The Effectiveness of Cognitive-Behavioural Interventions at Increasing Adherence to Physical Activity in Mental Health Populations: A Systematic Review

Objectives: There is growing global evidence for stark inequalities in the physical health status and life-expectancy of people with a mental health diagnosis. In most cases, physical activity (PA) is one of the most effective methods of maintaining physical and mental health. However, people with mental health challenges are less likely to adhere to recommended levels of PA, leading to a vicious cycle of poor physical and mental health. The objective of this paper is to assess if, and how cognitive-behavioural (CB) techniques increase adherence to PA in mental health populations.

Method: Systematic review and narrative synthesis. Included studies detailed a behavioural change intervention which targeted PA using CB approaches, delivered to adults with a mental health condition as defined by DSM V or ICD-10. Adherence to the intervention AND physical activity was reported within RCT, cluster RCT, quasi-experimental, or controlled before and after study. Electronic searches conducted in MEDLINE, CINAHL, Cochrane Library (Trials), SPORTDiscus and PsycINFO.

Results: Ten studies from seven countries were synthesised. Methodologically moderate to weak, all showed adherence to the intervention to be associated with increased levels of PA. All studies reported higher than average adherence to PA in the intervention groups.

Discussion: CB interventions were associated with improved adherence to PA in international samples of people with mental health conditions. Studies adopting more robust designs are needed to quantify optimal interventions and impact, but this original synthesis is encouraging for researchers and clinicians alike looking to maximise the synergy between physical and mental health.
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DECLARATION OF INTEREST: None

Key Words: Anxiety, depression, exercise, behaviour change, interventions, physical activity
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, Home, 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
PA should be defined according to the purpose of the study. Following Hawley-Hague et al (2016) the key elements of adherence to PA are defined here using the following parameters: a) completion of programme of activity or not (retention), b) proportion of sessions/classes attended (frequency), c) amount of physical activity, measured in time, during intervention (duration), d) intensity of activity during programme, and e) b to d at follow-up.

BACKGROUND

Physical activity is essential for maintaining health and well-being. For example, it can reduce the risk of chronic physical diseases, such as cardiovascular disease (CVD), type 2 diabetes, hypertension, and respiratory illnesses (Naci & Ioannidis, 2013). However, PA is not only beneficial for physical health. A growing body of evidence also supports the positive relationship between PA and mental health (Schuch, Vancampfort, Richards, et al., 2016). Physical activity has been shown to be an effective treatment in populations with clinical depression (Craft & Perna, 2004; Daley, 2008). In some studies PA has been shown to be as effective as pharmacology or psychotherapies for reducing severity of depressive symptoms (Schuch, Vancampfort, Richards, et al., 2016). The UK National Institute for Health and Clinical Excellence (NICE) guidelines recommend structured physical activity as an appropriate treatment for people with mild to moderate depression (NICE, 2010).

There is less research investigating PA in patients with diagnosed anxiety disorders, however, available evidence suggests that exercise can reduce symptoms and is an acceptable treatment (Herring, Lindheimer, & O’Connor, 2013). A review of exercise interventions for people diagnosed with schizophrenia concluded that PA could help to alleviate secondary symptoms, such as anxiety and depression, and other negative symptoms of schizophrenia (Faulkner, Gorczynski, & Arbour-Nicitopoulos, 2013).

Engagement in PA can have a wide range of benefits for people with mental health conditions, even in the absence of objective diagnostic improvements. PA can improve
quality of life, reduce isolation by providing opportunities for social interaction and increase the likelihood of individuals returning to ‘normal’ previously enjoyed activities (Crone, Heaney, & Owens, 2009). This increasingly extensive body of evidence of the positive effects of PA and exercise on a broad range of mental health conditions has led to the recommendation that PA should be used as an adjunct to usual treatment for a range of conditions, including anxiety disorders, depression, substance abuse and schizophrenia (Rosenbaum et al., 2015).

However, despite these well-established benefits, people diagnosed with mental health problems are significantly less active than the general population (Nyboe & Lund, 2013). They often face substantial illness-related barriers to PA, above and beyond those experienced by healthy individuals (Glowacki, Duncan, Gainforth, & Faulkner, 2017). Psychotropic medicines cause weight gain and metabolic changes (Haddad, 2004), as well as other side effects such as lack of energy and motivation (Glover, Ferron, & Whitley, 2013). On average, people with chronic mental health conditions die 10 to 25 years earlier than people without mental health conditions (WHO, 2014). As much of this mortality is linked to cardiovascular issues, it is logical to suggest that PA may be beneficial for reducing this risk (Nocon et al., 2008). The problem is that physical activity is uniquely difficult for people with mental health problems.

In the general population, adherence to PA programmes drops off after six months, with less than half the participants completing (Gidlow, Johnston, Crone, & James, 2005; Richardson et al., 2005). In people with mental health conditions, some suggest that attrition is significantly greater (Rosenbaum et al., 2015). However, cognitive behavioural interventions have been found to be somewhat effective at increasing PA. Reviews which have looked at adherence to PA interventions in a range of populations, including people with chronic illness, elderly and obese populations (O’Halloran et al., 2014; Picorelli, Pereira, Pereira, Felício, & Sherrington, 2014; Samdal, Eide, Barth, Williams, & Meland, 2017), have found
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
pre and post assessment data were included. Comparison groups included control groups who receive no intervention or usual treatment. Studies without a control group were eligible for inclusion provided pre and post data were available.

Studies were excluded if they were delivered to children or adolescents. Studies which focused on chronic health or physical conditions were excluded although papers which stated participants had comorbid health conditions were considered based on meeting the other eligibility criteria. Interventions that did not have a psychological or behavioural element, or were not behaviour change focused were not included. There was no exclusion based on the duration of intervention, length of follow up or format of intervention. Studies were excluded if they were not available in English, due to practical limitations. Qualitative studies were excluded since it was not within the scope of this review to examine qualitative data. Systematic reviews and study protocols were excluded, as were conference abstracts and papers where no full-text was available.

INFORMATION SOURCES AND SEARCH

Electronic searches were performed in the following databases from the year of inception to May 2017: MEDLINE, CINAHL, Cochrane Library (Trials), SPORTDiscus and PsycINFO. The following search terms were entered in each database: ("Motivational interviewing" OR “Cognitive interventions” OR Behaviour Therapy OR Cognition Therapy OR “Cognitive Behaviour Therapy” OR “Cognitive Behavioural Therapy” OR Cognitive Psychotherapy OR Cognitive Therapy OR Psychotherapy OR Behaviour Change OR Intervention OR treatment OR “Goal setting” OR “Self-monitoring”) AND (Adherence OR Compliance OR Concordance OR “Noncompliance” OR “Non Adherence” OR Engagement) AND (“Physical activity” OR “Leisure activity” OR Exercise OR Running OR Jogging OR Swimming OR Sport OR Cycling OR Inactivity OR Sedentary) AND (Lifestyle OR Gym OR outpatient OR structured exercise) AND (“Mental health” OR “Psychological wellbeing” OR “Mental well-being” OR “Mental wellbeing” OR Anxiety OR Depression OR Psychosis OR Schizophrenia OR Dementia). In addition, hand searches of reference lists and most recent reviews (Rebar & Taylor, 2017;
Glowacki et al., 2017; Rosenbaum et al., 2014; Schuch et al., 2016) were conducted to identify additional relevant studies.

STUDY SELECTION

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

DATA EXTRACTION

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

QUALITY ASSESSMENT OF SELECTED STUDIES

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

DATA ANALYSIS

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

RESULTS

STUDY SELECTION

In total, 1253 studies were identified through the search. An additional 12 papers were identified through hand searches. 937 papers remained after duplicates were removed. This number was reduced to 56 through the screening of titles and abstracts. The full-texts of these 56 papers were reviewed using the inclusion/exclusion criteria. Of the full-text papers, 10 met the inclusion criteria. The full results of the search and reasons for exclusion can be seen in the PRISMA flowchart (Figure 1).
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;
Lovell et al., 2014). Two of the interventions combined group CBT with a PA intervention (Merom et al., 2008; Rector et al., 2015).

The majority of the interventions were delivered as an adjunct to supervised exercise programmes or offered access to group activities (Attux et al., 2013; Brown et al., 2014; Curtis et al., 2016; Duda et al., 2014; Lindegard et al., 2015; Lovell, et al., 2014; Rector et al., 2015). Three studies focused on increasing PA through walking (Beebe et al., 2011; Goracci et al., 2016; Merom et al, 2008).

MEASUREMENT OF PHYSICAL ACTIVITY

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

EFFECT ON PHYSICAL ACTIVITY

Of the included studies, four reported significant improvements in PA (Attux et al., 2013; Curtis et al., 2016; Duda et al., 2014; Merom et al., 2008). However, of these studies, only two reported significant effects of the intervention (Curtis et al., 2016; Merom et al., 2008). Four did not report a significant change in levels of PA (Beebe et al., 2011; Brown et al., 2014; Lovell et al., 2014; Rector, Richter, Lerman, & Regev, 2015). Two studies did not report changes in PA, even though measures had been taken at baseline and follow up (Goracci et al., 2016; Lindegård et al., 2015).
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
improving adherence to PA in this cohort. Cognitive behavioural interventions are effective, but only moderately. This is important to understand, as future interventions are much more likely to become sustainable if they meet realistic expectations (Shelton, Cooper & Stirman; 2018).

Regarding adherence rates within the individual studies, Merom et al’s (2008) data went as expected with non-completers demonstrating significantly lower amounts of PA than completers. Brown et al. (2014) also found that the intervention was more effective for participants with better adherence. These results are important because they suggest that adherence to the intervention is an important factor in increasing levels of PA. Similar findings have been found elsewhere: O’Halloran et al. (2014) found that motivational interviewing (MI) had a small but positive effect on self-reported PA, with the effect increasing with levels of participation in MI. This highlights the importance of monitoring all aspects of adherence in intervention studies.

Given the variability in measurement of PA, it was not possible to meaningfully compare adherence rates between studies. This is unsurprising as no gold standard way of measuring adherence to PA has been established (Nyboe & Lund, 2013). This hinders the understanding of adherence to PA, particularly in mental health populations.

Most of the included studies relied on self-report measures of PA, which are subject to recall and social desirability bias, which can lead to over or underestimations of PA (Rhodes et al., 2017). Non self-report measures of PA, such as accelerometers, are considered more accurate at measuring actual levels of PA, as findings suggest that self-report measures of adherence to PA are much higher than those that are objectively measured (Prince et al., 2008). Therefore, it is recommended that non-subjective measures should be used in combination with self-report measures, particularly in studies which aim to measure the percentage of participants meeting PA guidelines or actual levels of activity.
Beyond the benefits to mental health, PA is beneficial for improving physical health, which is particularly relevant to people with mental health conditions, as they are at a significantly greater risk of comorbid conditions, such as heart disease, obesity and diabetes (Nocon et al., 2008). Of the included studies, very few made reference to any co-morbid health-related issues present in the participants under study. In light of this, other outcomes, such as quality of life, sleep quality, self-esteem etc. may be valuable when examining PA interventions, particularly in mental health populations, as the benefits that come from PA are not necessarily just physical (Schuch, Vancampfort, Rosenbaum, et al., 2016). It is possible that psychological benefits, such as improved self-esteem, body image and positive feelings, can accrue without a change in physical fitness. However, in the included studies quality of life outcomes were not always measured, therefore an analysis of the effects was not within the scope of this paper, but something that could be considered in future research.

Taking into consideration the nature of complex behavioural change interventions and the fact that terms such as “cognitive” or “motivational” can be used to describe a range of techniques for eliciting behaviour change, it is unsurprising that the included interventions varied in their content and delivery. The majority of the included studies also only provided brief descriptions of the interventions, which often lacked detail, for example, stating that techniques such as goal setting or self-regulation would be used, but not stating how. This made identifying the specific behavioural change techniques and how they were utilised very challenging. This is a recurring issue within behaviour change intervention studies, as noted by Michie, Fixsen, Grimshaw, and Eccles (2009). Complex behaviour change interventions are not well described in journal articles, and when they are the terminology used is often inconsistent. One way around this problem would be for authors of interventions to publish details online. That way, authors would be able to refer to this detail in publications, saving space in journal articles, and fellow researchers and clinicians alike would be better able to understand and replicate where appropriate.
As highlighted by the quality assessment, the overall methodological quality of the included studies was moderate to weak. This can be attributed to the particular challenges that are faced in designing methodologically robust studies for people with mental health conditions.

RCTs are considered the “gold standard” design for trialling intervention efficacy, however in the community and clinical settings person level randomisation is not always possible (Landsverk, Brown, Reutz, Palinkas, & Horwitz, 2011). The screening and methods of recruitment of participants also threaten the generalisability of the results. For the most part the included studies screened participants for suitability or had very specific inclusion/exclusion criteria, and as a result, the participants may not be truly representative of the general mental health population (Borschmann et al. 2014). Another challenge in developing robustly designed trials of psychological interventions is in blinding. Whilst in medical interventions placebo treatments can be used to blind participants and practitioners, it is almost impossible to blind participants and practitioners from interventions which involve exercise and psychological interventions (Feliu-Soler et al., 2017; Shean, 2014). One long term solution would be for policy makers to take a different perspective of the research hierarchy when considering ‘real world’ evidence, and place a higher value on observational research conducted in appropriate complex environments. There has certainly been progress in this regard, with a much wider recognition of the limitations of reductionist thinking in relation to multifactorial community interventions (Shelton, Cooper & Stirman; 2018). A less radical method would of course be to conduct cluster randomised trials (Hemming et al., 2017).

Finally, there was considerable variation in a) the duration of the interventions and in b) the length of follow-up in the included studies. In relation to the intervention duration, again it is difficult to compare studies due to their heterogeneity, and so, despite the intuitive appeal, it is not possible from these studies to say whether longer interventions lead to better adherence. To answer this question, the intervention would need to be standardised and impact monitored over varying lengths of time. The law of diminishing returns would suggest
an optimal amount of intervention is likely (Stebbins, 1944). For example, patients referred to chaplains for their spiritual needs seem to benefit more from having two sessions as opposed to one, and benefit more again for three sessions as opposed to two, but don’t appear to improve further for having more than three (Snowden, et al., 2018). In fact, benefit reduces at four. Mental health could be different though, as there is evidence of slow but continuous benefit from psychotherapy (Falkenström, Josefsson, Berggren, & Holmqvist, 2016). Dedicated research is need here to establish any ‘dose’ of optimal support for people with mental health problems adhering to lifestyle change to incorporate more physical activity.

In relation to long term impact, only six of the included studies examined impact of the intervention beyond the initial intervention period. Very few studies have evaluated long-term PA behaviour change (Fjeldsoe, Neuhaus, Winkler, & Eakin, 2011). There is a number of reasons why there has been a lack of research into the maintenance of PA, post-intervention, such as publication bias for successful interventions (Ferrari, 2015) and the simple fact that there are more short research programmes than there are longer ones. Most concerningly, funding is very difficult to obtain to support long term interventions. Governments and third sector providers alike appear trapped in short term thinking commensurate with their terms of office and so long-term projects are rarely funded even when there is overwhelming evidence of their efficacy. The long-term impact of behaviour change interventions is therefore largely unknown, and is likely to remain so without considerable shift in the way public services are funded.

LIMITATIONS

A limitation of this review was the range of different conceptualisations of adherence. Because there was wide variation in interpretation and measurement of adherence in the reviewed papers, there is a clear risk that the different interpretations may not have been conceptually comparable. A more restrictive approach to inclusion/exclusion criteria at selection stage would likely have concluded with a more straightforward interpretation. By
setting the bar for inclusion criteria very high it is easy to conclude that ‘more evidence is needed’. However, this would not have been a fair representation of the literature. The authors instead concluded that a broad inclusion approach was defensible because despite the heterogeneity, the papers were all measuring similar elements of adherence. Further, this narrative synthesis highlighted the complexity of the issue of measuring adherence to physical activity, hopefully encouraging future researchers to consider the concept very carefully. The elements suggested by Hawley-Hague, Horne, Skelton, and Todd (2016) could help with standardisation here: completion/retention, frequency, duration and intensity.

This review also has several practical limitations. Although checked by all, the search of the literature was conducted predominately by the lead author, as was data extraction. The search was limited to studies which were published in English.

CONCLUSION

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

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For Peer Review Only


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<table>
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<tr>
<th>Study &amp; country</th>
<th>Design</th>
<th>Participants</th>
<th>Diagnosis</th>
<th>Comorbidities Declared?</th>
<th>Intervention Duration</th>
<th>Follow up</th>
<th>Intervention (Frequency/Components)</th>
<th>PA Measure</th>
<th>Adherence Measure</th>
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<tbody>
<tr>
<td>Attux et al. (2013) Brazil</td>
<td>RCT</td>
<td>N = 160; 64 female/96 male; average age in intervention group 36.2 (SD = 9.9); 60% Caucasian, 11% Afro-American; 10% other.</td>
<td>Schizophrenia</td>
<td>No</td>
<td>12 weeks</td>
<td>6 months</td>
<td>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.</td>
<td>Self-report: International Physical Activity Questionnaire (IPAQ)</td>
<td>Attendance: No. of sessions attended.</td>
</tr>
<tr>
<td>Beebe et al. (2011) USA</td>
<td>RCT</td>
<td>N = 97; age 46.9 (SD = 2.0); 46 female/51 male; Caucasian 54.6%; 44.4% African American, 1% Asian.</td>
<td>Schizoaffective disorder (n = 69), Schizophrenia (n = 28)</td>
<td>No</td>
<td>20 weeks</td>
<td>No follow up</td>
<td>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.</td>
<td>Self-report: Total number of minutes each subject walked during the walking groups each month</td>
<td>Attendance and duration: No of groups attended and no. of weeks attended at least one group.</td>
</tr>
<tr>
<td>Brown et al. (2014) USA</td>
<td>RCT</td>
<td>N = 49; age 44.37 (SD = 10.75); 22 females/27 males; Caucasian 91.3%, 8.7%</td>
<td>Alcohol dependence</td>
<td>Yes: Anxiety and depression</td>
<td>12 weeks</td>
<td>6 months.</td>
<td>12 weekly aerobic exercise sessions and brief 15–20 minutes group behavioural sessions; Exercise sessions began at 20 minutes per session and gradually</td>
<td>Self-report: Health questionnaire and Physical Activity</td>
<td>Attendance: No of sessions attended</td>
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<th>Intervention Details</th>
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<tr>
<td>Curtis et al. (2016)</td>
<td>Quasi-RCT</td>
<td>Australia</td>
<td>N = 28; age 20.7 (SD = 2.2); 17 men/11 women.</td>
<td>62% Caucasian, 25% Asian and 13% Indigenous.</td>
<td>First episode Psychosis (Schizophreniform, Schizophrenia, Schizoaffective disorder, Delusional disorder, brief Psychotic disorder, Bipolar affective disorder, or Depression with psychotic features)</td>
<td>12 weeks.</td>
<td>No follow-up</td>
<td>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.</td>
<td>Self-report: IPAQ-SF</td>
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<tr>
<td>Study</td>
<td>Design</td>
<td>Country</td>
<td>Sample Size</td>
<td>Gender Distribution</td>
<td>Probable Conditions</td>
<td>Duration</td>
<td>Description</td>
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<td>Duda et al. (2014)</td>
<td>RCT</td>
<td>UK</td>
<td>N = 347; 72.9% female/27.1% male; 74.9% White British, Black African or Caribbean 10.6%, South Asian 9.5%, Mixed 5%</td>
<td>Yes: Two or more risk factors for Coronary Heart Disease; Chronic medical conditions: asthma, bronchitis, diabetes, hypertension</td>
<td>3 months 6 months</td>
<td>A Health and Fitness Advisor had one-to-one contact, in person or via telephone, with participants on four occasions. The intervention used motivational interviewing techniques, such as careful listening, parroting, and handling resistance and double-sided reflection, and Self Determination Theory-based strategies. Participants took part in 10-12 weeks of exercise programmes overseen by the HFA.</td>
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<td>Goracci et al. (2016)</td>
<td>RCT</td>
<td>Italy</td>
<td>N = 160; age 49; 80% female/20% male</td>
<td>No</td>
<td>10-12 weeks 12 months</td>
<td>10 weekly 45-60-minute sessions (12 if participants elected to take part in the smoking cessation module) all sessions included cognitive and behavioural techniques and homework for participants, sessions were run by psychiatrists and dieticians.</td>
<td>Self-report: The Paffenbarger Physical Activity Questionnaire Completion: no. completing program.</td>
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<td>Lindegård et al. (2015)</td>
<td>Cohort</td>
<td>Sweden</td>
<td>N = 69; age 42.6; 45 female/24 male</td>
<td>Yes: Anxiety and Depression</td>
<td>12 months 18 months</td>
<td>The composition of the program was tailored to each participant's needs. Participants were allowed to self-select the components appropriate for their needs. The frequency and duration of visits were similar for all patients (on average, patients had two visits per week).</td>
<td>Self-report: Saltin-Grimby Physical Activity Level Scale. Duration: Level complied with American College of Sport Medicine Guidelines post-intervention</td>
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consultations lasting 1.5 h and 10 consultations lasting 30 min). The program offered cognitive behavioural group therapy, stress management, and Physical Activity Counselling.

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<thead>
<tr>
<th>Study</th>
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<th>Location</th>
<th>Sample Size</th>
<th>Sample Characteristics</th>
<th>Conditions</th>
<th>Follow-up</th>
<th>Intervention Details</th>
<th>Outcome Measures</th>
<th>Attendance Measure</th>
<th>Notes</th>
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<tr>
<td>Lovell et al. (2014)</td>
<td>RCT</td>
<td>UK</td>
<td>N = 105; Age 25.7 (SD = 5.7); 63 male/42 female; 82% Caucasian, Black African or Caribbean 2.9%, Indian 2.9%, Pakistani 6.7%, Bangladeshi 1%, Other Asian 3.8%, Other 1%</td>
<td>Schizophrenia, Schizophreniform disorder, Schizoaffective disorder, Delusional disorder, brief reactive Psychosis, or Psychosis not otherwise specified</td>
<td>No</td>
<td>6 months 12 months</td>
<td>Based on Leventhal’s Common Sense Model, the intervention contained behavioural and motivational components, such as psychoeducation, goal setting and action plans. The intervention was delivered by support, time and recovery workers, participants received 7 individual face-to-face sessions over 6 months, with a “booster” session at 9–10 months.</td>
<td>Self-report: IPAQ</td>
<td>Attendance: No. of sessions attended</td>
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<td>Merom et al. (2008)</td>
<td>RCT</td>
<td>Australia</td>
<td>N = 85; Age 38.7 (SD = 12.1); 71% female/29% male;</td>
<td>Generalized Anxiety disorder, Panic Disorder, or Social Phobia</td>
<td>No</td>
<td>10 weeks No follow up</td>
<td>Group CBT, 90-min session delivered once a week for 8 weeks by clinical psychologists. Exercise program delivered by an exercise trainer, with the aim to gradually increase the 30-minute sessions of moderate-intensity exercise to accumulate 150 minutes per week.</td>
<td>Self-report: The Active Australia Questionnaire; change in minutes of walking “for exercise and recreation”</td>
<td>Attendance: No of sessions attended</td>
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<tr>
<td>Study</td>
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<td>Country</td>
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<td>Age</td>
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<td>Rector et al. (2015)</td>
<td>Canada</td>
<td>N = 14; Age 35.54 (SD = 8.47); 8 male/6 female; 55% Caucasian, 18% Asian, 9% East Indian and the remaining 18% preferred not to specify.</td>
<td>Yes: Binge-eating disorder, major depressive episode, phobia</td>
<td>15 weeks</td>
<td>No follow up</td>
<td>Combined CBT and physical exercise delivered in a group format, for 15 consecutive weeks. The physical exercise involved 12 weeks of aerobic exercise.</td>
<td>Self-report: The Physical Activity Readiness Questionnaire</td>
<td>Attendance, duration and intensity: Self-reported exercise logs.</td>
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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 ++ Not significant p<10
Medium risk of bias + p<0.1
High risk of bias -

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