Circulation

AHA SCIENTIFIC STATEMENT

Role of Physical Activity in Obesity Treatment and Cardiometabolic Health: A Scientific Statement From the American Heart Association

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ABSTRACT: Weight loss and weight loss maintenance are prominent topics of discussion for clinicians and health professionals involved in treatment to reduce obesity and the risk of cardiovascular disease. Because physical activity is a key component of comprehensive obesity treatment, this scientific statement summarizes the role of physical activity in promoting weight loss, weight loss maintenance, and cardiometabolic health, complementing lifestyle, pharmacological, and surgical-based weight loss intervention strategies. Independently of weight loss, physical activity and exercise programs improve major cardiometabolic risk factors, including hypertension, insulin resistance, and dyslipidemia, which are highly prevalent in patients with overweight or obesity. As a single treatment modality, physical activity and exercise programs are unlikely to result in clinically meaningful weight loss (ie, at least 5% loss of initial body weight) unless aerobic physical activity levels are exceptionally high. When combined with diet-induced negative energy balance, obesity medication, or surgical treatment, increased physical activity can augment total weight loss and improve cardiometabolic outcomes. Because clinicians and health professionals play a pivotal role in fostering and sustaining patients' health goals, this scientific statement also provides an overview of evidence-based strategies for targeted weight loss counseling and for leveraging digital technology, particularly to engage patients and achieve realistic physical activity goals.

Key Words: AHA Scientific Statements ■ bariatric surgery ■ body weight maintenance ■ exercise ■ glucagon-like peptide-1 receptor agonists ■ heart disease risk factors ■ obesity management ■ weight loss

Obesity rates have reached all-time highs, with obesity affecting 42% of adults in the United States.[1] In addition, obesity is strongly associated with numerous cardiovascular disease (CVD) risk factors such as hypertension, dyslipidemia, and insulin resistance.[2] Thus, treatment strategies aimed at promoting obesity-related weight loss (WL) and reducing CVD risk are a prominent focus in health care. Physical activity (PA; any bodily movement produced by skeletal muscles resulting in energy expenditure)[3] is a key component of these strategies, playing a major role in WL, WL maintenance (WLM), CVD risk reduction, and overall health promotion. This scientific statement aims (1) to provide an overview of the cardiometabolic health benefits and role of PA in comprehensive obesity treatment approaches, complementing lifestyle, pharmacological, and surgical-based WL intervention strategies, and (2) to provide potential behavioral strategies that can be considered in efforts to enhance PA in patients with overweight or obesity. Figure 1 provides a practical framework for integrating PA across the WL and WLM continuum, illustrating the distinct phases and corresponding PA considerations discussed throughout this scientific statement.

CARDIOMETABOLIC HEALTH BENEFITS OF PA

Before we discuss the relationship of PA with WL and WLM, it is important to emphasize that PA and exercise

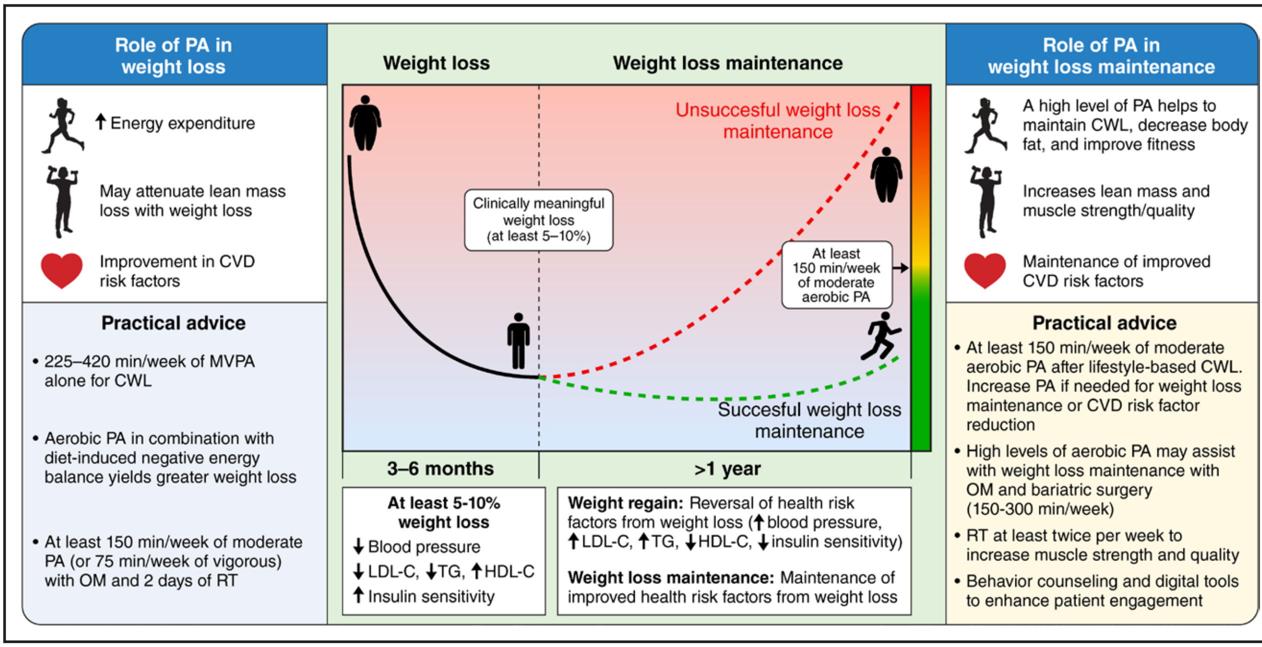

Figure 1. Practical application of physical activity for weight loss and weight loss maintenance.
CVD indicates cardiovascular disease; CWL, clinically meaningful weight loss; HDL-C, high-density lipoprotein cholesterol; LDL-C, low-density lipoprotein cholesterol; MVPA, moderate-to-vigorous physical activity; OM, obesity medication; PA, physical activity; RT, resistance training; and TG, triglycerides.

(a planned, structured, and repetitive subset of PA performed to maintain or improve health, fitness, or both)[3] have cardiometabolic health benefits independently of WL. The Physical Activity Guidelines for Americans[4] recommend that adults engage in at least 150 to 300 minutes of moderate-intensity aerobic PA or 75 to 150 minutes of vigorous-intensity PA per week for significant health benefits. In addition, muscle-strengthening activities of moderate or greater intensity involving major muscle groups should be performed ≥2 d/wk. For those initiating PA, it is important to note that health benefits can be obtained by adopting modest amounts of PA (ie, below the recommendations)[5]; some health benefits, including reduced blood pressure and increased insulin sensitivity, can be observed even after a single episode of moderate to vigorous PA on the day of the activity.[4]

PA and exercise programs are well established for improving major cardiometabolic risk factors (eg, hypertension, insulin resistance, and dyslipidemia), which are highly prevalent in patients with overweight or obesity.[6,7] Aerobic exercise reduces resting blood pressure (Δsystolic, −4 mm Hg; Δdiastolic, ≈−3 mm Hg) in the general popualtion.[8] Specifically in adults with overweight or obesity, a meta-analysis of 54 randomized controlled trials (RCTs) of PA and exercise, which encompassed aerobic, resistance, or combinations of the 2 training modalities with program durations ranging from 4 to 48 weeks,[9] showed that exercise training improved resting blood pressure in the total sample (Δsystolic, −3.0 mm Hg; Δdiastolic, −1.9 mm Hg) and in a subset of participants with hypertension (Δsystolic, −3.4 mm Hg; Δdiastolic, −2.1 mm Hg). Exercise training also decreased insulin resistance (Δhomeostatic model assessment for insulin resistance, −0.34) with a more pronounced effect in a subanalysis, specifically in adults with type 2 diabetes (Δhomeostatic model assessment for insulin resistance, −0.50).[9]

Aerobic exercise has also been shown to improve lipids, with the most established effects being increases in high-density lipoprotein cholesterol and reductions in triglycerides, with minimal or no impact on low-density lipoprotein cholesterol.[8] In a recent meta-analysis of 2990 adults with ≥3 metabolic syndrome criteria, aerobic training at ≥40% $\dot{V}o_2$max for at least 12 weeks significantly improved total cholesterol (−11.2 mg/dL), triglycerides (−15.1 mg/dL), high-density lipoprotein cholesterol (3.1 mg/dL), and low-density lipoprotein cholesterol (−4.6 mg/dL).[10] In a meta-analysis of 619 adults with overweight or obesity, Cai and Zou[11] reported a reduction in triglycerides (−10.1 mg/dL) after aerobic training (duration, 6–24 weeks; relative intensity, 45–80%), with no significant changes in other lipid variables.

In addition to improving traditional CVD risk factors (Table 1),[9,12–21] aerobic training increases cardiorespiratory fitness (CRF).[19] Low CRF is a risk factor for CVD, CVD mortality, and all-cause mortality independently of other risk factors (including obesity level)[19] and specifically in adults with overweight and obesity.[22,23] According to a meta-analysis by Kodama et al,[24] a 1−metabolic equivalent (MET; a multiple of the resting metabolic rate approximating 3.5 mL·kg^{-1}·min^{-1}) higher level of CRF is associated with a 15% reduction in CVD-related events

Table 1. Effects of Aerobic, Resistance, and Combination Exercise Training on Cardiometabolic Risk Factors Regardless of WL

	Magnitude of benefit			
	Aerobic	Resistance	Combination	Summary of evidence
Resting blood pressure	+	+	+	AT, RT, and CT have similar favorable effects on resting SBP (range, −5.2 to −1.8 mm Hg) and DBP (range, −3.9 to −1.9 mm Hg) in adults with and without obesity.[9,12,13] AT effects on SBP and DBP tend to be greater in men compared with women; in those with hypertension; and from interventions ≤24 wk and at moderate- to vigorous-intensity levels.[12] RT effects on SBP and DBP tend to be greater in those with prehypertension or hypertension; greater effect is seen on SBP from interventions >8 wk.[12,13]
Insulin sensitivity and glycemic control	++	+	+++	All modes elicit favorable effects for fasting and dynamic markers of insulin sensitivity and glycemic control; CT tends to produce the greatest impact, followed by AT and then RT.[14] In adults with overweight or obesity, the average effect of AT, RT, and CT on HOMA-IR is −0.34, with a more pronounced effect in those with T2D (−0.50).[9]
Lipid profile	+	+	+	AT, RT, and CT have similar favorable effects on standard lipid profiles. Greater exercise volume results in greater improvements.[15] In adults with metabolic syndrome, average effects of ≥12 wk of AT are as follows: −11.2 mg/dL for TC, −15.1 mg/dL for TG, 3.1 mg/dL for HDL-C, and −4.6 mg/dL for LDL-C.[10]
Lean mass	+	++	++	RT has a more favorable effect than AT on preserving and increasing lean mass.[16] The average effects of RT and CT are 1.3 and 0.9 kg, respectively, compared with AT.[17]
Fat mass	++	0	+++	AT has a greater effect than RT on reducing fat mass.[16,18] The average effects of AT and CT are −1.2 and −1.9 kg, respectively, compared with RT.[17] CT provides the greatest benefits for both fat mass and lean mass.
CRF	++	+ or 0	++	AT has a more favorable effect than RT for improving CRF in adults with and without obesity.[16] Exercise effects on CRF can be modified by sex, age, baseline CRF, and health status.[19] AT improves CRF in a dose-dependent manner; higher-intensity AT increases CRF to a larger degree than moderate-intensity AT.[20] In adults with obesity, average improvements in absolute $\dot{V}o_2$max range from 15% for CT, 9.2%–12.9% for AT, and 7.2%–7.4% for RT.[21]

AT indicates aerobic training; CRF, cardiorespiratory fitness; CT, combination training (including aerobic and resistance training); DBP, diastolic blood pressure; HDL-C, high-density lipoprotein cholesterol; HOMA-IR, homeostatic model assessment of insulin resistance; LDL-C, low-density lipoprotein cholesterol; RT, resistance training; SBP, systolic blood pressure; T2D, type 2 diabetes; TC, total cholesterol; TG, triglycerides; $\dot{V}o_2$max, maximal oxygen consumption; WL, weight loss; +, small to moderate benefit; ++, moderate benefit; +++, moderate to large benefit; and 0, no effect.

and mortality (combined outcome). Much of the CVD burden attributable to CRF is experienced by adults in a "low fitness" category; epidemiological data suggest that most of the CVD risk reduction is observed when low (<7.9 METs) and moderate (7.9–10.8 METs) fitness levels (↓47%) are compared as opposed to moderate to high (≥10.9 METs) fitness levels (↓7%; not significant).[24] Aerobic exercise training improves CRF in a dose-dependent manner, with improvements observed even at aerobic exercise levels below PA guidelines.[25] Furthermore, high-intensity (65%–80% of $\dot{V}o_2$max) aerobic exercise increases CRF to a greater extent than moderate-intensity (45%–55% of $\dot{V}o_2$max) aerobic exercise,[20] even when matched for total energy expenditure.[20,26,27] From a clinical standpoint, helping patients participate in aerobic exercise to increase their CRF from the low to moderate categorization is critical for reducing CVD risk.[19]

Resistance training (RT) is a muscle-strengthening PA that involves contracting muscles against external resistance.[4] As discussed in a recent AHA scientific statement[16] based largely on RCTs of 2 to 6 months, mostly moderate- to high-intensity RT (40%–80% maximum effort) on 2 to 3 d/wk, RT (without reduction in caloric intake) has been shown to improve lean mass (0.8 kg) and reduce body fat (−1.6%) and blood pressure (systolic, −4 mm Hg; diastolic, −2 mm Hg). RT also demonstrates modest yet beneficial effects on blood lipids, including increases in high-density lipoprotein cholesterol of 2 to 12 mg/dL and decreases in total cholesterol of −8 mg/dL and triglycerides of 7 to 13 mg/dL.[16] Moreover, combining aerobic and RT (both typically of moderate to vigorous intensity) has shown to be especially effective in improving insulin sensitivity and lowering hemoglobin A1c compared with aerobic exercise or RT alone, which has clinical relevance for adults with insulin resistance or type 2 diabetes.[14,16] Thus, the independent role of PA and exercise in improving cardiometabolic health is important to discuss with patients who have difficulty achieving or maintaining WL.

PA and WL

In general, PA and exercise programs without a reduction in energy intake are unlikely to result in clinically meaningful WL (CWL; ≥5% loss of initial body weight[2]) unless exercise levels are especially high (eg, 225–420 min/wk of aerobic exercise[28]). A network meta-analysis of 34 RCTs (6 intervention categories of aerobic training, RT, or combinations of the 2 training modalities with different intensities and durations ranging from 8–52 weeks) including 2064 adults with obesity estimated mean WL between −0.05 and −1.01 kg.[21] Another meta-analysis specific to aerobic exercise programs (moderate to vigorous intensity; 120–240 min/wk) including 1126 adults with overweight or obesity demonstrated mean WL ranging from −1.4 to −2.5 kg for interventions lasting 6 and 12 months.[29] However, large aerobic training studies with participants losing weight demonstrate considerable individual response variability, with some participants having no change and some even increasing weight.[30–34] Studies estimating the prevalence of individuals who achieve CWL with aerobic training suggest that <15% achieve CWL.[34,35] Still, modest WL (≈3%–<5% body weight) through increased PA alone is achievable and realistic,[21,29,34–36] with greater WL occurring in a dose-response manner.[28]

When combined with reduced energy intake (500–1000 kcal·d^{-1}), PA typically enhances WL, potentially augmenting cardiometabolic health benefits (because the magnitude of WL is associated with increased cardiometabolic health benefits).[36] Meta-analyses demonstrate that exercise combined with diet-induced negative energy balance yields greater WL (an additional 1.2–1.7 kg of WL)[37–39] or 20%[36] compared with diet alone, with the dietary components driving the majority of the WL response. Factors associated with reduced WL responses to PA include those that are to some degree within the patients' control such as decreased PA and increased caloric intake (which reduces negative energy balance for WL).[2,30,36] However, with CWL, patients also have changes in hormone levels associated with increased hunger (↑Ghrelin, ↓glucagon-like peptide-1 [GLP-1], ↓PYY, ↓CCK) and food reward pathways.[40] In addition, WL could be countered by a reduction in resting energy expenditure (3%–5% in patients with obesity), which accounts for 60% to 70% of 24-hour energy expenditure.[40] Thus, patients need to be adequately counseled about increases in hunger (and PA level) during WL attempts. Overall, PA should be included along with WL attempts to augment WL response, to support compensatory responses to WL, and to provide the aforementioned independent health benefits of exercise.

In cases in which PA levels greatly exceed the minimum PA guidelines (eg, 225–420 min/wk of exercise), CWL may be achieved with aerobic exercise alone; however, individual variability remains.[28] The total amount of exercise (time or energy expenditure) appears to have a greater impact on WL than other exercise program components (eg, intensity or modality).[28] In general, moderate- and vigorous-intensity exercise training programs produce similar magnitudes of WL when matched for total amount of exercise.[36,39] Compared with continuous aerobic training, high-intensity interval training has been shown to elicit similar overall changes in body weight, suggesting that this may a potential option for patients without medical contraindications.[36] RCTs including a combination of aerobic and RT have shown a WL response (0%–3% of initial body weight) similar to that of aerobic training alone.[41] Alternatively, substituting light-intensity PA for sedentary activities may have additive effects with moderate- to vigorous-intensity PA for weight management.[36] This substitution may provide patients with additional options for achieving their PA goals.

In adults who achieve CWL, a potential concern is the loss of lean body mass, including muscle, bone, and organs.[36] This reduction in lean mass during WL is accompanied by a reduction in resting metabolic rate, which potentially counteracts WL and WLM.[28,42] Because most WL attempts are unsuccessful in the long term,[43] the lean mass loss may not be fully recovered during weight regain,[44,45] potentially resulting in a higher body fat percentage than before the WL attempt.[44–46] The loss of lean mass is particularly important for adults with low lean mass before WL such as older adults or those with frailty, sarcopenic obesity, or related chronic conditions because a reduction in muscular strength typically occurs with dietary WL.[47]

Lean mass loss during dietary WL may be attenuated by adequate protein intake (at least the recommended daily amount, 0.8 g/kg per day) and exercise training.[42] Although findings are mixed[39] and mostly from middle-aged to older adults, some studies support the ability of aerobic exercise, RT, or the combination to attenuate lean mass (or skeletal muscle or fat-free mass) loss when performed with dietary WL.[48–54] A meta-analysis estimated that adding exercise to dietary WL may preserve fat-free mass by 13% compared with dietary WL alone.[52] A meta-analysis of 6 studies comparing diet alone with diet plus RT (interventions ranging from 12–24 weeks; training 3 times/wk)[55] in older adults showed that RT prevented 93% of lean mass loss compared with dietary WL alone. However, the extent to which lean mass is preserved with RT may be modulated by the magnitude of the reduction in caloric intake.[56] Muscle quality (encompassing strength, power, enzymatic activity, and metabolic function relative to lean mass or muscle mass)[57,58] has been proposed as another metric to evaluate muscle loss in WL interventions, offering a more comprehensive view of muscle function beyond just the amount of lean mass loss. A recent meta-analysis of 33 studies showed that dietary WL reduced knee extensor strength (−7.5%) with a nonsignificant reduction in handgrip strength (−1.7%).[59] In older adults with obesity, combining RT with dietary WL has been shown in some studies to attenuate or improve indices of muscle quality compared with diet alone.[55,60,61] Evidence from the Cooperative Lifestyle Intervention Program suggests that RT may be more effective than aerobic exercise or diet alone for improving muscle quality and preserving lean mass after WL in older adults.[62] Another concern with lean mass loss is the potential loss of skeletal muscle tissue, which is a major site of glucose uptake.[63] Despite the loss of lean mass, WL generally improves insulin sensitivity, especially when combined with exercise.[64] In addition, exercise training improves other aspects of muscle function during WL, including maintaining/increasing CRF,[49,64,65] improving skeletal muscle mitochondrial capacity,[66] and increasing physical function.[48] Therefore, counseling patients to engage in exercise during WL has clinical relevance, especially for those with low muscle mass before WL.

PA and WLM

In general, weight regain after CWL is associated with reversal of the health improvements that occurred during the initial WL.[67–69] Thus, WLM is of paramount clinical significance, albeit undeniably challenging to sustain long term.[2] Engaging in high PA levels appears to have an important role in successful WLM. Health organizations recommend 200 to 300 min/wk of moderate PA for WLM.[2,28] This guidance is based primarily on retrospective data from lifestyle interventions suggesting that higher PA levels are more likely to result in greater WLM in a dose-response manner.[28] For example, Jakicic et al[70] evaluated PA and WLM in a retrospective analysis of a 24-month WL intervention. Higher versus lower PA level at 24 months was associated with greater percent WL maintained (≥300 min/wk, ≈11% initial WL; 250–299 min/wk, ≈8%; 150–249 min/wk, ≈6%; <150 min/wk, ≈3%). Long-term data from the Diabetes Prevention Program[71] and Look AHEAD[72] studies also show that higher PA levels are predictive of long-term WLM. On the contrary, prospective studies that randomized adults with overweight and obesity to distinct aerobic exercise levels have reported mixed findings for WLM, with some suggesting potential benefit with higher amounts of exercise[73] and others observing no dose response.[74] In a 12-month behavioral CWL maintenance intervention, Washburn et al[74] observed no significant differences in weight regain among participants randomized to 150, 225, or 300 min/wk of semisupervised aerobic exercise (70% of maximum heart rate) combined with behavioral counseling. The authors noted that the lack of dose response between exercise level and WLM could be due to low exercise adherence, especially for the high-volume exercise group (who achieved an average of 179 of 300 prescribed weekly minutes). Although there was high individual variability among the groups, the weight regain across the exercise groups was minimal (1.2%–3.4%).[74] Thus, combined with behavioral therapy, exercising at volumes lower than those currently recommended for CWL maintenance was effective in preventing weight regain.[74] Given the lack of a clear dose response from prospective trials and issues with adherence to high exercise levels, a recent American College of Sports Medicine consensus statement[36] on WL advocated for the PA level to progress up to 150 min/wk of moderate to vigorous PA. Afterward, PA can be increased if needed to enhance WLM or to improve health risk factors.[36] However, more data are needed from prospective trials to better understand the dose-response relationships after CWL on weight and changes in CVD risk factors.

Because preventing weight regain can be challenging after successful CWL, another important area of research is understanding whether maintaining adherence to PA can counter regression in the cardiometabolic profile, even in cases of modest weight regain. Few studies exist in this area. Prospective studies after CWL (ranging from 10%–16%) have shown that compared with no exercise, aerobic exercise may help maintain improvements in diastolic blood pressure,[75] homeostatic model assessment for insulin resistance,[75] and insulin sensitivity (through an intravenous glucose tolerance test)[64] despite weight regain of ≈55% of the total WL. Such cardiometabolic benefits from exercise could be explained by the independent effects of exercise on insulin action and glucose homeostasis despite the potential negative impacts of weight regain. However, more data are needed in this area with respect to the cardiometabolic risk factors assessed, exercise program components (amount, modality), and participant characteristics (eg, disease status, sex, age, race, and ethnicity).

Overall, the present data suggest that after CWL patients should initially progress to a PA level of at least 150 min/wk of moderate-intensity activity and, if necessary, to higher PA doses to further promote WLM or to induce greater improvements in cardiometabolic risk factors.[36] Although limited data are available on whether PA can attenuate the increase in cardiometabolic risk parameters with weight regain, exercise may play a role in maintaining the improvement in diastolic blood pressure and insulin sensitivity from the initial WL.[64,75]

PA IN THE CONTEXT OF TREATMENT WITH OBESITY MEDICATIONS OR BARIATRIC SURGERY

Generally, obesity medications are indicated for patients with a body mass index (BMI) of ≥30 kg/m² or a BMI of 27 to 29.9 kg/m² with weight-related comorbidities who have not met WL goals with lifestyle changes alone.[76] Bariatric surgery is indicated for patients with a BMI ≥35 kg/m^2 or a BMI of 30 to 34.9 kg/m^2 with diabetes or inability to achieve WL through nonsurgical methods. Although many adults qualify for obesity medications, surgery, or both, there are numerous barriers to receiving these treatments such as a lack of adequate health insurance/health care, the cost of treatment, and concern about potential side effects. To be most effective, obesity medications and surgery should be accompanied by ongoing lifestyle changes, including dietary approaches and increased PA to enhance body weight regulation through their contribution to regulating energy balance with these obesity treatments.[77]

In the following sections, we examine patient populations treated with obesity medications and bariatric surgery to determine whether existing data indicate PA augments WL or WLM or has synergistic effects on other health-related outcomes, particularly cardiometabolic risk factors and cardiovascular outcomes.

Obesity Medications and PA

For many years, obesity medications received little attention given the relatively modest WL observed in clinical trials. However, the advent of GLP-1 receptor agonists (GLP-1RAs) has reignited the field, with several medications resulting in CWL and perhaps rivaling bariatric surgery.[78] Currently, 3 GLP-1RA medications have been approved for WL: liraglutide, semaglutide, and tirzepatide.[77] Although exact WL mechanisms are not completely understood, GLP-1RAs are thought to reduce weight by slowing gastric emptying and motility and by increasing central satiety signals, which lead to reductions in appetite and food intake.[79] These mechanisms also explain their side-effect profile, which is largely gastrointestinal (eg, nausea, vomiting, diarrhea). However, these side effects often improve over time and can be mitigated with slower titration of the medication.[80]

Liraglutide, the first GLP-1RA approved for weight management, in addition to lifestyle counseling demonstrated consistent WL of 4 to 6 kg across various populations in the SCALE program (Satiety and Clinical Adiposity–Liraglutide Evidence in Non-Diabetic and Diabetic Individuals).[81] Subsequently, the LEADER trial (Liraglutide and Cardiovascular Outcomes in Type 2 Diabetes) demonstrated that liraglutide compared with placebo significantly reduced major adverse cardiovascular events among patients (average BMI, 32.5 kg/m^2) with type 2 diabetes and high cardiovascular risk (hazard ratio, 0.87 [95% CI, 0.78–0.97]) over a median follow-up of 3.8 years.[82]

The STEP series of clinical trials (Semaglutide Treatment Effect in People With Obesity) established semaglutide as an efficacious agent for weight management, with harmonized data suggesting a 11.4% placebo-adjusted reduction in weight.[83] Notably, the STEP 3 trial (Research Study to Look at How Well Semaglutide Is at Lowering Weight When Taken Together With an Intensive Lifestyle Program) was conducted to understand the effect of semaglutide on body weight when added to intensive behavioral therapy, including a low-calorie diet, regular lifestyle counseling, and exercise. At randomization, participants were asked to engage in 100 min/wk of PA in bouts >10 minutes spread equally over 4 to 5 days. Participants were asked to gradually increase PA by 25 minutes every 4 weeks, aiming for 200 min/wk. At 68 weeks of follow-up, participants experienced a 16% reduction in weight compared with baseline, which is more than what was observed with less intensive lifestyle counseling in STEP 1 (Research Study Investigating How Well Semaglutide Works in People Suffering From Overweight or Obesity).[84] The recently published SELECT trial (Semaglutide Effects on Heart Disease and Stroke in Patients With Overweight or Obesity) represents the first cardiovascular outcomes trial to demonstrate a reduction in major adverse cardiovascular events among patients with established CVD, with overweight or obesity, and without with type 2 diabetes (hazard ratio, 0.80 [95% CI, 0.72–0.90]).[85]

Tirzepatide is a novel GLP-1RA and glucose-dependent insulinotropic polypeptide receptor agonist approved for the management of type 2 diabetes with overweight and obesity. The SURMOUNT-1 clinical trial (A Study of Tirzepatide [LY3298176] in Participants With Obesity or Overweight) demonstrated that a 15-mg weekly dose of tirzepatide resulted in a 21% reduction in weight from baseline over a 72-week follow-up period.[86] The SURMOUNT-3 trial (A Study of Tirzepatide [LY3298176] in Participants After A Lifestyle Weight Loss Program) tested the effect of intensive lifestyle modification before administration of tirzepatide for WL.[87] Participants were required to lose ≥5% of total body weight during a 12-week lead-in period in which individuals received 8 sessions with a dietician or similarly qualified health care professional and encouraged to engage in at least 150 min/wk of moderate-intensity PA. During this lead-in period, participants lost an average of 7% of their total body weight. Then, participants treated with tirzepatide lost an additional 18% of weight compared with ≈3% weight gain observed in the placebo group. These results suggest that CWL can be achieved with healthy lifestyle changes and enhanced with the addition of tirzepatide compared with placebo; this added effect has also been observed with other obesity management medications.[88] Although PA behavioral support was provided to participants to increase PA, these trials did not quantify participants' PA levels or run subanalyses to determine whether PA affected weight or other outcome measures. The SURMOUNT-MMO trial (A Study of Tirzepatide [LY3298176] on the Reduction on Morbidity and Mortality in Adults With Obesity) is currently underway to assess whether tirzepatide reduces major adverse cardiovascular events in patients with overweight or obesity at high risk of CVD (established CVD or high-risk primary prevention) who do not have type 2 diabetes.

With reference to lean mass, clinical trial data have shown a notable proportion of total WL due to lean mass (as opposed to fat mass loss) for both semaglutide (≈45%) and tirzepatide (25.7%).[89] There are ongoing discussion and uncertainty about the health consequences of lean mass loss in patients on GLP-1RA therapy (eg, heterogeneity across studies, lean mass does not directly indicate skeletal muscle mass or quality, beneficial changes to skeletal muscle mediated by GLP-1RAs),[89] which is beyond the scope of this document.

There are limited data comparing GLP1-RA therapy alone with GLP-1RA therapy combined with exercise. Lundgren et al[88] evaluated the impact of an exercise training program (designed to meet aerobic PA recommendations) in participants taking liraglutide after an 8-week run-in period on a low-calorie diet. At 52 weeks, participants in the exercise+liraglutide group compared with those in the liraglutide alone group experienced greater total WL (−3.4 kg versus −0.7 kg) and fat mass loss (−4.7 kg versus −2.0 kg). However, no changes in lean mass were significant between groups (0.0 kg versus 0.5 kg) or within groups. Moreover, CRF significantly improved in the exercise+liraglutide group (4.8 $mL·kg^{-1}·min^{-1}$ [95% CI, 3.4–6.1]), whereas CRF in the liraglutide alone group did not change significantly (1.1 $mL·kg^{-1}·min^{-1}$ [95% CI, −0.3 to 2.6]). A secondary report of this trial demonstrated greater android fat loss in the exercise+liraglutide group compared with the liraglutide alone group, with similar reductions in metabolic syndrome *z* score.[90]

Although there is promise that PA and exercise may provide additional health benefits compared with obesity medication therapy alone, sufficient data are not available to conclusively address the effect of PA for patients on GLP-1RA therapy. Thus, the health effects of specific PA program components (dose, intensity, or modality) in combination with GLP-1RA therapy need to be evaluated in future studies. However, it is logical that patients on GLP-1RAs should derive health benefits from the general PA recommendations[4] (ie, at least 150 min/wk of moderate-intensity PA or 75 min/wk of vigorous-intensity PA plus muscle-strengthening activities at least 2 d/wk) because exercise is associated with increased CRF and reductions in cardiometabolic risk factors while improving quality of life and mortality independently of weight status.[4] Potential mechanisms by which PA may improve health in GLP-1RA therapy include (1) affecting initial WL or WLM through increased energy expenditure, (2) attenuating loss of lean mass (or skeletal muscle), or (3) providing improvements in health that might not be accomplished with GLP-1RA therapy alone (eg, improving CRF). Rigorously designed RCTs evaluating exercise dose response, exercise modality, and impacts of PA on health end points in patients taking GLP-1RAs are needed to develop PA recommendations specific to this population.

PA Before Bariatric Surgery

Nationally representative data demonstrate that adults who are eligible for bariatric surgery based on BMI criteria are significantly less likely than those with normal body weight to meet PA guidelines (20.3% versus 45.6%); in comparison, 23.1% of US adults who have had bariatric surgery meet PA guidelines.[91] Notably, there are no criteria in bariatric surgery clinical guidelines for ideal PA levels in the preoperative population according to the guidelines from the American Society for Metabolic & Bariatric Surgery.[92] Before approval for surgery, most insurance companies require patients to demonstrate participation in a behavioral lifestyle program; such programs typically include PA goals, yet there is no agreement on ideal PA preoperatively.

Numerous trials have been conducted in preoperative bariatric surgery populations to understand the effect of a PA intervention and increased PA levels on outcomes assessed after PA intervention (before surgery) or after surgery. A systematic review by Jabbour et al[93] indicates that these studies (n=21) tended to be small and many did not have an appropriate control or comparison group; the PA interventions ranged in duration from 7 days to 24 weeks; and the PA intervention types were heterogeneous, spanning aerobic activity of various intensities, strength/RT, and aquatic exercise. Although some studies demonstrated within-group improvements for preoperative PA and certain outcomes, the wide array of outcomes across studies and the lack of comparator groups yield mixed findings. One study found a relationship between increased preoperative PA and decreased blood pressure and Framingham risk score. In contrast, most studies did not specifically examine cardiometabolic risk factors, and none measured cardiovascular outcomes.[93] Some studies support better postsurgical outcomes in patients who increased PA before surgery[93]; however, because bariatric surgery itself has such a large impact on weight outcomes in many patients, the independent effect of a presurgical PA intervention might be difficult to detect, contributing to the fact that some studies did not show a relationship between the presurgical intervention and postsurgical outcomes. A systematic review restricted to controlled trials of preoperative PA interventions (n=4) further demonstrates mixed findings.[94] Compared with control, 2 of 3 short-term studies reported significant improvements in preoperative body weight or BMI but discordant findings for other outcomes, and 1 long-term follow-up study reported decreased body mass, including decreased fat-free mass, 12 months after bariatric surgery.[94] Thus, future presurgical PA intervention studies including a control group and longer postsurgical follow-up periods are warranted.

PA After Bariatric Surgery

The American Society for Metabolic & Bariatric Surgery suggests an individualized and gradual approach to PA after bariatric surgery with a minimum of 150 min/wk and a goal of 300 min/wk of moderate aerobic PA with RT 2 to 3 times/wk and states that individuals who become and remain physically active after surgery are more likely to have and maintain WL.[92] The suggestion that higher PA levels after bariatric surgery are associated with better weight outcomes is supported by observational[95] and clinical trial data.[94]

Meta-analyses generally suggest that PA after bariatric surgery leads to greater WL (1.8–2.5 kg)[94,96] and fat loss[94,96] and improvements in CRF and muscle strength[94] compared with control conditions not including PA. On the other hand, a recent meta-analysis by Bond et al[97] of predominantly supervised exercise studies (range, 12–26 weeks) showed nonsignificant weight change (−1.5 kg). This finding may be attributable to the limited amount of studies (5) and to PA levels below recommended levels (80–120 min/wk).[97] In addition, some evidence suggests a positive effect of postoperative PA on improved bone mineral density and WLM.[94] However, no significant changes were observed in cardiometabolic risk factors such as blood pressure, insulin sensitivity, or cholesterol levels.[94] Few studies exist that include CVD risk factors and major adverse cardiovascular event outcomes.[94]

Overall, clinical trial data of mixed quality suggest that PA after bariatric surgery is associated with better weight outcomes (including WLM). Currently, most surgical WL centers lack comprehensive postsurgical PA programs, and insurance typically does not cover access to high-quality PA programs after bariatric surgery. Ideally, a treatment team including a certified exercise physiologist would be available to prescribe and implement PA programs for individuals after bariatric surgery.

STRATEGIES FOR COUNSELING ON PA FOR OBESITY TREATMENT AND CARDIOMETABOLIC HEALTH, WITH ATTENTION TO LEVERAGING CONTEMPORARY DIGITAL TECHNOLOGY

Clinicians play a pivotal role in fostering and sustaining WL, including encouraging regular PA through gradual, progressive changes.[98,99] Using evidence-based approaches intended for clinical settings such as the 5A model (assess, advise, agree, assist, arrange) for targeted WL counseling[98,100] has been shown to significantly improve obesity treatment practices, including physician-patient communication, medical assessments for obesity, and plans for follow-up care.[100,101] Each additional step in the 5A model delivered by a physician is associated with a greater likelihood that patients will attempt to lose weight by adopting healthier behaviors such as eating better and exercising regularly.[102,103] The 5A model can be used to address the overall WL goal and goals related to individual WL strategies such as changes in diet and increased PA. In line with that article, this section focuses on applying the 5A model to increase PA (Table 2).

When the 5A model is used, it is important to assess PA levels, including psychosocial, psychiatric, or related comorbidity burden that may hinder attempts to engage in or maintain PA and manage weight. Along with clinical assessments, it is important to ask patients about their readiness and confidence to engage in PA or to establish new PA behaviors. Assessing whether patients acknowledge the importance of regular PA for managing their weight will also provide insight into a patient's intention and motivation to take necessary PA behavior modifications. Advising patients on the role of PA in WL while considering their clinical condition may reinforce their intentions to engage in routine PA while strengthening the clinician-patient relationship.[101]

A key outcome of the 5A approach is agreeing on a personal action plan, which, in the case of obesity treatment, would include behavioral goals related to PA.[100] Discussion about adopting and maintaining regular PA should be collaborative, using patient-centered strategies such as motivational interviewing and guided action planning. Clinicians are encouraged to work with patients to establish achievable and personalized behavioral goals using the SMART framework (specific, measurable, achievable, relevant, time bound). These goals should focus on the type of activity, frequency, intensity, and duration and should be tailored to the patient's current PA level, allowing gradual progression (Table 3).[104–106] When setting these agreed-on goals, clinicians should also guide patients in setting realistic expectations for PA and WL, emphasizing the broader health benefits. Small amounts of PA yield significant mental and physical health benefits, supporting therapeutic objectives for obesity treatment.[4] Although high PA levels are aligned with successful obesity treatment, encouraging a "some is better than none approach"[107] may be a more appropriate strategy to motivate sedentary and low-activity individuals to initiate regular PA.

Critical to operationalizing the 5A model is assisting patients in achieving their behavioral goals, including helping them identify barriers and challenges and finding resources or opportunities to engage in and increase PA. Collaborative problem-solving and discussion can also assist patients in overcoming obstacles and fostering PA engagement,[104,108] which is especially important for underresourced groups with low PA participation, high rates of overweight/obesity, and increased risk for poor cardiovascular health.[7,105]

Table 2. Using the 5A Model to Encourage Regular PA Participation

5A elements	Examples of applying 5A elements to promote regular physical activity
Assess: uncover the patient's intention to and knowledge of increased physical activity.	"It sounds like you have a lot going on right now." "Often, (event) can be very demanding. How might you carve out a few minutes to take time for yourself?" "Do you have some ideas on how to get started, or are you looking for some suggestions?" "It sounds like you are open to exercising more. Do you have an idea of how you might incorporate regular physical activity into your day? Is there something that has worked in the past?"
Advise: offer information to further the patient's understanding of approaches to incorporate regular physical activity into their day.	"It sounds like you are interested in being more physically active. Do you believe you will set aside some time to work on your personal goal of increased physical activity?" "It sounds like you want to exercise 3 days a week but feel like you are tight on time. Would you be interested in hearing how others have included some physical activity into their busy schedule?"
Agree: collaborate on establishing SMART goals (specific, measurable, achievable, relevant, time-bound)	"What do you think about taking a 10- to 20-min (walk)* daily during (your lunch break)? Is that something you can fit in?" "You indicated you will walk briskly in your neighborhood for 30 min each day after work. That sounds like a good goal. Would it help if you put this on your calendar to avoid scheduling conflicts?" "You said you would join an exercise group in the community so you can exercise with a group 3 days per week. That is a great plan to build support for your exercise goal. Do you know of a specific community group that you will join?"
Assist: collaborative problem solving and strategies to achieve a SMART goal.	"It's a great plan to schedule your walking time after work. If there is a week when you cannot walk after work, is there an alternate plan, such as walking on your lunch break or 1 day during the weekend?" "Here is a list of community recreational centers and local walking groups. Are any of these locations convenient for you?" (target: time, social, environment cue) "It sounds like meeting your exercise goals of 30 to 40 min on Tuesdays and Thursdays is challenging. Is it possible for you to split your exercise schedule into multiple short periods, eg, ~40 min divided into 10-minute sessions, 5 days per week?" (target: time, alternative behavior cue) "It sounds like getting to the gym is a challenge because of traffic. Is there a home-based exercise program on a digital app that you would be open to trying so you can meet your activity goals?" (target: time, resource availability, and accessibility cue)
Arrange: work on plans to review progress and provide references for additional support	"It looks like your follow-up visit is [date]. Would you bring in your calendar where you record your exercise days so we can look over your progress?" "You have a follow-up visit on [date]. Can we plan to look at the step count on your phone and review your progress on your 8,000 steps per day goal?" "I see that you are putting in the work to regularly exercise. To support your efforts, I believe it would be beneficial for you to work with an exercise physiologist and a dietitian. They specialize in helping people create personalized exercise and nutrition plans. By working together, we can develop a routine that fits your lifestyle and supports your long-term goal of managing your weight."

5A indicates assess, advise, agree, assist, arrange; app, application; PA, physical activity; and SMART, specific, measurable, achievable, relevant, time-bound.

Given the limitations of providing adequate PA and weight counseling during brief, episodic clinic visits,[98,99] acknowledging the challenges associated with long-term maintenance of PA, providing effective support for obesity treatment, and increasing accountability to adhere to WLM goals, clinicians may consider referring patients who are slow to respond (ie, negligible WL or episodes of weight regain or weight relapse) to intensive behavioral counseling such as community or commercial obesity treatment programs.[98–100,109] Arranging effective support for obesity treatment, when combined with physician oversight, not only encourages evidence-based interventions from other health care professionals but also increases patient accountability in adhering to WL and WLM goals. This approach may include referrals to physiotherapists, physical therapists, or exercise physiologists, in combination with other auxiliary health care professionals (eg, nurses/nurse practitioners, registered dietitians, health educators/coaches, or behavioral counselors), to encourage sustained PA changes for obesity treatment and cardiometabolic health.[101,103] This approach may also increase the likelihood of patients achieving CWL.[109] However, maintaining physician oversight and follow-up care is crucial to supporting patients' motivation and intentions to exercise within a multidisciplinary intervention.[109] The 5A process can be iterative, and ongoing assessments of PA are vital, even if a patient shows no initial interest. Regular patient-centered discussions help patients and clinicians understand challenges, readiness, progress, problem-solving, and goals to support obesity treatment.[98,104,110]

The US Preventive Services Task Force and American Heart Association/American College of Cardiology/The Obesity Society guidelines support the benefits of intensive individual or group counseling sessions, often delivered outside an office visit, for CWL within the first 6 months.[2,106] Despite the effectiveness of intensive behavioral counseling for initial WL, weight regain after 6 to 12 months of treatment is common,

Table 3. Examples of SMART Goals Based on Individual PA Levels and Weight Management Goals

SMART goal examples
SMART goals should be developed collaboratively between the clinician (interventionist) and the patient to enhance the likelihood of goal achievement, to promote success, and to increase self-efficacy. Goals and compliance can be achieved by adding unstructured lifestyle activities, exercise, or both (eg, walking the dog, hiking, swimming, cycling, household cleaning, and using stairs).
Daily goals:
"I will walk/jog/run during my 30-min lunch break during the workday and include 30 min of brisk walking on the weekend."
"I will take the stairs instead of the elevator or escalator."
"I will go for a walk or bike ride with my family after dinner."
"I will increase the distance I run by ¼ to ½ mile each week."
"I will attend a fitness class (in person or online) 3 d/wk over the next 6 mo."
"I will enroll in a strength class once a week to learn proper form and technique for exercises."
Short-term goals:
"By fall, I will walk/jog/run a 5-km race."
"Over the next 3 mo, I will increase my current average step count from 6000 to 8000 steps/d to achieve 10 000 steps/d by 6 mo."
Long-term goals (achievable in 6 mo–1 y):
"By next year, I will participate in a 10-km race or half-marathon."
"By this time next year, I will be able to jog/run for at least 20–30 min a day without stopping."
"By spring of next year, I will increase my jogging pace from 13 to 12 min/mile."
"By winter, I will progress from doing 10 body-weight squats to 10 weighted squats with proper form and technique."

PA indicates physical activity; and SMART, specific, measurable, achievable, relevant, time bound.

underscoring the utility of sustained PA and ongoing, adaptive behavior modification techniques.[28,111] The current health care landscape demonstrates a multifaceted integration of technology for promoting PA, spanning the incorporation of PA in electronic health records to the use of cost-effective pedometers and digital technologies such as mobile health applications and wearables (eg, smartwatches or adhesive patches with sensors) for real-time monitoring to support or facilitate lifestyle changes.[7,112]

Advancements in digital technologies have enabled scalable, patient-tailored, and engaging experiences to promote PA.[113] Leveraging digital technology–based support is also instrumental in enhancing self-monitoring, which is key to success in promoting and increasing PA.[114] These methods contribute to short-term WL and may support WLM efforts.[115] Emerging evidence suggests that technology-based programs motivate sedentary individuals to exercise and improve patient-physician collaboration.[116] A meta-analysis of 28 RCTs found that text messaging and personalization were associated with more effective PA promotion.[117]

By adopting wearables, clinicians and health care professionals can empower patients to self-monitor various aspects of their PA, including steps taken, distance covered, activity type, minutes spent, calorie expenditure, and heart rate.[118,119] They can also encourage patients to explore using applications and web-based programs tailored to their preferences and goals, offering personalized insights (text and visualizations) from cooperative wearables, social networking features, and group-based PA challenges.[120] Digital technologies can also expand on traditional research methodologies by enabling real-time measurement of various parameters. They also facilitate immediate contact between patients and health care professionals beyond measuring discrete, well-defined outcomes at specific points in time.[118,121]

Although technology promises low marginal costs and a broader reach,[115] concerns about measurement validity and reliability across devices persist.[113,122] Understanding digital determinants of health and ensuring inclusivity in digital technology development and testing are also imperative.[123,124] Despite these obstacles, leveraging the accessibility of digital health may help provide opportunities to reach diverse and underresourced patient groups traditionally underrepresented in medical research, enhance screening risk assessments, shape future digital health interventions, and lead to more streamlined, equitable health care.[125,126] Advancements in digital health and artificial intelligence are expected to enhance future PA promotion by involving earlier identification and intervention through electronic health record–based algorithms and facilitating just-in-time interventions leveraging wearable health metrics. It is also critical for health care professionals to acknowledge that digital technologies are limited by what patients can do from home such as giving consent through a video conference, independently administering a therapy, or gathering data with a wearable device.[119] Although these technologies will likely become increasingly complicated, they are

Physical Activity & Weight Loss	Physical Activity & Weight Loss Maintenance	Physical Activity Counseling Strategies
• PA along with reduced energy intake is recommended to improve the likelihood of CWL. • Diet-induced negative energy balance drives the majority of weight loss response (~80%); PA can enhance weight loss in a dose response manner. • Weight loss responses to aerobic PA without dietary changes are highly variable and in general, do not result in CWL (unless PA levels are very high). • RT helps attenuate lean mass loss with dietary weight loss. RT also improves muscle strength and quality. • PA counseling for patients and referral to a PA program when available is strongly encouraged in conjunction with obesity medication or bariatric surgery.	• Weight regain after CWL worsens CVD risk factors (lipids, glucose control, and blood pressure) that were initially improved with weight loss. • Following CWL achieved through lifestyle-, pharmacologic-, or surgery-based approaches, aerobic PA can attenuate weight regain. • Following behavioral weight loss, patients are encouraged to progress to at least 150 min/week of PA with subsequent modification to higher PA levels as needed to improve weight loss maintenance or CVD risk factor management. • Following surgery-based weight loss, 150-300 min of aerobic PA plus RT 2-3 times per week is recommended, which may also lead to greater weight and fat loss, and improvements in cardiorespiratory fitness and muscular strength compared to not engaging in PA.	• Clinicians are encouraged to work with patients to establish achievable and personalized PA goals using the SMART framework (Specific, Measurable, Achievable, Relevant, Time-bound). • Utilizing evidence-based approaches intended for clinical settings, such as the 5A model (assess, advise, agree, assist, arrange), to encourage PA engagement can help clinicians and healthcare professionals foster and sustain patients' weight loss goals. • Integrating technology for PA promotion can provide scalable, patient-tailored, and engaging experiences, while enhancing self-monitoring of PA.

Note: at present, sufficient data are not available to conclusively address the effects of PA during weight loss or weight loss maintenance for patients taking glucagon-like peptide-1 receptor agonist (GLP-1RA) therapy. However, patients taking GLP-1RAs will likely derive holistic health benefits from initiating and progressing PA levels to the general recommendations (*i.e.,* ≥ 150 min/week of moderate PA or ≥ 75 min/week vigorous PA plus RT at least 2 days/week)

Figure 2. Key takeaways.
CVD indicates cardiovascular disease; CWL, clinically meaningful weight loss; PA, physical activity; and RT, resistance training.

essential to clinical practice and PA promotion research, offering innovative tools and strategies to complement comprehensive obesity treatment approaches.[118]

CONCLUSIONS

PA is essential for comprehensive obesity treatment, enhancing WL and WLM, while also improving CVD risk profiles, body composition, CRF, and quality of life. Despite recent advancements in obesity medications and bariatric surgery, including PA as an adjunctive treatment holds promise of additional health benefits. Multidisciplinary approaches involving both clinicians and auxiliary health care professionals are pivotal for fostering and sustaining WL; key considerations for integrating PA across WL, WLM, and counseling contexts to support these efforts are summarized in Figure 2. Given the unprecedented obesity rates, especially among underresourced groups who are also less likely to be physically active, these programs should be effective, available, and affordable across diverse populations. By leveraging the unique, multifaceted health benefits of PA, we can improve the likelihood of long-term success of comprehensive obesity treatment approaches and help reduce the prevalence of obesity and obesity-related cardiovascular outcomes.

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The American Heart Association makes every effort to avoid any actual or potential conflicts of interest that may arise as a result of an outside relationship or a personal, professional, or business interest of a member of the writing panel. Specifically, all members of the writing group are required to complete and submit a Disclosure Questionnaire showing all such relationships that might be perceived as real or potential conflicts of interest.

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*Modest.

†Significant.

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†Significant.

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