Clinical Practice GUIDELINE for the Management of Obesity in Adults in Ireland

Physical Activity in Obesity Management

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KEY MESSAGES FOR HEALTHCARE PROFESSIONALS

- **Regular physical activity induces a wide range of health benefits in adults across all body weight categories, even in the absence of weight loss.**
- **Aerobic and resistance exercise can favour the maintenance or improvements in cardiorespiratory fitness, mobility, strength and muscle mass during obesity-management interventions.** This can be important, as these outcomes are not targeted and sometimes are negatively affected by other therapies, such as caloric restriction, medications and bariatric surgery.
- **Weight stigma is linked to reduced engagement in physical activity.** The role of healthcare professionals is to provide non-judgemental support for physical activity as a health-promoting behaviour, regardless of body size or obesity complexity.
- **In Ireland body weight tends to increase with age.** Physical activity is particularly important for preserving lean tissue and reducing metabolic effects of higher levels of fat mass in older adults due to the changes in body composition associated with ageing (higher levels of fat tissue and lower levels of lean tissue).

RECOMMENDATIONS

1. Aerobic physical activity (30–60 minutes of moderate to vigorous intensity most days of the week) can be considered for adults who want to:
   a) Increase cardiorespiratory fitness (Level 2a, Grade B)[1] and mobility (Level 2a, Grade B)[2];
   b) Optimise the maintenance of muscle mass and physical function during weight loss (Level 2a, Grade B)[3];
   c) Achieve small amounts of body weight and fat loss (Level 2a, Grade B)[4];
   d) Achieve reductions in abdominal visceral fat (Level 1a, Grade A)[5-7] and ectopic fat such as liver and heart fat (Level 1a, Grade A)[7], even in the absence of weight loss; and
   e) Optimise weight maintenance after weight loss (Level 2a, Grade B)[4,8].

2. For adults living with overweight or obesity, resistance training may promote weight maintenance or modest increases in mass or fat-free mass and mobility (Level 2a, Grade B)[9].

3. Increasing exercise intensity, including high-intensity interval training, can achieve greater increases in cardiorespiratory fitness and reduce the amount of time required to achieve similar benefits as from moderate-intensity aerobic activity (Level 2a, Grade B)[1,10].

4. Regular physical activity, with and without weight loss, can improve many cardiometabolic risk factors in adults who have overweight or obesity, including:
   a) Hyperglycemia and insulin sensitivity (Level 2b, Grade B)[1,11,12];
   b) High blood pressure (Level 1a, Grade B)[13,14]; and
   c) Dyslipidemia (Level 2a, Grade B)[15,16].

5. Regular (120 or more minutes per week) aerobic physical activity may improve overall mental health and health-related quality of life in adults who are middle aged or older living with overweight or obesity (Level 2, Grade B)[17,18]. There is evidence to suggest that regular exercise (dance therapy) may improve body image (Level 3, Grade C)[19].

KEY MESSAGES FOR PATIENTS LIVING WITH OBESITY

- **Physical activity has a wide range of health benefits in adults across all body weight categories, even in the absence of weight loss.** It improves mobility, quality of life, fitness, strength and helps you to maintain muscle during obesity management.
- **Increasing physical activity is one of the key components of all obesity-management strategies but weight loss should not be the sole outcome by which the success of physical activity therapy is judged.**
- **In Ireland, body weight tends to increase with age.** Physical activity is particularly important for preserving muscle in older adults due to the changes in body composition that happen as we get older.
- **Weight stigma is proven to reduce physical activity for people living with obesity.** Seek non-judgemental support for physical activity as a health-promoting part of your daily routines, regardless of your body size or obesity complexity.

Introduction

Higher physical activity (PA) levels and lower sedentary (sitting) time are associated with improved cardiovascular health outcomes (e.g., blood pressure, low density lipoprotein-cholesterol (LDL-C), triglycerides, glucose, high density lipoprotein-cholesterol (HDL-C) levels, visceral fat and a lower incidence of chronic disease (e.g., type 2 diabetes mellitus (T2DM), cardiovascular disease (CVD), certain types of cancer)[20,21]. It is recommended that adults perform a minimum of 30 minutes of moderate to vigorous intensity aerobic physical activity on most days of the week (accumulating at least 150 minutes per week), engage in strength (resistance) activity at least two days per week and reduce the amount of daily sedentary time[22].

The nature of the relationship between behavioural PA interventions and health is such that the greatest health gains associated with physical activity can occur with small improvements among persons who have PA levels lower than the consensus guidelines[23]. There are many variables that influence the therapeutic effect of behavioural PA interventions, such as type of PA (e.g., aerobic or muscle strengthening) and volume (time per day or per week) and intensity (how hard the physical experience is)[8,24,25]. There are also individual variables that are influential, such as genetics and phenotype, age, sex, presence of disability, disease category, physical ability and body mass index (BMI)[26,27]. This explains why there are heterogeneous responses to PA interventions amongst people living with obesity to PA and other interventions.

Within the context of obesity management, PA alone has a modest effect on weight loss (2 kg – 3 kg) and is more effective when combined with dietary strategies (about 6 kg). More importantly, PA interventions have repeatedly been shown to

have a positive influence on broader health outcomes and disease risk in this vulnerable group. Weight stigma however is associated with reduced engagement with physical activity[28,29] and needs to be considered during all obesity interventions (See Chapter 1 Reducing Weight Bias in Obesity Management, Practice and Policy). Multiple systematic reviews and meta-analyses have show that PA and exercise interventions are effective in reducing abdominal visceral and intra-hepatic fat (which have independent associations with adverse health risks). PA interventions have been shown to improve insulin sensitivity blood pressure, cardiorespiratory and muscular fitness, benefitting quality of life (QoL) and optimising outcomes of bariatric surgery[30-34]. The value of PA in this context is therefore much less about weight loss and more about improving health and wellbeing[28,29].

The objective of this chapter is to provide healthcare professionals (HCPs) working in obesity care with an interpretation of evidence regarding the importance of facilitating PA through behavioural support and interventions and, where necessary, tailored exercise therapy or rehabilitation. It will outline the relationship between PA and body weight, physical health, mental health and physical function. The chapter introduces how PA can affect health outcomes at different stages of life in order to support better decision making around the most appropriate therapeutic approach for different individual adults living with obesity. The chapter appendix describes a series of case studies of PA intervention in different scenarios ranging from general practice, a hospital outpatient department and a health and social care professional consultation.

Table 1: **Physical Activity Terminology & Categorisations (A Non-Exhaustive List)**

Name	Description
Physical activity	Any bodily movement produced by skeletal muscles that requires energy expenditure, greater than that at rest.
Exercise	A subcategory of physical activity that is planned, structured, repetitive and purposeful in the sense that the improvement or maintenance of one or more components of physical fitness is the objective. "Exercise" and "exercise training" frequently are used interchangeably and generally refer to physical activity performed during leisure time with the primary purpose of improving or maintaining physical fitness, physical performance or health.
Resistance	Resistance training is any exercise that causes the muscles to contract against an external resistance with the expectation of increases in strength, power, hypertrophy and/or endurance. It may be done using external equipment or body weight.
Aerobic	Activity in which the body's large muscles move in a rhythmic manner for a sustained period of time. Aerobic activity improves cardiorespiratory fitness. Examples include walking, swimming and cycling.
Flexibility	Flexibility is defined as range of motion (ROM) of a joint or group of joints, as per the skeletal muscles and not any external forces. The flexibility of any given movable joint includes both static and dynamic components.
Physical activity domains	**Occupational:** Physical activity undertaken during paid or voluntary work. **Domestic:** Physical activity undertaken in the home for domestic duties (such as cleaning, caring for children, gardening, etc.). **Transportation:** Physical activity performed for the purpose of getting to and from places, and refers to walking, cycling and wheeling (the use of non-motorised means of locomotion with wheels, such as scooters, rollerblades, manual wheelchair, etc.). **Leisure time:** Physical activity performed by an individual that is not required as an essential activity of daily living and is performed at the discretion of the individual. Such activities include sports participation, exercise conditioning or training and recreational activities, such as going for a walk, dancing and gardening.
Self-monitoring	A method used in behavioural management in which individuals keep a record of their behaviour. Behavioural support for PA may include minutes/week (of leisure time or other PA), step counting, sedentary pursuit limits, sleep hours, etc.
Intensity	Moderate to vigorous physical activity (MVPA).
FITT / FITTE	This is a framework to help patients understand the different aspects of PA prescription. It is an acronym for F – frequency, I – intensity, T – type, T – time and E – enjoyment.
MVPA & VPA	These acronyms describe the intensity of the physical activity being undertaken. MVPA stands for moderate to vigorous physical activity. VPA stands for vigorous physical activity.
Energy expenditure (EE)	The total energy cost of maintaining constant conditions in the body plus the energy cost of physical activities.
Non-exercise activity thermogenesis (NEAT)	Human movement that excludes planned (leisure) "exercise". Also includes activities such as posture change, incidental movements, VPA, MVPA, etc.

Physical activity behaviours

PA and sedentary pursuits are influenced by the social determinants of health[25] and are key behaviours that influence health. The social ecological model (SEM) provides a useful framework for examining influences on PA and sedentary behaviour where concentric circles identify spheres of proximal (or individual-level) to distal (or more community/sectoral/society levels) influences on PA as depicted in Figure 1[35]. The more distal influences of community-/sectoral-related variables, and the physical or policy environments include societal norms (values and beliefs within a society), physical infrastructure (built environment) or programmes and public sector policies (education, planning law, health, etc.) that support the use of PA as part of routine care[36]. Factors that hinder weight management and PA participation include living in an unsafe neighbourhood or one with a poor built environment and lower household income[37-40].

One individual factor that is associated with PA levels of people with obesity is their physical function. Physical function describes the ability to engage in activities of daily living, such as climbing stairs and participation in occupational work, domestic activities, education or social events. There is strong evidence that physical function is lowered by obesity and often associated with higher rates of impairments, such as pain, musculoskeletal disorders, respiratory disease or psychological burdens[41-43]. These impairments, in turn are associated with further declines in PA levels and physical fitness, and therefore symbiotic effect of health decline. Research highlights the importance of wellbeing and feeling safe during PA for those with obesity, in addition to having enough time and promoting internal motivation to be active[44,45]. Similarly, function can be supported and facilitated through adaptations of environment (e.g., handrails on stairs or in bathrooms) or access to suitable seating[46].

Lean muscle mass and muscle function play important roles in the relationship between impairments, physical function and health. Batsis *et al*.[47] observed that a decline in physical function is accelerated for those with obesity and lower muscle strength compared to those with obesity and higher muscle strength. These authors also found associations with higher PA and QoL.

Health outcomes associated with obesity are also affected by the co-occurrence of sarcopenic-obesity. This term describes the coexistence of sarcopenia (low muscle mass) and obesity[48]. There is now international consensus on diagnosis of this condition[49], and it is widely accepted that sarcopenia and obesity share several pathophysiological mechanisms and appear to potentiate each other's detrimental effects on health (see Chapter 6 Clinical Assessment of People Living with Obesity for further information)[50]. Sarcopenic-obesity has been shown to have a negative association with physical function[48] and importantly and has been shown to increase both morbidity and mortality[50]. Obesity-care interventions that incorporate PA generally report either maintenance or gain in muscle mass and therefore optimising PA is a vital strategy to ameliorate this condition and preserve physical function and health[3,4] (see Chapter 8 Medical Nutrition Therapy in Obesity Management for more information on nutritional strategies for sarcopenic obesity).

Figure 1: **Ecological Model of Four Domains of Active Living**

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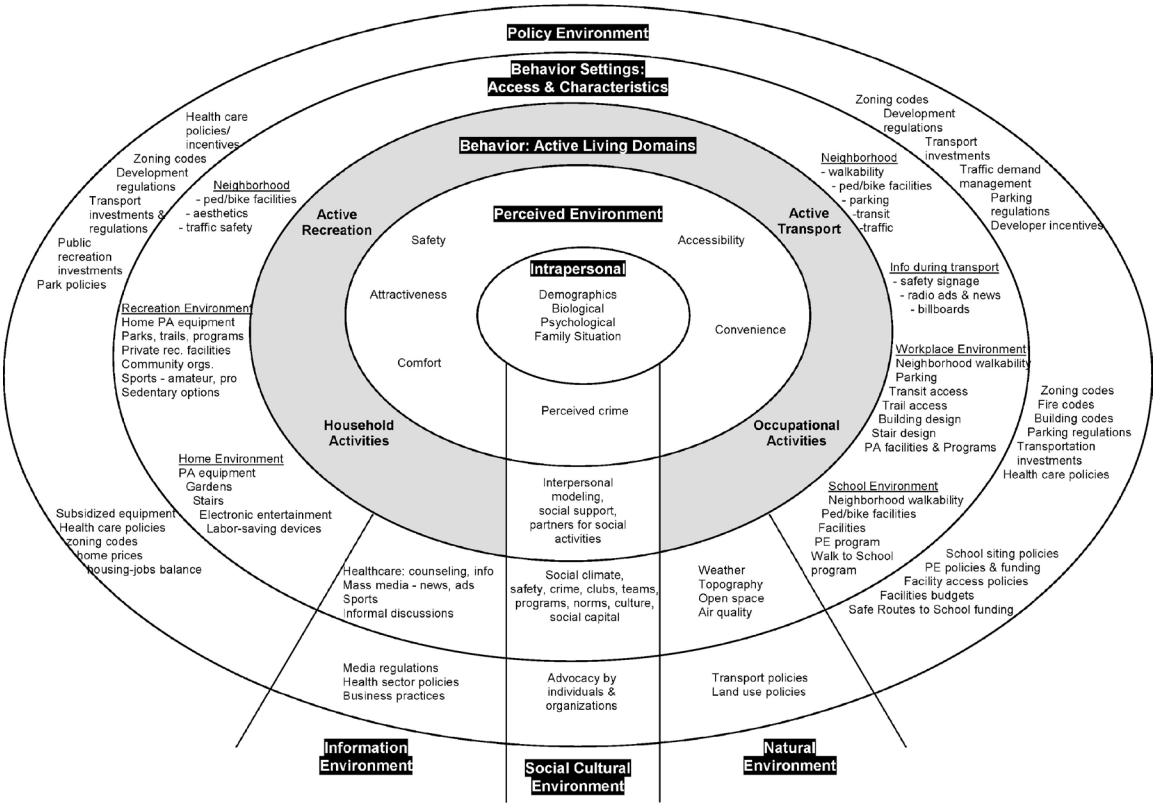


Energy expenditure – A constrained system

New research findings have helped clarify the relationship between PA and EE[51-54]. Up to this point, there has been an assumption of an "Additive Model" for EE and PA, i.e., a continuous positive correlation between an individual's PA levels and associated calorie "burn" and a proportionate increase in total EE. The narrative created by this assumption was that if an individual with obesity would "move more", they would create a negative energy balance and lose weight. This link seems intuitive but appears to be based on an over simplistic understanding of the energy cost of movement[55].

Pontzer *et al*.[53,54] and Careau *et al*.[52] have both used doubly labelled water analyses to show that there is little correlation between chronic PA and total EE. Careau *et al*.[52] examined the total EE of 1,754 individuals and established that there are significant physiological constraints to total EE and that our metabolic systems are adaptive to variations in demand and compensate accordingly (i.e., an increase in PA EE results in a lowering of basal metabolic EE). Careau *et al*. found that compensations for basal metabolic EE ranged from 27.7% for lean individuals to 49.2% for individuals with obesity. Pontzer *et al*.[53,54] labels this model of total EE as the "constraint model" of total EE. These insights may help us to understand that while increasing PA is highly beneficial for health it does not have a linear relationship with total EE and weight loss. However, we should recognise that if a person increases their routine daily PA there will most likely be a period of adjustment within these metabolic adaptations and compensations[56].

A further related finding from studies conducted in general populations, shows that there are also behavioural compensations that follow increased PA. During times of increased PA, either during occupational and domestic activities[54] or leisure time PA[57] there will be an associated drop in another PA domain. For example, if PA increases in leisure time, there may be a compensatory fall in another domain (i.e., domestic PA) in order to help restrain the total volume PA. Both physiological EE adaptations and behavioural compensations suggest a strong internal drive for EE homoeostasis as a means of energy regulation.

An understanding of these concepts should help people working in this area to dismiss the notion that increasing PA consistently results in weight loss and that it is unhelpful to advocate the "Additive Model". Rather, we should understand the "Constraint Model" of total EE and promote PA as a means to achieve health regardless of body size.

Benefits of physical activity across the life stages

PA plays an essential role in obesity management by optimising metabolic balance, positively influencing weight maintenance, enhancing the lean-to-fat mass ratio and body composition, reducing ectopic fat, reducing cardiometabolic risk factors and incidence for a wide range of chronic conditions and helps to maintain physical function[31-34,58]. The benefits of PA exist for all adult life stages, although the most prominent benefits and their magnitudes of importance may vary across lifestyles.

In **young adulthood** (e.g., ages 20–44) the absolute risk of major chronic diseases and related events are generally low[59]. However, this is also the period of increased incidence and progression of obesity[60]. Thus some of the most important benefits of PA in this age bracket relate to the establishment of sustainable health behaviours that can extend through other periods of life, as well as in its potential to reduce physiological risk factors like high blood pressure, hyperlipidemia, insulin resistance and inflammation levels that with time increase the risk of health complications[61,62]. Even in young adulthood obesity is associated with a 10-fold increased risk of diabetes, five-fold increased risk of hypertension (HTN), two- to three-fold increased risk of cardiovascular events and modest but significant increases in certain cancers[63,64]. Maintaining healthy PA levels is associated with 30% – 50% reduced risk in each of these outcomes and importantly is also observed in people living with obesity.

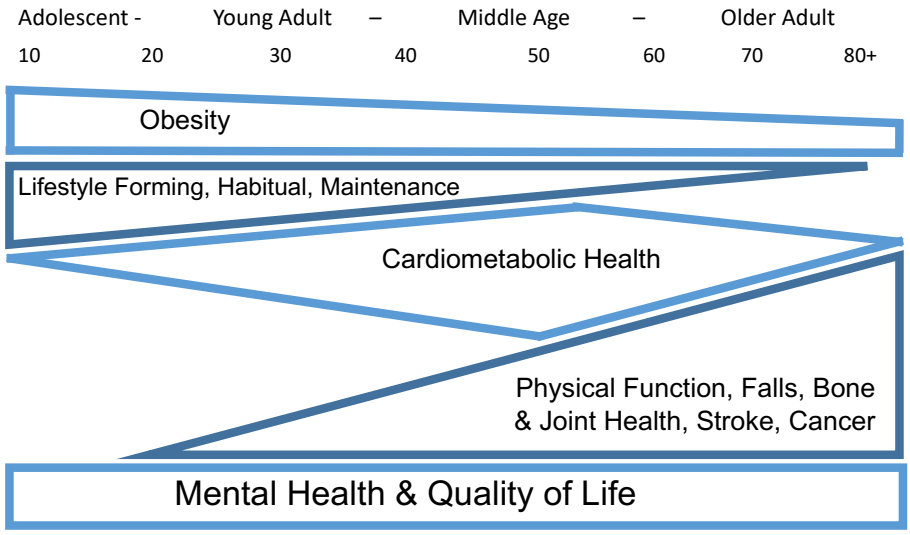
In **middle adulthood** (e.g., aged 45–64), North American and North European populations have an increased risk for T2DM (15%) and HTN (50%) by the age of 60[65]. Furthermore, early manifestation of CVD events increases considerably from young adulthood onwards. Thus, obesity becomes an important contributor to the new onset of cardiometabolic disease and PA becomes an important prevention strategy at all levels of obesity. Randomised controlled trials (RCTs) have shown PA interventions over one year can reduce glycated haemoglobin (HbA1c) by 0.2% and blood pressure levels by ~2 mmHg. When PA is paired with dietary interventions and associated with moderate weight loss the magnitude of these benefits is doubled or tripled[66-68].

In addition to these effects on cardiometabolic conditions, the impact of PA on the risk of musculoskeletal conditions becomes increasingly important. One-fourth of the adult population aged 45–64 years already have some limitation in mobility and ability to walk for extended periods, and this risk increases significantly with each class of obesity[43]. PA has consistently been associated with delays in the onset of mobility limitations[69] and thereby enables the maintenance of physical function and participation across the domains of life. Behavioural interventions combining modest weight loss with PA and nutritional changes are associated with a 20% reduction in HTN, 20% – 60% reduction in T2DM incidence and have been associated with reductions in risk of chronic kidney disease[70,71].

Among the "**young old**" (e.g., ages 65–74), rates of myocardial infarction and stroke increase significantly compared to earlier ages. Similarly, T2DM and HTN continue to increase in prevalence and PA continues to play a protective role[59]. In this age group PA becomes increasingly important to maintain lean body mass.

As adults age (**age 75+**), diverse forms of PA, including walking, strength training and activities that maintain balance, flexibility and mobility, are all important to prevent a decline in physical function and the onset of frailty and disability, reduce symptoms from arthritis and prevent major osteoporotic fractures[72,73].

Figure 2: **Potential Impact of Physical Activity on Disease and Conditions Across the Lifespan**



Exercise prescription and guidelines

Developing our understanding of how the components of FITTE (frequency, intensity, type, time, enjoyment; see Table 1) relate to the management of individuals with obesity is important. It helps us to modify exercise goals and targets and provide individuals with more autonomy over their selected strategies for achieving their activity goals.

Type of activity

Aerobic: Aerobic activity optimises EE regulation. There is consensus that any aerobic activity is beneficial and importantly should be one selected by the individual based on their likelihood of regular engagement. Some popular forms of aerobic activity reported include walking, swimming, or cycling.

Resistance: Resistance activity is often used as a complement to aerobic activity, as it can attenuate the loss of fat-free mass which may accompany obesity management.

Flexibility: The ability to move joints through their full functional range of motion (ROM) should be considered along with aerobic and resistance exercise. The American College of Sports and Exercise Medicine recommends that all adults participate in flexibility work two to three times per week. This may help preserve individual joint function and be used as a pain treatment when combined with motor control techniques.

Volume/duration

Differences in volume maybe achieved by lengthening the duration of the activity, changing the frequency or the intensity, while keeping type of activity type consistent. One study by Jukicic *et al*.[74] examined different combinations of intensity and duration and found no difference in terms of weight outcomes at six months or 24 months. PA volume for optimal obesity management should be sustainable to optimise PA behaviours and a long-term view must be taken. Thus, emphasis should be on behavioural support, maintenance of healthy PA habits and achievable PA goals.

Intensity

Research to date is equivocal on the impact of moderate versus high intensity physical activity on weight loss or changes in fat mass[68]. Recently, a review by Rugbeer *et al*.[75] stated the moderate intensity was significantly better at improving cardiovascular fitness, compared to higher intensity exercise in patients living with overweight or obesity. While the higher intensity exercises may mean less leisure time spent on planned exercise to reach guidelines, moderate intensity may be associated with more enjoyment and better adherence. Individuals with overweight and obesity reported higher rates of perceived exertion and less pleasure from exercise especially when intensity and volume were prescribed and not self-selected[76,77].

Frequency

Evaluation of the impact of the frequency of PA on obesity is relatively new. Boulé *et al*.[68] reports on one study that showed that a low frequency group (three days/week x 100 minutes) had a greater decrease in weight (9.6 kg vs. 7.8 kg) in comparison to the high frequency group (five days/week x 60 minutes) over the same time period. However, more research is needed to confirm this effect.

Exercise prescription for "best weight"

People living with obesity should be supported to optimise PA behaviours towards the Health Service Executive (HSE) PA guidelines[78]. For adults, between 150 and 300 minutes of moderate intensity aerobic PA; or 75 minutes to 105 minutes of vigorous intensity aerobic PA per week is recommended for health benefits. In addition, adults should engage in muscle-strengthening activities of at least moderate effort level on two or more days per week for additional benefit. These recommendations have been tailored to different age groups (18 – 64, 65+) and level of ability.

The World Health Organisation (WHO) also recommends that

individuals replace sedentary time with PA (even light intensity PA) as "every move counts towards better health"[79]. However, the WHO campaign also acknowledges that "threshold recommendations" (i.e., 150 minutes moderate intensity aerobic PA or 75 minutes vigorous intensity aerobic PA) may be a barrier to the most inactive, or to high-risk groups and it may serve to discourage them from initiating behaviour change. It is a key role for HCPs to help tailor goals and support each individual given their unique circumstance and barriers. HCPs should understand the increased effort involved in virtually all forms of movement for those living with obesity — whether this is due to mechanical loading, pain, sleep disorders, metabolic disease, cardiorespiratory disease or an array of other unique challenges.

Behavioural and clinical support for physical activity and obesity care

Clinical guidelines for the management of obesity recommend the use of behavioural-support interventions, delivered by trained professionals for adults[80]. Interventions involving clinical skills in this area are associated with improved outcomes[81]. For example, techniques related to goal setting and self-monitoring of PA, providing feedback on PA behaviour, implementing graded tasks (e.g., increasing time spent in PA gradually) and adding objects to the environment (e.g., using a step counter) are particularly effective for increasing PA in those with obesity[82]. Additional techniques to support an increase in PA also include: stimulus control (e.g., keeping screens off to avoid substituting PA with sedentary activity or keeping comfortable shoes by the door to prompt use); social support (e.g., planning an activity with a peer or walking the dog); problem solving (e.g., planning shorter, more frequent walks to help manage pain/discomfort); cognitive restructuring (e.g., changing thoughts related to PA or PA barriers such as pain); relapse recognition (e.g., expecting and planning for reduced PA as time passes or at times of upheaval); strategies for dealing with weight regain (e.g., anticipating that weight will regain after a period of weight loss and the importance of PA for general health, wellbeing and weight stability)[80].

In the Look AHEAD (Action for Health in Diabetes) study, Pownall *et al*. [83] monitored body composition changes in a subset of 1,019 participants with overweight or obesity and T2DM over eight years. This RCT examined an intensive behavioural intervention that included an increase of physical activity of up to 175 minutes per week and a reduction of caloric intake between 1,200 kcal and 1,800 kcal/day. They observed a significant effect of the behavioural intervention on changes in body composition after one year. In addition, weight, fat mass and lean mass were lower in the intervention group versus control (diabetes support and education) at all testing points during the eight-year follow-up. Overall, there seems consistent evidence from many large, relatively high-quality trials and meta-analyses that professional support for PA behaviours that enables tailoring of goals and problem-solving sessions contributes to improvements in body composition and other indications of cardiometabolic health.

The "Making Every Contact Count Framework" provides guidance and training on how health and social care professionals may undertake brief behavioural support in any contact that they have with people who are living with overweight or obesity. It adopts the "5As approach" to brief interventions. This is a flexible framework to help HCPs have supportive conversations with patients about weight and health, originally developed for smoking cessation[84] and adapted for use in other areas (e.g., obesity)[85]. The 5As framework involves the following steps: ask permission to discuss health, weight and health behaviour; advise on weight and health; assess readiness to change; assist with exploring benefits and barriers of change, identifying options for change; and arrange referral to more intensive support if appropriate.

When planning an appropriate behavioural support for a person with obesity Michie's COM-B model[86] can be used to understand how the human behaviour (B) of PA results from the interaction between a person's physical and psychological capabilities (C), to use social and environmental opportunities (O) via motivators (M) that include reflective or automatic (emotional) thinking. Table 2 illustrates how the COM-B model can be applied when working with adults with obesity.

Table 2: **Examples of Using the COM-B Model when Working with Adults with Obesity**

COM-B domain	Example of adult with obesity who engages in PA	Example of adult with obesity who does not engage in PA
Capability (physical or psychological)	Positively affected due to level of physical fitness and a good understanding of the importance of staying active for health/wellbeing.	Adversely affected due to physical impairment, presence of pain or fatigue and low level of health literacy and understanding around PA for health.
Opportunity (social or environmental)	Person has strong social network, is involved in groups/classes and lives in neighbourhood that supports active transport and indoor/outdoor activities.	Person may not have family/friends to be active with or roads may be unsafe for walking/cycling in their neighbourhood.
Motivation (reflective or automatic thinking)	Person wants to stay active for health and social reasons and feels confident and positive about PA.	Person may not have time for PA at present or may have had negative experiences of PA in the past.

In Ireland the HSE's Model of Care for the Management of Overweight and Obesity was published in 2021[87]. This document describes the organisation, delivery and resourcing of healthcare services for people living with obesity. It recommends access to physiotherapists in ambulatory care hubs and in specialist obesity multi-disciplinary teams to support clinical assessments and interventions relating to physical function, musculoskeletal, neurodevelopmental, gait, mobility, postural and balance, physical activity behaviours, sleep behaviour and sleep apnoea triage, pain management, rehabilitation, exercise therapy and strength training based on both individual and group sessions. Additionally other interventions are mentioned that include hydrotherapy, manual therapy, prescription of orthoses, gait/mobility aids and lymphoedema management, including compression wrapping and tailored garments[87].

Risk-benefit ratio of increasing physical activity

Increasing PA should be viewed as a health intervention and, as such, the potential for adverse events should be considered. Some patients or HCPs may hold fears regarding the potential harm associated with increasing PA. This may concern the potential for a cardiovascular event, falls risk, acute musculoskeletal injury or increasing intensity of chronic pain.

Obesity has been shown to accelerate the age-related decline in physical function[88]. The Irish Longitudinal Study on Ageing (TILDA) among other ageing studies have shown that obesity is associated with an increased prevalence of frailty in older adults[89-91]. These factors may have contributed to the higher risk of falls that was observed in cross-sectional studies. For example, a cross-sectional analysis of over 10,000 individuals in the US compared lean individuals to those living with obesity and found a correlation between BMI and falls risk independent of variation in PA[92].

With regard to increasing the risk of injury there is some uncertainty as it has been highlighted in some, but not all studies[93,94]. In the study by Janney and Jakicic[94], which included data from 397 participants from two separate trials, walking was prescribed as the primary mode of exercise. Participants included men and women with BMI ranging from 25 kg/m^2 to 40 kg/m^2. While there was no increased risk of injury compared to control, a substantial proportion of participants (46%) from both groups reported some injury or illness during the trial period and 7% of the reported injuries were associated with the walking programme. A higher BMI was associated with increased odds of injury over time, as well as being injured earlier during the PA intervention.

In the Diabetes Prevention Programme, the researchers randomised 3,234 participants to placebo, metformin or a behavioural intervention which included PA. There was a small increased incidence of musculoskeletal symptoms (number of events/100 person) of approximately 3% in the behavioural intervention group compared to placebo and metformin (24%, 21% and 20%, respectively)[95]. Both of these studies suggest increasing PA is associated with a small increase in injury especially for those living with obesity. Fortunately, none of the adverse events reported required hospital treatment nor were there any fatalities. This allows us to interrupt these events as of relatively minor concern from a clinical management point of view.

In contrast, Goodpaster *et al*.[96] studied 130 participants who had a BMI above 35 kg/m^2. Their study compared a combined diet and PA intervention against a sequence of separate dietary intervention followed by a PA intervention commenced after six months. There was no difference in the incidence of any adverse events when the two types of intervention were compared. This suggests that increasing PA did not present an increased risk of cardiovascular events, falls or musculoskeletal injury.

One possible explanation for the variations between studies' level of adverse events may be the guidance the patient received regarding the intensity of the PA and the rate of progression. This is particularly relevant if expectations are set that the PA/exercise should be at a challenging level or higher intensity. If the individual is not accustomed to working at a high intensity, they may not be physically able to maintain the higher workload without an acute mechanical overload which may in turn cause a soft tissue injury.

As we move away from advice regarding the need to burn calories at a high intensity to obtain a negative energy balance and embrace the concept of PA interventions that are aimed at preservation and rehabilitation of physical function and encouraging the person to enjoy the PA experience, this may allow a natural progression of function and gradual mechanical loading without the pressure or risk of substantial mechanical overload. This may help to further minimise the risk of injury or other adverse events.

Quality of life and mental health

Obesity has a negative impact on psychological health with increased rates of anxiety, depression, body dissatisfaction and poorer QoL reported[32]. However, the evidence in relation to the impact of physical activity on mental health and QoL in obesity is mixed depending on the context, outcome variable measured and population studied.

Fanning *et al*. randomised 249 older adults with obesity and found that the addition of aerobic or resistance training to a weight-management programme improved health-related QoL and satisfaction with physical function indicators, such as greater self-efficacy in walking and climbing[17]. Similarly, Brown *et al*. assessed the effect of PA in 173 women of middle-age who were sedentary. This randomised trial of moderate-to-vigorous intensity exercise showed significant improvements in mental health scores and QoL[18].

In contrast, Baker reported no significant changes in mental health outcomes and QoL following an exercise intervention in post-menopausal women[97]. Baillot *et al*.'s 2018 systematic review and meta-analysis found that while the RCTs and before-and-after studies reported significant improvements in many QoL domains (e.g., psychosocial and physical functioning, self-esteem, public

distress), the RCTs showed no significant effect for physical or mental domains of QoL, depression, anxiety or body image[98]. Specifically in relation to body image, two hours of dance therapy per week lasting for 36 weeks has been shown to significantly improve health-related QoL, body consciousness and mental representations linked to self-body image in females of middle age[19].

A more recent systematic review examined 32 RCTs for the effects of exercise training on psychosocial outcomes in adults with overweight/obesity[32] and in agreement with other studies, reported moderate positive effects on QoL, vitality and mental health but not depression. Further-more, psychological outcomes, such as body image, anxiety and stress, showed conflicting or null results. More studies, with greater descriptions of intervention characteristics, and longer follow-ups are required to further understand the relationship between PA and mental health in those living with obesity[32].

Conclusion

Adults living with obesity should be supported to engage in PA as an integral component of all obesity management and healthy living strategies. PA offers a wide range of health benefits that are often independent of weight loss. The key goals of PA in obesity management are to optimise health gain and to avoid erosion of physical function.

PA behaviour in those with obesity can be influenced by social fears based on stigmatising experiences, low mood, fatigue, pain and higher rates of perceived exertion. Recommended guidelines and thresholds for PA are helpful for the general population but goals may need to be tailored to address an individual's physical abilities and preferences.

Understanding the relationship between PA, physical fitness and physical function forms the basis for the effective use of therapeutic PA in obesity care. Rather than viewing PA through a narrow focus of its influence on body weight, PA should be considered in the context of its broader influence on physical and mental health outcomes and ultimately its role in optimising participation and QoL. Health and exercise professionals supporting people with obesity should use non-stigmatising approaches and optimise PA goals in order to improve health outcomes, rehabilitate or preserve physical function.

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Appendix 1:

The therapeutic use of physical activity

All case studies are fictional and assume the practitioner is familiar with both Obesity Canada's "5 As" (ask, assess, advise, agree, assist) and Ireland's HSE's "Make Every Contact Count" frameworks.

Guiding principles for case studies:
Each patient is an individual. Guided by COM-B, any consultation should consider the individuals goals and needs, likes and dislikes – providing the individual with the opportunity to identify their motives for changing their behaviour and any barriers preventing them from becoming more active. Providing the patient with a sense of autonomy in relation to their choice of activity and control over their FITT will help to generate positive motivation. Readers should consult Chapter 10 Effective Psychological and Behavioural Interventions in Obesity Management also.

Case study 1 – Clinical nurse specialist in a hospital outpatient department

A 62-year-old man attends a hypertension (HTN) out-patient clinic and is reviewed by a clinical nurse specialist (CNS). Using the Edmonton Obesity Staging System (EOSS) he is living with Stage 3 obesity. He has declined an invitation for a weight check but at his last appointment his BMI was 41 kg/m^2. He lives alone, has been unemployed for the last 10 years, reports poor sleep and only leaves home approximately twice a week to go to the shops or to attend appointments and uses public transport. He feels he gets short of breath very quickly, has less ability to complete daily tasks than previously and, while he hasn't fallen, he expresses a fear of falling.

The out-patient department has been adapted for all patient needs, including those patients living with obesity. There are appropriate chairs and blood pressure cuffs. The HCP who checks the patient in has respected the patients wish not to have a weight check today.

The CNS has cultivated a collaborative relationship with the patient and this has previously helped the patient with smoking cessation. The CNS would now like to explore how optimising his physical activity level (PAL) may improve his HTN, general health, physical function and quality of life (QoL).

Aims:

- To ask his permission to discuss PA in the context of health outcomes.
- To assess his previous and current PAL.
- To help him identify the barriers and enablers to engaging in PA.
- To advise on how PA may influence his current and long-term health.
- To consider ways to overcome barriers and to check if now is a good time to address this issue. If the patient feels it is not the right time, that decision is respected and the door is left open for a future time.
- To agree and identify a realistic plan to support his PA goals and behaviours. This includes how to manage shortness of breath with pacing and short bouts of activity.
- To discuss trying to leave his home more than twice a week and attempt to define a specific goal for this.
- To assist in finding further supports (e.g., community services, patient groups, etc.) or refer onto other services to help with his barriers, such as mobility issues or pain and possibly arrange a sleep apnoea review.

Table 3: **Case Study 1**

Problem	Agreed goal
Decline in physical function / Leaving home infrequently / Social isolation	Increase routine PA by leaving house more frequently for short walks of approximately 5–10 minutes. This could include short bouts of work in his garden. Due to social isolation, he may need to focus his walk on doing a task rather than solely walking (e.g., visiting the library, going to the shop on foot or recycling glass bottles). Consider joining community group (e.g., Men's Shed, Siel Bleu, Grow it Yourself (GIY), etc.).
Increased shortness of breath on exercise	Slower pace of walking and plan rest breaks (plan the route). Possibly use an online map to visualise the route and plan breaks. To keep walking to short bouts (~10 minutes) and use the Borg Rating of Perceived Exertion scale to keep the experience at moderate intensity. Plan to check back in and progress time in activity bouts.
Poor sleep / Possible dysregulated pattern	Refer to sleep apnoea service. Consider sleep hygiene strategies.
Fear of falling	Refer to local physiotherapy service to assess his balance and prescribe home-based exercises to improve his balance.

Reflective practice:

- What change outcome would make you feel your intervention was successful?
  - o Achieving a non-adversarial conversation about PA and chronic disease management;
  - o Reporting that he is feeling more socially connected by being outside more and meeting people while doing his daily tasks;
  - o Reporting that he is feeling more confident and in control of his breathlessness;
  - o Reporting that he has had an improvement in mobility (longer bouts, less short of breath, less sedentary time and generally being more active);
  - o Reporting that he is feeling proud for planning and completing his activity-related goals; and
  - o Reporting that he feels less overwhelmed and more empowered regarding his barriers to PA.

- What change in this man's behaviour would have an effect on his HTN?

- What outcome would make you feel your intervention had "failed"?

- How would you ensure that this man would seek further support from you at his next appointment?

What might success look like?
For this man success might include: doing more frequent or longer bouts of incidental physical activity; feeling more socially connected by being outside more and meeting people while doing his daily tasks; feeling more confident and in control of his breathlessness; feeling proud for planning and completing his activity-related goals; feeling empowered that his barriers are not set in stone and his function can be improved with some support to solve his specific concerns; and agreeing to check back with the nurse in the future with an update and to consider progressing his goals.

Case study 2 – General practitioner in a GP surgery

A 45-year-old female attends her general practitioner (GP) complaining of chronic established bilateral knee osteoarthritis and pain (left > right). She has a BMI of 53 kg/m^2, a history of high cholesterol and polycystic ovarian syndrome (PCOS) and reports that her mood routinely becomes very low and has increased anxiety. This suggests an EOSS Stage 2 obesity diagnosis. She works from home, lives with her partner and has two teenage children.

Pain symptoms have worsened over the last two years and are aggravated by standing up from sitting, being on her feet for more than 15 minutes and using the stairs. During the last year she has stopped her routine habit of walking 20 minutes five times a week as she is worried that she is damaging her knees by walking. She is now leaving home less often, has become more sedentary and has had a recent 5 kg weight gain which she is concerned about.

The GP has an in-depth understanding and experience of patients living with obesity and has a supportive environment, e.g., chairs, blood pressure cuffs and weighing scales. The patient feels comfortable discussing her health with her GP.

After a clinical exam, the GP feels that there are no red flags and her pain is in line with early osteoarthritis. Appropriate pain medications are prescribed and advice to allay her fear avoidance is discussed regarding the nature of the pain and benefits of staying active. It is also suggested that starting some lower limb strength work would be appropriate and that she could consider using a mobility aid intermittently (e.g., walking stick) to enable increasing her PA to prior levels, or that for now she considers other forms of PA that may cause less knee pain symptoms, such as walking in a swimming pool, swimming or cycling.

Aims:

- To ask her permission to discuss PA is the context of pain, fear of movement, long-term physical function, obesity management and healthy ageing.

- To assess barriers and enablers to PA in light of her current symptoms. These may include stigma and vulnerability of using a public swimming pool, using a walking stick or attending groups.

- To advise her on how adapting PA may help in the long-term outcome of common knee pain (as above, mobility aid [walking stick] and changing the type of PA, changing her walking goals, strength training, cycling or pool exercise groups).

- To agree to a set of realistic goals as to how to adapt and use different types of PA to improve and maintain her physical function despite ongoing knee pain.

- To arrange further supports (e.g., community services, pool access, patient groups) or refer onto other health services to help with pain and rehabilitation (e.g., physiotherapy).

Reflective practice:

- Would it take a change in a measurable outcome to qualify your intervention as a success?

- What change in behaviour would allow you to feel that your intervention was worthwhile?

- At her next visit, how would you respond if she reported an increase in knee pain, body weight or no change in her PA levels?

Table 4: **Case Study 2**

Problem	Agreed goal
Knee pain	Pain medications. Improved thoughts on reason for pain (less fear avoidance). Progression of PA to rehabilitate knee function, including strength work, restarting walking but with shorter bouts at a slower pace, explore pool use and/or using cycling. To considered referral to local physiotherapist to support rehabilitation of knee function. To consider using a walking stick to enable safe and supported leisure time PA.
Lower PA levels and increased sedentary time	Start using step counter to monitor PA levels. Use self-monitoring to increase awareness of sedentary time and use this for goal setting. Plan best time to take movement breaks when working from home and whether a "buddy" (e.g., partner, child or friend) might be able to support activity goals.
Weight gain	To restart previously used dietary strategies to help self-management of weight gain. To consider referring to community-based obesity-management services. To use targeted analgesia if pain is disturbing domestic tasks, sleep, etc. To consider (re)joining commercial weight-management group. Improving PA levels.
Leaving home infrequently	Restart short-bout walking habit with new pain-management strategies and a buddy for support if needed.

What might success look like?
For this woman success might include: a better understanding of pain symptoms; a better understanding that increased pain symptoms during bouts of PA was not associated with joint damage and were not "wearing out" her knees; a better understanding that routine PA was associated with better outcomes for osteoarthritis and joint health; leaving the house more often; increased and improved quality of participation in routine activities, such as socialising, household activities, shopping, etc.; and engaging in five minutes of knee strengthening exercises routinely.

Case study 3 – Physiotherapist in a primary care consultation

A 23-year-old female attends a local physiotherapist for re-occurrence of low back pain. During the assessment she reports to the physiotherapist that she is considering joining the gym with the aim of "losing my weight". She gives a self-reported weight of 125 kg which she reports as "up and down" but generally stable over the past two years. Her height is 1.67 m giving a BMI of 43 kg/m^2. She is reluctant to have a weight check in the gym environment. She reports that she has recently been told by her GP that she is borderline for T2DM and reports intermittent bouts of minor low back pain suggesting an EOSS Stage 1 obesity diagnosis.

She works in retail and is on her feet for approximately seven hours each day for five days each week. She lives in her parental home and has no dependants. She has previously attended group exercises in a gym for high-intensity interval training and voiced her frustration at its limited impact on her goal of substantial weight loss.

The physiotherapist has a good understanding of obesity as a complex disease and is able to hold the consultation in a professional non-judgemental manner. They discuss the frustration she feels regarding weight management and previous exercise experiences. She reports that she has always found it very difficult to achieve sustained weight loss. She expresses her beliefs that she is a lazy person and generally doesn't do enough exercise. It is a running joke at home that she is "the lazy one", and a previous exercise professional told her that she "needs to work harder."

Aims:

- To ask permission to discuss links between health and weight in more detail.
- To assess her barriers and enablers to a sustainable approach to gym-based leisure time PA. The discussion involves enjoyment of the experience, expectations regarding weight outcome and other health outcomes, time availability and financial ability to meet costs.
- To advise her regarding realistic health outcomes for her attendance and gym exercise behaviours, especially the impact of aerobic and resistance work on T2DM risk.
- To advise on the impact on improved weight maintenance on mental health and QoL.

- To validate that she already has high PA levels due to her occupational demands, which are already impacting her weight profile and risk for chronic disease.

- To agree a set of realistic goals – identifying a gym where she would feel comfortable, draft an attendance schedule, discuss typical flexibility required for long-term gym attendance, and realistic goal setting of outcomes; making a sense of enjoyment, personal achievement and positive impact on mental health the key outcomes and also agreeing on strength and fitness goals based on a mix of aerobic and resistance exercise types.

- To arrange a follow-up schedule, help in pricing options, link with appropriate group classes and ensure understanding regarding safe use of equipment.

Reflective practice:

- Would it take a change in body weight to define her gym attendance as a success?
- How would you respond if her attendance dropped off after the first six weeks?

- Is it important to address her language and beliefs around being "lazy"?

What might success look like?

For this woman success might include: recognising the benefits of her high baseline PA associated with her work in retail; a better understanding of the role of resistance work for glycaemia; engaging in resistance work at her own pace and episodically, i.e., in recurrent periods throughout the year; an improved understanding of the role of PA in obesity management; moving away from stigmatising language and identification as "lazy"; engagement with PA in a more positive and sustainable way.

Table 5: **Case Study 3**

Problem	Agreed goal
Frustration with lack of weight loss and a poor understanding of the role of PA in obesity management	To structure her engagement with gym-based PA based on an understanding of obesity as a chronic disease with many contributing factors. Increasing PA within the gym as a standalone behaviour will unlikely lead to substantial weight loss. Understanding the impact of PA on body composition, glycaemia, blood pressure and other health outcomes. Work on the enjoyment aspect of attending the gym and building strength and fitness.
A limited understanding of the role of PA on her obesity complications / other chronic diseases (T2DM and PCOS)	Understanding the value of both resistance and aerobic exercise for their therapeutic effect that can be tailored to her needs.
Previous sub-optimal experience with exercise attempts	Use of goal setting and review to become aware of each non weight related small success and achievement. Consider the use of a structured approach to planning engagement in the gym, such as frequency, intensity, time, type, volume and progression. Adaptations as necessary to ensure using gym equipment safely and to avoid increasing back pain. Modifying exercises for larger body size where appropriate. Discuss alternative options for leisure-time activity outside of the gym environment as she progresses over time.