ARTICLE

Physical activity as an intervention in severe mental illness†

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SUMMARY

Physical activity is a modifiable risk factor for several physical and mental health conditions. It is well established that people with severe mental illness have increased risk of physical health complications, particularly cardiovascular disease. They are also more likely to be physically inactive, contributing to the elevated cardiovascular and metabolic risks, which are further compounded by antipsychotic medication use. Interventions involving physical activity are a relatively low risk and accessible way of reducing physical health problems and weight in people with severe mental illness. They also have wider benefits for mental health symptoms and quality of life. However, many barriers still exist to the widespread implementation of physical activity interventions in the treatment of severe mental illness. A more concerted effort is needed to facilitate their translation into routine practice and to increase adherence to activity interventions.

LEARNING OBJECTIVES

After reading this article you will be able to:

- understand why physical activity is clinically important for people with severe mental illness
- recognise the possible barriers to and facilitators of engagement in physical activity by people with severe mental illness
- consider the next steps for commissioners, researchers and practitioners in this area.

KEYWORDS

Physical activity; exercise; fitness; schizophrenia; bipolar affective disorder.

Physical activity refers to any bodily movement that results in some degree of energy expenditure (Caspersen 1985). The importance of physical activity for treating and preventing many chronic diseases is well established. For example, population-level research shows that higher levels of physical activity are associated with lower incidence of cardiovascular disease, diabetes, cancer and common mental health disorders (Wilmot 2012; Kyu 2016; Bennett 2017; Schuch 2018, 2019). A recent umbrella review of 27 systematic reviews found that physical activity is effective for treating symptoms of depression, anxiety and stress disorders, schizophrenia, and alcohol or substance use disorders (Ashdown-Franks 2021). These results are primarily based on data from randomised controlled trials (RCTs), with a total of 152 studies included in the review.

The importance of physical activity to public health is exemplified by the widespread adoption of standardised physical activity guidelines (World Health Organization 2015). In the UK, the Chief Medical Officer's report recommends that adults engage in at least 150 min of moderate-intensity aerobic activity or 75 min of vigorous-intensity aerobic activity per week (Department of Health and Social Care 2019). Moderate-intensity activity might include brisk walking or riding a bicycle, whereas vigorous-intensity activity refers to running or sports such as football and athletics.

Among other health benefits, aerobic activity improves cardiorespiratory fitness and helps with weight management. Cardiorespiratory fitness reflects the efficiency of the circulatory and cardiovascular system during activity in adults (Blair 1996). Low cardiorespiratory fitness is associated with a greater risk of several chronic conditions, cardiovascular disease and common mental disorders (Lee 2011; Kandola 2019). Guidelines also recommend engaging in strength training at least twice per week. Strength training refers to exercises that strengthen muscles, such as using resistance bands or lifting weights. These exercises improve muscular fitness, which is another important marker of chronic health conditions, common mental disorders and cognitive performance (Celis-Morales 2017; Wu 2017; Firth 2018c; Kandola 2020).

Physical inactivity refers to not meeting national physical activity guidelines (Kohl 2012). Physical inactivity is widely recognised as different from sedentary behaviour, even though they both sit on the same activity spectrum. Sedentary behaviour refers to any activity in a sitting, lying or reclining position with very low energy expenditure (Tremblay 2017). Driving or watching television while seated are examples of sedentary behaviours. Physical activity guidelines in the UK recently included recommendations for reducing sedentary behaviour, where possible (Department of Health and Social Care 2019).

Despite sustained global health campaigns, physical activity levels in the general population are still

lower than recommended. Worldwide, over 27% of adults (around 1.4 billion individuals) and 81% of young people aged 11 to 17 were estimated to not be achieving national physical activity guidelines in 2016, with little improvement since 2001 (Guthold 2018, 2020). Global cardiorespiratory fitness appears to have decreased in adults and children over the past few decades (Lamoureux 2019; Tomkinson 2019). Estimates suggest that around 5 million deaths worldwide are directly attributable to physical inactivity each year (Lee 2012).

Reducing physical inactivity has the potential to improve population physical and mental health. Approaches for increasing physical activity are generally safe, have few to no side-effects, are widely accessible and are cost-effective in the population (Roux 2008). The following sections will explore how and why people with severe mental illness (SMI) represent a high-risk group that would benefit from interventions to increase activity. We use SMI in this article to indicate a diagnosis of any bipolar disorder, non-affective psychoses or major depressive disorder. However, much of the current literature focuses on people with a schizophrenia diagnosis specifically.

Physical activity and SMI

People with SMI are generally less physically active than the general population. A recent meta-analysis of 69 studies ($n = 35\,684$) found that people with SMI engaged in an average of 38.4 min of moderate to vigorous physical activity per day, around 13 min fewer than comparison groups without SMI (Vancampfort 2017b). These findings are mostly from self-report questionnaires, and data from the UK Biobank suggest that these measures likely overestimate physical activity in SMI populations (Firth 2018d). Data from activity monitors in 1078 people with schizophrenia from the UK Biobank suggest that their total physical activity is 80% lower than that of the general population. There are also differences between diagnoses. For example, people diagnosed with bipolar disorder had higher sedentary behaviour but higher moderate to vigorous physical activity per day than those reporting a diagnosis of schizophrenia (Vancampfort 2017b).

The lower activity levels in SMI populations have implications for physical health (Firth 2019). People with SMI have lower levels of cardiorespiratory fitness ($g = -1.01$) than healthy controls, with no difference between those with bipolar disorder or schizophrenia (Vancampfort 2017a). Physical inactivity and high levels of sedentary behaviour tend to cluster with other behavioural risk factors for physical ill health in SMI populations, such as smoking (Jackson 2015) and poor diet (Firth 2018a). These unhealthy lifestyle factors likely contribute to the 1.4–2 times increased risk of cardiovascular and metabolic disease in people with SMI compared with the general population (Firth 2019). Data from primary care records indicate that the risk of premature mortality is elevated in people with SMI (HR = 1.79 for bipolar disorder and HR = 2.08 for schizophrenia) and this mortality gap from the general population appears to be widening (Hayes 2017). The development of comorbid physical health conditions in people with SMI creates an enormous healthcare challenge for the UK's National Health Service (NHS) (Naylor 2016). As set out in its long-term plan, the NHS is committed to improving physical health outcomes for people with SMI and reducing this mortality gap (NHS England 2019).

Physical inactivity is a major component of an unhealthy lifestyle that is likely to contribute to the physical health risks associated with SMI. It may also affect symptoms of mental illness. Physical activity conveys a range of mental health benefits for people with SMI, including reducing depression and anxiety symptoms and improving cognitive functioning, sleep, quality of life and social adjustment (Rosenbaum 2014; Firth 2015, 2017; Ashdown-Franks 2020). Increasing physical activity and reducing sedentary behaviour in SMI populations may have transdiagnostic benefits that improve psychiatric symptoms and well-being while reducing the risk of physical health complications over time.

The effectiveness of physical activity interventions in SMI populations

The British Association for Psychopharmacology (BAP) recommends the use of lifestyle interventions for managing weight and cardiovascular disease risk in treating SMI (Cooper 2016). A recent European Psychiatric Association statement highlighted that interventions involving physical activity also have wider physical and mental health benefits in SMI populations, and there is an increasing focus on increasing their acceptability and effectiveness (Stubbs 2018). These interventions use various types of physical activity, such as stationary cycling, walking, resistance training, jogging and group-based aerobics sessions. Protocols are sometimes based on national activity guidelines or specific recommendations from authoritative bodies, such as the American College of Sports Medicine. But the content of these interventions may be perceived as unrealistically high for people with low activity. Some interventions consist of multiple short bouts of activity, such as two or three bouts of 10 min per day (Linke 2011). These approaches are less intense and allow greater flexibility to incorporate activity throughout the day.

Mental health

There is evidence that these physical activity interventions can improve mental health outcomes. A meta-analysis of 20 studies suggested that aerobic exercise interventions involving at least 90 min of moderate to vigorous physical activity per week can reduce positive (s.m.d. = −0.54, 95% CI −0.95 to −0.13) and negative (s.m.d. = −0.44, 95% CI −0.78 to −0.09) symptoms in people with schizophrenia (Firth 2015). The exercise intensities for these studies are typically based on individual factors, such as baseline fitness, activity levels, heart rate and other health factors. For example, exercises may be set at 40–60% of a participant's maximum capacity. A systematic review of six studies found that strength training also reduced positive and negative symptoms in people with schizophrenia (Keller-Varady 2018). The strength training interventions in these trials typically focused on resistance exercises for large muscle groups, such as the legs, chest, shoulders and back. Some interventions also included an aerobic component, such as running or walking. Interventions were delivered by a study investigator or trained exercise professional. Another meta-analysis of 10 studies involving with 20–60 min of aerobic exercise 2–4 times per week were associated with improved global cognitive function ($g = 0.33$, 95% CI = 0.13–0.53) in people with schizophrenia (Firth 2017).

Far fewer studies exist that investigate the relationship between physical activity interventions and psychiatric symptoms in people with bipolar disorder (Ashdown-Franks 2020). One systematic review with 31 studies of varying design found that higher exercise levels were associated with fewer depressive symptoms in people with bipolar disorder (Melo 2016). Associations with mania symptoms were inconsistent. However, this review included observational studies and some interventional studies, but no RCTs. Evidence for the utility of exercise in bipolar disorder is typically based on extrapolated evidence from trials in people with unipolar depression (Thomson 2015). For example, several meta-analyses of RCTs using physical activity interventions have consistently found moderate to large effect sizes for reducing symptoms of depression and anxiety disorders (Bridle 2012; Herring 2012; Cooney 2013; Josefsson 2014; Kvam 2016; Schuch 2016; Stubbs 2017). The role of exercise in bipolar disorder could be more complex than in unipolar depression. For example, preliminary evidence suggests that exercise can help people with bipolar disorder manage their excess energy, but may exacerbate manic and hypomanic symptoms (Thomson 2015).

Physical health and quality of life

There is evidence that exercise can also improve physical health outcomes in people with SMI. A meta-analysis of four RCTs suggests that around 12 weeks of aerobic exercise 2–3 times per week can improve cardiorespiratory fitness in people with schizophrenia ($g = 0.43$, 95% CI = 0.05 to 0.82) (Vancampfort 2015). A systematic review of ten studies found that walking-based interventions can produce small reductions in body fat or body mass index (BMI) in people with schizophrenia (Soundy 2014b). Another systematic review of seven RCTs found that combined aerobic and resistance training for around 95 min twice per week was effective for improving strength and overall mental health in people with schizophrenia (Martin 2017). Although less research is available for bipolar disorder, regular aerobic exercise in people with mild to severe depression improves various aspects of physical health, including cardiorespiratory fitness, body fat percentage and blood glucose levels (de Souza Moura 2015; Vancampfort 2017a).

Physical activity interventions also provide broader of range benefits to people with SMI. For example, two RCTs found that at least 120 min of moderate to vigorous physical activity per week improved quality of life and reduced disability (Firth 2015). A meta-analysis of eight RCTs using various types of exercise found large improvements in sleep ($g = 0.73$, 95% CI 0.18–1.28) in people with SMI (Lederman 2019).

Aerobic exercise can also stimulate a multitude of changes in the brain that are relevant to SMI (Kandola 2016). For example, aerobic exercise can increase the volume (Firth 2018b) and functioning of the hippocampus (Erickson 2009), including in people with schizophrenia (Pajonk 2010; Woodward 2018). These improvements in hippocampal integrity may contribute to reductions in overall symptoms and cognitive deficits in people with schizophrenia (Kandola 2016).

Evidence from 160 RCTs also suggests that both aerobic and strength training over a median of 12 weeks can reduce several pro-inflammatory markers in predominantly healthy participants (Lin 2015). There is also some early evidence of this in psychiatric populations (Euteneuer 2017; Lavebratt 2017). Pro-inflammatory cytokine levels are elevated in many people with SMI and could contribute to both psychiatric symptoms and physical health risks (Khandaker 2015; Rosenblat 2016).

Safety, dose–response and cost-effectiveness

Interventions to increase activity are a relatively low-risk approach for improving the mental and physical

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health of people with SMI. Exercise interventions do not substantially increase the risk of adverse events in the treatment of mental illness, although more consistent data on safety would be beneficial (Czosnek 2019). Despite promising initial findings, there remains a lack of large-scale RCTs of activity interventions in SMI populations (Vancampfort 2019).

There remain unanswered questions regarding dose–response (frequency, intensity and duration of intervention) and safety. For example, people with SMI may experience balance or other musculoskeletal problems that increase the risk of falling during exercise (Hamera 2010). Tailored exercise programmes that incorporate balance and coordination exercises could be a useful method of addressing these concerns (Vancampfort 2016a). The cardiovascular and metabolic benefits of exercise likely outweigh the risk of falls, which only represent a concern for a minority of people with SMI (Firth 2016).

Achieving 150 min of moderate to vigorous physical activity is a viable target in many populations, but different targets may be necessary for people with SMI (Vancampfort 2015a). For example, people with SMI may benefit from engaging in frequent bouts of light activity throughout the day to break up extended periods of sitting. Large RCTs are necessary to compare the relative benefits of different intensities, durations and frequencies of activity in people with SMI.

Although community-based exercise interventions are increasingly demonstrated as being cost-effective in non-SMI populations (Kelly 2021), similar data in SMI groups are lacking (Czosnek 2019).

Barriers and facilitators for implementation

Although there is a growing evidence base for their transdiagnostic benefits, research on the clinical implementation of physical activity interventions for people with SMI is lacking (Vancampfort 2015a; Lederman 2017). However, available research has indicated a number of barriers and facilitators in implementation (Box 1).

Barriers

Modifying physical activity is a challenge in any population and requires varying approaches for different people (Heath 2012). There are several physical, psychosocial and environmental barriers to increasing physical activity and decreasing sedentary behaviour in people with SMI (Soundy 2014a; Firth 2016b). These factors likely underlie the substantial drop-out rates from activity interventions in SMI populations, which are estimated to be around 27% in people with schizophrenia (Vancampfort 2015b). Nevertheless, this is within the range of drop-out rates for activity interventions found in other populations (18–35%), such as obese individuals (Linke 2011).

BOX 1 Engagement in physical activity interventions by people with severe mental illness: barriers and facilitators

Barriers

- Medication side-effects
- Co-existing physical health conditions
- Lack of motivation
- Illness-related symptoms (e.g. negative symptoms of psychosis, social anxiety, low self-esteem)
- Lack of access to a suitable environment

Facilitators

- Use of a qualified professional to deliver the activity
- Social support of peers and healthcare professionals
- Providing information about the activity
- Personalised goal setting and activity plans

Medication side-effects and co-existing physical health conditions are examples of possible physical barriers to increasing activity in people with SMI. Physical activity is typically lower in adolescents and adults with SMI who are taking second-generation antipsychotic medications (Cuerda 2014; Vancampfort 2016b; Perez-Cruzado 2018). A qualitative study of 151 physical therapists working in psychiatric services suggests that medication side-effects are among the most commonly cited barriers to increasing activity in people with schizophrenia (Soundy 2014a). However, it remains unclear whether the medication or other factors explain the lower activity (Cuerda 2014).

Nurses and other healthcare staff also commonly report a lack of motivation and negative symptoms as common barriers to implementing physical activity interventions in people with SMI (Harding 2013; Robson 2013; Soundy 2014a). Related symptoms may also affect motivation. For example, social anxiety may reduce the likelihood of exercising outside or in a gym. Other motivational factors may relate to SMI treatment. For example, medication side-effects can affect motivation to exercise through sedation and neuromuscular side-effects (Soundy 2014a; Firth 2016). Understanding factors that increase motivation for activity in people with SMI is an essential but understudied area. A systematic review of 79 studies in SMI populations was able to identify only one that included motivation for physical activity as its main

outcome (Farholm 2016). The review suggests that interventional studies commonly use motivational interviewing and goal-setting techniques without directly evaluating their effectiveness. Related factors include a reduced sense of self-esteem and confidence in people with SMI that limit motivation to increase activity (Soundy 2014a).

Facilitators

A number of factors facilitate the successful implementation of activity interventions in SMI populations. A meta-analysis of 19 activity interventions in people with schizophrenia found that having a qualified professional delivering the intervention moderated dropout (Vancampfort 2015b). For example, including a physical therapist or exercise physiologist to lead the activity may increase adherence. A qualified exercise professional may increase the quality and enjoyment of exercise sessions. Social support is another facilitator of activity in SMI populations (Soundy 2014a). Peers and healthcare professionals can play an active role in fostering a supportive and encouraging environment to encourage adherence. These factors may help with psychosocial barriers of self-esteem and motivation.

The provision of information about the activity is another possible facilitator of activity (Soundy 2014a). People with SMI may lack knowledge about the benefits of the activity or how to perform activities that most interest them (Matthews 2018). Providing this information contributes to a supportive environment and promotes self-efficacy, which can lead to increased activity. Goal setting and creating personalised activity plans are also likely to provide complementary benefits for promoting sustainable improvements in activity (McEwan 2016). For example, the PRIMROSE trial for reducing cardiovascular risk in SMI groups obtained good adherence to the intervention through the use of behavioural change techniques that included goal setting, action plans, progress tracking, providing positive feedback and dealing with setbacks (Osborn 2018).

Future directions

Adherence

Implementing physical activity interventions in the treatment of SMI will be an important step in achieving the NHS's long-term goal of improving physical health outcomes for SMI groups (National Health Service 2019). Studies of activity in SMI populations are increasingly moving beyond demonstrating efficacy to establishing effectiveness in real-world settings, including the use of behavioural change techniques (Farholm 2016). Increasing adherence to interventions will be key to improving the quality of physical healthcare in SMI populations in accordance with NICE guidelines (National Institute for Health and Care Excellence 2014). Further research must directly examine successful methods for designing and implementing activity interventions in SMI populations, particularly in people with bipolar disorder, where there is a paucity of work. The field may benefit from developing novel methods for motivating people with SMI to increase their activity. For example, 'exergaming' interventions target motivation through enjoyable video games that promote exercise and bodily movements. An exergaming study involving 16 outpatients with schizophrenia found good acceptability, feasibility and an attrition rate of around 19% (Campos 2015). However, no significant improvements in fitness, mobility or symptoms resulted from the intervention.

A recent trial in people with SMI also integrated self-management concepts and social cognitive theory to promote adherence to a cardiovascular risk reduction intervention delivered through community mental health programmes (Daumit 2020). For example, they used motivational interviewing and solution-focused therapy sessions tailored to minimise the impact of memory and executive functioning deficits. The intervention also included a points system to encourage participants to attend sessions and achieve goals. Further interventions in community settings that utilise novel techniques to promote adherence would be beneficial.

It will also be necessary to take a practical and realistic approach to developing better activity interventions in SMI populations. Maintaining good activity levels across the life course is necessary to improve long-term physical health outcomes. But activity interventions typically last between 12 and 24 weeks in SMI populations and follow-up periods rarely exceed 36 weeks (Firth 2017). It remains unclear whether increased activity levels during the study period reflect sustainable changes in activity habits.

Dose

Despite a growing number of studies in the area, there is still no consensus regarding the type, frequency, duration and intensity of activity most suitable for treating people with SMI (Cooper 2016; Lederman 2017). A recent systematic review of 32 studies found inconsistent and low-quality evidence that interventions can increase activity or reduce sedentary behaviour in people with SMI (Ashdown-Franks 2018). Large-scale RCTs are necessary to establish the type, frequency, duration and intensity of activity that will be most beneficial for people with SMI.

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Safety, cost and cost-effectiveness

More research should focus on establishing safety and outlining the cost of activity interventions in mental health settings (Czosnek 2019). Although developing personalised activity plans and hiring exercise physiologists will likely promote adherence, they will also increase the cost. Managing cost-effectiveness will be essential, as activity interventions are most suitable as part of complex, multifactorial treatments approaches to mental illness (Firth 2019). Developing personalised approaches also requires accurate assessments of baseline activity and fitness. The use of devices to monitor activity levels could be prohibitively expensive in many clinical settings, where self-report measures would be more feasible. However, to our knowledge just one physical activity questionnaire has been specifically designed and validated for recording activity in people with mental illness (Rosenbaum 2020a).

A recent meta-review of 33 reviews found no available data on the cost of implementing activity interventions in mental health settings (Czosnek 2019). The long-term benefits of activity may outweigh the immediate costs of interventions. For example, physical activity may reduce cardiovascular risk, potentially offsetting future treatment costs for cardiovascular disease. More careful consideration of cost will be necessary to translate research into practice (Czosnek 2019).

Introducing lifestyle changes during routine care

The recent *Lancet Psychiatry* Commission on physical health in mental illness called for more routine implementation of lifestyle approaches in mental healthcare, including the involvement of physical therapists and exercise specialists (Firth 2019). This integrative approach to routine care reflects a need to manage the physical health of people with SMI more effectively, both with and without physical comorbidities. A greater integration of lifestyle approaches will contribute to the prevention or reduction of physical health problems over time and help to close the mortality gap between those with SMI and the general population. It will also help to mitigate some long-term medication side-effects, such as weight gain. Lifestyle approaches aiming to counteract weight gain in people with SMI are most effective when combining exercise with dietary changes, rather than exercise alone (Gurusamy 2018). Implementing these lifestyle approaches as part of routine care in SMI groups may require changing staff perspectives and culture, such as by offering brief lifestyle interventions to clinical and non-clinical staff (Rosenbaum 2020b). Practitioners' lack of knowledge of physical activity interventions is a common barrier to their prescription in mental health services (Way 2018).

Systemic changes to reduce health inequalities

There has also been an increase in local and national initiatives to highlight systemic changes that facilitate the integration of physical and mental healthcare. For example, the World Health Organization has published guidance on changes at the individual, health-system and societal level for reducing health inequalities in SMI groups (World Health Organization 2017). Similar reports from Public Health England highlight local actions necessary to reduce these inequalities, including addressing the social determinants of poor health and early detection and intervention (Public Health England 2018). Co-producing these initiatives with SMI groups will be an important strategy for their successful implementation (Deenik 2020).

Long-term evaluation

It remains unclear to what extent these new ideas and best practice guidelines will produce meaningful improvements for SMI groups. However, the growing recognition of these issues may promote a wider-scale adoption and implementation of strategies that do result in sustainable improvements. Current interventions are based on theory and behavioural science and the BAP guidance highlights the limited evidence on long-term maintenance of lifestyle interventions (Cooper 2016). Demonstrating sustainable reductions in physical health risks may require further investment in long-term approaches with several years between follow-up assessments. The long-term maintenance of these interventions may also require environmental changes that facilitate greater incidental physical activity, such as accessible and comfortable walking and cycling areas (Vancampfort 2013).

Conclusions

The challenges of implementing successful activity interventions in SMI populations does not detract from their importance. People with SMI are at an elevated risk of physical health complications over time, including obesity, cardiovascular and metabolic disease, and premature mortality. Low physical activity, low fitness and high levels of sedentary behaviour are modifiable risk factors for many of these health complications. These risk factors are highly prevalent in SMI populations and likely compounded by other risk factors, including smoking and poor diet.

Activity interventions for people with SMI are an essential adjunctive to treatment. Promoting activity will reduce the risk of these physical health

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complications. It will also have a positive impact on mental health symptoms and have wider benefits, including improving sleep quality and quality of life. However, large-scale RCTs will be necessary to provide further information on dose–response and other fundamental aspects of treatment. There is also a paucity of research focusing on translation of trial evidence into practice. Details on practical considerations such as cost and safety are still lacking. One of the greatest challenges relates to improving adherence to activity in people with SMI. A more direct approach is necessary to identify methods to address poor adherence, such as developing novel ways of increasing motivation and enjoyment of activity.

Author contributions

Both authors made substantial contributions to the conception, drafting, revising and final approval of the manuscript in accordance with ICMJE guidelines. The authors agree to be accountable for the integrity or accuracy of the work.

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Declaration of interest

None.

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References

Ashdown-Franks G, Williams J, Vancampfort D, et al (2018) Is it possible for people with severe mental illness to sit less and move more? A systematic review of interventions to increase physical activity or reduce sedentary behaviour. *Schizophrenia Research*, **202**: 3–16.

Ashdown-Franks G, Firth J, Carney R, et al (2020) Exercise as medicine for mental and substance use disorders: a meta-review of the benefits for neuropsychiatric and cognitive outcomes. *Sports Medicine*, **50**: 151–70.

Bennett DA, Du H, Clarke R, Guo Y, et al (2017) Association of physical activity with risk of major cardiovascular diseases in Chinese men and women. *JAMA Cardiology*, **2**: 1349–358.

Blair SN, Kampert JB, Kohl HW 3rd, et al (1996) Influences of cardiorespiratory fitness and other precursors on cardiovascular disease and all-cause mortality in men and women. *JAMA*, **276**: 205–10.

Bridle C, Spanjers K, Patel S, et al (2012) Effect of exercise on depression severity in older people: systematic review and meta-analysis of randomised controlled trials. *British Journal of Psychiatry*, **201**: 180–5.

Campos C, Mesquita F, Marquesa A, et al (2015) Feasibility and acceptability of an exergame intervention for schizophrenia. *Psychology of Sport and Exercise*, **19**: 50–8.

Caspersen CJ, Powell KE, Christenson GM (1985) Physical activity, exercise, and physical fitness: definitions and distinctions for health-related research. *Public Health Reports*, **100**: 126–31.

Celis-Morales CA, Petermann F, Hui L, et al (2017) Associations between diabetes and both cardiovascular disease and all-cause mortality are modified by grip strength: evidence from UK Biobank, a prospective population-based cohort study. *Diabetes Care*, **40**: 1710–8.

Cooney GM, Dwan K, Greig CA, et al (2013) Exercise for depression. *Cochrane Database of Systematic Reviews*, **9**: CD004366.

Cooper SJ, Reynolds GP, Barnes T, et al (2016) BAP guidelines on the management of weight gain, metabolic disturbances and cardiovascular risk associated with psychosis and antipsychotic drug treatment. *Journal of Psychopharmacology*, **30**: 717–48.

Cuerda C, Velasco C, Merchán-Naranjo J, et al (2014) The effects of second-generation antipsychotics on food intake, resting energy expenditure and physical activity. *European Journal of Clinical Nutrition*, **68**: 146–52.

Czosnek L, Lederman O, Cormie P, et al (2019) Health benefits, safety and cost of physical activity interventions for mental health conditions: a meta-review to inform translation efforts. *Mental Health and Physical Activity*, **16**: 140–51.

Daumit GL, Dalcin AT, Dickerson FB, et al (2020) Effect of a comprehensive cardiovascular risk reduction intervention in persons with serious mental illness: a randomized clinical trial. *JAMA Network Open*, **3**(6): e207247.

Deenik J, Czosnek L, Teasdale SB, et al (2020) From impact factors to real impact: translating evidence on lifestyle interventions into routine mental health care. *Translational Behavioral Medicine*, **10**: 1070–3.

Department of Health and Social Care (2019) *UK Chief Medical Officers' Physical Activity Guidelines*. GOV.UK.

de Souza Moura A, Lamego MK, Paes F, et al (2015) Comparison among aerobic exercise and other types of interventions to treat depression: a systematic review. *CNS & Neurological Disorders – Drug Targets*, **14**: 1171–83.

Erickson KI, Prakash RS, Voss MW, et al (2009) Aerobic fitness is associated with hippocampal volume in elderly humans. *Hippocampus*, **19**: 1030–9.

Euteneuer F, Dannehl K, Del Rey A, et al (2017) Immunological effects of behavioral activation with exercise in major depression: an exploratory randomized controlled trial. *Translational Psychiatry*, **7**(5): e1132.

Farholm A, Sørensen M (2016) Motivation for physical activity and exercise in severe mental illness: a systematic review of intervention studies. *International Journal of Mental Health Nursing*, **25**: 194–205.

Firth J, Cotter J, Elliott R, et al (2015) A systematic review and meta-analysis of exercise interventions in schizophrenia patients. *Psychological Medicine*, **45**: 1343–61.

Firth J, Rosenbaum S, Stubbs B, et al (2016) Motivating factors and barriers towards exercise in severe mental illness: a systematic review and meta-analysis. *Psychological Medicine*, **46**: 2869–81.

Firth J, Stubbs B, Rosenbaum S, et al (2017) Aerobic exercise improves cognitive functioning in people with schizophrenia: a systematic review and meta-analysis. *Schizophrenia Bulletin*, **43**: 546–56.

Firth J, Stubbs B, Teasdale SB, et al (2018a) Diet as a hot topic in psychiatry: a population-scale study of nutritional intake and inflammatory potential in severe mental illness. *World Psychiatry*, **17**: 365–7.

Firth J, Stubbs B, Vancampfort D, et al (2018b) Effect of aerobic exercise on hippocampal volume in humans: a systematic review and meta-analysis. *NeuroImage*, **166**: 230–8.

Firth J, Stubbs B, Vancampfort D, et al (2018c) Grip strength is associated with cognitive performance in schizophrenia and the general population: a UK biobank study of 476559 participants. *Schizophrenia Bulletin*, **44**: 728–36.

Firth J, Stubbs B, Vancampfort D, et al (2018d) The validity and value of self-reported physical activity and accelerometry in people with schizophrenia: a population-scale study of the UK biobank. *Schizophrenia Bulletin*, **44**: 1293–300.

Firth J, Siddiqi N, Koyanagi A, et al (2019) The *Lancet Psychiatry* Commission: a blueprint for protecting physical health in people with mental illness. *Lancet Psychiatry*, **6**: 675–712.

Gurusamy J, Gandhi S, Damodharan D, et al (2018) Exercise, diet and educational interventions for metabolic syndrome in persons with schizophrenia: a systematic review. *Asian Journal of Psychiatry*, **36**: 73–85.

Guthold R, Stevens GA, Riley LM, et al (2018) Worldwide trends in insufficient physical activity from 2001 to 2016: a pooled analysis of 358 population-based surveys with 1.9 million participants. *Lancet Global Health*, **6**: e1077–86.

Guthold R, Stevens GA, Riley LM, et al (2020) Global trends in insufficient physical activity among adolescents: a pooled analysis of 298 population-based surveys with 1.6 million participants. *Lancet Child and Adolescent Health*, **4**: 23–35.

Hamera E, Goetz J, Brown C, et al (2010) Safety considerations when promoting exercise in individuals with serious mental illness. *Psychiatry Research*, **178**: 220–2.

Harding SL (2013) Direct care staff perspectives related to physical activity in mental health group homes. *Journal of Psychosocial Nursing and Mental Health Services*, **51**(12): 38–43.

Hayes JF, Marston L, Walters K, et al (2017) Mortality gap for people with bipolar disorder and schizophrenia: UK-based cohort study 2000-2014. *British Journal of Psychiatry*, **211**: 175–81.

Heath GW, Parra DC, Sarmiento OL, et al (2012) Evidence-based intervention in physical activity: lessons from around the world. *Lancet*, **380**: 272–81.

Herring MP, Puetz TW, O'Connor PJ, et al (2012) Effect of exercise training on depressive symptoms among patients with a chronic illness: a systematic review and meta-analysis of randomized controlled trials. *Archives of Internal Medicine*, **172**: 101–11.

Jackson JG, Diaz FJ, Lopez L, et al (2015) A combined analysis of worldwide studies demonstrates an association between bipolar disorder and tobacco smoking behaviors in adults. *Bipolar Disorders*, **17**: 575–97.

Josefsson T, Lindwall M, Archer T (2014) Physical exercise intervention in depressive disorders: meta-analysis and systematic review. *Scandinavian Journal of Medicine & Science in Sports*, **24**: 259–72.

Kandola A, Hendrikse J, Lucassen PJ, et al (2016) Aerobic exercise as a tool to improve hippocampal plasticity and function in humans: practical implications for mental health treatment. *Frontiers in Human Neuroscience*, **10**: 373.

Kandola A, Ashdown-Franks G, Stubbs B, et al (2019) The association between cardiorespiratory fitness and the incidence of common mental health disorders: a systematic review and meta-analysis. *Journal of Affective Disorders*, **257**: 748–57.

Kandola AA, Osborn DPJ, Stubbs B, et al (2020) Individual and combined associations between cardiorespiratory fitness and grip strength with common mental disorders: a prospective cohort study in the UK Biobank. *BMC Medicine*, **18**(1): 303.

Keller-Varady K, Varady PA, Röh A, et al (2018) A systematic review of trials investigating strength training in schizophrenia spectrum disorders. *Schizophrenia Research*, **192**: 64–8.

Kelly L, Harrison M, Richardson N, et al (2021) Economic evaluation of 'Men on the Move', a 'real world' community-based physical activity programme for men. *European Journal of Public Health*, **31**: 156–60.

Khandaker GM, Cousins L, Deakin J, et al (2015) Inflammation and immunity in schizophrenia: implications for pathophysiology and treatment. *Lancet Psychiatry*, **2**: 258–70.

Kohl HW 3rd, Craig CL, Lambert EV, et al (2012) The pandemic of physical inactivity: global action for public health. *Lancet*, **380**: 294–305.

Kvam S, Kleppe CL, Nordhus IH, et al (2016) Exercise as a treatment for depression: a meta-analysis. *Journal of Affective Disorders*, **202**: 67–86.

Kyu HH, Bachman VF, Alexander LT, et al (2016) Physical activity and risk of breast cancer, colon cancer, diabetes, ischemic heart disease, and ischemic stroke events: systematic review and dose–response meta-analysis for the Global Burden of Disease Study 2013. *BMJ*, **354**: i3857.

Lamoureux NR, Fitzgerald JS, Norton KI, et al (2019) Temporal trends in the cardiorespiratory fitness of 2,525,827 adults between 1967 and 2016: a systematic review. *Sports Medicine*, **49**: 41–55.

Lavebratt C, Herring MP, Liu JJ, et al (2017) Interleukin-6 and depressive symptom severity in response to physical exercise. *Psychiatry Research*, **252**: 270–6.

Lederman O, Suetani S, Stanton R, et al (2017) Embedding exercise interventions as routine mental health care: implementation strategies in residential, inpatient and community settings. *Australasian Psychiatry*, **25**: 451–5.

Lederman O, Ward PB, Firth J, et al (2019) Does exercise improve sleep quality in individuals with mental illness? A systematic review and meta-analysis. *Journal of Psychiatric Research*, **109**: 96–106.

Lee DC, Sui X, Artero EG, et al (2011) Long-term effects of changes in cardiorespiratory fitness and body mass index on all-cause and cardiovascular disease mortality in men: the Aerobics Center Longitudinal Study. *Circulation*, **124**: 2483–90.

Lee I-M, Shiroma EJ, Lobelo F, et al (2012) Effect of physical inactivity on major non-communicable diseases worldwide: an analysis of burden of disease and life expectancy. *Lancet*, **380**: 219–29.

Lin X, Zhang X, Guo J, et al (2015) Effects of exercise training on cardiorespiratory fitness and biomarkers of cardiometabolic health: a systematic review and meta-analysis of randomized controlled trials. *Journal of the American Heart Association*, **4**(7): e002014.

Linke SE, Gallo LC, Norman GJ (2011) Attrition and adherence rates of sustained vs. intermittent exercise interventions. *Annals of Behavioral Medicine*, **42**: 197–209.

Martin H, Beard S, Clissold N, et al (2017) Combined aerobic and resistance exercise interventions for individuals with schizophrenia: a systematic review. *Mental Health and Physical Activity*, **12**: 147–55.

Matthews E, Cowman M, Brannigan M, et al (2018) Examining the barriers to physical activity between active and inactive people with severe mental illness in Ireland. *Mental Health and Physical Activity*, **15**: 139–44.

McEwan D, Harden SM, Zumbo BD, et al (2016) The effectiveness of multi-component goal setting interventions for changing physical activity behaviour: a systematic review and meta-analysis. *Health Psychology Review*, **10**: 67–88.

Melo MCA, Daher E de F, Albuquerque SGC, et al (2016) Exercise in bipolar patients: a systematic review. *Journal of Affective Disorders*, **198**: 32–8.

National Institute for Health and Care Excellence (2014) *Psychosis and Schizophrenia in Adults: Prevention and Management (Clinical Guideline CG178)*. NICE.

Naylor C, Das P, Ross S, et al (2016) *Bringing Together Physical and Mental Health: A New Frontier for Integrated Care*. The King's Fund.

NHS England (2019) *The NHS Long Term Plan*. NHS (https://www.longtermplan.nhs.uk/wp-content/uploads/2019/08/nhs-long-term-plan-version-1.2.pdf).

Osborn D, Burton A, Hunter R, et al (2018) Clinical and cost-effectiveness of an intervention for reducing cholesterol and cardiovascular risk for people with severe mental illness in English primary care: a cluster randomised controlled trial. *Lancet Psychiatry*, **5**: 145–54.

Pajonk F-G, Wobrock T, Gruber O, et al (2010) Hippocampal plasticity in response to exercise in schizophrenia. *Archives of General Psychiatry*, **67**: 133–43.

Perez-Cruzado D, Cuesta-Vargas A, Vera-Garcia E, et al (2018) Medication and physical activity and physical fitness in severe mental illness. *Psychiatry Research*, **267**: 19–24.

Public Health England (2018) *Health Matters: Reducing Health Inequalities in Mental Illness*. GOV.UK (https://www.gov.uk/government/publications/health-matters-reducing-health-inequalities-in-mental-illness/health-matters-reducing-health-inequalities-in-mental-illness [Accessed: 4 June 2020]).

Robson D, Haddad M, Gray R, et al (2013) Mental health nursing and physical health care: a cross-sectional study of nurses' attitudes, practice, and perceived training needs for the physical health care of people with severe mental illness. *International Journal of Mental Health Nursing*, **22**: 409–17.

Rosenbaum S, Tiedemann A, Sherrington C, et al (2014) Physical activity interventions for people with mental illness: a systematic review and meta-analysis. *Journal of Clinical Psychiatry*, **75**: 964–74.

Rosenbaum S, Morell R, Abdel-Baki A, et al (2020a) Assessing physical activity in people with mental illness: 23-country reliability and validity of the simple physical activity questionnaire (SIMPAQ). *BMC Psychiatry*, **20**: 108.

Rosenbaum S, Ward PB, Baldeo R, et al (2020b) Changing health workforce attitudes to promote improved physical health in mental health service users: keeping our Staff in Mind (KoSiM). *Health Promotion Journal of Australia*, **31**: 447–55.

Rosenblat JD, McIntyre RS (2016) Bipolar disorder and inflammation. *Psychiatric Clinics of North America*, **39**: 125–37.

Roux L, Pratt M, Tengs TO, et al (2008) Cost effectiveness of community-based physical activity interventions. *American Journal of Preventive Medicine*, **35**: 578–88.

Schuch FB, Vancampfort D, Richards J, et al (2016) Exercise as a treatment for depression: a meta-analysis adjusting for publication bias. *Journal of Psychiatric Research*, **77**: 42–51.

Schuch FB, Vancampfort D, Firth J, et al (2018) Physical activity and incident depression: a meta-analysis of prospective cohort studies. *American Journal of Psychiatry*, **175**: 631–48.

Schuch FB, Stubbs B, Meyer J, et al (2019) Physical activity protects from incident anxiety: a meta-analysis of prospective cohort studies. *Depression and Anxiety*, **36**: 846–58.

Soundy A, Stubbs B, Probst M, et al (2014a) Barriers to and facilitators of physical activity among persons with schizophrenia: a survey of physical therapists. *Psychiatric Services*, **65**: 693–6.

Soundy A, Muhamed A, Stubbs B, et al (2014b) The benefits of walking for individuals with schizophrenia spectrum disorders: a systematic review. *International Journal of Therapy and Rehabilitation*, **21**: 410–20.

Stubbs B, Vancampfort D, Rosenbaum S, et al (2017) An examination of the anxiolytic effects of exercise for people with anxiety and stress-related disorders: a meta-analysis. *Psychiatry Research*, **249**: 102–8.

Stubbs B, Vancampfort D, Hallgren M, et al (2018) EPA guidance on physical activity as a treatment for severe mental illness: a meta-review of the evidence and Position Statement from the European Psychiatric Association (EPA), supported by the International Organization of Physical Therapists in Mental Health (IOPTMH). *European Psychiatry*, **54**: 124–44.

Thomson D, Turner A, Lauder S, et al (2015) A brief review of exercise, bipolar disorder, and mechanistic pathways. *Frontiers in Psychology*, **6**: 147.

Tomkinson GR, Lang JJ, Tremblay MS (2019) Temporal trends in the cardiorespiratory fitness of children and adolescents representing 19 high-income and upper middle-income countries between 1981 and 2014. *British Journal of Sports Medicine*, **53**: 478–86.

Tremblay MS, Aubert S, Barnes JD, et al (2017) Sedentary Behavior Research Network (SBRN) – Terminology Consensus Project process and outcome. *International Journal of Behavioral Nutrition and Physical Activity*, **14**: 75.

Vancampfort D, De Hert M, De Herdt A, et al (2013) Associations between physical activity and the built environment in patients with schizophrenia: a multi-centre study. *General Hospital Psychiatry*, **35**: 653–8.

Vancampfort D, Stubbs B, Ward PB, et al (2015a) Integrating physical activity as medicine in the care of people with severe mental illness. *Australian & New Zealand Journal of Psychiatry*, **49**: 681–2.

Vancampfort D, Rosenbaum S, Schuch FB, et al (2015b) Prevalence and predictors of treatment dropout from physical activity interventions in schizophrenia: a meta-analysis. *General Hospital Psychiatry*, **39**: 15–23.

Vancampfort D (2015) Exercise and cardiorespiratory fitness in people with schizophrenia: a systematic review and meta-analysis. *Schizophrenia Research*, **169**: 453–7

Vancampfort D, Stubbs B, Sienaert P, et al (2016a) A comparison of physical fitness in patients with bipolar disorder, schizophrenia and healthy controls. *Disability and Rehabilitation*, **38**: 2047–51.

Vancampfort D, Probst M, Daenen A, et al (2016b) Impact of antipsychotic medication on physical activity and physical fitness in adolescents: an exploratory study. *Psychiatry Research*, **242**: 192–7.

Vancampfort D, Rosenbaum S, Schuch F, et al (2017a) Cardiorespiratory fitness in severe mental illness: a systematic review and meta-analysis. *Sports Medicine*, **47**: 343–52.

Vancampfort D, Firth J, Schuch FB, et al (2017b) Sedentary behavior and physical activity levels in people with schizophrenia, bipolar disorder and major depressive disorder: a global systematic review and meta-analysis. *World Psychiatry*, **16**: 308–15.

Vancampfort D, Firth J, Correll CU, et al (2019) The impact of pharmacological and non-pharmacological interventions to improve physical health outcomes in people with schizophrenia: a meta-review of meta-analyses of randomized controlled trials. *World Psychiatry*, **18**: 53–66.

Way K, Kannis-Dymand L, Lastella M, et al (2018) Mental health practitioners' reported barriers to prescription of exercise for mental health consumers. *Mental Health and Physical Activity*, **14**: 52–60.

Wilmot EG, Edwardson CL, Achana FA, et al (2012) Sedentary time in adults and the association with diabetes, cardiovascular disease and death: systematic review and meta-analysis. *Diabetologia*, **55**: 2895–905.

Woodward MLL, Gicas KM, Warburton DE, et al (2018) Hippocampal volume and vasculature before and after exercise in treatment-resistant schizophrenia. *Schizophrenia Research*, **202**: 158–65.

World Health Organization (2015) *Physical Activity and Adults*. WHO (https://www.who.int/news-room/fact-sheets/detail/physical-activity#:~:text=Adults%20aged%2018%E2%80%9364%20years&text=-may%20increase%20moderate%2Dintensity%20aerobic,week%20for%20additional%20health%20benefits).

World Health Organization (2017) *Helping People with Severe Mental Disorders Live Longer and Healthier Lives (Policy Brief)*. WHO.

Wu Y, Wang W, Liu T, et al (2017) Association of grip strength with risk of all-cause mortality, cardiovascular diseases, and cancer in community-dwelling populations: a meta-analysis of prospective cohort studies. *Journal of the American Medical Directors Association*, **18**: 551.e17–e35.

MCQs

Select the single best option for each question stem

1 Why might the inclusion of physical activity in SMI treatment be beneficial for patients?

a physical activity can reduce feelings of stress and improve sleep
b physical activity can improve psychiatric symptoms
c physical activity reduces the long-term risk of physical health complications
d options a and b
e all of the above.

2 A key factor in reducing drop-out from physical activity interventions in people with SMI is:

a a lack of peer support
b physical limitations and discomfort
c cost of travel to sessions
d having a qualified exercise professional leading sessions
e all of the above

3 A commonly cited barrier to engagement in physical activity by people with SMI is:

a medication side-effects
b positive symptoms
c unrealistic goal setting
d the difficulty of the activity
e all of the above

4 To facilitate the widespread implementation of physical activity interventions in the treatment of SMI, a priority for future work is to:

a establish longer-term effects of activity on physical health
b establish the safety and cost-effectiveness of activity interventions in SMI groups
c establish the impact of activity on brain functioning
d establish whether aerobic or resistance training is more effective for improving outcomes
e all of the above

5 According to the UK's Chief Medical Officer's report, the current recommendations for physical activity for adults aged 19–64 is:

a at least 300 min of moderate activity or 150 min of vigorous activity per week
b at least 75 min of moderate to vigorous activity per week
c up to 150 min of moderate to vigorous activity twice a week
d at least 150 min of moderate activity or 75 min of vigorous activity per week
e at least 75 min of moderate activity three times per week.

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