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REVIEW ARTICLE

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Systematic review of physical activity interventions assessing physical and mental health outcomes on patients with severe mental illness (SMI) within secure forensic settings

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Accessible Summary

What is known on the subject?

- Individuals with a severe mental illness (SMI) are less physically active and have a lower life expectancy than the general population due to increased risks of cardiometabolic diseases (obesity, diabetes and respiratory diseases) and other health risks.
- Physical activity has been used as an adjunct therapy for individuals with SMI yielding improvements in cognitive functioning, quality of life and a reduction in psychiatric symptoms.
- Individuals with SMI residing within a secure forensic setting have reduced physical activity opportunities, possibly due to a number of factors including low motivation and restricted access to exercise facilities combined with a lack of knowledge and/or confidence in staff members to assist in physical activity programmes.

What the paper adds to existing knowledge?

- This review demonstrates that little is known around the effects of physical activity for people with SMI who reside in secure forensic settings, with little to no long-term effects reported.
- Physical activity interventions have shown some positive results through decreasing weight and waist circumference as well as a reduction in negative symptom scores in an exercise group compared with the "no treatment" control group post-intervention.

What are the implications for practice?

- Service users' reluctance to engage in physical activity may be overcome by improving staff commitment, creating a motivational atmosphere and promoting service user decision making.

Abstract

Introduction: Participating in physical activity has many benefits, yet those with severe mental illness (SMI) living in forensic settings are less likely to be active, and more likely to experience ill-health. The aim of this study was to systematically review the effectiveness of physical activity programmes on mental and physical health and specifically on reducing symptoms of SMI in forensic settings.

Method: A systematic search of six databases was conducted, in addition to a grey literature search. Studies were included if they had participants with SMI; were based in a forensic setting; involved a physical activity programme and reported physical and mental health outcomes.

Results: A total of 112 participants were included in four studies. One study showed a significant improvement in negative symptom scores in the exercise group compared with a treatment as usual group. Two studies reported improvements in psychiatric symptoms with no significant difference between groups; however, statistically significant changes in weight and waist circumference were evident ($p < .001$). No adverse effects were reported.

Conclusion: Only a small number of studies were included and of limited design and quality, with no follow-up assessments; therefore, more research is needed to determine the true effects of physical activity for improving SMI symptoms in a forensic setting.

This review highlights the need for further studies exploring the barriers and facilitators of physical activity in secure forensic settings. Studies are required that include a more thorough research design. Furthermore, interventions if designed with patients and caring staff in mind may lead to lowered psychiatric symptoms and increased physical health benefits for all in forensic settings.

KEYWORDS

physical activity, secure forensic setting, severe mental illness

1 | INTRODUCTION

Individuals living with severe mental illness (SMI) (e.g., schizophrenia, psychosis, major depressive disorder and bipolar disorder) are significantly less physically active than the general population. Scheewe et al. (2013) reported 70–75% of individuals with schizophrenia do not meet the recommendations for daily physical activity. Furthermore, a meta-analysis reported individuals with SMI are significantly less active than those without. Individuals with SMI accumulate 38.4 min of moderate to vigorous activity (MVPA) per day, compared with 47.6 min per day in individuals without SMI (Vancampfort et al., 2017). Low activity levels are linked to increased metabolic risk for SMI individuals due to comorbidities such as obesity, diabetes and respiratory diseases (Graham et al., 2017; Stubbs et al., 2018), which in turn elevates their risk of cardiovascular disease by 78% compared with the general population (Correll et al., 2017). Worryingly, insufficient physical activity has been shown as a one of the main causes for the reduced life expectancy of those with mental illness by up to 25 years (Ringen et al., 2014; Vancampfort et al., 2017; Walburg et al., 2019; Walker et al., 2015). It has also been reported that individuals with SMI are more likely to participate in unhealthy behaviour such as smoking and excessive sedentary behaviour compared with the general population (Firth et al., 2019).

Across clinical and non-clinical samples, physical activity is effective for the prevention and treatment of somatic diseases (Pérez et al., 2019). Researchers have recommended physical activity as a monotherapy for mild mental illnesses (Glowacki et al., 2019) and as an adjunctive therapy for SMI, with improvements observed in cognitive functioning and positive changes in psychiatric symptoms and quality of life (Deenik et al., 2017; Stubbs et al., 2018). Although previous research and public health guidance stresses the importance of physical activity for mental health, many additional barriers remain to engaging in regular physical activity for the SMI population compared with the general population. For those with SMI, a side effect of the illness and medication can be lack of motivation,

leading to low levels of physical activity programme compliance (Bergman et al., 2020) and high participant dropout rates (i.e., 26.7%) (Vancampfort et al., 2016), weight gain and a general lack of confidence when it comes to trying new activities (Stubbs et al., 2017). Although research till date is limited with SMI, there are a few large-scale studies, in particular randomised control trails (RCTs), which have reported promising results and the benefits of physical activity for individuals. These include that physical activity interventions have positive associations (Ringen et al., 2018) with metabolic health (Deenik et al., 2019), cognitive function (Oertel-Knöchel et al., 2014), lowered depressive symptoms (Legrand & Neff, 2016; Schuch et al., 2015) and increased motivation towards physical activity (Firth et al., 2017; Fogarty et al., 2004). However, there may be many other factors involved in the mental and physical health of people with SMI. There are higher risks due to medication side effects and a higher likelihood of their mental illness overshadowing a physical health condition. Along with this, the stigma surrounding mental illness can impact the quality of care being provided to them (Lien et al., 2020), as physical healthcare providers may feel they lack knowledge on SMI and do not want to aggravate potential symptoms.

An individual's intention to change behaviour or participate in an activity is also determined by their attitudes and self-motivation, therefore, specific plans with staff participation and peer support may be necessary to increase positive behaviours (Deenik et al., 2017). Within the existing research on physical activity and SMI, a multitude of study designs and SMI outcome measures are reported. Overall, the results suggest that implementing a form of physical activity, through walking, structured circuit training or exercise equipment, and/or within a lifestyle intervention (diet and physical activity), is beneficial for individuals with SMI. A systematic review on interventions for individuals with schizophrenia showed that exercise was effective when participants were active for at least 90-min per week, (Firth et al., 2015) with the exercises being aerobic, resistance or a combination. Stubbs et al. (2018) also outlined that physical activity three times per week with supervision is effective for improving cardiovascular fitness (i.e., reduced cardiometabolic disorder) and decreased the symptoms of psychosis in people with SMI. Moreover, group-based physical activity to accommodate any level of fitness were shown to be beneficial, likely due to the social dimensions associated with engaging with each other in the group as well as the activity (Stanton et al., 2015).

Despite the above findings, little is known on the effects of physical activity interventions for patients with SMI within a secure forensic setting. The specific challenges to perform physical activity are further heightened due to lack of autonomy to move between areas and having to be supervised by a staff member (Marklund et al., 2019), which creates a restrictive environment for the individuals who may want to exercise (Vollm et al., 2017). A forensic secure setting is where health and social care staff, support patients who are involved in the criminal justice system and/or present a high level of risk to themselves and/or others. The relevant legal context provides the powers by which people can be held in secure forensic settings with the aim of provide the best and safest environment for care and treatment (McClelland, 2007). In 2014, there was spending of USD$4.1 billion on forensic inpatient services which accounts for 43.7% of the overall spend within inpatient services. Prisons report to have one in seven prisoners presenting with major depression or psychosis (Fazel et al., 2016). A recent systematic review and meta-analysis reported that the prevelance of mental illness within prison settings are higher than that of the general population (Rebbapragada et al., 2021) highlighting the scale of the health problem. A recent study of a physical activity intervention in a prison setting reported significant reductions in anger levels of prisoners who suffer from a mental illness (O'Toole et al., 2018), although this is not specific to a secure forensic healthcare setting, it does reveal that the inclusion of physical activity within a weekly routine can improve more than mental health outcomes and also shows openness to physical activity as a modifiable, and importantly acceptable, health behaviour for prisoners.

Secure settings by their isolated and restrictive nature, can influence levels of physical activity (Mateo-Urdiales et al., 2020) and obesity (Long et al., 2014). Prescription medication, comorbid cardiometabolic and other health issues may also influence motivation or capacity to exercise (Stubbs & Rosenbaum, 2018). Opportunities for physical activity may be limited due to a lack of resources, insufficiently stimulating environments, low patient motivation and limited opportunities to leave the ward for activity (Long et al., 2014; Mateo-Urdiales et al., 2020; Rogers et al., 2019). Within one study, participants reported that the environment is monotonous and boring with little happening throughout the days (Marklund et al., 2019). In addition, physical activity was deemed low due to patients staying in bed or spending extended periods of time sitting, along with their own perceptions about their physical capabilities (Rogers et al., 2019). Moreover, those caring for the patients (e.g., nurses, doctors and activity coordinators), highlighted further practical challenges. For instance, Glowacki et al. (2019) stated that caring staff reported a lack of ability or knowledge to support and encourage patients being physically active, alongside insufficient time to accompany patients when being active (Rogers et al., 2019). Therefore, the environment, the individual's motivation and the limitations relating to staff time constraints can collectively reduce the likelihood of a physical activity programme being effectively implemented.

A systematic review of available evidence is therefore required to inform future research and guide intervention designs for the implementation of a sustainable programme within a secure forensic setting. Systematic reviews represent a methodologically rigorous way to inform healthcare practice and science and represent the apex of evidence in hierarchies of research designs (Ganeshkumar & Gopalakrishnan, 2013). By applying a pre-defined criterion on a study topic and implementing iterative screening and evaluation of study method qualities and bias, systematic reviews can inform practitioners, intervention and policy developers, and those involved in programme design and implementation on what works effectively for programme efficacy. In response to the lack of available physical activity intervention information in individuals with SMI residing in forensic settings, the aims of the current systematic review were

twofold: (1) assess the effectiveness of physical activity intervention programmes on the mental health (well-being outcomes) and symptom severity of patients with SMI in a secure setting and (2) to assess the effectiveness of physical activity intervention programmes on the physical health (Body Mass Index (BMI), waist circumference and cardiovascular fitness) of patients with SMI in a secure forensic setting.

2 | METHODS

This systematic review was conducted in accordance with Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) guidance (Moher et al., 2015). After initial searches were completed in May 2020, the protocol was registered on the PROSPERO database in July 2020, registration occurred prior to data extraction with the anticipated start date of May 2020 (#CRD42020188093).

2.1 | Search strategy

An electronic database search of peer reviewed literature was conducted in September 2021 using six databases (MEDLINE, PsycINFO, EMBASE, Scopus, EBSCO and CINAHL). The grey literature was searched through OpenGrey and the EthOS British Library e-theses online services. Each database search was conducted from their inception until September 2021 using wildcards, truncation and MeSH terms. A search strategy to include but not limited to severe mental illness; physical activit*; and types of severe mental illness, (i.e., schiz* or psycho*), are detailed in Appendix 1 with the terms used within the search strategy displayed in Appendix 2.

2.1.1 | Eligibility criteria

We included randomized controlled trials, non-randomized controlled trials, or quasi-randomized trials. Studies were also included if they had a pre-and-post intervention, were a feasibility study design with a qualitative, quantitative or mixed data collection methods. We excluded cross-sectional designs, editorials, studies with active controls such as other therapies or a second exercise control or studies without a physical activity component. Non-peer reviewed sources including unpublished reports, and/or PhD theses were included. Participants were adults aged 18–65 who had a DSM-IV diagnosis of SMI (schizophrenia, psychosis, major depression disorder or bipolar disorder), and who were detained within a secure forensic mental health facility. We included physical activity interventions related to any general component or intensity of physical activity (e.g., resistance activity and low intensity aerobic activity), or physical movement relating to fitness or exercise. We included physical (BMI, weight, waist circumference, blood pressure and cardiovascular fitness levels (Appendices 1 and 3) or mental health outcome measures (symptom severity, quality of life and/or well-being).

2.1.2 | Study selection

The database searches were exported to reference software Mendeley version 1.19.8 and a Microsoft Excel file. Duplicates were removed and reference lists were assessed for any further articles to be screened. About 7558 titles and abstracts were screened by the first author (JH). To check reliability and validity of the initial title and abstract screening, 10% of title and abstracts were screened by a second author (SS), with a 100% agreement level reached.

Prior to full screening articles, the remaining articles reference lists were reviewed for any further articles, this add a further 27 articles for screening. Full text screening was completed against the eligibility criteria. A screening tool (Appendix 3) was used to assess for inclusion by authors. JH screened all articles followed by GB, SS and MT independently screening a random selection of articles ($n = 52$). There was a high level of agreement (93%) within the screening process, any disagreements were discussed between authors until consensus was reached.

2.1.3 | Data extraction and synthesis

Information extracted from the remaining studies were summarized and presented in a table using narrative analysis. The data regarding type of study, number of participants, detailed description of the intervention (setting, duration, frequency and duration), study length were placed in Table 1. Table 2 displays the outcome measures (mental health outcomes—well-being, psychiatric symptoms, severity of symptoms and physical health outcomes—BMI, waist circumference, blood pressure, heart rate and cardiovascular fitness), a summary of the main findings and lastly a column was included for comments on the overall study referring to sample size and intervention groups.

2.1.4 | Study methodological quality assessment

The Modified Methodological Quality Checklist (Downs & Black, 1998) was used to assess methodological quality (Appendix 4). This assessment tool has a criterion validity score of $r = .90$, an internal consistency of 0.89 and a test-retest reliability of $r = .88$ (Olivo et al., 2008). The Checklist consists of 27 items across 5 domains (reporting, external validity, internal validity, bias and statistical power). Item 5 was scored from 0 to 2 (2: yes, 1: partially and 0: no) with all other items scored 0–1. If no or unable to determine it was scored 0 and if yes it was scored 1, the highest score possible was 28. Studies were rated as: excellent with a score of >21; moderate if scored 14–20; limited with a score of 7–13 and poor if scored 7 or less (Sattler

TABLE 1 Characteristics of included studies of physical activity interventions for individuals with SMI in secure settings

Author	Age (years)	Participants (gender)	Sample characteristics	Study length (length)	Intervention element
Dodd et al. (2011)	33–62 Mean – 45 & 9 mths; *SD*: 10 & 1 months	*N* = 8 (6 male, two female)	DSM-IV diagnosis of schizophrenia	Single group, pre-post clinical research design (28 weeks)	Structured and supervised aerobic exercise group training (2–3 people) lasting 24 weeks with an initial 4-week familiarisation period. Along with a weekly circuit session, a 30 min brisk walk was advised. Overall dosage of 60–90 min/week
Tetlie et al. (2008)	20–48 Mean – 32.5	*N* = 13 (10 male, three female)	Patients admitted into a secure psychiatric unit	Feasibility study within a secure psychiatric unit (8–12 weeks)	Group-based exercise three times per week (1 outdoors & 2 indoors) for 8 to 12 weeks lasting 45–60 min. Overall dosage of 2 h 15 min – 3 h/week
Cormac et al. (2008)	20–63 Mean – 37.91	*N* = 46 (39 male seven female)	Overweight patients with a DSM-IV diagnosis of psychoses, schizophrenia, bipolar disorder or major depression disorder who had passed a health and fitness assessment.	Single group, pre-post design with intent to treat approach (10–12 weeks)	One educational and one fitness session (1 h/week) focus on weight management through healthy eating advise and individual goal setting. Exercise dosage of 60 min/week
Gholipour et al. (2012)	20–50	*N* = 45 (all male)	Patients with a diagnosis of schizophrenia who have a minimum of a 3-year history	Randomized control clinical trial (3 months)	Three groups – two intervention and one control group. The exercise and token-behaviour therapy intervention sessions ran three times per week lasting 2 h with trained individuals. Overall dosage of 6 h/week

TABLE 2 Study outcomes, main findings and comments of the included studies

Author	Outcome measures	Main findings	Comments
Dodd et al. (2011)	Programme attendance Cardio-respiratory fitness (6-min walk test/VO2 max) Weight, BMI PANSS	73% attendance to the 48 aerobic session and 83% attendance to the 24 walking sessions Statistically significant results improvements? ($p < .05$) in weight and BMI. Positive improvements in VO_{2max} of 4 ml/kg/min No systematic changes in PANSS	Small sample size ($n = 8$), and no study follow-up. The use of one group for pre-testing and post-testing, therefore no control group
Tetlie et al. (2008)	Programme attendance Aerobic capacity (12 min walk on treadmill with HR monitor) Weight, BMI 7 symptom scale (self-reported) Blood pressure Heart rate	87% completed the exercise programme Statistically significant improvements in resting HR No significant changes found in weight and BMI Well-being measure of the seven symptom scale improved significantly after exercising	Small sample size ($n = 13$) and no study follow-up. The use of one group for pre-testing and post-testing, therefore no control group
Cormac et al. (2008)	Programme attendance Aerobic capacity Weight, BMI Blood pressure Heart rate	Average session attendance was 5 with a range of 0–11. A statistically significant change in weight and waist circumference from pre- to post-test ($p < .001$) Mean increase in resting HR of 1.4 bpm and an improved aerobic capacity level of 4[a]	Small sample size ($n = 46$) and no study follow-up. The use of one group for pre-testing and post-testing, therefore no control group
Gholipour et al. (2012)	Psychological measures – SANS	A significant higher improvement in negative symptom scores for the exercise group compared to the control group ($p < .001$)	Small sample size ($n = 45$) No study follow up

Note: Abbreviations: BMI, Body Mass Index; bpm, beats per minute; HR, heart rate; PANSS, Positive and Negative Symptom Scale; SANS, Scale for the Assessment of Negative Symptoms.

[a]Beginner 1–10 intermediate 11–20 athlete 21–30.

et al., 2019). JH and SS independently completed the Downs and Black Checklist with 100% agreement in the scores.

3 | RESULTS

3.1 | Search results

The initial search yielded 11,878 articles, (MEDLINE 2017, PsycINFO 728, EMBASE 1550, Scopus 5046 and CINAHL 1479). Duplicates were removed prior to the first screening of articles, leaving 7561 for title and abstract screening. Following the identification of 130 potentially relevant articles, an additional 27 articles were identified through searching existing article reference lists, totalling to 157 full-text articles. After systematically searching the grey literature databases (OpenGrey and the EthOS British Library e-theses online services), no additional literature was found. The 157 full texts were iteratively screened for inclusion by four of the authors (JH, GB, SS and MT). Following discussion and consensus, 153 were excluded for the following reasons: incorrect setting ($n = 78$) or population ($n = 17$), inappropriate controls ($n = 12$), article type (e.g., conference abstracts, editorials or thesis chapters without study protocols) ($n = 18$), study design (no intervention) ($n = 17$) or insufficient outcome measures ($n = 11$) (Figure 1). A total of four studies met the inclusion criteria and were included in the review.

3.2 | Methodological quality assessment

Variation in quality was demonstrated through the scoring of the Modified Methodological Quality Checklist by Downs and Black (1998) with a range of 11–17, see Appendix 3 for the checklist questions and scoring (Table 3). One study was rated as poor methodological quality with a score of 12 (Tetlie et al., 2008). Two studies were rated as limited with a score of 13 (Cormac et al., 2008), and the final study scored as moderate with a score of 17 (Gholipour et al., 2012). This was evident due to no control groups in three studies (Cormac et al., 2008; Dodd et al., 2011; Tetlie et al., 2008) and the lack of long-term follow-up assessments in all four studies.

3.3 | Study design

The included four studies varied in study design and duration. Specifically, Dodd et al. (2011) used a pre-post intervention study design with a single arm, lasting 28 weeks. Gholipour et al. (2012)

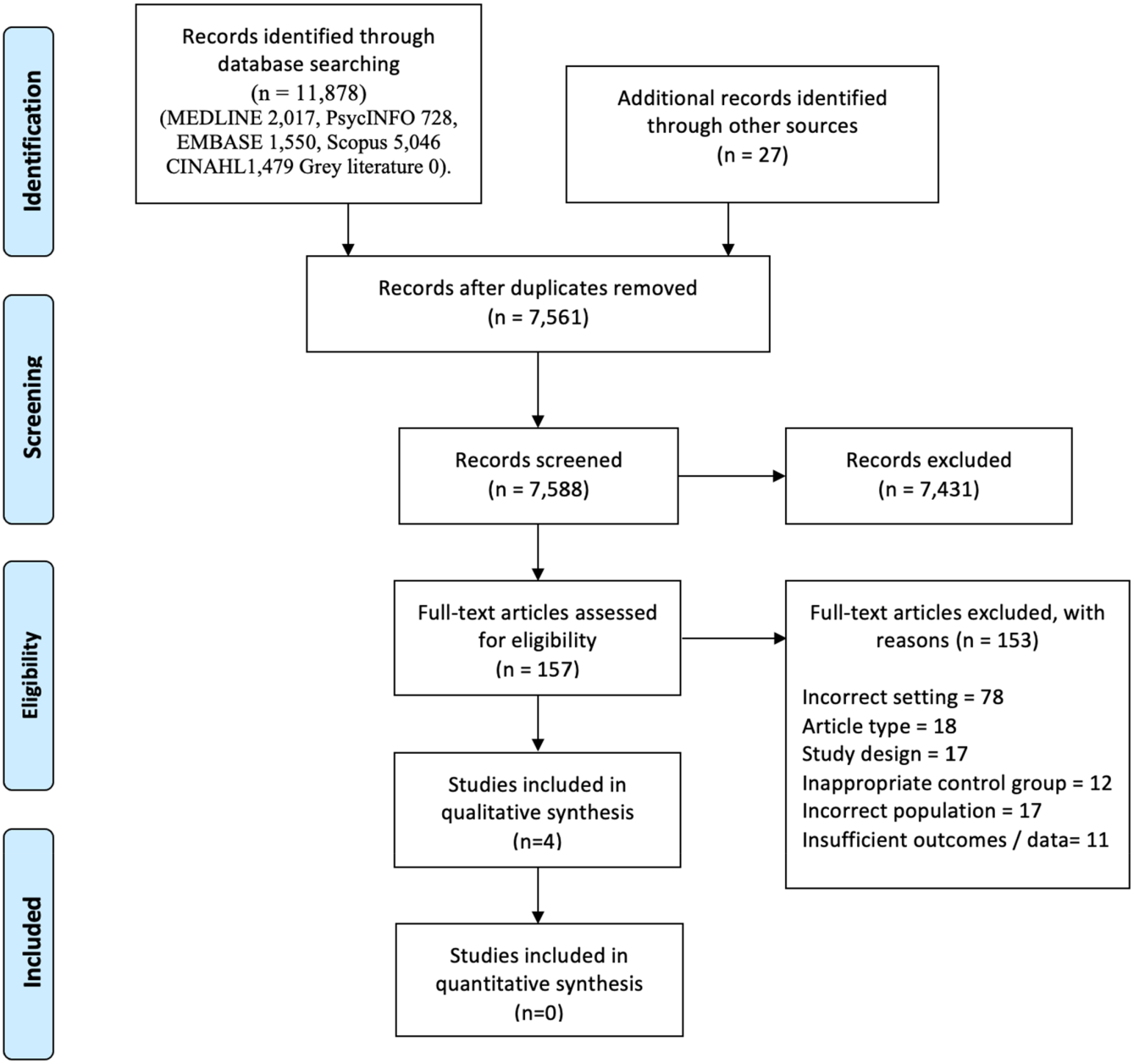

FIGURE 1 Prisma flow diagram of the study's screening process

conducted a randomized control trial (RCT) lasting 12 weeks. The remaining two studies were similar in length with an 8–12-week feasibility period (Tetlie et al., 2008), and a 10–12-week intention to treat intervention (Cormac et al., 2008). All included studies included were published within a 5-year period from 2008 to 2012 (Table 1).

3.4 | Participants

Studies reported in the review included 112 participants (100 males and 12 females) and ranged in age from 20 to 63 years. One study used weight as a single recruitment factor; 46 patients were selected for the research study (Cormac et al., 2008). Tetlie et al. (2008) used admission to the forensic psychiatric ward as a factor for inclusion ($n = 13$). In Dodd et al. (2011), participants were included if they had a DSM-IV diagnosis of schizophrenia ($n = 8$), while Gholipour et al. (2012) involved 45 patients with an inclusion criterion based on a 3-year history of schizophrenia and admission to a psychiatric ward (Table 1).

3.5 | Intervention content

Three out of four studies were group-based interventions; one did not state the size of the group (Tetlie et al., 2008), another having two or three participants per-session (Dodd et al., 2011), and the other included 15 per group (Gholipour et al., 2012). Cormac et al.

TABLE 3 Modified methodological quality checklist scoring for included articles

Domain	Items	Study	Dodd et al. (2011)	Tetlie et al. (2008)	Cormac et al. (2008)	Gholipour et al. (2012)
Reporting	1		1	1	1	1
	2		1	1	1	1
	3		1	1	1	1
	4		1	1	1	1
	5		1	1	1	1
	6		1	1	1	1
	7		1	1	0	1
	8		1	0	0	0
	9		0	0	0	0
	10		0	0	0	0
External validity	11		0	0	1	1
	12		1	1	1	1
	13		1	1	1	1
Internal validity	14		0	0	0	0
	15		0	0	0	0
	16		1	1	1	1
	17		0	0	0	0
	18		0	0	1	1
	19		0	0	0	1
	20		1	1	1	1
Selection bias	21		0	0	0	1
	22		1	1	1	1
	23		0	0	0	1
	24		0	0	0	0
	25		0	0	0	0
	26		0	0	0	0
Power	27		0	0	0	0
Total (28)			13	12	13	17

(2008) used individual tailored programmes for each participant that included personal goal setting. Two studies required patients to undertake physical activity once a week (Cormac et al., 2008; Dodd et al., 2011) while the others encouraged participation three times per week (Gholipour et al., 2012; Tetlie et al., 2008). The length of the interventions varied from 30 min (Dodd et al., 2011) to 2 h (Gholipour et al., 2012). Within the other two studies, activity lasted up to 60 min (Cormac et al., 2008; Tetlie et al., 2008). Within one study, a healthy eating/diet and goal setting educational session was included for 1 h per week (Cormac et al., 2008), while another study included rehabilitation exercises for the patients (Gholipour et al., 2012).

3.6 | Outcomes

A variety of psychological and physiological outcome measures were used across studies; behavioural aspects including violence were not reported in the four included studies.

3.6.1 | Psychological outcome measures

Three of the studies (Dodd et al., 2011; Gholipour et al., 2012; Tetlie et al., 2008) used different psychometric scales to report symptoms; hence, comparison between study outcomes is limited. Dodd et al. (2011) used the Positive and Negative Symptom Scale (PANSS) (Kay et al., 1987) for assessing the symptoms of schizophrenia and reported no systematic changes; however, the general and negative scale demonstrated associations less then $r = .50$. These two studies (Dodd et al., 2011; Gholipour et al., 2012) used scales which have been tested for reliability and validity. Tetlie et al. (2008) used the 7-symptoms scale assessing psychological health, measured by anxiety, irritability, hallucinations, physiological tension, psychological tension, feelings of well-being and feelings of safety, these incorporate the individual and staff self-reported observations and reported a positive change in symptoms, yet it was non-significant. Gholipour et al. (2012) reported the negative symptoms of schizophrenia using the Scale for the Assessment of Negative Symptoms (SANS) (Andreasen, 1984) Gholipour et al. (2012) reported no pre-test

differences between groups. However, a significant improvement in negative symptom scores for the exercise group compared with the control group after intervention implementation ($p < .001$). The control group results remained unaffected with a mean pre-test score of 84 (*SD* 16) and post-test score of 85 (*SD* 12), whereas the exercise group mean scores decreased from 71 (*SD* 14) to 50 (*SD* 13) (Table 2).

3.6.2 | Physiological outcome measures

Three studies (Cormac et al., 2008; Dodd et al., 2011; Tetlie et al., 2008) reported weight and/or BMI of participants, with Cormac et al. (2008) also reporting on waist circumference. The study by Tetlie et al. (2008) reported no statistically significant changes in weight or BMI, while Dodd et al. (2011) found a significant change in BMI ($p < .05$) with scores lowering from 27.2 (*SD* 9.3) to 26.6 (*SD* 8.2). Lastly, Cormac et al. (2008) reported a clinically significant reduction in weight ($p < .001$) with a mean weight loss of 1.3 kg (*SD* 2.73, range 12 kg gain to 9 kg loss) and clinically significant reduction in waist circumference ($p < .001$) with a mean waist reduction of 2 cm (*SD* 3.73, range 8 cm gain to 8 cm loss).

Two studies (Cormac et al., 2008; Tetlie et al., 2008) reported resting heart rate and blood pressure. There were no significant changes reported by Cormac et al. (2008), however a statistically significant improvement in resting heart rate and blood pressure was shown post treadmill test ($p < .05$) by Tetlie et al. (2008).

Three (Cormac et al., 2008; Dodd et al., 2011; Tetlie et al., 2008) out of four studies report on the participants' cardiorespiratory fitness. All studies used an aerobic machine for assessment; however, one study (Dodd et al., 2011) also included the 6-min walk test (Tappen et al., 1997). Dodd et al. (2011) found no significant change in cardiorespiratory fitness or VO_{2max} from baseline measures to the end of the intervention. The VO_{2max} test showed improvement in oxygen use, each min, per kilogram of body weight with a change from 36.5 ml/kg/min (*SD* 9.1) to 40.5 ml/kg/min (*SD* 8.8). Tetlie et al. (2008) used the treadmill and a heart rate monitor to report physical health, positive improvements in heart rate and blood pressure were shown. Lastly, the use of a submaximal test on an exercise bike was used to test the participants' physical fitness with the use of the heart rate monitor. However, despite a small improvement, this was not statistically significant (Cormac et al., 2008).

3.6.3 | Programme completion

Programme completion rates were reported within three studies. Two with lower participation levels (Dodd et al., 2011; Tetlie et al., 2008), and one (Cormac et al., 2008) had a much higher rate of participation but unfortunately no reasons were reported. All participants completed the intervention within Dodd et al. (2011); however, attendance to the aerobic sessions was reported as: 73% out of 48 and 83% out of 24 respectively. Tetlie et al. (2008) reported participant completion as 87% (13/15 participants) with 2 dropouts reported due to hospital transfers. Cormac et al. (2008) reported attendance to the intervention programmes was 48%, with session attendance on average being five (*SD* 3.7, range 0–11). Although higher dropout was recorded in comparison with the other studies above, participant numbers were higher. Where dropouts occurred, the reason was patients undergoing hospital transfers.

4 | DISCUSSION

This review was the first to explore the effects of physical activity on physical and mental health among individuals with severe mental illness (SMI) residing in secure forensic settings. From a review of 10,798 studies, four met the inclusion criteria. Among the four studies, improvements were shown in physical and mental health outcomes; however, study quality was considered low to moderate, and sample sizes were small. The included studies ranged in methodological design, along with this there was low participant numbers across all studies with a total of 112 participants. This is low in comparison to most research studies, as a single study within the general population assessing psychological measurements had 262 participants (Lawton et al., 2017). Therefore, caution is advised when interpreting the generalizability and strength of the findings.

Although increased knowledge on the benefits and recommendations to increase physical activity levels within this population is evident, given the low number of available studies, the field remains relatively under researched, despite such individuals being amongst the highest risk category for insufficient physical activity and poorer health. Indeed, Vigo et al. (2016) state an "unacceptable apathy" of governments and funders of mental health care, and this review would suggest further difficulties for individuals with SMI in a secure forensic setting with the restrictive nature hindering the ability to perform activities.

Research suggests that a longer intervention period appears to positively influence the study effects (Nguyen et al., 2020). One of the studies Cormac et al. (2008) contradicts this finding as it implemented a shorter intervention period than the other articles (10–12 weeks), yet showed positive significant improvements through the physiological outcomes; however, this may be due to the individualized goal setting and the educational advice on healthy eating alongside the physical activity programme. This suggests that there are other factors affecting results such as psychological and social (e.g., instructor style of delivery) factors rather than the physical activity behaviour itself (Biddle et al., 2019). Physical activity was the main intervention activity in three studies (Dodd et al., 2011; Gholipour et al., 2012; Tetlie et al., 2008), with one study (Cormac et al., 2008) implementing lifestyle factors through goal setting. The physical activity differed greatly in length, as well as the frequency and activity type in the review. Previous research shows that frequency (three times per week (Vancampfort et al., 2017)) and dose minimum of 90 mins per week (Firth et al., 2015). One study (Gholipour et al., 2012) exceeded these recommendations, another study meet the dosage recommendation but not the frequency

(Tetlie et al., 2008) and two studies were below the recommended frequency (Cormac et al., 2008) however one did meet the dosage (Dodd et al., 2011). The two studies (Cormac et al., 2008; Dodd et al., 2011) below these recommendation have shown positive results in changing physiological and psychological outcomes. This shows that there is more research needed within this area to confirm optimal activity levels.

Psychological outcomes reporting a reduction in symptom severity were reported in two studies (Gholipour et al., 2012; Tetlie et al., 2008). These matched the recommended frequency of physical activity per week but varied in duration 120 min (Gholipour et al., 2012) and 45–60 min (Tetlie et al., 2008). Gholipour et al. (2012) sessions lasted 2 h and involved exercises linked to individual rehabilitation of an individual and consequently, may be more specific in nature, therefore, directed to the improvement of the symptomology of the mental illness. Tetlie et al. (2008) sessions of 45–60 min also implemented small group-based activity with a mixture of indoor and outdoor sessions, delivered by an instructor known to the participants and staff members. More research is required to identify the optimal amount, type, and frequency of activity for individuals who are within a secure forensic setting.

With encouraging results and high participation levels in the four included studies, physical activity interventions can be acceptable and effective in forensic settings. However, the improved adherence could not be clearly defined. The reasons for any dropout was not reported within two studies (Cormac et al., 2008; Dodd et al., 2011); therefore, a rationale on specific techniques to improve participation is not possible. One study (Tetlie et al., 2008) had an uncontrollable factor within the study for dropout (i.e., hospital transfers).

Accommodating senior-level staff, encouraging staff buy-in can increase participation and improve outcomes in physical activity interventions (Mateo-Urdiales et al., 2020). The studies included in our review reported varied levels of attendance, with group sessions the best attended. With participation being varied, it was acknowledged that group sessions had better adherence, which is similar to previous literature as improvements between physical activity and social interactions have positively affected mental health (Brown & Baker, 2018). The inclusion of motivational aspects may increase participation (Ringen et al., 2018), and the use of goal setting and exercise educational content may not be a sufficient method of increasing participation. Cormac et al. (2008) observed a higher dropout (46%) suggesting that goal setting may not encourage participants to partake in activity; however, this study included a large treatment group at the start. In addition to this, Dodd et al. (2011) did not include specific motivational components but showed positive significant results and high participation.

The review has suggested that physical activity and educational aspects referring to healthy eating and goal setting interventions can improve aspects of mental and physical health in individuals with SMI in secure forensic settings, with the caveats of varied results and programme complexity. Further research is needed to identify the optimal programme length, frequency, dose and the type/style of intervention to promote positive outcomes for people in forensic settings. Furthermore, the role that staff can play to encourage lifestyle change and increase physical activity requires further understanding. Understanding the educational components that lead to positive physical outcomes may also provide learning for improving psychological outcomes. With growing concerns relating to the cardiometabolic health issues within this population, as reported through (Wahlbeck et al., 2011) longitudinal study where individuals with SMI received inadequate physical healthcare and the treatment of physical health concerns are overlooked for the sole treatment of psychiatric symptoms. In addition to this, poorer access to physical healthcare is reported compared with the general population along with poorer quality care (Thornicroft, 2011). Due to this reduced care for the physical health of people with SMI, there are issues arising around their human rights and concerns surrounding the higher mortality rates compared with the population (Firth et al., 2019; Thornicroft, 2011). Cardiovascular fitness measurements are scarce in this population, and therefore, more research is needed in relation to the best measure for this population and its effectiveness. As previously stated, within the SMI population, the participant numbers are low, and there is a lack of consistency in outcome measurements. Future research is needed into methods of increasing participation and lowering the attrition rates in SMI research. Alongside this, research is needed into how to create a more effective intervention environment for positive results in both mental and physical activities. Involving patient involvement in research design may help to further understand the needs of the population.

4.1 | Strengths and limitations

This review implemented a number of strengths through the use of PRISMA guidelines and a pre-defined search strategy allowing for a clear understanding of the process with transparency throughout. The review did not focus on solely exercise or physical activity programmes creating wider scope within this setting and population. Including grey literature also increased the scope of the research results. The methods identified available interventions, their effective features and helped clarify future research and practical considerations for intervention design.

Despite the robust methodological approach, there are limits in the number of included studies and sample sizes. Sample sizes can affect the reliability, as a wide 95% confidence intervals and large standard errors will occur within small samples, i.e., 20 participants may not produce precise results for the cohort (Hackshaw, 2008). In addition, Vasileiou et al. (2018) referred to insufficient sample sizes as an interference to the generalizability of study results. Due to lower participation numbers, the samples are statistically underpowered, along with the possible inappropriate use of parametric statistical analysis, there is a higher risk of bias, therefore causing difficulty in recreating within a secondary setting. Notably, within the SMI population, the number of participants involved is often

lowered due to the more challenging factors, such as lack of capacity; continued participation being difficult due to medication; the side effects and psychotic episodes (Ang et al., 2019). The included studies reported results over a relatively short timeframe, with no follow-up. Methodological quality assessment was rated from poor to moderate.

4.2 | Implications for research and practice

Future research should focus on increasing opportunities for service users to become involved in physical activity. This could be aided by improving the knowledge gap around staff perceptions and ways to increase their buy-in for physical activity interventions, helping to create a more motivational setting to help improve decision making around lifestyle choices. More research is also required to identify the most effective timeframe, frequency and type of physical activity to create a sustainable programme.

5 | CONCLUSION

This review explored the effects of physical activity interventions conducted within a secure forensic setting. Although limited due to a small number of studies, the findings were promising with positive results in weight reduction and improvements in psychiatric symptoms, and these results mirror previous cross-sectional and interventional studies among individuals with SMI. Although the results are positive there are many limitations, namely the length of study designs, the intensity and frequency to be determined before physical activity can be confirmed as rehabilitation/therapy method as well as the effectiveness and sustainability. Further studies should determine the longitudinal effects of physical activity interventions on SMI symptoms and other health outcomes that may be designed in line with implementation science accounting for feasibility and sustainability of physical activity programmes for individuals with SMI in forensic settings.

AUTHOR CONTRIBUTION

JH, GB, SS and MAT contributed to the substantial contributions to conception and design, or acquizition of data, or analysis and interpretation of data. All authors were involved in drafting the manuscript or revising it and providing critical feedback to helped shape the research and given final approval of the version to be published.

DATA AVAILABILITY STATEMENT

Data sharing not applicable to this article as no datasets were generated or analysed during the current study.

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APPENDIX 1

PICOS SEARCH STRATEGY AND ASSOCIATED KEYWORD SEARCH

PICOS	Inclusion	Exclusion
Population	Aged 18–65 years Be living with a Severe Mental Illness (SMI) Inpatient within a secure mental health facility	Aged under 18 or over 65 Living in the community or residential care Physical disability inhibiting movement Additional medical conditions (cancer, dementia, brain injury)
Intervention	Physical Activity Exercise Movement Activity Physical Fitness	Telephone based Computer Based Online Services
Outcomes	Physical Health Mental Health SMI Symptoms	
Study Design	Qualitative Quantitative or Mixed Methods Randomized Control Trial, Non-Randomized Trial or Quasi-Randomized Trial Pre and Post Feasibility Study	

APPENDIX 2

SEARCH TERMS AND SEARCH STRATEGY

Search terms	Severe Mental Illness Moderate Mental Illness Mental Health Well-Being or Wellbeing Schizophrenia Psychosis Psychiatry Bi-Polar Major Depressive Disorder Or MDD Physical Activity Exercise or Movement Physical Fitness Programme or Intervention
Search strategy for PsycInfo	("severe mental illness" or "moderate mental illness or "light mental illness" or "mental health" or well-being or wellbeing) AND (Schiz* or psycho* or psychiatr* or bi-polar or "major depressive disorder" or MDD) AND ("physical activit*" or exercise or movement or "physical fitness") AND (Programme or intervention)
Search limiters	English Language

APPENDIX 3

SCREENING TOOL FOR PAPERS

	Yes	No	Comments
Language Is the full paper in English?			
Type of study IS the study described as one of the following; (i) Qualitative, Quantitative or mixed method design (ii) Randomized controlled trial (iii) Non-randomized controlled trials/Quasi-randomized trial (iv) Pre- and post			
Participants (i) Participants aged 18–65 years old			
(i) Are the participants considered to have a severe mental illness (SMI) or have a clinical diagnosis through DSM and ICD codes?			
(i) Do they live with one of the following SMI? (ii) Schizophrenia, schizoaffective, psychosis, Major Depressive Disorder (MDD) or Bipolar Disorder (BD)			
Intervention type Does the study contain a component of exercise or physical activity?			
Intervention location Is the study within a secure setting? Are the participants detained, hospitalized, within residential living, an inpatient within a psychiatric ward?			
Control Group (if applicable) Does the control have treatment as usual			
Outcomes (i) Does the study report on the symptomology of the SMI? (ii) Does the study report on mental health outcomes? (iii) Does the study report on any of the factors relating to well-being (i.e., self-esteem, mood changes and self-perception confidence levels)? (iv) Does the study report on the physical health outcomes (i.e., BMI blood pressure, cardiorespiratory fitness or aerobic fitness)?			
Comments:			

APPENDIX 4

THE MODIFIED METHODOLOGICAL QUALITY CHECKLIST ITEMS AND SCORING METHOD DOWNS AND BLACK (1998)

Item	Criteria	Possible answers
Reporting		
1	*Is the hypothesis/aim/objective of the study clearly described?*	Yes = 1 No = 0
2	*Are the main outcomes to be measured clearly described in the Introduction or Methods section?* If the main outcomes are first mentioned in the Results section, the question should be answered no	Yes = 1 No = 0
3	*Are the characteristics of the patients included in the study clearly described?* In cohort studies and trials, inclusion and/or exclusion criteria should be given. In case-control studies, a case-definition and the source for controls should be given	Yes = 1 No = 0
4	*Are the interventions of interest clearly described?* Treatments and placebo (where relevant) that are to be compared should be clearly described	Yes = 1 No = 0
5	*Are the distributions of principal confounders in each group of subjects to be compared clearly described?* A list of principal confounders is provided	Yes = 2 Partially = 1 No = 0

Item	Criteria	Possible answers
6	*Are the main findings of the study clearly described?* Simple outcome data (including denominators and numerators) should be reported for all major findings so that the reader can check the major analyses and conclusions. (This question does not cover statistical tests which are considered below)	Yes = 1 No = 0
7	*Does the study provide estimates of the random variability in the data for the main outcomes?* In non-normally distributed data the interquartile range of results should be reported. In normally distributed data the standard error, standard deviation or confidence intervals should be reported. If the distribution of the data is not described, it must be assumed that the estimates used were appropriate and the question should be answered yes	Yes =1 No = 0
8	*Have all important adverse events that may be a consequence of the intervention been reported?* This should be answered yes if the study demonstrates that there was a comprehensive attempt to measure adverse events. (A list of possible adverse events is provided)	Yes = 1 No = 0
9	*Have the characteristics of patients lost to follow-up been described?* This should be answered yes where there were no losses to follow-up or where losses to follow-up were so small that findings would be unaffected by their inclusion. This should be answered no where a study does not report the number of patients lost to follow-up	Yes = 1 No = 0
10	*Have actual probability values been reported (e.g. .035 rather than <.05) for the main outcomes except where the probability value is less than .001?*	Yes = 1 No = 0
External validity		
11	*Were the subjects asked to participate in the study representative of the entire population from which they were recruited?* The study must identify the source population for patients and describe how the patients were selected. Patients would be representative if they comprised the entire source population, an unselected sample of consecutive patients, or a random sample. Random sampling is only feasible where a list of all members of the relevant population exists. Where a study does not report the proportion of the source population from which the patients are derived, the question should be answered as unable to determine	Yes = 1 No = 0 Unable to determine = 0
12	*Were those subjects who were prepared to participate representative of the entire population from which they were recruited?* The proportion of those asked who agreed should be stated. Validation that the sample was representative would include demonstrating that the distribution of the main confounding factors was the same in the study sample and the source population	Yes = 1 No = 0 Unable to determine = 0
13	*Were the staff, places, and facilities where the patients were treated, representative of the treatment the majority of patients receive?* For the question to be answered yes the study should demonstrate that the intervention was representative of that in use in the source population. The question should be answered no if, for example, the intervention was undertaken in a specialist centre unrepresentative of the hospitals most of the source population would attend	Yes = 1 No = 0 Unable to determine = 0
Internal validity – bias		
14	*Was an attempt made to blind study subjects to the intervention they have received?* For studies where the patients would have no way of knowing which intervention they received, this should be answered yes	Yes = 1 No = 0 Unable to determine = 0
15	*Was an attempt made to blind those measuring the main outcomes of the intervention?*	Yes = 1 No =0 Unable to determine = 0
16	*If any of the results of the study were based on "data dredging", was this made clear?* Any analyses that had not been planned at the outset of the study should be clearly indicated. If no retrospective unplanned subgroup analyses were reported, then answer yes	Yes = 1 No = 0 Unable to determine = 0
17	*In trials and cohort studies, do the analyses adjust for different lengths of follow-up of patients, or in case-control studies, is the time period between the intervention and outcome the same for cases and controls?* Where follow-up was the same for all study patients the answer should be yes. If different lengths of follow-up were adjusted for by, for example, survival analysis the answer should be yes. Studies where differences in follow-up are ignored should be answered no	Yes = 1 No = 0 Unable to determine = 0

Item	Criteria	Possible answers
18	*Were the statistical tests used to assess the main outcomes appropriate?* The statistical techniques used must be appropriate to the data. For example nonparametric methods should be used for small sample sizes. Where little statistical analysis has been undertaken but where there is no evidence of bias, the question should be answered yes. If the distribution of the data (normal or not) is not described it must be assumed that the estimates used were appropriate and the question should be answered yes	Yes = 1 No = 0 Unable to determine = 0
19	*Was compliance with the intervention/s reliable?* Where there was non- compliance with the allocated treatment or where there was contamination of one group, the question should be answered no. For studies where the effect of any misclassification was likely to bias any association to the null, the question should be answered yes	Yes = 1 No = 0 Unable to determine = 0
20	*Were the main outcome measures used accurate (valid and reliable)?* For studies where the outcome measures are clearly described, the question should be answered yes. For studies which refer to other work or that demonstrates the outcome measures are accurate, the question should be answered as yes	Yes = 1 No = 0 Unable to determine = 0
Internal validity – confounding (selection bias)		
21	*Were the patients in different intervention groups (trials and cohort studies) or were the cases and controls (case-control studies) recruited from the same population?* For example, patients for all comparison groups should be selected from the same hospital. The question should be answered unable to determine for cohort and case-control studies where there is no information concerning the source of patients included in the study.	Yes = 1 No = 0 Unable to determine = 0
22	*Were study subjects in different intervention groups (trials and cohort studies) or were the cases and controls (case-control studies) recruited over the same period of time?* For a study which does not specify the time period over which patients were recruited, the question should be answered as unable to determine	Yes = 1 No = 0 Unable to determine = 0
23	*Were study subjects randomized to intervention groups?* Studies which state that subjects were randomized should be answered yes except where method of randomization would not ensure random allocation. For example alternate allocation would score no because it is predictable	Yes = 1 No = 0 Unable to determine = 0
24	*Was the randomized intervention assignment concealed from both patients and health care staff until recruitment was complete and irrevocable?* All non- randomized studies should be answered no. If assignment was concealed from patients but not from staff, it should be answered no	Yes = 1 No = 0 Unable to determine = 0
25	*Was there adequate adjustment for confounding in the analyses from which the main findings were drawn?* This question should be answered no for trials if: the main conclusions of the study were based on analyses of treatment rather than intention to treat; the distribution of known confounders in the different treatment groups was not described; or the distribution of known confounders differed between the treatment groups but was not taken into account in the analyses. In non-randomized studies if the effect of the main confounders was not investigated or confounding was demonstrated but no adjustment was made in the final analyses the question should be answered as no	Yes = 1 No = 0 Unable to determine = 0
26	*Were losses of patients to follow-up taken into account?* If the numbers of patients lost to follow-up are not reported, the question should be answered as unable to determine. If the proportion lost to follow-up was too small to affect the main findings, the question should be answered yes	Yes = 1 No = 0 Unable to determine = 0
Power		
27[a]	*Did the study have sufficient power to detect a clinically important effect where the probability value for a difference being due to chance is less than 5%?* Sample sizes have been calculated to detect a difference of x% and y%	Yes = 1 No = 0 Unable to determine = 0

see Downs and Black (1998).

[a] Item has been modified.