

Review

# Physical activity and exercise within the context of obesity treatment: Enhancing health beyond weight loss

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## Abstract

Overweight and obesity are significant public health concerns worldwide due to their association with many chronic health conditions. This has resulted in the development of various interventions focused on weight loss to reduce the associated health burden. Physical activity is an important lifestyle behavior associated with enhanced health. Evidence supports that many of the benefits of physical activity are realized independent of initial weight status or whether weight loss is achieved, with some benefits additive to what is achieved with weight loss alone. These benefits include enhanced cardiometabolic, brain, cognitive and psychological health, and others. Moreover, in adults with overweight or obesity, physical activity has independent effects on cardiorespiratory fitness, muscular strength, physical function, and mobility. There are also benefits to body composition, with physical activity improving the quality of key tissues, such as skeletal muscle, which may not occur with diet-induced weight loss. Therefore, physical activity is an important public health target for adults with overweight or obesity to provide a wide range of health benefits that extend beyond those of weight loss alone. However, physical activity recommendations and programming efforts should consider the unique characteristics of adults with overweight or obesity to be most effective, and should support a focus on mobility, physical function, and other health outcomes.

**Keywords:** Physical activity; Exercise; Obesity; Body composition; Health risk

## 1. Introduction

Excess body weight and adiposity that result in overweight or obesity is a significant public health concern, and this is observed in many countries and regions worldwide.<sup>1</sup> It is associated with increased risk of mortality as well as numerous other health conditions that include but are not limited to cardiovascular disease, diabetes, many forms of cancer,

musculoskeletal disorders, psychological conditions, reduced brain health and cognition, and others.<sup>2</sup> While there is some variability in prevalence rates of overweight/obesity, this has been shown to be a public health concern across the lifespan and other individual demographic characteristics (e.g., sex). The public health concerns regarding excess weight and adiposity contribute to the need for prevention and treatment approaches to address these issues.

While there is a public health need to address the primary prevention of weight gain and increased adiposity, given the high prevalence rates,<sup>1,3</sup> many efforts have been focused on

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the promotion of weight loss. A foundational component of these approaches has been to alter lifestyle factors (primarily dietary interventions to reduce energy intake and physical activity increases to enhance energy expenditure) that result in a negative energy balance, thus contributing to weight loss. These lifestyle focused interventions have been shown to reduce body weight by approximately 8%–10% when implemented in research settings,<sup>2</sup> with most of the weight loss resulting from the reduction in energy intake. Commercially available programs typically result in less weight loss.<sup>2</sup>

While these approaches have demonstrated that weight loss is associated with reductions in various health-related risk factors and improvement in many chronic health conditions,<sup>2</sup> it is recognized that weight loss and weight loss maintenance are challenging for many individuals. Moreover, even though medical treatments that include metabolic/bariatric surgery and more recent pharmacotherapies have been demonstrated to be more effective than lifestyle programs alone for weight loss, these medical treatments may not be an accessible or appealing treatment for all individuals or it may be medically contraindicated. Therefore, it is important to also consider how selective lifestyle factors can enhance health for individuals living with overweight or obesity in a way that extends beyond a primary focus on weight loss.

A key lifestyle factor that warrants consideration within this context is physical activity. This can include activities of daily living (household, transportation, *etc.*), occupational physical activity, and structured periods of activity that are typically referred to as exercise. Here we address key considerations regarding the health benefits of physical activity, which may occur independent of weight loss, for individuals living with overweight or obesity. While it is recognized that these health benefits may accrue with physical activity for all individuals with overweight/obesity across the lifespan, the focus for this perspective is adults and older adults.

## 2. Body composition

Treatment programs have typically placed a primary emphasis on changes in body weight and body size, with the latter typically represented via body mass index (BMI, kg/m<sup>2</sup>). However, measures of weight and BMI fail to differentiate between body composition compartments, which are more appropriately quantified using techniques to measure body composition. Body composition consists of 2 primary components that include fat mass (adiposity) and fat-free mass (all body mass that is not adiposity). Fat-free mass can further be divided into additional compartments via sophisticated multi-compartment body composition models that quantify water, bone mineral, soft-tissue mineral, protein, and glycogen. It is important to note that body composition methods are designed to assess specific compartments, but none measure all components directly. Thus, while not within the scope of this perspective, it is important to note that selection of the method of measuring body composition needs to consider the cost and feasibility, accuracy of the measurement, and the setting in

which it will be implemented (research, clinical, health-fitness, *etc.*).

Body composition may be an important target that can be modified with physical activity/exercise. Physical activity/exercise can induce profound changes in body composition, beyond reduction in body weight, by modulating the volume, quality, and distribution of the body's tissues, including adipose tissue, lean mass, and bone. These adaptations occur via distinct physiological mechanisms that are not always observed through changes in total body weight. The following summarizes the effects of exercise on body composition in terms of adiposity, muscle mass, and bone, with an emphasis on both volumetric and qualitative changes in these tissues.

### 2.1. Effects of physical activity/exercise on the volume of adiposity, lean mass, and bone

#### 2.1.1. Adiposity

Exercise, particularly aerobic and resistance training, exerts significant effects on adipose tissue volume, even in the absence of substantial weight loss. For example, physical activity has been shown to decrease total fat mass, particularly visceral adipose tissue, which is an important contributor to several secondary cardiometabolic comorbidities.<sup>4</sup> Resistance training has been shown to selectively decrease visceral fat despite minimal changes in body mass, suggesting that exercise-induced reductions in fat are not necessarily reflected with a simple measurement of body weight.<sup>5</sup> Aerobic exercise also contributes to fat mass reduction, with the magnitude of fat loss varying based on the frequency, intensity, time, and type of the exercise intervention.<sup>6</sup>

#### 2.1.2. Lean mass

Exercise, particularly resistance training, when not combined with an energy-restricted diet, can increase lean tissue. This is partially attributed to muscle hypertrophy, defined by an increase in muscle fiber cross-sectional area. Importantly, with severe energy restriction resulting in a significant reduction in fat-free mass, the addition of resistance exercise conferred muscle hypertrophy as measured by muscle biopsy in adults with obesity.<sup>7</sup> Even with significant weight loss in response to bariatric surgery, accompanied by a reduction in lean mass as measured by dual-energy X-ray absorptiometry (DXA), walking has been shown to preserve muscle.<sup>8</sup>

The response of lean tissue to exercise is mediated by mechanical tension, muscle damage, and metabolic stress, which collectively stimulate anabolic pathways, particularly those involving mammalian target of rapamycin (mTOR) signaling.<sup>9</sup> Even in the absence of significant reductions in body weight, resistance exercise can increase skeletal muscle mass and improve muscle function. Importantly, these adaptations may enhance resting energy expenditure and glucose metabolism, making the preservation or augmentation of lean mass crucial in metabolic disease prevention.<sup>10</sup> However, it is important to highlight that in the presence of diet-induced energy restriction resulting in clinically meaningful weight loss, exercise (including resistance exercise) has not been

demonstrated to increase lean mass, but rather may blunt the loss of lean mass that can be typically observed with diet-induced weight loss.<sup>11</sup>

Contemporary treatments for obesity include very effective obesity management medications (OMM), with the most recent OMMs being semaglutide and tirzepatide, and with many others in the developmental pipeline.<sup>12</sup> Percent weight loss with semaglutide is approximately 14.9% vs. 2.4% with placebo for adults without type 2 diabetes and 9.6% vs. 3.4% with placebo for adults with type 2 diabetes.<sup>13,14</sup> For tirzepatide, weight loss is approximately 20.9% vs. 3.1% with placebo for adults without type 2 diabetes and 14.7% vs. 3.2% with placebo for adults with type 2 diabetes.<sup>15,16</sup> While these OMMs are effective for weight loss, there has been some concern that the weight loss is accompanied by excessive loss of lean mass.<sup>17</sup> To date, there are no published studies that have reported on the effects of adding exercise at the onset of treatment using an OMM and, therefore, it is unclear whether exercise may attenuate the observed decrease in lean mass. Moreover, studies of lean mass do not necessarily reflect the effects that may be observed for change in muscle mass, which has not been extensively examined.<sup>18,19</sup>

In a study conducted by Jensen et al.,<sup>20</sup> participants initially received a low-energy diet for a period of 8 weeks, which resulted in weight loss of approximately 13 kg. Following this weight-loss period, participants were randomized to receive placebo, exercise alone, OMM (liraglutide), or OMM plus exercise for a period of 52 weeks. Results showed lean mass did not differ between the OMM and OMM plus exercise conditions, suggesting that exercise provided no added benefit to preservation of lean mass. However, because muscle mass was not measured, the effects on that component of body composition cannot be determined.

### 2.1.3. Bone

Regular physical activity is also important for bone health, particularly for maintaining or augmenting bone mineral density (BMD). Weight-bearing and resistance exercises impose mechanical loading on the skeletal system, stimulating osteogenesis and promoting bone accrual.<sup>21</sup> This may suggest that the mechanical forces generated during physical activity directly influence bone remodeling processes. Regular mechanical loading increases bone mass and strength, thereby reducing the risk of osteoporosis and fractures, particularly in populations at risk for bone loss, such as postmenopausal women and older adults. However, there is also evidence that the benefits of exercise on BMD may be modest, and there is even some evidence that exercise may have a negative influence on BMD in some individuals, which warrants consideration.<sup>22</sup>

In the study described above, wherein Jensen et al.<sup>20</sup> evaluated the addition of exercise to an OMM, bone density and bone turnover markers were also measured. Results showed that the change in bone density and bone turnover markers did not differ between the OMM and the OMM plus exercise conditions. These findings appear to indicate that exercise may not mitigate the changes in bone observed with weight loss induced by an OMM. However, caution is warranted regarding

these findings given that neither the OMM or exercise was initiated at the onset of weight loss, and because the study was not specifically conducted in adults who have or may be at risk for having low bone density. Thus, further studies are needed in this important area of research.

## 2.2. Effects on the quality of tissues: Adipose, lean mass, and bone

### 2.2.1. Adipose tissue quality

Exercise not only reduces the volume of adipose tissue but also enhances its metabolic quality. Regular physical activity induces changes in adipocyte morphology and function, leading to smaller, more insulin-sensitive adipocytes with reduced pro-inflammatory cytokine secretion.<sup>23</sup> Moreover, exercise promotes the browning of white adipose tissue, which is characterized by an increase in uncoupling protein-1 (UCP-1) expression and a shift toward a more metabolically active phenotype that enhances thermogenesis and energy expenditure.<sup>24</sup> These adaptations improve the overall metabolic health of adipose tissue, independent of reductions in fat mass.

### 2.2.2. Muscle quality

Muscle quality may be defined as muscle-specific strength, muscle strength per unit of muscle, or muscle composition that includes an evaluation of muscle fat infiltration.<sup>25</sup> Exercise may enhance muscle quality by enhancing the functional and metabolic capacity of skeletal muscle fibers. Resistance training promotes hypertrophy of type II muscle fibers, which are fast-twitch fibers involved in generating high-force, rapid contractions.<sup>26</sup> Conversely, aerobic exercise enhances mitochondrial density and oxidative capacity within type I muscle fibers, which improves endurance and the muscle's ability to sustain prolonged activity.<sup>27</sup> This may be an adaptation given that persons with obesity may have a lower proportion of type I fibers.<sup>28</sup> These adaptations increase muscle efficiency and functionality, contributing to improved metabolic health, strength, and physical performance.

Muscle quality in adults with overweight/obesity may be less than optimal despite their having a large volume of skeletal muscle.<sup>25</sup> The effects of exercise on improving muscle quality are also observed in individuals with overweight/obesity. For example, Menshikova et al.<sup>29</sup> reported that exercise training enhanced skeletal muscle mitochondria content, electron transport chain activity, and fat oxidation enzyme activity in older adults with overweight/obesity. Toledo and Goodpaster<sup>30</sup> have also summarized the beneficial effects of exercise on muscle mitochondria in persons with overweight/obesity; however, they did not observe these same effects with diet-induced weight loss. Non-invasive measures of muscle quality, such as cardiorespiratory fitness and muscular strength, are also improved with exercise in individuals with overweight/obesity, even without the occurrence of weight loss.<sup>4,31,32</sup>

### 2.2.3. Bone quality

Exercise improves bone quality beyond increases in bone mass. Mechanical loading through resistance and high-impact

activities enhances bone microarchitecture, including trabecular connectivity and cortical thickness, both of which are key determinants of bone strength.<sup>33</sup> Additionally, exercise influences bone turnover rates by promoting bone formation and reducing resorption, thereby optimizing the bone remodeling cycle.<sup>21</sup> These changes collectively contribute to a reduced risk of fractures, highlighting the importance of physical activity for maintaining bone integrity.

### 2.3. Distribution of adiposity

Exercise plays a pivotal role in the redistribution of adipose tissue, particularly in reducing visceral fat, which is strongly associated with metabolic complications. Aerobic exercise is particularly effective at reducing visceral adipose tissue, as it has been shown to preferentially target fat deposits within the abdominal cavity, even in the absence of significant weight loss.<sup>4</sup> This redistribution of fat away from central depots, which may be more metabolically harmful, toward subcutaneous or peripheral depots represents a critical mechanism by which exercise improves cardiometabolic health. Resistance training has also been shown to preferentially reduce visceral fat and redistribute adiposity, contributing to a healthier body fat distribution.<sup>5</sup>

## 3. Cardiorespiratory fitness, muscular fitness, and physical function

### 3.1. Cardiorespiratory fitness

Cardiorespiratory fitness is associated with a variety of important health outcomes. There is extensive literature demonstrating that a higher level of cardiorespiratory fitness is associated with reduced all-cause mortality, cardiovascular disease, mortality from various forms of cancer, risk of type 2 diabetes mellitus, and other health outcomes.<sup>34–37</sup> Higher cardiorespiratory fitness is also associated with reduced risk of adverse health conditions for individuals with overweight or obesity.<sup>34,38,39</sup> Therefore, improving cardiorespiratory fitness should be an important outcome for individuals with overweight or obesity.

Interventions focused on physical activity/exercise have demonstrated improvements in cardiorespiratory fitness in adults with overweight/obesity. For example, Ross et al.<sup>4</sup> reported that in adult men with overweight/obesity who remained weight stable, cardiorespiratory fitness, as measured by maximal oxygen uptake, increased significantly in response to 12 weeks of exercise training on a treadmill compared to control. Similar changes have been observed in adult women with overweight or obesity who remained weight stable in response to 14 weeks of exercise training on a treadmill.<sup>32</sup> Moreover, studies that have compared similar magnitudes of weight loss induced by diet alone or exercise alone have shown that cardiorespiratory fitness was significantly greater following weight loss with exercise training compared to diet, with this being observed in both men and women.<sup>4,32</sup>

It has also been demonstrated that when physical activity is combined with a reduced energy diet to induce weight loss in

individuals with overweight/obesity, the improvement in cardiorespiratory fitness is significantly greater compared to diet-induced weight loss without physical activity.<sup>31,40</sup> Similar findings have also been observed in older adults when comparing diet-induced weight loss to weight loss achieved through a combination of diet and exercise.<sup>41</sup> These findings support the importance of including physical activity, primarily in the form of aerobic activities, in interventions for individuals with overweight/obesity, regardless of whether weight loss is achieved.

### 3.2. Muscular fitness

Muscular fitness is associated with beneficial health outcomes. Ruiz et al.<sup>42</sup> reported that muscular strength was associated with reduced risk of all-cause mortality and cancer, an effect that persisted even after adjusting for cardiorespiratory fitness. The beneficial association between muscular strength and all-cause mortality has been reported by others.<sup>43</sup> This effect has also been observed in adults with a known health condition, such as hypertension<sup>43</sup> or heart failure.<sup>44</sup> Additionally, adult cancer survivors who participated in resistance exercise had a lower risk of all-cause mortality.<sup>45</sup>

Resistance exercise training is commonly recommended to enhance muscle strength. A recent meta-analysis concluded that resistance exercise training can increase muscular strength in adults with overweight/obesity even when not coupled with an energy-reduced diet.<sup>46</sup> A systematic review also concluded that combining resistance exercise, or both resistance and aerobic exercise, with an energy-reduced diet for weight loss improved muscle strength compared to weight loss achieved through an energy-reduced diet alone.<sup>41</sup> Of importance, this improvement in muscular strength is also observed with resistance training even in the context of weight loss and a concomitant reduction in lean mass.<sup>47</sup> This suggests that within the context of weight loss and an accompanying reduction in lean body mass, resistance training can still result in improvements in muscular strength in adults with overweight/obesity. Given that overweight and obesity are associated with reduced mobility and physical function,<sup>48</sup> the improvement in muscular strength may be an important consideration for enhancing these outcomes in adults with overweight/obesity.

## 4. Physical activity and cardiometabolic health

Excess weight and adiposity are associated with an increased risk for cardiovascular disease and other cardiometabolic health conditions.<sup>2</sup> A recent meta-analysis reported that for adults with obesity, higher physical activity is associated with a 21% lower risk of all-cause mortality and a 24% lower risk of cardiovascular disease.<sup>49</sup> This may be a result of physical activity conferring benefits to cardiometabolic health, which includes risk factors such as elevated blood lipids and blood pressure, poor glucose regulation and insulin sensitivity, and excessive inflammation and oxidative stress.<sup>50</sup> Therefore, physical activity may be particularly important as a lifestyle intervention target for individuals living with overweight/obesity to help control these risks. However, it is also

important to consider whether these benefits of physical activity can be realized in adults with overweight/obesity without weight loss or whether weight loss may be an important pathway that influences how physical activity impacts cardiometabolic outcomes.

#### 4.1. Blood lipids and blood pressure

Blood lipids are traditional cardiometabolic risk factors that are central to cardiovascular health. For individuals with less than optimal levels of selective blood lipids, when these levels are improved there is an associated reduction in risk for atherosclerosis, a key contributor to cardiovascular disease. Studies show that aerobic and resistance exercise improve lipid profile by increasing high-density lipoprotein (HDL) cholesterol levels while lowering triglycerides and low-density lipoprotein (LDL) cholesterol.<sup>51</sup> However, not all studies are focused specifically on adults with overweight/obesity, and it is important to understand these effects in this population. They were examined in a study of adults with overweight/obesity involving 6 months of supervised exercise training at an energy expenditure of either 14 kcal or 23 kcal per kg of body weight per week (kcal/kg/week).<sup>52</sup> Results showed that neither of the exercise doses were effective for altering LDL cholesterol concentrations compared to a non-exercise control, but both exercise doses were effective for increasing the size of the LDL particles. Moreover, only the 23 kcal/kg/week exercise condition was effective for decreasing the concentrations of small LDL and LDL particles. HDL cholesterol was significantly increased in only the 23 kcal/kg/week exercise condition. These findings support the idea that a relatively high level of physical activity/exercise may be necessary to favorably alter selective blood lipids in adults with overweight/obesity.

Exercise also exerts a beneficial effect on blood pressure regulation. Aerobic exercise, in particular, has been shown to reduce both systolic and diastolic blood pressure in individuals with hypertension, with improvements observed even in the absence of weight loss.<sup>53</sup> However, it has also been demonstrated that the magnitude of the reduction in resting blood pressure resulting from physical activity/exercise in adults with hypertension may be enhanced with an increased magnitude of weight loss.<sup>54</sup> This suggests that the effects of physical activity/exercise on body weight may be a contributing pathway to improve blood pressure in adults with hypertension. Additional factors that may be attributed to this blood pressure-lowering effect are improved endothelial function, increased nitric oxide production, and enhanced vasodilation, which promote better blood flow and reduce vascular resistance.<sup>55</sup> Given that excess weight and adiposity are associated with risk for hypertension,<sup>2</sup> these exercise-induced changes play a critical role in improving overall cardiovascular health for individuals living with overweight/obesity.

#### 4.2. Glucose regulation and insulin sensitivity

Physical activity/exercise is a powerful tool for improving glucose regulation and insulin sensitivity, 2 critical factors in

the development and treatment of metabolic disorders such as type 2 diabetes. Even without weight loss, regular physical activity enhances the body's ability to uptake glucose and respond to insulin more efficiently. During exercise, muscles increase their glucose uptake independent of insulin, which lowers blood glucose levels.<sup>56</sup> Both aerobic and resistance training have been shown to improve insulin sensitivity, though through slightly different mechanisms. Aerobic exercise increases the expression of glucose transporter type 4 (GLUT4) in muscle cells, enhancing glucose uptake, while resistance training could also increase muscle mass, providing more tissue to store and utilize glucose. These adaptations are critical in preventing insulin resistance, a hallmark of type 2 diabetes and metabolic syndrome.

While physical activity/exercise has been demonstrated to improve glucose regulation and insulin sensitivity, the presence of obesity may mask these effects. For example, Malin et al.<sup>57</sup> reported that 7 weeks of resistance exercise training enhanced insulin sensitivity in women classified as having normal body fatness (29.9%), with no change in insulin sensitivity compared to control for women classified with high body fatness (48.2%). In a small study of 19 men (10 classified as lean; 9 classified with obesity), measures of insulin sensitivity, hepatic insulin resistance, and insulin area under the curve improved in men classified as lean (BMI =  $22.7 \pm 2.5$  kg/m<sup>2</sup>, mean  $\pm$  SD;  $n = 10$ ) following resistance training but did not improve in men with obesity (BMI =  $33.2 \pm 3.2$  kg/m<sup>2</sup>;  $n = 9$ ).<sup>58</sup> Ross et al.<sup>32</sup> reported that 14 weeks of exercise training resulting in weight loss of 6.1 kg showed significant improvements in glucose disposal and insulin area in response to an oral glucose tolerance test in women with obesity when compared to control. However, the same exercise without weight loss showed no difference in these outcomes compared to control. Moreover, the changes in these outcomes did not differ when comparing those participants who lost weight with exercise vs. those who lost a similar amount of weight with diet and no exercise.<sup>32</sup> In a similar study of men with obesity, the same pattern of results was observed for the change in glucose disposal.<sup>4</sup>

Taken collectively, these findings suggest that the beneficial effects of exercise on glucose regulation may be impacted by the presence of obesity. This may be a result of attenuated muscle adaptations to exercise in individuals with obesity compared to their normal weight counterparts.<sup>59</sup> Moreover, the effects of exercise on glucose regulation in individuals with obesity may be partially dependent on whether this also results in weight loss.

#### 4.3. Inflammation and endogenous antioxidant status

Chronic low-grade inflammation and oxidative stress are key drivers of cardiometabolic diseases. Exercise, independent of weight loss, plays a crucial role in modulating both inflammation and the body's endogenous antioxidant defense systems. Regular physical activity has been shown to reduce circulating levels of pro-inflammatory markers such as C-reactive protein (CRP), tumor necrosis factor-alpha (TNF- $\alpha$ ), and

interleukin-6 (IL-6), which are often elevated in individuals with metabolic syndrome and type 2 diabetes.<sup>60</sup> The anti-inflammatory effects of exercise are mediated through multiple mechanisms, including improved adipokine profiles, reductions in visceral fat (even without weight loss), and enhanced immune system regulation.

In addition to its anti-inflammatory effects, exercise boosts the body's endogenous antioxidant defenses, protecting against oxidative stress. Physical activity stimulates the production of antioxidant enzymes such as superoxide dismutase (SOD), catalase, and glutathione peroxidase, which neutralize reactive oxygen species (ROS) produced during metabolic processes.<sup>61</sup> Over time, regular exercise strengthens these antioxidant systems, reducing oxidative damage to cells and tissues, which is particularly important in preventing the progression of cardiovascular and metabolic diseases.

Despite these findings, not all studies support the notion that exercise can reduce measures of inflammation in adults with overweight/obesity. Church et al.<sup>62</sup> examined the effects of 4 months of exercise training on changes in CRP in women with obesity and elevated CRP at baseline. Results showed no effect of the exercise training on change in CRP; however, weight loss resulting from the exercise training was associated with a reduction in CRP. Similar results were reported from another study of women with overweight/obesity in response to 3 different doses of exercise training.<sup>63</sup> These findings appear to support the assumption that exercise resulting in weight loss may be more effective for reducing measures of systemic inflammation than exercise that is not accompanied by weight loss in adults with overweight/obesity.

## 5. Brain health, cognition, and psychological health

In addition to the classical effects of obesity that jeopardize biological health, excessive adiposity is associated with a range of adverse effects on brain structure<sup>64</sup> and function,<sup>65</sup> psychological well-being, and overall quality of life.<sup>66</sup> Exercise, independent of weight loss, is described as a potent co-adjuvant non-pharmacological therapy to ameliorate these outcomes, with substantial evidence supporting its benefits on cognitive function, mood, and mental health in individuals with overweight/obesity.

### 5.1. Brain health

Physical activity improves cognitive function by promoting volume and connectivity in the hippocampus, which is a region crucial for memory and learning.<sup>67</sup> Studies utilizing magnetic resonance imaging (MRI) have demonstrated that regular aerobic exercise enhances hippocampal volume and connectivity.<sup>67</sup> Preliminary cross-sectional work also demonstrates that active individuals with overweight/obesity at risk for metabolic syndrome have better cerebral white matter integrity compared to their sedentary peers and were comparable to a healthy weight control group.<sup>68</sup> Additional benefits of physical activity include increases in cerebral blood flow and the release of neurotrophic factors, such as brain-derived neurotrophic factor (BDNF).<sup>69,70</sup> Potential pathways through

which physical activity could be associated with enhanced brain health and cognition may include reduced inflammation and improved glucose control and insulin sensitivity. The effects of physical activity on these metabolic parameters have been presented in the sections above (see [Sections 4.2 and 4.3](#)). For individuals with overweight/obesity, physical activity may need to be accompanied with weight loss to demonstrate these beneficial effects.

### 5.2. Cognition

Physical activity can have beneficial effects on cognition in individuals with obesity.<sup>71</sup> Adults with obesity with higher fitness levels performed better on tests of executive function and short-term memory than adults with obesity with lower fitness levels and had comparable scores to adults of a healthy weight.<sup>72</sup> Further, results from a randomized trial conducted in older adults with obesity showed that exercise resulted in significant improvements in cognitive outcomes compared to control, and that the benefit was not further enhanced when the exercise was coupled with a dietary intervention to induce weight loss.<sup>73</sup> A systematic review also concluded that exercise was positively associated with memory in individuals with obesity and that this was not impacted by the intensity of the exercise.<sup>74</sup>

### 5.3. Psychological health

Obesity is associated with negative psychological outcomes such as depression.<sup>75,76</sup> However, the causal direction of this relationship is unclear, which makes it difficult to determine whether the primary aim should be to target obesity to reduce depression or to treat the depression to possibly assist with the treatment of obesity.

The benefits of physical activity on mood and psychological outcomes are well-documented. Physical activity induces the release of endorphins and other neurotransmitters that are associated with improved mood and reduced symptoms of depression and anxiety. Some research demonstrates an association between physical activity, especially at moderate intensity, and improved depressive symptoms and anxiety levels in individuals with obesity.<sup>77,78</sup> In contrast, other research finds limited support for structured exercise to reduce depressive symptoms.<sup>79</sup>

The psychological benefits of physical activity may be mediated by reductions in obesity-related inflammatory markers and improvements in metabolic health, again, even without reductions in body weight or adiposity.<sup>80</sup> Obesity is associated with chronic low-grade inflammation, which may adversely affect brain function and mood, and physical activity may mitigate this inflammation by increasing anti-inflammatory cytokines and reducing pro-inflammatory cytokines. Moreover, physical activity improves insulin sensitivity, which is also associated with better brain function and mood regulation.<sup>80</sup> However, as presented in the sections above, the physical activity effects on insulin sensitivity (see [Section 4.2](#)) and inflammation (see [Section 4.3](#)) may be best realized when accompanied by weight loss in adults with overweight/obesity.

### 6. Physical activity programming considerations for individuals with overweight/obesity

As presented in the above sections, there are numerous health benefits that can be realized for individuals with overweight/obesity. However, for these benefits to occur, individuals need to initiate and sustain regular engagement in physical activity, and this requires consideration of how physical activity interventions should be tailored to individuals with overweight/obesity. The recent American College of Sports Medicine’s (ACSM) Consensus Statement regarding physical activity for adults with excess weight and adiposity (e.g., overweight/obesity) provides guidance on important considerations.<sup>11</sup>

The 2018 United States Physical Activity Guidelines<sup>50,81</sup> and 2020 Canadian 24-h movement guidelines<sup>82</sup> provide frameworks for the dose (duration, intensity, and frequency) and mode of physical activity that is recommended to elicit a variety of health benefits, and these should be considered when providing guidance to individuals with overweight/obesity. These guidelines also encourage an emphasis on reducing sedentary behavior to enhance 24-h movement patterns and the health benefits of lower doses and intensities of physical activity.

The ACSM provides guidance on dose, intensity, and mode considerations for physical activity that are specific to addressing excess weight and adiposity.<sup>11</sup> Within the context of exercise dose, intensity, and mode, the focus should primarily be on health effects vs. physical performance effects. This approach has recently been iterated by Jakicic and Rogers,<sup>18</sup> who describe it as primarily focusing on the “health zone” benefits (mobility, physical function, and additional health benefits) with less of an initial emphasis on the “performance zone” benefits (recreational and athletic performance). This will allow individuals with overweight/obesity to develop the physical capacity to support a regular pattern of physical activity and to experience these primary benefits. Only once that is established, and only if the individual has the desire, should the physical activity progress to a dose, intensity,

mode, and pattern that will support performance-based outcomes.

The ACSM also provides guidance on the population- and individual-specific considerations that warrant attention when recommending physical activity for individuals with overweight/obesity, as well as strategies for supporting the engagement and sustainability of physical activity.<sup>11</sup> Within the context of these considerations, the ACSM also advocates for appropriately trained and certified exercise professionals to engage in physical activity initiatives and interventions that are applied to individuals with overweight/obesity. Others have also highlighted the need for an exercise professional to be involved in efforts to enhance physical activity approaches for individuals living with overweight/obesity.<sup>19,83,84</sup>

### 7. Conclusion

Overweight/obesity contribute to significant public health concerns, which signals a need for effective treatments for obesity as a chronic health condition. Weight loss, which is accompanied primarily by a decrease in adiposity, can significantly contribute to many health benefits. However, physical activity/exercise is also an important lifestyle behavior that can enhance the health and well-being of persons living with overweight/obesity. Some of these health benefits are realized through the effects that physical activity/exercise has on weight and body composition, while it appears that other effects occur independent of these effects (Fig. 1). Given this, there is a need to include measures beyond body weight, including body composition (which includes measures of both tissue volume and tissue quality), when exploring the pathways by which physical activity/exercise enhances health for individuals with overweight/obesity.

Physical activity/exercise should be recommended in some form for all persons living with overweight/obesity to realize the comprehensive health benefits. For adults living with obesity, physical activity can confer many health benefits even with little to modest levels of weight loss or changes in body composition. Therefore, physical activity should be

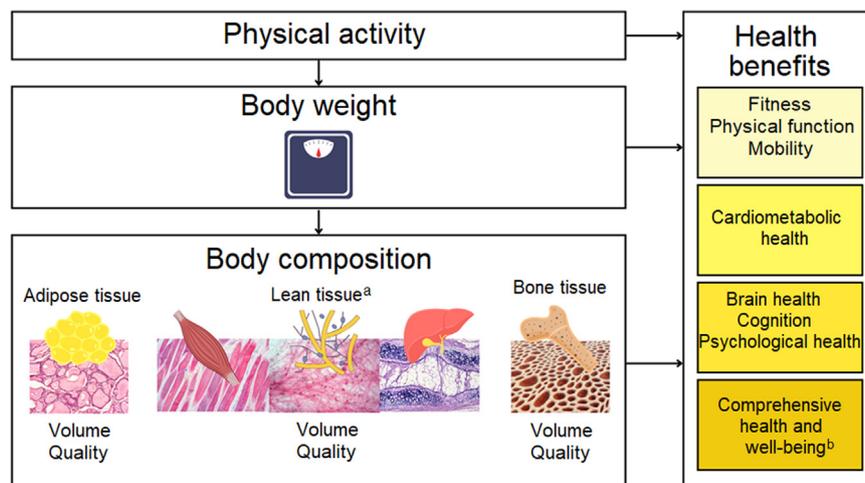


Fig. 1. Health effects of physical activity and exercise for adults with overweight or obesity. <sup>a</sup> Includes skeletal muscle, connective, and organ tissues. <sup>b</sup> Defined in Powell et al.<sup>50</sup>.

encouraged and supported as an important behavior that can enhance the health and well-being for adults living with obesity. As appropriate, physical activity/exercise recommendations and programs to support these efforts should be adapted to the needs and physical abilities of the individual, with a primary emphasis focused on enhancing mobility, physical function, and health, rather than on physical performance. This may require a comprehensive team-based approach that includes appropriate medical management, physical and occupational therapists to assist with mobility and functional limitations, and appropriately trained and certified exercise professionals to assist in initiation and progression of the physical activity/exercise of the individual to achieve a broad array of health benefits that extend beyond weight loss.

### Authors' contributions

JMJ conceived the concept and drafted the final manuscript; CEB, SED, BF, CSK, BSN, WLP, XW, and LSD assisted with drafting the manuscript; RJR assisted with drafting the manuscript. All authors have read and approved the final version of the manuscript, and agree with the order of presentation of the authors.

### Declaration of competing interest

JMK is on the Scientific Advisory Board for Wondr Health, Inc. RJR serves as an educational consultant for Seca and a consultant and instructor for Wondr Health, Inc. For CEB, the views and opinions expressed in this paper are solely those of this author and do not necessarily reflect the official policy or position of this author's employer or any affiliated organizations, and the research and conclusions presented are the result of independent work and are not sponsored, endorsed, or approved by this author's employer. The other authors declare that they have no competing interests.

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### Supplementary materials

Supplementary materials associated with this article can be found in the online version at [doi:10.1016/j.jshs.2025.101097](https://doi.org/10.1016/j.jshs.2025.101097).

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