from several months to several years and the results indicated that individuals who engaged in exercise experienced less regain than those individuals who did not, and those individuals who engaged in greater amounts of PA experienced less regain than those with more moderate levels of PA. Only three studies used a design in which individuals were randomized to PA after weight loss ([48,87,112]), and the results showed that PA had an indifferent, negative, or positive effect on prevention of weight regain. Failure to randomize to PA

levels after weight loss is a serious design flaw and diminishes the evidence available for evaluation.

Despite the accepted concept that PA is necessary for successful weight maintenance after weight loss, the amount that is needed remains uncertain and may vary among individuals ([70]). The CDC/ACSM recommendations for PA specified the accumulation of 30 min of moderate-intensity PA for most days of the week ([111]). These guidelines were provided for health promotion and disease prevention; however, they were widely interpreted to be useful for weight management. Minimum levels of 150 min·wk^{-1} (30 min·d^{-1}, 5 d·wk^{-1}) of moderate-intensity PA were also recommended by the ACSM Position Stand in "Appropriate Intervention Strategies for Weight Loss and Prevention of Weight Regain for Adults" for health benefits; however, 200-300 min·wk^{-1} was recommended for long-term weight loss ([68]). Jakicic et al. ([69,71]) and Andersen et al. ([2]) provide data from randomized trials that indicate individuals who perform greater amounts of PA maintain greater amounts of weight loss at follow-up of 18, 12, and 12 months, respectively. In particular, Jakicic et al. ([69,71]) show very little weight regain in individuals who performed >200 min·wk^{-1} of moderate-intensity PA. Recently, Jakicic et al. ([70]) have reported that individuals who achieved a weight loss of >10% of initial body weight at 24 months were participating in 275 min·wk^{-1} (approximately 1500 kcal·wk^{-1}) of PA activity above baseline levels. Likewise, Ewbank et al. ([40]) found similar results 2 yr after weight loss by a very low energy diet. Retrospectively grouping participants by levels of self-reported PA, individuals who reported greater levels of PA (walking □16 miles·wk^{-1}) had significantly less weight regain than individuals reporting less PA per week (4.8-9.1 miles·wk^{-1}). However, it is important to note that individuals in all three studies mentioned were grouped into PA categories retrospectively and were not randomly assigned to these PA groups after weight loss. Thus, the amount of PA was self-selected and therefore does not provide clear evidence for the amount of PA needed to prevent weight regain.

To explore the effects of levels of PA greater than those normally recommended in weight management programs, Jeffery et al. ([74]) targeted 1000 and 2500 kcal·wk^{-1} for 18 months in two groups of participants, and these levels of PA were randomly assigned at baseline. The actual reported energy expenditure for kilocalories per week at 18 months was 1629 ± 1483 and 2317 ± 1854 for the 1000- and 2500-kcal·wk^{-1} groups, respectively. There were no differences for weight loss between groups at 6 months (weight loss), but there were significant differences at 12 and 18 months (weight maintenance) of follow-up with the 2500-kcal·wk^{-1} group showing significantly greater weight losses (6.7 ± 8.1 vs 4.1 ± 7.3 kg). This study indicates that greater levels of PA provided significantly lower levels of weight regain. However, the results must be interpreted with caution because there was great variation in the percentage of individuals meeting the targeted energy expenditure, and the behavioral interventions were not equal.

In summary, most of the available literature indicates that "more is better" regarding the amount of PA needed to prevent weight regain after weight loss. However, as indicated above, there are some major flaws in the literature relative to the appropriate research design needed to directly address this question. Specifically, there are no adequately

powered studies of sufficient duration with randomization to different levels of PA after weight loss. In addition, the literature is absent of randomized, controlled studies that used state-of-the-art energy balance techniques. Given these limitations, **weight maintenance (weight fluctuation <3%) is likely to be associated with ≈60 min walking per day (≈4 miles·d^{-1}) at a moderate intensity.**

PA combined with energy restriction will increase weight loss.

Examination of the weight loss literature shows that a reduction in energy intake plays a significant role in reducing body weight and this topic has been extensively reviewed ([11,50]). However, most recommendations for weight loss include both energy restriction and PA. Weight loss programs can vary dramatically in the amount of PA used and the level of energy restriction imposed, with a greater energy deficit producing a greater weight loss. Most weight loss programs either limit energy intake to a specific amount (e.g., 500-1500 kcal·d^{-1}) regardless of the size or gender of the individuals participating in the program ([4,8,9]) or select a specific energy deficit through diet (e.g., energy restriction of -300 kcal·d^{-1}) and/or exercise (e.g., -300 kcal·d^{-1}) to bring about a total energy reduction (e.g., -600 kcal·d^{-1}) ([18,39,59,72,96]).

Virtually all recommendations from public health groups and governmental agencies include the use of PA in conjunction with diet to promote weight loss ([57,101,111,122,145-147]). When the energy deficit imposed by diet-only and diet plus PA interventions are similar, weight loss and/or percent change in body weight are similar ([4,8,18,39,58,59,72,82,103,120,140]). When energy intake is reduced severely, diet and diet and PA groups tend to have similar results ([34]). For example, several investigations have used 600-1000 kcal·d^{-1} deficits for 12-16 wk, and the group assigned to PA participated in three to five sessions per week of 30-60 min in duration. Weight loss ranged from ≈4 to 11 kg (e.g., ≈1-1.5 lb·wk^{-1}), regardless of group assignment (i.e., diet-only or diet plus exercise) ([39,72,140]). Thus, the addition of PA to severe diet restriction may result in metabolic adaptations that diminish any additive effect of the energy expenditure from PA on weight loss.

In studies where energy restriction is not severe (i.e., 500-700 kcal), there is evidence that diet combined with PA is associated with significantly greater weight loss compared to diet alone. For example, a recent meta-analysis ([128]) found a small but significant increase in weight loss in diet plus PA programs of 1.1 kg compared to diet-only programs. Curioni and Lourenco ([23]) compared six randomized clinical trials ranging from 10 to 52 wk that also followed up subjects (n = 265) for 1 yr after the weight loss intervention. They found a 20% greater weight loss in diet plus exercise programs (-13 kg) compared to diet-only programs (-9.9 kg) and a 20% greater sustained weight loss after 1 yr ([23]). In summary**, PA and diet restriction provide comparable weight loss if they provide similar levels of negative energy balance. It seems PA will increase weight loss in combination with diet restriction if the diet restriction is moderate but not if it is severe.**

A thorough review of the diet literature and recommendations for effective diet counseling are available through the American Dietetic Association position paper on weight management [*J Am Diet Assoc*. 2009;109(2):330-46]. Exercise professionals should be cautioned regarding the provision of dietary advice to overweight and obese adults. In particular, caution is advised when chronic disease risk factors or known chronic disease are present. Providing specific diet recommendations may be outside the scope of practice for the exercise professional, and the appropriate course of action may require referral to a registered dietitian.