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3 **The Effectiveness of Cognitive-Behavioural Interventions at Increasing Adherence to**
4 **Physical Activity in Mental Health Populations: A Systematic Review**
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6 **ABSTRACT**
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10 **Objective:** There is growing global evidence for stark inequalities in the physical health
11 status and life-expectancy of people with a mental health diagnosis. In most cases, physical
12 activity (PA) is one of the most effective methods of maintaining physical and mental health.
13 However, people with mental health challenges are less likely to adhere to recommended
14 levels of PA, leading to a vicious cycle of poor physical and mental health. The objective of
15 this paper is to assess if, and how cognitive-behavioural (CB) techniques increase
16 adherence to PA in mental health populations.
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21 **Method:** Systematic review and narrative synthesis. Included studies detailed a behavioural
22 change intervention which targeted PA using CB approaches, delivered to adults with a
23 mental health condition as defined by DSM V or ICD-10. Adherence to the intervention AND
24 physical activity was reported within RCT, cluster RCT, quasi-experimental, or controlled
25 before and after study. Electronic searches conducted in MEDLINE, CINAHL, Cochrane
26 Library (Trials), SPORTDiscus and PsycINFO.
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31 **Results:** Ten studies from seven countries were synthesised. Methodologically moderate to
32 weak, all showed adherence to the intervention to be associated with increased levels of PA.
33 All studies reported higher than average adherence to PA in the intervention groups.
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37 **Discussion:** CB interventions were associated with improved adherence to PA in
38 international samples of people with mental health conditions. Studies adopting more robust
39 designs are needed to quantify optimal interventions and impact, but this original synthesis is
40 encouraging for researchers and clinicians alike looking to maximise the synergy between
41 physical and mental health.
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47 **Registration number:** CRD42017057918
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50 **DECLARATION OF INTEREST:** None
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52
53 **Key Words:** Anxiety, depression, exercise, behaviour change, interventions, physical activity
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Introduction

The aim of this review is to assess if and how cognitive behavioural (CB) techniques increase adherence to physical activity (PA) for those presenting with mental health concerns. The first section of this paper examines the evidence for the mental health benefits of physical activity. It describes the unique barriers to PA faced by those with mental illness to show that adherence is a discrete problem in this population. It goes on to suggest that cognitive behavioural approaches may help this population start and maintain physical activity. It concludes with a justification for the need to review the literature to examine the degree to which this is true.

For the purpose of review, physical activity (PA) is defined as “*bodily movement produced by skeletal muscles that results in energy expenditure*” (Caspersen, Powell, & Christenson, 1985, p6). In this review, physical activity includes exercise. Exercise is defined as PA that is “*planned, structured or repetitive, targeted to maintain or improve one or more components of health-related physical fitness*” (WHO, 2018, webpage) such as aerobic endurance, muscular strength, muscular endurance, body composition, flexibility. The distinction is important because PA can include walking-based interventions, lifestyle improvement intervention, and non-structured exercise.

People ‘diagnosed with mental health problems’ are those with a diagnosis as defined by the DSM V and ICD-11 (WHO, 2019). Cognitive behavioural interventions refer to interventions that employ cognitive behavioural techniques, such as goal setting, problem-solving and homework to examine associations between thoughts, feelings and behaviour in order to elicit behaviour change.

Finally, ‘adherence to PA’ is inconsistently defined in the literature. Hawley-Hague, Horne, Skelton, and Todd (2016) concluded that adherence to PA should refer to one or all of the following: completion of a prescribed programme of activity (i.e. retention), attendance frequency, attendance duration, and intensity of activity. They concluded that adherence to

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3 PA should be defined according to the purpose of the study. Following Hawley-Hague et al
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5 (2016) the key elements of adherence to PA are defined here using the following
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7 parameters: a) completion of programme of activity or not (retention), b) proportion of
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9 sessions/classes attended (frequency), c) amount of physical activity, measured in time,
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11 during intervention (duration), d) intensity of activity during programme, and e) b to d at
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13 follow-up.
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16 BACKGROUND

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19 Physical activity is essential for maintaining health and well-being. For example, it can
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21 reduce the risk of chronic physical diseases, such as cardiovascular disease (CVD), type 2
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23 diabetes, hypertension, and respiratory illnesses (Naci & Ioannidis, 2013). However, PA is
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25 not only beneficial for physical health. A growing body of evidence also supports the positive
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27 relationship between PA and mental health (Schuch, Vancampfort, Richards, et al., 2016).
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29 Physical activity has been shown to be an effective treatment in populations with clinical
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31 depression (Craft & Perna, 2004; Daley, 2008). In some studies PA has been shown to be
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33 as effective as pharmacology or psychotherapies for reducing severity of depressive
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35 symptoms (Schuch, Vancampfort, Richards, et al., 2016). The UK National Institute for
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37 Health and Clinical Excellence (NICE) guidelines recommend structured physical activity as
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39 an appropriate treatment for people with mild to moderate depression (NICE, 2010).
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43 There is less research investigating PA in patients with diagnosed anxiety disorders,
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45 however, available evidence suggests that exercise can reduce symptoms and is an
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47 acceptable treatment (Herring, Lindheimer, & O'Connor, 2013). A review of exercise
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49 interventions for people diagnosed with schizophrenia concluded that PA could help to
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51 alleviate secondary symptoms, such as anxiety and depression, and other negative
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53 symptoms of schizophrenia (Faulkner, Gorczynski, & Arbour-Nicitopoulos, 2013).
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57 Engagement in PA can have a wide range of benefits for people with mental health
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59 conditions, even in the absence of objective diagnostic improvements. PA can improve
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3 quality of life, reduce isolation by providing opportunities for social interaction and increase
4 the likelihood of individuals returning to 'normal' previously enjoyed activities (Crone,
5 Heaney, & Owens, 2009). This increasingly extensive body of evidence of the positive
6 effects of PA and exercise on a broad range of mental health conditions has led to the
7 recommendation that PA should be used as an adjunct to usual treatment for a range of
8 conditions, including anxiety disorders, depression, substance abuse and schizophrenia
9 (Rosenbaum et al., 2015).
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13 However, despite these well-established benefits, people diagnosed with mental health
14 problems are significantly less active than the general population (Nyboe & Lund, 2013).
15 They often face substantial illness-related barriers to PA, above and beyond those
16 experienced by healthy individuals (Glowacki, Duncan, Gainforth, & Faulkner, 2017).
17 Psychotropic medicines cause weight gain and metabolic changes (Haddad, 2004), as well
18 as other side effects such as lack of energy and motivation (Glover, Ferron, & Whitley,
19 2013). On average, people with chronic mental health conditions die 10 to 25 years earlier
20 than people without mental health conditions (WHO, 2014). As much of this mortality is
21 linked to cardiovascular issues, it is logical to suggest that PA may be beneficial for reducing
22 this risk (Nocon et al., 2008). The problem is that physical activity is uniquely difficult for
23 people with mental health problems.
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27 In the general population, adherence to PA programmes drops off after six months, with less
28 than half the participants completing (Gidlow, Johnston, Crone, & James, 2005; Richardson
29 et al., 2005). In people with mental health conditions, some suggest that attrition is
30 significantly greater (Rosenbaum et al., 2015). However, cognitive behavioural interventions
31 have been found to be somewhat effective at increasing PA. Reviews which have looked at
32 adherence to PA interventions in a range of populations, including people with chronic
33 illness, elderly and obese populations (O'Halloran et al., 2014; Picorelli, Pereira, Pereira,
34 Felício, & Sherrington, 2014; Samdal, Eide, Barth, Williams, & Meland, 2017), have found
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evidence to suggest that interventions which emphasize a person-centred style, facilitate self-regulation and sustained positive motivation are associated with long-term effectiveness and maintenance of behaviour change. Cognitive behavioural interventions may therefore be helpful in increasing PA in individuals with mental health conditions.

There have been relevant systematic reviews conducted in this area which have examined the relationship between mental health, PA, and adherence (Rosenbaum, Tiedemann, Sherrington, Curtis, & Ward, 2014; Rosenbaum, Tiedemann, Stanton, et al., 2016; Firth, Rosenbaum, Stubbs, Gorczynski, Yung, & Vancampfort, 2016; Stonerock, Hoffman, Smith & Blumenthal, 2015; Stubbs et al., 2016; Vancampfort, et al., 2017). However, these reviews examine the impact of PA on individuals with mental health conditions, rather than examining how cognitive behavioural techniques can be used to enhance the effectiveness of PA interventions. The aim of the present review is to assess if and how the use of cognitive behavioural interventions increases adherence to PA in adults with mental health conditions.

METHODS

The protocol for this systematic review was registered 24th April 2017 on the PROSPERO database prior to conducting this review (CRD42017057918) and can be accessed at https://www.crd.york.ac.uk/PROSPERO/display_record.asp?ID=CRD42017057918.

Reporting has been conducted as per the PRISMA statement (Moher, Liberati, Tetzlaff, & Altman, 2009).

ELIGIBILITY CRITERIA

To be included in this review, studies had to (1) contain a behaviour change intervention which targeted physical activity using cognitive behavioural/psychological approaches; (2) be delivered to adults aged over 18 with a diagnosis of a mental health condition as defined by relevant editions of the DSM or ICD-10 (3) reported adherence to the intervention; (4) be a Randomised Controlled Trial (RCT) or cluster RCT(s), quasi-experimental, or studies with

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3 pre and post assessment data were included. Comparison groups included control groups
4 who receive no intervention or usual treatment. Studies without a control group were eligible
5 for inclusion provided pre and post data were available.
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10 Studies were excluded if they were delivered to children or adolescents. Studies which
11 focused on chronic health or physical conditions were excluded although papers which
12 stated participants had comorbid health conditions were considered based on meeting the
13 other eligibility criteria. Interventions that did not have a psychological or behavioural
14 element, or were not behaviour change focused were not included. There was no exclusion
15 based on the duration of intervention, length of follow up or format of intervention. Studies
16 were excluded if they were not available in English, due to practical limitations. Qualitative
17 studies were excluded since it was not within the scope of this review to examine qualitative
18 data. Systematic reviews and study protocols were excluded, as were conference abstracts
19 and papers where no full-text was available.
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31 INFORMATION SOURCES AND SEARCH

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34 Electronic searches were performed in the following databases from the year of inception to
35 May 2017: MEDLINE, CINAHL, Cochrane Library (Trials), SPORTDiscus and PsycINFO.

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37 The following search terms were entered in each database: (“Motivational interviewing” OR
38 “Cognitive interventions” OR Behaviour Therapy OR Cognition Therapy OR “Cognitive
39 Behaviour Therapy” OR “Cognitive Behavioural Therapy” OR Cognitive Psychotherapy OR
40 Cognitive Therapy OR Psychotherapy OR Behaviour Change OR Intervention OR treatment
41 OR “Goal setting” OR “Self-monitoring”) AND (Adherence OR Compliance OR Concordance
42 OR “Noncompliance” OR “Non Adherence” OR Engagement) AND (“Physical activity” OR
43 “Leisure activity” OR Exercise OR Running OR Jogging OR Swimming OR Sport OR Cycling
44 OR Inactivity OR Sedentary) AND (Lifestyle OR Gym OR outpatient OR structured exercise)
45 AND (“Mental health” OR “Psychological wellbeing” OR “Mental well-being” OR “Mental
46 wellbeing” OR Anxiety OR Depression OR Psychosis OR Schizophrenia OR Dementia). In
47 addition, hand searches of reference lists and most recent reviews (Rebar & Taylor, 2017;
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3 Glowacki et al., 2017; Rosenbaum et al., 2014; Schuch et al., 2016) were conducted to
4 identify additional relevant studies.
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7 8 STUDY SELECTION 9

10 After the removal of duplicates, all the remaining titles generated from the search were
11 screened. Articles were rejected on initial screening if the reviewers could determine from
12 the title that the articles were an inappropriate design. Titles and abstracts were then
13 screened using the inclusion/exclusion criteria. If an abstract did not provide sufficient
14 exclusion information then the article was obtained for full-text screening. All searches were
15 performed by one investigator and a second reviewer checked a random set of 20% studies
16 (using the true random number generator at www.random.org), to assess agreement
17 regarding whether they met the inclusion criteria. Where any dubiety remained a third author
18 would adjudicate. The final list of included articles was reached through consensus.
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30 DATA EXTRACTION 31

32 Data were extracted by the principle investigator using a data extraction form. Data were
33 extracted from the method and results sections of the included studies. The following
34 information was extracted for all included studies: study design and method, country,
35 participants (sample size, age, gender, cultural background when reported and diagnosis),
36 intervention (delivery, timing, content and duration), outcome measures and results.
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44 QUALITY ASSESSMENT OF SELECTED STUDIES 45

46 An analysis of the methodological quality of each study included in this review was
47 performed, using the Quality Assessment Tool for Quantitative studies, developed by the
48 Effective Public Health Practice Project, Canada (Thomas, Ciliska, Dobbins, & Micucci,
49 2004). This tool was selected as it can be used for a variety of quantitative designs, such as
50 RCTs, quasi-experimental studies and uncontrolled studies (Jackson & Waters, 2005) and
51 has been reported to have construct and content validity (Armijo-Olivo, Stiles, Hagen,
52 Biondo, & Cummings, 2012). This tool assesses the following domains: selection bias, study
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3 design, confounders, blinding, data collection methods, withdrawals and dropouts,
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5 intervention integrity, and statistical analyses. Each domain was rated as either strong,
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7 moderate or weak, and the domain scores were averaged to provide a total score to
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9 determine the strength of the quality of evidence. Lead author assessed all of the included
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11 studies, whilst the two other authors assessed 20% each of the included studies at each
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13 phase. Level of agreement was discussed between authors, and where dubiety remained a
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15 third author would also review, with final adjudication going with majority view. However,
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17 dubiety was very rare.
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20 21 DATA ANALYSIS

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23 A narrative review of all studies was conducted due to the methodological and clinical
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25 heterogeneity between the studies. The focus of the review was to summarise key findings
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27 pertinent to the research question (Ferrari, 2015). Harvest plot (Ogilvie et al., 2008), was
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29 constructed to assist the process of synthesis and provide a visual representation of
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31 evidence according to whether the interventions favoured the control, the intervention or no
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33 difference; how significant the finding was, and whether the effect was low, moderate or
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35 high. Where no comparison was available the outcome was excluded from the synthesis.
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38 39 RESULTS

40 41 STUDY SELECTION

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43 In total, 1253 studies were identified through the search. An additional 12 papers were
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45 identified through hand searches. 937 papers remained after duplicates were removed. This
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47 number was reduced to 56 through the screening of titles and abstracts. The full-texts of
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49 these 56 papers were reviewed using the inclusion/exclusion criteria. Of the full-text papers,
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51 10 met the inclusion criteria. The full results of the search and reasons for exclusion can be
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53 seen in the PRISMA flowchart (Figure 1).
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STUDY CHARACTERISTICS

The studies came from seven countries: Canada, Brazil, Italy, Sweden, UK (n=2), USA (n=2) and Australia (n=2). Methodological quality of the individual studies ranged from low to high, and taken together constituted weak to moderate evidence. Four of the included studies targeted populations with severe mental illnesses, such as schizophrenia, psychosis and other psychotic illnesses; three studies were focused on anxiety and depressive disorder; one study included participants with alcohol dependency, one with OCD and one with exhaustion disorder. Sample sizes ranged from 13 – 347, with four of the studies having sample sizes over 100. The duration of the studies varied from 10 weeks to 12 months, with the number of sessions in which the behavioural interventions was delivered ranging from 4 sessions to 24 sessions. Follow up periods ranged from 6 months – 18 months, although only 6 studies examined the effect of the intervention beyond the intervention period. On average studies consisted of 12 intervention sessions, usually delivered on a weekly basis. PA was the sole targeted behaviour in eight of the included studies. In the other two studies PA was reported alongside diet. This was because the main purpose of increasing PA was principally as a means of weight management rather than to reduce psychological symptoms. For further detail of individual interventions and study characteristics (eg country, sample size etc) please see table 1.

INTERVENTIONS

Self-monitoring of behaviour was a common feature of the interventions, with interventions utilising diaries and pedometers (Attux et al., 2013; Brown et al., 2014; Duda et al., 2014; Goracci et al., 2016; Merom et al., 2008). Goal setting was also a commonly used cognitive-behavioural strategy implemented in the interventions (Brown et al., 2014; Duda et al., 2014; Lindegard et al., 2015; Lovell et al., 2014). The use of motivational interviewing was implemented in two of the studies (Curtis et al., 2016; Duda et al., 2014) and psychoeducation featured in three of the studies (Attux et al., 2013; Beebe et al., 2011;

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3 Lovell et al., 2014). Two of the interventions combined group CBT with a PA intervention
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5 (Merom et al., 2008; Rector et al., 2015).
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8 The majority of the interventions were delivered as an adjunct to supervised exercise
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10 programmes or offered access to group activities (Attux et al., 2013; Brown et al., 2014;
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12 Curtis et al., 2016; Duda et al., 2014; Lindegard et al., 2015; Lovell, et al., 2014; Rector et
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14 al., 2015). Three studies focused on increasing PA through walking (Beebe et al., 2011;
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16 Goracci et al., 2016; Merom et al., 2008).
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19 MEASUREMENT OF PHYSICAL ACTIVITY 20

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22 All of the studies measured PA using self-reported measures. The International Physical
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24 Activity Questionnaire (IPAQ) was used the most frequently, with three studies using either
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26 the full or short form version (Attux et al., 2013; Curtis et al., 2016; Lovell et al., 2014). Other
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28 questionnaire measures included the 7-Day Physical Activity Recall (PAR) (Duda et al.,
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30 2014), The Paffenbarger Physical Activity Questionnaire (Goracci et al., 2016), The Active
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32 Australia Questionnaire (Merom et al., 2008) and Saltin-Grimby Physical Activity Level Scale
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34 (Lindegård, Jonsdottir, Börjesson, Lindwall, & Gerber, 2015). Two studies used a measure of
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36 minutes walked (Beebe et al., 2011; Merom et al., 2008). None of the included studies used
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38 an objective measure of PA (i.e. pedometers or accelerometers).
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41 EFFECT ON PHYSICAL ACTIVITY 42

43 Of the included studies, four reported significant improvements in PA (Attux et al., 2013;
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45 Curtis et al., 2016; Duda et al., 2014; Merom et al., 2008). However, of these studies, only
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47 two reported significant effects of the intervention (Curtis et al., 2016; Merom et al., 2008).
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49 Four did not report a significant change in levels of PA (Beebe et al., 2011; Brown et al.,
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51 2014; Lovell et al., 2014; Rector, Richter, Lerman, & Regev, 2015). Two studies did not
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53 report changes in PA, even though measures had been taken at baseline and follow up
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55 (Goracci et al., 2016; Lindegård et al., 2015).
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ADHERENCE OUTCOMES

The method of measuring adherence to the interventions in each of the included studies is presented in Table 1. The most common measure of adherence was attendance (5 studies, range 39%-79%); followed by attrition (3 studies, range 49.5%-78.1%); only one study used a self-reported exercise log and another used adherence to physical activity guidelines.

The reported levels of adherence ranged from 39%-80.56%; with 7 of the included studies reporting adherence higher than 60% (Attux et al., 2013; Brown et al., 2014; Curtis et al., 2016; Goracci et al., 2016; Lovell et al., 2014; Merom et al., 2008; Rector et al., 2015). The highest level of adherence to the intervention was reported in Rector et al. (2015) and the lowest level of adherence was reported in Beebe et al. (2011). The studies that reported the greatest level of effectiveness of the intervention (Curtis et al., 2016; Merom et al., 2008) reported adherence levels of 62% and 55% respectively. However, as adherence to the intervention was measured in a variety of different ways, it was not possible to meaningfully compare adherence rates across the studies included in this review.

DISCUSSION

The aim of this systematic review was to assess the effectiveness of cognitive-behavioural interventions at increasing adherence to PA in people with mental health conditions. Due to the heterogeneity in the study designs and mental health conditions targeted it is difficult to draw strong conclusions. Further, the majority of the studies did not report significant changes in levels of PA. This is consistent with the wider evidence that suggests changing PA behaviour is complex, with many interventions targeted at adults reporting small effect sizes (Rhodes, Janssen, Bredin, Warburton, & Bauman, 2017).

Changing PA behaviour in people with mental health conditions appears to be particularly challenging. However, the majority of the studies here reported adherence rates above 60%. Given that between 40-50% of adults that begin an exercise program drop out within 6 months (Dishman, 1991; Richardson et al., 2005), the results of this review can be interpreted as an indicator of the positive potential of cognitive behavioural interventions at

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3 improving adherence to PA in this cohort. Cognitive behavioural interventions are effective,
4 but only moderately. This is important to understand, as future interventions are much more
5 likely to become sustainable if they meet realistic expectations (Shelton, Cooper & Stirman;
6 2018).
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12 Regarding adherence rates within the individual studies, Merom et al's (2008) data went as
13 expected with non-completers demonstrating significantly lower amounts of PA than
14 completers. Brown et al. (2014) also found that the intervention was more effective for
15 participants with better adherence. These results are important because they suggest that
16 adherence to the intervention is an important factor in increasing levels of PA. Similar
17 findings have been found elsewhere: O'Halloran et al. (2014) found that motivational
18 interviewing (MI) had a small but positive effect on self-reported PA, with the effect
19 increasing with levels of participation in MI. This highlights the importance of monitoring all
20 aspects of adherence in intervention studies.
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32 Given the variability in measurement of PA, it was not possible to meaningfully compare
33 adherence rates between studies. This is unsurprising as no gold standard way of
34 measuring adherence to PA has been established (Nyboe & Lund, 2013). This hinders the
35 understanding of adherence to PA, particularly in mental health populations.
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42 Most of the included studies relied on self-report measures of PA, which are subject to recall
43 and social desirability bias, which can lead to over or underestimations of PA (Rhodes et al.,
44 2017). Non self-report measures of PA, such as accelerometers, are considered more
45 accurate at measuring actual levels of PA, as findings suggest that self-report measures of
46 adherence to PA are much higher than those that are objectively measured (Prince et al.,
47 2008). Therefore, it is recommended that non-subjective measures should be used in
48 combination with self-report measures, particularly in studies which aim to measure the
49 percentage of participants meeting PA guidelines or actual levels of activity.
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3 Beyond the benefits to mental health, PA is beneficial for improving physical health, which is
4 particularly relevant to people with mental health conditions, as they are at a significantly
5 greater risk of comorbid conditions, such as heart disease, obesity and diabetes (Nocon et
6 al., 2008). Of the included studies, very few made reference to any co-morbid health-related
7 issues present in the participants under study. In light of this, other outcomes, such as
8 quality of life, sleep quality, self-esteem etc. may be valuable when examining PA
9 interventions, particularly in mental health populations, as the benefits that come from PA
10 are not necessarily just physical (Schuch, Vancampfort, Rosenbaum, et al., 2016). It is
11 possible that psychological benefits, such as improved self-esteem, body image and positive
12 feelings, can accrue without a change in physical fitness. However, in the included studies
13 quality of life outcomes were not always measured, therefore an analysis of the effects was
14 not within the scope of this paper, but something that could be considered in future research.

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29 Taking into consideration the nature of complex behavioural change interventions and the
30 fact that terms such as “cognitive” or “motivational” can be used to describe a range of
31 techniques for eliciting behaviour change, it is unsurprising that the included interventions
32 varied in their content and delivery. The majority of the included studies also only provided
33 brief descriptions of the interventions, which often lacked detail, for example, stating that
34 techniques such as goal setting or self-regulation would be used, but not stating how. This
35 made identifying the specific behavioural change techniques and how they were utilised very
36 challenging. This is a recurring issue within behaviour change intervention studies, as noted
37 by Michie, Fixsen, Grimshaw, and Eccles (2009). Complex behaviour change interventions
38 are not well described in journal articles, and when they are the terminology used is often
39 inconsistent. One way around this problem would be for authors of interventions to publish
40 details online. That way, authors would be able to refer to this detail in publications, saving
41 space in journal articles, and fellow researchers and clinicians alike would be better able to
42 understand and replicate where appropriate.

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3 As highlighted by the quality assessment, the overall methodological quality of the included
4 studies was moderate to weak. This can be attributed to the particular challenges that are
5 faced in designing methodologically robust studies for people with mental health conditions.
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7 RCTs are considered the “gold standard” design for trialling intervention efficacy, however in
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9 the community and clinical settings person level randomisation is not always possible
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11 (Landsverk, Brown, Reutz, Palinkas, & Horwitz, 2011). The screening and methods of
12
13 recruitment of participants also threaten the generalisability of the results. For the most part
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15 the included studies screened participants for suitability or had very specific
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17 inclusion/exclusion criteria, and as a result, the participants may not be truly representative
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19 of the general mental health population (Borschmann et al. 2014). Another challenge in
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21 developing robustly designed trials of psychological interventions is in blinding. Whilst in
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23 medical interventions placebo treatments can be used to blind participants and practitioners,
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25 it is almost impossible to blind participants and practitioners from interventions which involve
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27 exercise and psychological interventions (Feliu-Soler et al., 2017; Shean, 2014). One long
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29 term solution would be for policy makers to take a different perspective of the research
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31 hierarchy when considering ‘real world’ evidence, and place a higher value on observational
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33 research conducted in appropriate complex environments. There has certainly been
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35 progress in this regard, with a much wider recognition of the limitations of reductionist
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37 thinking in relation to multifactorial community interventions (Shelton, Cooper & Stirman;
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39 2018). A less radical method would of course be to conduct cluster randomised trials
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41 (Hemming et al., 2017).

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48 Finally, there was considerable variation in a) the duration of the interventions and in b) the
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50 length of follow-up in the included studies. In relation to the intervention duration, again it is
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52 difficult to compare studies due to their heterogeneity, and so, despite the intuitive appeal, it
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54 is not possible from these studies to say whether longer interventions lead to better
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56 adherence. To answer this question, the intervention would need to be standardised and
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58 impact monitored over varying lengths of time. The law of diminishing returns would suggest
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3 an optimal amount of intervention is likely (Stebbins, 1944). For example, patients referred to
4 chaplains for their spiritual needs seem to benefit more from having two sessions as
5 opposed to one, and benefit more again for three sessions as opposed to two, but don't
6 appear to improve further for having more than three (Snowden, et al., 2018). In fact, benefit
7 reduces at four. Mental health could be different though, as there is evidence of slow but
8 continuous benefit from psychotherapy (Falkenström, Josefsson, Berggren, & Holmqvist,
9 2016). Dedicated research is need here to establish any 'dose' of optimal support for people
10 with mental health problems adhering to lifestyle change to incorporate more physical
11 activity.
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14 In relation to long term impact, only six of the included studies examined impact of the
15 intervention beyond the initial intervention period. Very few studies have evaluated long-term
16 PA behaviour change (Fjeldsoe, Neuhaus, Winkler, & Eakin, 2011). There is a number of
17 reasons why there has been a lack of research into the maintenance of PA, post-
18 intervention, such as publication bias for successful interventions (Ferrari, 2015) and the
19 simple fact that there are more short research programmes than there are longer ones. Most
20 concerningly, funding is very difficult to obtain to support long term interventions.
21 Governments and third sector providers alike appear trapped in short term thinking
22 commensurate with their terms of office and so long-term projects are rarely funded even
23 when there is overwhelming evidence of their efficacy. The long-term impact of behaviour
24 change interventions is therefore largely unknown, and is likely to remain so without
25 considerable shift in the way public services are funded.
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27 LIMITATIONS

28 A limitation of this review was the range of different conceptualisations of adherence.
29 Because there was wide variation in interpretation and measurement of adherence in the
30 reviewed papers, there is a clear risk that the different interpretations may not have been
31 conceptually comparable. A more restrictive approach to inclusion/exclusion criteria at
32 selection stage would likely have concluded with a more straightforward interpretation. By
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3 setting the bar for inclusion criteria very high it is easy to conclude that 'more evidence is
4 needed'. However, this would not have been a fair representation of the literature. The
5 authors instead concluded that a broad inclusion approach was defensible because despite
6 the heterogeneity, the papers were all measuring similar elements of adherence. Further,
7 this narrative synthesis highlighted the complexity of the issue of measuring adherence to
8 physical activity, hopefully encouraging future researchers to consider the concept very
9 carefully. The elements suggested by Hawley-Hague, Horne, Skelton, and Todd (2016)
10 could help with standardisation here: completion/retention, frequency, duration and intensity.
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12 This review also has several practical limitations. Although checked by all, the search of the
13 literature was conducted predominately by the lead author, as was data extraction. The
14 search was limited to studies which were published in English.

27 CONCLUSION

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30 In conclusion, the studies included in this review varied considerably in terms of their design,
31 delivery, and content. This heterogeneity made drawing conclusions about the effectiveness
32 of cognitive behavioural interventions difficult. However, all the studies reported higher than
33 average adherence to PA, which suggests that cognitive behavioural interventions have a
34 limited but positive effect on increasing adherence to PA in mental health populations.
35
36 Future prospective longitudinal research should be constructed to examine the long-term
37 effects of cognitive behavioural interventions on the adherence and maintenance of physical
38 activity in people with a range of mental health problems. The research should be
39 constructed with reporting guidelines in mind. That way, the findings, including the details
40 and effect size of the intervention, will be more easily synthesised with comparable research,
41 creating transferable knowledge of both the intervention and its outcome.
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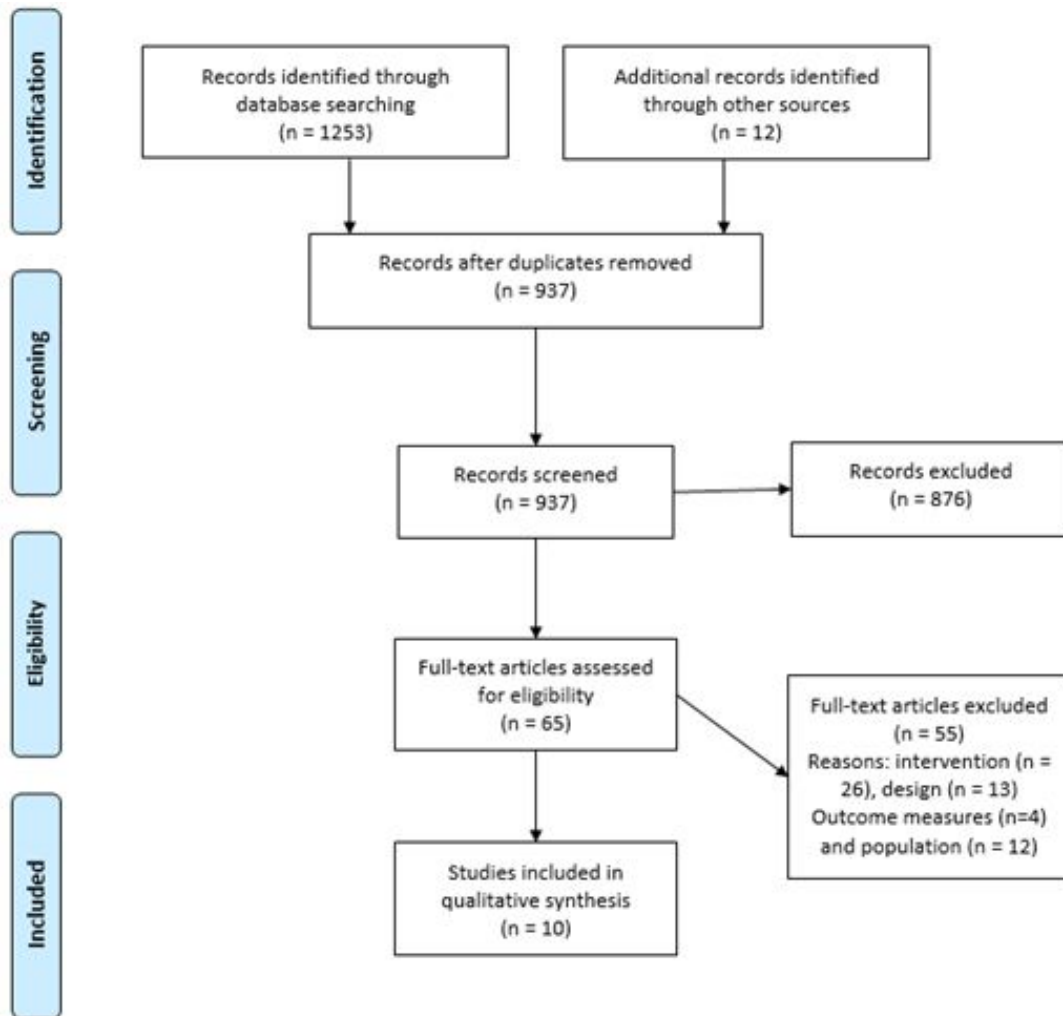


Figure 1 PRISMA Flow Chart

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Table 1 Study Characteristics

Study & country	Design	Participants	Diagnosis	Comorbidities Declared?	Intervention Duration	Follow up	Intervention (Frequency/Components)	PA Measure	Adherence Measure
Attux et al. (2013) Brazil	RCT	N = 160; 64 female/96 male; average age in intervention group 36.2 (SD = 9.9); 60% Caucasian, 11% Afro-American; 10% other.	Schizophrenia	No	12 weeks	6 months	12 one-hour weekly group sessions led by mental health professionals which combined behavioural techniques such as the use of diaries and role play, with psychoeducation components.	Self-report: International Physical Activity Questionnaire (IPAQ)	Attendance: No. of sessions attended.
Beebe et al. (2011) USA	RCT	N = 97; age 46.9 (SD = 2.0); 46 female/51 male; Caucasian 54.6%; 44.4% African American, 1% Asian.	Schizoaffective disorder (n = 69), Schizophrenia (n = 28)	No	20 weeks	No follow up	4 weekly, hour-long group sessions, content was based on self-efficacy theory and included goal setting, barrier identification and behavioural prompts; Walking groups met 3 times weekly for 16 weeks.	Self-report: Total number of minutes each subject walked during the walking groups each month	Attendance and duration: No of groups attended and no. of weeks attended at least one group.
Brown et al. (2014) USA	RCT	N = 49; age 44.37 (SD = 10.75); 22 females/27 males; Caucasian 91.3%, 8.7%	Alcohol dependence	Yes: Anxiety and depression	12 weeks	6 months.	12 weekly aerobic exercise sessions and brief 15–20 minutes group behavioural sessions; Exercise sessions began at 20 minutes per session and gradually	Self-report: Health questionnaire and Physical Activity	Attendance: No of sessions attended

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African American. progressed to 40 minutes per session by week 12; Group behavioural sessions involved cognitive and behavioural techniques such as goal setting, barrier identification and relapse prevention techniques aimed to increase motivation and adherence. Monetary incentives provided for participants who attended weekly sessions.

Screen; Timeline Follow Back for Exercise

Curtis et al. (2016)	Quasi-RCT	N = 28; age 20.7 (SD = 2.2); 17 men/11 women. 62% Caucasian, 25% Asian and 13% Indigenous.	First episode Psychosis (Schizophreniform Psychosis, Schizoaffective disorder, Delusional disorder, brief Psychotic disorder, Bipolar affective disorder, or Depression with psychotic features)	No	12 weeks.	No follow up	The intervention involved health coaching, dietetic support and supervised exercise prescriptions; delivered by a team that included a clinical nurse consultant, a dietician, an exercise physiologist and youth peer wellness coaches. The health coaching involved goal identification and motivational interviewing.	Self-report: IPAQ-SF	Attrition rate.
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3	Duda et al.	Cluster	N = 347; 72.9%	Probable	Yes: Two or more	3 months	6 months	A Health and Fitness Advisor had	Self-report: 7-	Completion:
4	(2014)	RCT	female/27.1%	Anxiety and	risk factors for			one-to-one contact, in person or	Day Physical	Attrition level.
5	UK		male; 74.9%	Depression	Coronary Heart			via telephone, with participants on	Activity Recall	
6			White British,		Disease; Chronic			four occasions. The intervention	(PAR)	
7			Black African or		medical			used motivational interviewing		
8			Caribbean 10.6%,		conditions:			techniques, such as careful		
9			South Asian 9.5%,		asthma,			listening, parroting, and handling		
10			Mixed 5%.		bronchitis,			resistance and double-sided		
11					diabetes,			reflection, and Self Determination		
12					hypertension			Theory-based strategies.		
13								Participants took part in 10-12		
14								weeks of exercise programmes		
15								overseen by the HFA.		
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20	Goracci et al.	RCT	N = 160; age 49;	Bi-polar	No	10-12 weeks	12 months	10 weekly 45-60-minute sessions	Self-report:	Completion:
21	(2016)		80% female/20%	disorder (n =				(12 if participants elected to take	The	no. completing
22	Italy		male.	105) and				part in the smoking cessation	Paffenbarger	program.
23				recurrent				module) all sessions included	Physical	
24				Unipolar				cognitive and behavioural	Activity	
25				Depression (n				techniques and homework for	Questionnaire	
26				= 55)				participants, sessions were run by		
27								psychiatrists and dieticians.		
28										
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30	Lindegård et	Cohort	N = 69; age 42.6;	Exhaustion	Yes: Anxiety and	12 months	18 months	The composition of the program	Self-report:	Duration:
31	al. (2015)		45 female/24	Disorder	Depression			was tailored to each participant's	Saltin-Grimby	Level complied
32	Sweden		male.					needs. Participants were allowed	Physical	with American
33								to self-select the components	Activity Level	College of
34								appropriate for their needs. The	Scale.	Sport Medicine
35								frequency and duration of visits		Guidelines
36								were similar for all patients (on		post-
37								average, patients had two		intervention
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4							consultations lasting 1.5 h and 10			
5							consultations lasting 30 min). The			
6							program offered cognitive			
7							behavioural group therapy, stress			
8							management, and Physical			
9							Activity Counselling.			
10										
11	Lovell et al.	RCT	N = 105; Age 25.7	Schizophrenia,	No	6 months	12 months	Based on Leventhal's Common	Self-report:	Attendance:
12	(2014)		(SD = 5.7); 63	Schizophrenifo				Sense Model, the intervention	IPAQ	No. of
13	UK		male/42 female;	rm disorder,				contained behavioural and		sessions
14			82% Caucasian,	Schizoaffectiv				motivational components, such as		attended.
15			Black African or	e disorder,				psychoeducation, goal setting and		
16			Caribbean 2.9%,	Delusional				action plans. The intervention was		
17			Indian 2.9%,	disorder, brief				delivered by support, time and		
18			Pakistani 6.7%,	reactive				recovery workers, participants		
19			Bangladeshi 1%,	Psychosis, or				received 7 individual face-to-face		
20			Other Asian 3.8%,	Psychosis not				sessions over 6 months, with a		
21			Other 1%	otherwise				"booster" session at 9–10 months.		
22				specified						
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26	Merom et al.	RCT	N = 85;	Generalized	No	10 weeks	No follow	Group CBT, 90-min session	Self-report:	Attendance:
27	(2008)		Age 38.7 (SD =	Anxiety			up	delivered once a week for 8	The Active	No of sessions
28	Australia		12.1); 71%	disorder, Panic				weeks by clinical psychologists.	Australia	attended,
29			female/29% male;	Disorder, or				Exercise program delivered by an	Questionnaire;	
30				Social Phobia				exercise trainer, with the aim to	change in	
31								gradually increase the 30-minute	minutes of	
32								sessions of moderate-intensity	walking "for	
33								exercise to accumulate 150	exercise and	
34								minutes per week.	recreation"	
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3	Rector et al.	Cohort	N = 14; Age 35.54	Obsessive	Yes: Binge-eating	15 weeks	No follow	Combined CBT and physical	Self-report:	Attendance,
4	(2015)		(SD = 8.47); 8	Compulsive	disorder, major		up	exercise delivered in a group	The Physical	duration and
5			male/6 female;	Disorder	depressive			format, for 15 consecutive weeks.	Activity	intensity: Self-
6	Canada		55% Caucasian,	(OCD)	episode, phobia			The physical exercise involved 12	Readiness	reported
7			18% Asian, 9%					weeks of aerobic exercise.	Questionnaire	exercise logs.
8			18% Asian, 9%							
9			18% Asian, 9%							
10			East Indian and							
11			the remaining							
12			18% preferred not							
13			to specify.							
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Notes: Each bar represents a study, referenced by the first three letters of the first authors' surname, or four where further differentiation is needed.

- Low risk of bias ++
- Medium risk of bias +
- High risk of bias -
- Not significant
- p < .10
- p < 0.05
- High bar = design can examine causal effect of intervention (RCT)
- Med bar = design can infer plausible causality
- Low bar = cannot infer causality

Figure 2: Harvest Plot

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