

INVESTIGATING THE BENEFITS OF SPORT PARTICIPATION FOR INDIVIDUALS WITH SCHIZOPHRENIA: A SYSTEMATIC REVIEW

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SUMMARY

Background: The purpose of this review was to consider the impact of being introduced to a sport and sport participation on (a) weight loss and psychiatric symptoms, (b) any other health benefits in people with schizophrenia, supported by quantitative and qualitative findings.

Subject and methods: A systematic review in accordance with the PRISMA statement was conducted. Searches were undertaken in January 2014. Articles were eligible that (1) considered the effect (quantitative studies) and experience (qualitative and case studies) of either; being introduced to a 'sport' or undertaking a sport activity, (2) included >85% of patients diagnosed with schizophrenia or schizo-affective spectrum disorders according to recognised criteria.

Results: A total of 10 studies including 5 trials (2*pre-experimental, 2*controlled trials, 1*randomised control trial), 2 qualitative studies and 3 case studies were included (n=185). Two out of 3 studies that considered weight as an outcome measure reported significant reductions in weight and psychiatric symptoms following sports participation. The mean reduction in body mass index (BMI) ranged from -0.7kg.m² (p<0.001) following 12 weeks of basketball to -1.33 kg.m² (p<0.001) after 12-weeks of soccer. The mean reduction in the Positive and Negative Symptoms score ranged from 2.4 points (F=-19.0, p<0.001) following 12 weeks of basketball to 7.4 points (t=-5.0, p<0.001) following a 40 week programme of horse riding. A range of secondary health and wellbeing outcomes identified some significant results. Qualitative findings showed that participants had positive experiences from participating in sports.

Conclusions: Sport participation may result in reduced BMI and psychiatric symptoms in patients with schizophrenia. Sport has the potential to improve an individual's quality of life through providing a meaningful normalizing activity that leads to achievement, success and satisfaction. Well-designed randomised controlled trials are required to fully determine the health effects of sports participation in schizophrenia.

Key words: schizophrenia – sport - physical activity - systematic review

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INTRODUCTION

There is irrefutable evidence that physical health of individuals with schizophrenia is considerably worse compared to the general population (De Hert et al. 2009, McNamee et al. 2013). A major contributory factor to this is lifestyle behaviour of these individuals (De Hert et al. 2011). This includes high levels of sedentary behaviour demonstrated by individuals with schizophrenia. For example, only a small number of individuals with schizophrenia meet the current recommendations for physical activity (Soundy et al. 2013). It is recommended to accumulate at least 150 minutes a week of moderate-intensity physical activity (Vancampfort et al. 2012). In addition, overweight and obese individuals with schizophrenia are recommended to increase the minutes of moderate physical activity to 200-300 minutes a week and introduce a dietary and behavior component to enhance weight loss (Faulkner et al. 2003).

Recently a number of studies and reviews have considered the influence of physical activity in patients with schizophrenia (Ellis et al. 2007, Gorczyński & Faulkner

2010, Holley et al. 2011, Soundy et al. 2014, Vancampfort et al. 2009, Vancampfort et al. 2012, Vancampfort et al. 2014). The most cited benefits are around physical health, focused mainly on weight, but also include benefits on an individual's positive and negative symptoms, quality of life and general well-being. Recent qualitative literature (Soundy et al. 2014) identified broader benefits including a positive influence of physical activity on individual's confidence and self-efficacy in the context of broader engagement and interaction. However, these articles have primarily focused on exercise therapy defined as physical activity that is planned, structured, repetitive, and purposive in the sense that improvement or maintenance of one or more components of physical fitness is an objective (Caspersen et al. 1985).

More creative ways to encourage physical activity are needed in order to accrue the well-established health benefits. Sport participation may allow individuals with schizophrenia to achieve or make significant steps towards the current physical activity recommendations (Vancampfort et al. 2012). Sport participation can be

considered as a particular type of leisure time physical activity (Howley 2001). The definition of how a sport should be defined includes: physical activities including an element of competition (Australian Sports Commission 2014, Khan et al. 2012, Council of Europe 2001), combined with a set of rules or expectations by which participation is governed to ensure fair competition is undertaken (Khan et al. 2012, Council of Europe 2001), involving activities that either require (a) an expression of physical skill (Australian Sports Commission 2014) or (b) an ability to improve physical fitness and mental well-being (Council of Europe 2001).

Sport participation is associated with distinct aspects which may foster and enable greater levels of physical activity. For instance, playing a sport is associated with a strong sense of identity, social confidence, social support and a sense of belonging (Corretti et al. 2011, Soundy et al. 2012). By developing a sense of identity, social confidence and belonging, individuals with schizophrenia can increase the levels of motivation and adherence to the sport and other physical activities and feel less vulnerable to the psychosocial barriers that prevent participation (Soundy et al. 2012). In this way it can be considered as developing key aspects which promote recovery as well as minimising aspects which challenge an individual's recovery (Soundy et al. in press). Further to this, sport participation may be particularly appealing to people with severe mental illness who have a history of sport participation.

There are good reasons to believe that sport participation may have multiple benefits for an individual's bio-psychosocial health (including physical health e.g., weight or hypertension, psychological health e.g., physical activity self-efficacy and social health e.g., benefits of a 'normalised' social experience) and have an important role in psychiatric rehabilitation. For instance, in the general population the International Olympic Committee consensus highlights a wealth of bio-psychosocial benefits of sport participation (Mountjoy et al. 2010) supported by recent reviews on particular sports which illustrate similar findings supporting the benefit to an individual's bio-psychosocial health (Krustrup et al. 2010).

Only one previous review was found focusing on sport participation in individuals with schizophrenia (Langle et al. 1999). The review identified that sport improved social interaction, the ability to organise time and leisure activities as well as self-esteem, body awareness, and overall physical activity participation. Nevertheless, the authors concluded that much more research on the health benefits of sport participation in individuals with schizophrenia was needed. There are several other reasons for an additional review to be conducted; first, the date of the last search was in 1998 and an updated review is required. Second, changes in policy for psychiatric treatment, access to sport and utilisation of sport have been recently highlighted (Corretti et al. 2011). Third, the methodological assessment of the quality of the studies is required as part of a

systematic review process. Finally, focus on primary and secondary outcome measures are needed to consider the quantifiable benefits of sport participation. Thus, since there is the potential for sport participation to have a positive effect on the physical and psychosocial health and well being of people with severe mental illness, a systematic review is required to synthesise the available evidence for rehabilitation clinicians.

The aim of this review was to investigate if the introduction to, and participation in sport can (a) reduce weight or body mass index (BMI) and psychiatric symptoms and (b) have a positive influence on other health parameters in individuals with schizophrenia. In addition, any harm from sport participation, as well as subjective experiences from individuals will be identified.

SUBJECTS AND METHODS

This review was guided by Cochrane review procedures (Higgins & Green 2011) and is reported in-line with the PRISMA statement (Moher et al. 2009) (Figure 1). Studies were considered eligible if they included the following information.

Subjects

Studies were included if >85% of patients had been diagnosed with schizophrenia spectrum disorder according to recognised diagnostics (e.g. American Psychiatric Association 2000, American Psychiatric Association 2013, or the International Classification of Diseases World Health Organization 1993). Alternatively, studies were included where data from individuals with schizophrenia could be extracted separately from patients with other diagnoses.

Interventions or experiences

Studies were only included if they focused on either: (a) initiating or engaging in a physical activity meeting our definition of 'sport'; this was important as individuals with schizophrenia would likely need a 'bridging' experience (an experience designed to enhance initiation of, and adherence to the sport, which uses different functional and structural domains of social support; see Soundy et al. (2014) for a definition of domain types) before being engaged in the common application of a sport, for instance, a negative experience of competition can have detrimental effects (Leutwyler et al. 2012, Soundy et al. 2012) or (b) undertaking sport participation with a competitive element. Thus, studies were required to have undertaken an intervention or experience that could be identified as a 'sport' according to our definition (see above). Finally, in order to capture a range of different sports, we included sports defined by the Olympic Committee (2014) and that are undertaken within the Olympics Games. The use and consideration of virtual experiences were included only if they used a sport according to the Olympic definition.

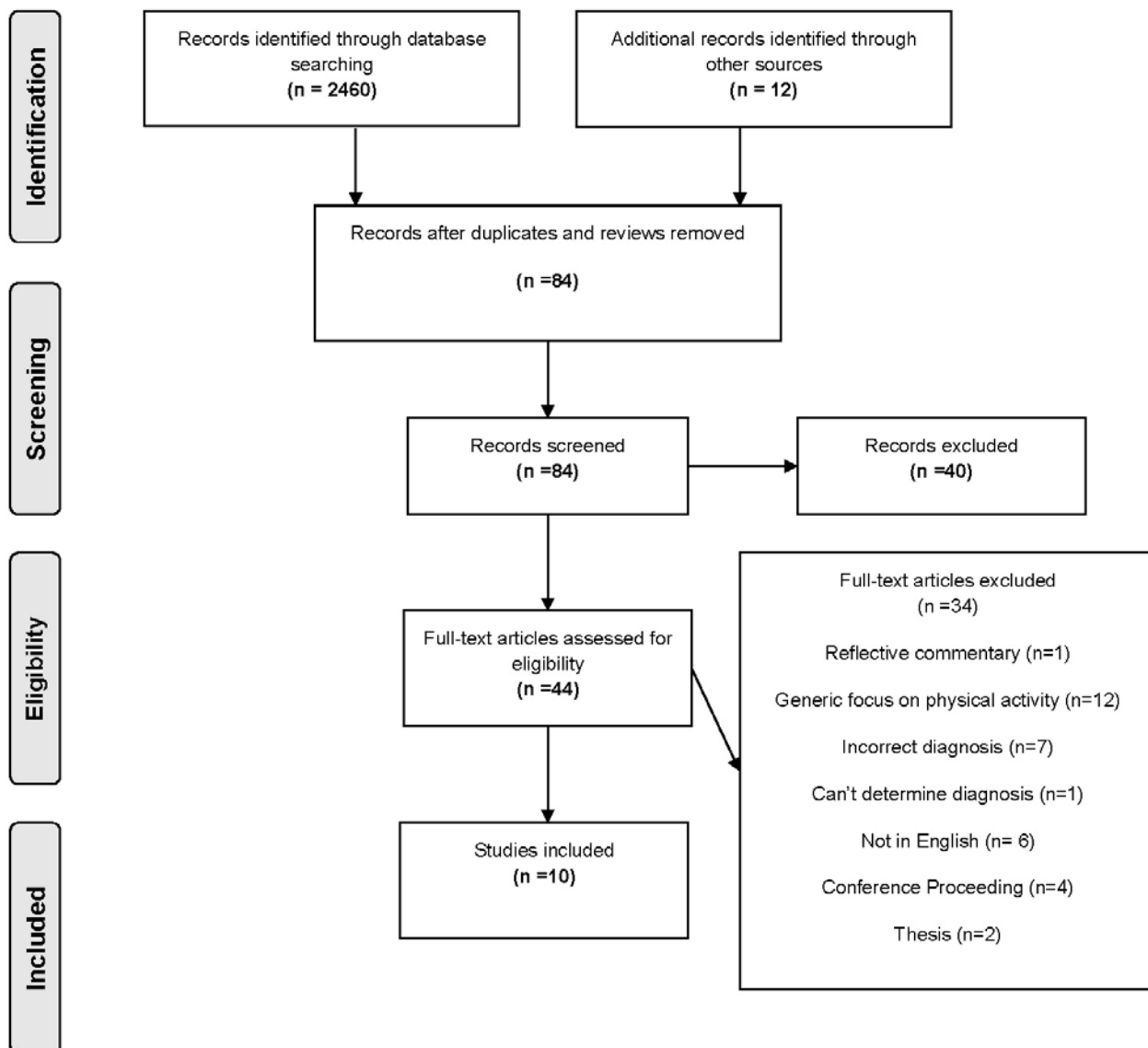


Figure 1. A PRISMA diagram for the study

Comparisons

There was no restriction on the use of a comparison group; all comparator groups (e.g., control, alternative form of physical activity) were included.

Outcomes

The primary outcomes of interest included (a) change in mean weight (KG), BMI, and/or waist circumference (WC) and (b) change in psychiatric symptoms using a recognised measure (e.g. the positive and negative syndrome scale (PANSS), the Brief Psychiatric Rating Scale (BPRS) or the Scale for the Assessment of Negative Symptoms (SANS)). Secondary outcomes of interest were: adherence to sessions across the study duration, self-efficacy, self-esteem, blood chemistries, steps undertaken and duration of physical activity, trust and co-operation with staff associated with the sport, qualitative reports of experiences and effects of sports

participation. Due to the anticipated paucity and heterogeneity of studies we did not contemplate a meta-analysis. Therefore, the results are presented in a thematic synthesis to highlight the outcomes/ themes of interest.

Study Designs

We included studies of any design, including interventional studies (experimental, quasi-experimental and pre-experimental), observational and case studies, and also qualitative research considering the individuals' experiences of sports participation.

Exclusion criteria

Studies were excluded if they (a) were not published in a peer reviewed journal, (b) were not written in English (c) did not include a sport according to our definition.

Search Strategy

Searches were conducted in major electronic databases including Amed, Pubmed, SportsDiscus, Cinahl plus, and the Cochrane Library. In addition, searches were conducted in Google Scholar and ScienceDirect. This was supplemented by (a) hand searches of relevant journals, (b) checking reference lists of included articles, and (c) assessing existing and recent summaries of evidence from similar and related topics. The key search terms included: sport OR physical activity OR exercise AND schizophrenia OR schizo-affective disorder.

Study Selection

One expert (AS) searched for information sources independently, and applied the eligibility criteria. When it was not clear if a study was eligible from the title and abstract, a full text of the study was retrieved. A second reviewer (BS) was available for mediation.

Data collection, risk of bias, and summary measures

Data extraction was conducted by one author (AS), using a standardised form. Extracted data included: design, characteristics of participants (age, gender, diagnosis, setting), details of the intervention and outcome measures/experiences, assessments, and main results. In addition, the approaches and results from qualitative findings were extracted.

The internal validity of each trial was assessed by one author (AS) using the Cochrane risk of bias assessment tool (Higgins et al. 2011). We documented each 'risk of bias' separately. The trustworthiness of the qualitative studies was documented using the consolidated criteria for reporting qualitative research (COREQ) critical appraisal tool (Tong et al. 2007) and finally the case studies were assessed using a 10-point check list developed from the work of Crombie (1996).

RESULTS

Study selection

In total, 10 studies met the inclusion criteria, including 5 trials (Battaglia et al. 2013, Cerino et al. 2011, Kelley et al. 1997, Takahashi et al. 2012, Warren et al. 2011) from 3 countries, 2 qualitative studies (Carter-Morris & Faulkner 2003, Clark et al. 1991) from 2 countries, and 3 case studies (Carless 2008, Carless & Douglas 2008, Iancu et al. 2004) from 2 countries.

Study characteristics

A total of 185 participants were represented across the included studies. Only 8 studies provided details on gender, establishing that over three quarters of participants were male (65/82, 79.3%). The mean age range across the studies was 30-59 years. Of the 5 trials, one

was a randomised control trial (Battaglia et al. 2013), two were controlled trials (Kelley et al. 1997, Takahashi et al. 2012) and two were pre-experimental studies (Cerino et al. 2011, Warren et al. 2011). The qualitative studies were both underpinned by a phenomenological approach (Carter-Morris & Faulkner 2003, Clark et al. 1991). One case study used an ethnographic approach (Carless 2008), one used interpretive interactionism (Carless & Douglas 2008), and one did not detail this information (Iancu et al. 2004).

A variety of sports experiences and intervention strategies were employed. Three studies focused on soccer (Battaglia et al. 2013, Carless & Douglas 2008, Carter-Morris & Faulkner 2003). Others included horse riding (Cerino et al. 2011), climbing within an outdoors sports recreation programme (Kelley et al. 1997), basketball (Takahashi et al. 2012), canoeing (Clark et al. 1991), and running (Warren et al. 2011, Carless 2008). The interventions were mostly well supported by health care professionals and exercise/sports professionals. Full details of these interventions can be seen in Table 1. Three trials reported data on weight or body mass index (Battaglia et al. 2013, Takahashi et al. 2012, Warren et al. 2011), and 3 reported data on psychiatric symptoms including the PANSS (N=2) (Cerino et al. 2011, Takahashi et al. 2012) and the BPRS (N=2) (Cerino et al. 2011, Warren et al. 2011). See Table 1 for full details of outcome measures.

Risk of bias within trials

Table 2 provides a summary of bias within studies. Four out of the 5 studies accumulated at least 4/6 components of bias. Thus, it can be stated that the overall risk of bias affecting the current studies could be considered as high.

Risk of bias across trials

Table 2 provides a summary of bias across studies. Selection bias was the most frequently reported with no trial reporting allocation concealment. Detection and performance bias were considered high for 3/5 studies (Cerino et al. 2011, Takahashi et al. 2012, Warren et al. 2011). The main other types of bias included the lack of registered study protocols prior to the research taking place, and no study undertook a power calculation.

Appraisal of qualitative data and case studies

The COREQ is assessed over 3 domains (only negative marks are highlighted within the text). Domain 1 considers the research team and reflexivity. Clark et al. (1991) scored 5/8, whereas Carter-Morris and Faulkner (2003) scored 1/8. Clark et al. (1991) provided a limited description of the research team, characteristics of researchers and relationship to participants. Domain 2 considers study design. Both studies scored a similar mark with the study by Clark et al. (1991) scoring 7/14 and the study by Carter-Morris and Faulkner (2003)

Table 1. The characteristics of the included studies

Study	Design	Participants	Assessment, interventions and setting	Outcome measures	Main results
Battaglia et al. (2013)	Randomised Control Trial	18 ♂ with schizophrenia 35.5 years 77.4 (WM) kgs outpatients were recruited from local 'psychiatric departments'	Pre (baseline)-post (12-wk) assessment of soccer undertaken Performance test characteristics taking by undertaking 3 maximal performances of tests. Training programme 12 wks programme 2*session/wk for 100-120 mins Each session included: Recording phase Social interaction phase Warm up period Central training period (2 games) Cool down period Feedback phase	*Kgs *BMI *height *30 meter sprint run *Slalom run test running with ball. *Short Form (SF)-12 Health Survey: physical component summary and mental component summary *Heart rate	Treatment group showed sig. decrease in BW (p<0.001) and BMI (p<0.001). BW was sig. higher in control group at wk 12 (p<0.05). Treatment group had sig. improved their performance tests (both at p<0.01) compared to control group. Treatment group showed sig. higher (p <0.001) SF-12 physical component and mental component summary scores.
Cerino et al. (2011)	Pre-Experimental Design	24 individuals with schizophrenia 10 with first onset 10 with chronic disease outpatients were recruited from local 'mental health departments'	Therapeutic horse riding sessions 1/wk for a total of 40 sessions for each patient. Study ran for a total of 24 months. Pre – post assessments were undertaken. 3 phases to each session. Phases 1 & 3 were ground work and grooming. Phase 2 was riding. Sessions were planned to improve patient knowledge of horse care.	*BPRS *PANSS	Total sample showed sig. improvements in the total (t=-6.6, p<0.001), positive (p<0.001) and negative (p<0.001) symptoms. Total score of PANSS showed sig. improvement (t=-5.0, p<0.001) Both sub-groups demonstrated the same sig. effects. No between-group comparisons were reported.
Kelley et al. (1997)	Controlled trial Design (2*2*2 design)	79 (after drop out ♂=56) 37 with schizophrenia 32 with schizoaffective 10 with other diagnosis. 31.6±5.3 years Outpatients at psychosocial rehabilitation programmes	Outdoors recreation program lasting 9 wks on three occasions across the year. 8-12 individuals in each session. Each session was a day long lasting 8-10 hours, including: *Hiking trip, 4 rock climbing trips, 4 cave exploring trips. For two groups a canoeing trip replaced one of the cave expeditions. Participants chose difficulty level of the challenges undertaken. Self -instruction training - 5 techniques: (1) orientation (2) cognitive rehearsal (3) self-instructions (4) coping self-statements (5) self-reinforcements. Control group was engaged in activities as usual.	* Attendance *Generalised self-efficacy scale * The self-efficacy scale * PPAPSP *Rosenberg self-esteem inventory *State-trait anxiety inventory *the beck depression inventory *The brief symptom inventory *Trust & co-operation scale *multi-dimensional locus of control scales for psychiatric patients	Average attendance was 6/day, but ranged from 2-10. Sig. main effect (F=6.64, p<0.01) of intervention versus control on Self-esteem and Self-efficacy. Sig. main effect for depression and anxiety (F=5.06, p<0.03) between control and experimental group and also between gender (F=8.56, p<0.01). Trust and co-operation scale demonstrate sig. difference between diagnosis (F=5.48, p=0.02). Locus of control scale yielded a sig. (F=31.3, p<0.001) interaction effect between intervention and control group.

Table 1. Continuous

Study	Design	Participants	Assessment, interventions and setting	Outcome measures	Main results
Warren et al. (2011)	Pre-Experimental Design	17 (\bar{X} =11) with schizophrenia In and outpatients status not provided. 39.9±10.1 years	Walking and running exercise programme designed to prepare individuals for a running event. 10 wks total duration, including 3 supervised walking/jogging session /wk and 1 group education session regarding healthy eating and exercise behaviours. Walking/jogging sessions started at 20 min and increased by 2-5 minutes per wk to allow an increase towards the end goal. Prior to walking sessions education was provided about the importance of hydration and signs and symptoms of over-exertion.	*Pulse rate taken by participant at end of each session *Pedometers measured step counts of each session. *weekly diet and activity logs for progress outside sessions *blood chemistries (glucose, cholesterol, VLDL, LDL, HDL), triglycerides, aspartate aminotransferase, alanine amino transferase, bilirubin) *EKG *kg *height *blood pressure *respiratory rate *BPRS *SANS *CGI *adherence *mean race time	14 (82%) participated in training sessions and completed the 5k race. 11 (64.7%) participated in all training sessions and 14 (82%) participated in 50% or more and all participants participated in 25% of the sessions. Mean race time 55.35 mins±13.40mins Positive association was obtained between exercise sessions and number of steps ($r=0.31$, $\chi^2=38$, $p<0.001$), as well as between number of sessions and walking duration ($r=0.75$, $\chi^2=163$, $p<0.001$) Pulse rate sig. increased over the 10 sessions (median difference 9.0bpm, IQR: 13.4bpm) No changes in BPRS total score ($p=0.19$), positive symptoms ($p=0.42$), anxiety/depression ($p=0.37$) No change in SANS ($p=0.37$) No change in CGI ($p=0.19$) Median weight change was +0.7kg, but 3 participants gained ≥ 7 kg.
Takahashi et al. (2012)	Control trial	23 (\bar{X} =13) inpatients with schizophrenia	12-wk weight management program Baseline Demographics (age, kg, BMI, illness duration and medication) 2* sessions each day between 30-60 minutes * 5/wk At an intensity of 11-13 of the Borg 20 scale Program consisted of a series of modules, exercise, nutritional education and medication counselling. Exercise included, basketball, walking and jogging and stretching. No treatment for control group	*BMI *fMRI *PANSS	Sig. group interaction over time on BMI ($F=5.0$, $p=0.04$) and PANSS ($F=19.0$, $p<0.001$). Sig. reduction in BMI ($t=3.8$, $p<0.001$) and general psychopathology ($t=4.7$, $p<0.001$) for intervention group but not for control group. *no sig. difference in fMRI
Clark et al. (1991)	Phenomenological approach	8 ♂ patients with schizophrenia Age range 19-42 Inpatients and staff recruited.	5-day white water canoe trip in Northern Ontario Days 1-2: training canoeing strokes, river morphology, camping skills and safety way to fall into the rapids. Days 2-5: canoeing down river, camping and working as a group. Semi-interviews were 1-hour long >6 month post experience	Questions from interviews on critical incidents, interactions with others, emotional experiences and self-perceptions.	Benefits in three categories: the experience of pleasure, belonging, and ability to talk. Challenging activity provided accomplishment and pride, positive emotions, fun excitement, and fear. Normalising activity for interactions between staff and patients

Table 1. Continuous

Study	Design	Participants	Assessment, interventions and setting	Outcome measures	Main results
Carter-Morris (2003)	Phenomenological approach	5 (♂=4) individuals with schizophrenia Outpatients were recruited	Interviewing participants who had become part of a football team for individuals with severe and enduring mental illness. Team trained 'regularly, involved in national tournaments and took part in 'Pallastrad' in Italy	Questions from interview schedule not identified.	Project as a normalising activity Importance of accessing a positive identity Project as a meaningful experience Assistance with positive symptoms Barriers to participation associated with medication
Carless (2008)	Case study – ethnographic approach	1 ♂ outpatient 36 years old	Author spent 18-months in vocational rehabilitation enter to gain trust. Four means of data collection (1) medical records analysis (2) participant observation (3) two interviews and a focus group with health care professionals (4) two in-depth interviews	Exercise participation Previous sport and exercise prior to mental illness Effects of changes experienced through sport, explanation of these changes.	Importance of a positive identity in the past. Decent into a period of four years where physical activity was not part of his life where medication, cigarettes were increased. At this time dramatic bodily changes adversely affected identity and sense of self. Role of health care professional (physiotherapist) in re-engaging patient 7 years post onset, following which athletic identity was restored. Physical activity gives more meaning success and satisfaction. Panic attacks could not be overcome.
Carless & Douglas (2008)	Case studies – interpretive interactionism	2 ♂ outpatients from a vocational rehabilitation centre	Authors spent 18-months in vocational rehabilitation enter to gain trust. Three means of data collection (1) observation (2) medical records (3) single in-depth, semi-structured interview.	Interview to consider current physical activity participation, previous sports and exercise prior to mental illness, as well as effects of sport and exercise	Importance of past sport achievements, successes and athletic identity. Role of health care professional (occupational therapist, physiotherapist) in re-engaging physical activity after illness. Challenge of medication side-effects Satisfaction and achievement from sport can result in social improvement Control over illness and sense of purpose in the future Desire to change identity and fitness
Iancu et al. (2004)	Case studies	8 ♂ inpatients with schizophrenia	Inpatient table tennis tournament was organised with rewards including trophies, sport shirts and two hats. 4 therapists assisted in the doubles tournaments	Vignettes of the experience of three patients	Provides a focus Provides sense of achievement (when successful) Potential to cause negative emotions because of losing or being fearful of the experience

Note: WM = weighted mean; kgs = kilograms; wk(s) = week(s); min(s) = minute(s); sig. = Significant/ly; BW = body weight, BMI = Body Mass Index; BPRS = Brief Psychiatric Rating Scale; PANSS = Positive and Negative Syndrome Scale, CGI = Clinical Global Impression; SANS = Scale for the assessment of negative symptoms; VLDL, LDL, HDL = very low, low and high-density lipoprotein; PPAPSP = the Perceived Physical Ability and Physical Self-Presentation Confidence subscale of the physical self-efficacy scale; fMRI = functional magnetic resonance imaging

Table 2. Summary assessment of the overall risk of bias

Trial*	Components of risk of bias/key risk criteria						Summary within trial	Comments on high risk components
	1	2	3	4	5	6		
Battaglia et al. (2013)	L	H	L	U	L	H	H=2 L=3 U=1	Attrition bias: researchers identified that two individuals were excluded from the treatment group but then state; “instead, three patients of the CG (control group) were not subjected to a second assessment” (pp. 579) Other bias: no protocol was registered prior to the study taking place. There was multiple testing with no adjustment made to the significance level.
Cerino et al. (2011)	H	H	H	U	L	H	H=4 L=1 U=1	Selection bias: no randomisation and no allocation concealment were undertaken. Detection/Performance bias: no blinding was undertaken. Other bias: no protocol was registered prior to the study taking place. Multiple t-tests were undertaken with no adjustment to significance level.
Kelley et al. (1997)	H	H	H	H	L	H	H=5 L=1 U=0	Selection bias: no randomisation and no allocation concealment were undertaken. Detection/ Performance bias: no blinding was undertaken. Attrition bias: it was not clear how many dropped out and some of the control group were drawn for individuals who dropped out. Other bias: there was no protocol registered prior to the study taking place.
Takhashi et al. (2012)	H	H	H	L	L	H	H=4 L=2 U=0	Selection bias: no randomisation and no concealment Detection/Performance bias: no blinding was undertaken. Other bias: there was no protocol registered prior to the study taking place.
Warren et al. (2011)	H	H	H	L	L	H	H=4 L=2 U=0	Selection bias: no randomisation and no allocation concealment were undertaken. Detection/Performance bias: no blinding was undertaken. Other bias: there was no protocol registered prior to the study taking place.

*Trial denoted by first author. Risk of bias criteria: 1, selection bias= random sequence generation; 2, selection bias= allocation concealment; 3, detection/performance bias= blinding of personnel, assessors and participants; 4, attrition bias= incomplete outcome data; 5, reporting bias= short-term selective outcome reporting; 6, other bias= potential threats to validity e.g., consideration of a protocol.

Levels of risk of bias: H - high risk of bias; U - unclear risk of bias; L - low risk of bias

scoring 6/14. Similar problems were found including not detailing the location of data collection and presence of others or contextual detail, not providing an interview guide, not using field notes for analysis and not considering the saturation of themes. Domain 3 considers analysis and findings. Both studies scored similarly with Clark et al. (1991) scoring 5/9 and Carter-Morris & Faulkner (2003) scoring 3/9. The main problems for both studies included a lack of the following aspects of analysis: a coding tree, details about derivation of themes and detail of minor themes.

The critical appraisal tool for the case studies showed that the two studies performed well (Carless 2008, Carless & Douglas 2008), with the only limitation identified as the need for more than one individual to act in a critical way to support the analysis. This was also a possible weakness for the study of Iancu et al. (2004), but this study had two more limitations (the methods for collecting data were not clearly described, and details of

reflexivity were not provided), creating 3 negative points out of 10.

Primary Outcomes

BMI, weight and waist circumference

Two studies reported significant reductions in body weight following a 12-week sport intervention. Takahashi et al. (2012) reported a BMI mean reduction of -0.7 kg.m² (t=3.8, p<0.001) following 12 weeks of basketball, whereas Battaglia et al. (2013) reported a reduction of BMI of -1.33 kg.m² (p<0.001) after 12-weeks of soccer in addition to a mean reduction in body weight of -3.55kg (p<0.001). One study (Warren et al. 2011) reported non-significant changes across time in weight (median difference increase 0.7kg; IQR:-0.5-3.9kgs), BMI (median difference increase of 0.8kg.m², IQR: 1.6), and WC (mean difference decrease of -0.1 cm) across a 10-week walking and running exercise.

Schizophrenia symptom severity (PANSS, BPRS, SANS, Clinical Global Impression)

Two studies that applied PANSS reported an improvement in mental health-related symptoms. Takahashi et al. (2012) reported the benefits of a 12-week basketball training programme and identified a reduction of the total score of 2.4 points ($F=-19.0$, $p<0.001$). Cerino et al. (2011) reported a reduction of 7.4 points ($t=-5.0$, $p<0.001$) following a 40 week programme of horse riding, as well as a mean total reduction of 16 points on the BPRS ($t=-6.596$, $p<0.001$). However, Warren et al. (2011) reported no significant pre-post change on the BPRS ($p=0.19$), SANS ($p=0.37$), or on Clinical Global Impression ($p=0.19$) following 10 weeks of brisk walking/running. Kelley et al. (1997) reported a decrease in depression and anxiety ($F=5.0$, $p<0.03$) and improvement in locus of control across examined groups ($F=31.1$, $p<0.001$).

Secondary Outcomes

Attendance and adherence

Two studies reported on adherence to sports participation (Kelley et al. 1997, Warren et al. 2011). Kelley et al. (1997) identified that the average attendance for an outdoors sports recreation programme was 6 individuals each day out of a possible 8-12 individuals for each group. However a range of between 2 and 10 was apparent. Warren et al. (2011) identified that a total of 14 (82%) participated in training sessions and completed the 5k race.

Physical performance

Battaglia et al. (2013) reported a significant improvement across time in a 30 meter sprint run test, as well as a significant improvement in a slalom run course (both at $p<0.01$). Warren et al. (2011) demonstrated a mean increase in the duration of walking/jogging ($r=0.75$, $\chi^2=163$, $p<0.001$) as well as an increase in the number of steps undertaken ($r=0.31$, $\chi^2=38$, $p<0.001$).

Self-efficacy and self-esteem

Kelley et al. (1997) reported significant improvement in both self-esteem and self-efficacy ($F=6.6$, $p<0.01$).

Quality of life

Battaglia et al. (2013) measured a physical and mental component summary of the SF-12. Both components showed significant ($p<0.001$) improvements, compared to controls, 12 weeks after the intervention, equating to an improvement on average of 10.5% and 10.8% on the physical and mental component score respectively.

Other physiological measures

One study (Warren et al. 2011) investigated a range of physiological measures following sports participation. However, no significant changes were identified for blood chemistries, including fasting lipids, fasting glucose, blood pressure, and respiratory rate.

Qualitative synthesis of qualitative and case studies

The qualitative thematic analysis utilising 2 qualitative studies identified: (1) the importance of sport in providing a sense of achievement and pride for individuals (Iancu et al. 2004), (2) that physical activity was associated with meaning in participants' lives, success, and satisfaction (Carless 2008, Carless & Douglas 2008), (3) that individuals described a sense of belonging and enhanced social interaction, which can in turn act as a 'normalising' activity for individuals (Carter-Morris & Faulkner 2003, Clark et al. 1991), and (4) for those who have been previously engaged in a particular sport, there was evidence that it can help create or provide access to a more positive athletic identity (Carless 2008, Carless & Douglas 2008, Carter-Morris & Faulkner 2003). However, it should be noted that the competitive element, experience of failure and requirement of skills could produce negative reactions to the sports participation (Iancu et al. 2004).

DISCUSSION

This is the first systematic review to our knowledge to investigate the effect and experiences of sport participation among individuals with schizophrenia. Ten studies are examined within this review, including a total of 185 people with schizophrenia. The findings showed that participation in sport may result in a small decrease in weight/ BMI, and in improvement in positive and negative symptoms of schizophrenia. It is also found that sports participation is associated with a range of wider health benefits, and is described as enjoyable by individuals with schizophrenia. This review extends the previous review made by Langle et al. (1999), by updating it, providing a methodological quality appraisal of the research, and by identifying specific findings relating to the utilised outcome measures.

Benefits on physical health

The current review suggests that sport participation provides a benefit on the weight of individuals with schizophrenia, with 2 out of 3 studies reporting significant reductions. This is an important finding and supports the suggestion that sport, as a form of physical activity, can aid individuals in achieving weight loss at a level possibly comparable to structured weight management programmes (Faulkner et al. 2003). Furthermore, it is likely that sports participation provides individuals with a way to accumulate the recommended levels of moderate and vigorous physical activity (Vancampfort et al. 2012). It is likely that further participation benefits certain aspects of fitness and performance; this is supported by a previous review which also highlights other potential gains in an individual's brain volumes and in particular in the hippocampus (Vancampfort et al. 2014). Improved performance likely enhances (for instance enjoyment, ability to engage) the experience of participation in that activity, as well as in other physical activities.

Benefits on mental health

Two out of 3 trials reported decreased psychiatric symptoms during sports participation. A decrease in mental health-related symptoms has been noted previously, for instance decrease in anxiety (Süle 1987). Given the beneficial results on the psychopathological symptoms of individuals from two studies, it is important that further well designed studies consider this in more detail.

An increase in self-confidence (Süle 1987), self-esteem and self-efficacy (Corretti et al. 2011) have been previously documented as outcomes of sport participation and, based on the current review, appear to be directly enhanced through sport participation. Further research of these important concepts is clearly indicated. Moreover, for those who enjoyed sport, participation provides a potential to develop a positive identity, which may be central to health psychology changes for individuals (Soundy et al. 2012). In addition, it is possible that sports participation can influence an individual's quality of life, providing individuals with an important sense of belonging and unity with others. For some individuals, sport was identified as providing a sense of meaning and purpose in their lives, supporting the development of hope. This reflects the ability of physical activity to provide 'transcending' benefits for the individuals with schizophrenia (Soundy et al. 2014), for instance confidence gained from social interactions during sports participation can have a positive impact on broader social interactions in different situations.

Clearly, there is potential for a range of benefits to be ascertained from sports participation in people with schizophrenia. However, it is important to recognise that participation in sport can also be associated with negative outcomes such as addiction (Lorente et al. 2004) and injuries (Doolan et al. 2012). The current review identified that there is a potential for the competitive element to cause some psychological harm to participants (Iancu et al. 2004, Carter-Morris & Faulkner 2003). In addition, deficit in emotional and social perception (Savla et al. 2013), and increased social anxiety (Soundy et al. 2007) or negative past experiences in sport may act as unseen barriers to participation. Thus, health care professionals need to consider these factors and the individual's preferences when encouraging sport participation in people with schizophrenia. The delivery of different sports would be possible across both inpatient and outpatient settings. The delivery may however be compromised by limited access to resources and environments, as well as political considerations such as policy of wards and motivation of staff to support such initiatives (Stubbs et al. 2014a, 2014b; Vancampfort et al. 2013). Considerations on how to initiate and maintain adherence in sessions over a longer period of time (>3 months), as well as on how to bridge the sessions into the community is needed. To achieve a success, the effort of different multidisciplinary teams (physiotherapists, nurses, and exercise specialists), as

well as between hospitals and community facilities is needed (Vancampfort & Faulkner 2014). Primarily, the introduction of sport should (a) respect and value the individual's choice of when and how to start, and (b) provide a supported (support from staff, peers, and carers) environment which is accessible on a longer term basis and is able to consider the barriers which may influence recovery (Soundy et al. in press) and access to sport, as identified above and within previous research (Soundy et al. 2013).

Limitations

It is important to stress several limitations of this review. First, the number of studies included in this review was modest, with small sample sizes which may have been underpowered, and often failed to include a power calculation. Second, a high risk of bias was found which may have affected the results. Third, due to the heterogeneity of outcome measures and paucity of studies, it was not possible to conduct a meta-analysis. Fourth, the majority of participants were male and thus the findings might be, to some extent, more male gender specific. Moreover, these studies did not consider the effect of important covariates (such as weight or psychiatric symptoms) on the results, nor stratified groups accordingly. Fifth, although the qualitative synthesis provided some valuable insights, it was limited by the level of details in reports. Sixth, the review included a wide range of sports and specific application of the current results to any one particular sport may be limited. Further, the inclusion criteria were rather broad: studies that introduced individuals to sport are also included rather than just focusing only on the effects or experiences of sports participation. Also, using the specific definition of a sport meant that some sports were excluded. Seventh, the influence of disease classification, medication, in/out-patient status, and adherence to medication on the observed results was not considered. Finally, research reported in languages other than English were not included. Notwithstanding these limitations, the current review has several important strengths: it followed recognised review guidelines (PRISMA), it is the first review of its kind including methodological appraisal of included studies, and it examined different types of studies simultaneously.

Future research and clinical implications

Our review demonstrated that sports participation may produce a range of positive effects on the health and well being of individuals with schizophrenia. In light of the methodological limitations we have outlined, it is important that adequately powered robust RCTs are conducted to clearly investigate the benefits of sports participation. Our results identified no physically harmful effects and limited psychologically harmful effects from sport participation (although publication bias may have influenced these findings).

One reason for this is that studies ‘introduced’ individuals to sport rather than required a competitive situation bound by rules. In light of our findings, and if the individuals are willing, clinicians should consider sport participation in the treatment and management of people with schizophrenia. Sports participation may be particularly beneficial for individuals who already have some previous experience in sports. Furthermore, their previous association with sport may make it easier to overcome the multiple barriers that prevent individuals with schizophrenia to become more active (Soundy et al. 2014). However, clinicians should consider that certain sports may be more popular, based on individual preferences and previous experiences. Further, some sports (such as soccer in the United Kingdom) may already have a greater infrastructure to support service users (Pringle 2009).

CONCLUSIONS

This review demonstrates that participation in sports may, at least in the short term, result in small reductions in weight and psychiatric symptoms, and possibly have wider health benefits. Notwithstanding the limitations of the examined studies, sports participation should be considered as an option to improve the physical and mental health of people with schizophrenia. However, further well-designed, adequately-powered studies are needed to confirm the benefits of sport participation in schizophrenia.

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References

1. American Psychiatric Association: *Diagnostic and statistical manual of mental disorders (4th ed.)*. American Psychiatric Association, Washington DC, 2000.
2. American Psychiatric Association: *Diagnostic and Statistical Manual of Mental Disorders (5th ed.)*. American Psychiatric Association, New York, 2013.
3. Australian Sports Commission: *ASC recognition. What is defined as a sport? 2014*. Obtained from the world wide web on the 2nd of April, 2014 from http://www.ausport.gov.au/supporting/nso/asc_recognition
4. Battaglia G, Alesi M, Inguglia M, Roccella M, Caramazza G, Bellafigliore M et al.: *Soccer practice as an add-on treatment in the management of individuals with a diagnosis of schizophrenia*. *Neuropsychiatr Dis Treat* 2013; 9:595-603.
5. Carless D: *Narrative, identity, and recovery from serious mental illness: A life history of a runner*. *Qual Res Psychol* 2008; 5:233-48.
6. Carless D & Douglas K: *The role of sport and exercise in recovery from serious mental illness: two case studies*. *Int J Mens Health* 2008; 7:137-56.
7. Carter-Morris P & Faulkner G: *A football project for service users: the role of football in reducing social exclusion*. *Journal of Mental Health Promotion* 2003; 2:24-30.
8. Caspersen CJ, Powell KE & Christenson GM: *Physical activity, exercise, and physical fitness: Definitions and distinctions for health related research*. *Public Health Rep* 1985; 100:126-31.
9. Cerino S, Cirulli F, Chiarotti F & Seripa S: *Non conventional psychiatric rehabilitation in schizophrenia using therapeutic riding: the FISE multicentre pindar project*. *Ann Ist Super Sanita* 2011; 47:409-14.
10. Clark C, Goering P & Tomlinson G: *Challenging expectations: client perceptions of white water canoeing*. *Psychiatr Rehabil J* 1991; 14:71-6.
11. Council of Europe: *The European sports charter (revised)*. Council of Europe, Brussels, 2001.
12. Corretti G, Martini C, Greco PL & Marchetti FP: *Sport in psychiatric rehabilitation: A tool in pre-acute, post-acute and chronic phase*. *Int J Clin Med* 2011; 2:568-9.
13. Crombie I: *The pocket guide to critical appraisal*. BMJ publishing group, London, 1996.
14. De Hert M, Schreurs V, Vancampfort D & Van Winkel RV: *Metabolic syndrome in people with schizophrenia: a review*. *World Psychiatry* 2009; 8:15-22.
15. De Hert M, Correll CU, Bobes J, Cetkovich-Bakmas M, Cohen D, Asai I et al.: *Physical illness in patients with severe mental disorders. I. Prevalence, impact of medications and disparities in health care*. *World Psychiatry* 2011; 10:52-77.
16. Doolan AW, Day DD, Maerlender AC, Goforth M & Brolinson PG: *A review of return to play issues and sports-related concussion*. *Ann Biomed Eng* 2012; 40:106-13.
17. Ellis N, Crone D, Davey R & Grogan S: *Exercise interventions as an adjunct therapy for psychosis: a critical review*. *Br J Clin Psychol* 2007; 46:95-111.
18. Faulkner G, Soundy AA & Lloyd K: *Schizophrenia and weight management: a systematic review of interventions to control weight*. *Acta Psychiatr Scand* 2003; 108:324-32.
19. Gorczynski P & Faulkner G: *Exercise therapy for schizophrenia*. *Schizophr Bull* 2010; 36:665-66.
20. Higgins JP, Altman DG & Sterne JA: *Chapter 8: assessing risk of bias in included studies*. In Higgins JP & Green S (eds.): *Cochrane Handbook for Systematic Reviews of Interventions Version 5.1.0*, 2011.
21. Higgins JP & Green S: *Cochrane Handbook for Systematic Reviews of Interventions Version 5.1.0*, 2011.
22. Holley J, Crone D, Tyson P & Lovell G: *The effects of physical activity on psychological well-being for those with schizophrenia: a systematic review*. *Br J Clin Psychol* 2011; 50:84-105.
23. Howley ET: *Type of activity: resistance, aerobic and leisure versus occupational physical activity*. *Med Sci Sports Exerc* 2001; 33:364-9.
24. Iancu I, Strous RD, Nevo N & Chelben JA: *Table Tennis Tournament in the Psychiatric Hospital: description and suggestion for salutogenic implications*. *International Journal of Psychosocial Rehabilitation* 2004; 9:11.
25. Kelley MP, Coursey RD & Selby PM: *Therapeutic adventures outdoors: A demonstration of benefits for people with mental illness*. *Psychiatr Rehabil J* 1997; 20:61-74.
26. Khan KM, Thompson AM, Blair SN, Sallis JF, Powell KE, Bull FC et al.: *Sport and exercise as contributors to the health of nations*. *The Lancet* 2012; 380:59-64.

27. Krusturup P, Dvorak J, Jungle A & Bangsbo J: Executive summary: the health and fitness benefits of regular participation in small-sided football games. *Scand J Med Sci Sports* 2010; 20:132-5.
28. Langle G, Siemben G & Hornberger S: Die rolle des sports in der behandlung und rehabilitation schizophrener patienten (The role of sports in the treatment and rehabilitation of Schizophrenic patients). *Rehabilitation* 1999; 39:276-82.
29. Leutwyler H, Hubbard EM, Vinogradov S & Dowling GA: Videogames to promote physical activity in older adults with schiozphrenia. *Games for Health Journal: Research, Development, and Clinical Applications* 2012; 1:381-3.
30. Lorente FO, Souville M, Griffet J & Grélot L: Participation in sports and alcohol consumption among french adolescents. *Addict Behav* 2004; 29:941-6.
31. McNamee L, Mead G, MacGillivray S & Lawrie SM: Schizophrenia, poor physical health and physical activity: evidence-based interventions are required to reduce major health inequalities. *Br J Psychiatry* 2013; 203:239-41.
32. Moher D, Liberati A, Tetzlaff J & Altman DG: Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. *BMJ* 2009; 339:332-6.
33. Mountjoy M, Andersen LB, Armstrong N, Biddle S, Boreham C, Bedenbeck H-PB et al.: International Olympic Committee consensus statement on the health and fitness of young people through physical activity and sport. *BMJ* 2010; 45:839-48.
34. Olympic Committee. Sports and disciplines, 2014. Retrieved on the 11/11/2014 from: <http://www.olympic.org/sports>.
35. Pringle A: The growing role of football as a vehicle for interventions in mental health care. *J Psychiatr Ment Hlt* 2009; 16:553-7.
36. Savla GN, Vella L, Armstrong CC, Penn DL & Twamley EW: Deficits in domains of social cognition in Schizophrenia: A meta analysis of the emprical evidence. *Schizophr Bull* 2013; 39:979-92.
37. Soundy A, Faulkner G & Taylor A: Exploring variability and perceptions of lifestyle physical activity among individuals with severe and enduring mental health problems: A qualitative study. *JMH* 2007; 16:493-503.
38. Soundy A, Kingstone T & Coffee P: Understanding the psychosocial process of physical activity for individuals with severe mental illness: A meta-ethnography. In L'Abate L (ed.): *Mental Illness 2*. Intech, 2012.
39. Soundy A, Wampers M, Probst M, De Hert M, Stubbs B, & Vancampfort D: Physical activity and sedentary behaviour in outpatients with schizophrenia: A systematic review and meta-analysis. *Int J Ther Rehabil* 2013; 20:588-96.
40. Soundy A, Freeman P, Stubbs B, Probst M, Coffee P & Vancampfort D: The transcending benefits of physical activity for individuals with schizophrenia: a systematic review and meta-ethnography. *Psychiatry Res* 2014; 220:11-9.
41. Soundy A, Stubbs B, Roskell C, Williams S, Fox A & Vancampfort D: Identifying the facilitators and processes which influence recovery in individuals with schizophrenia; a systematic review and thematic synthesis. *JMH*; in press.
42. Stubbs B, Soundy A, Probst M, De Hert M, De Herdt A, Parker A et al.: The assessment, benefits and delivery of physical activity in people with schizophrenia: a survey of members of the international organization of physical therapists in mental health. *Physiother Res Int* 2014a; 19:248-56.
43. Stubbs B, Soundy A, Probst M, Parker A, Skjaerven LH, Lundvik Gyllensten A et al.: Addressing the disparity in physical health provision for people with schizophrenia: an important role for physiotherapists. *Physiotherapy* 2014b; 100:185-6.
44. Süle F: Therapeutic use of sports in psychiatry and clinical psychology. *J Sports Med* 1987; 27:79-84.
45. Takahashi H, Sassa T, Shibuya T, Kato M, Koeda M, Murai T et al.: Effects of sports participation on psychitric symptoms and brain activations during sports observation in schizophrenia. *Transl Psychiatry* 2012; 2:e96.
46. Tong A, Sainsbury P & Craig J: Consolidated criteria for reporting qualitative research (COREQ): a 32-item checklist for interviews and focus groups. *International Journal of Qualitative Health Care* 2007; 19:349-57.
47. Vancampfort D, Knapen J, De Hert M, van Winkel R, Deckx S, Maurissen K et al.: Cardiometabolic effects of physical activity interventions for people with schizophrenia. *Physical Therapy Reviews* 2009; 14:388-98.
48. Vancampfort D, De Hert M, Skjaerven L, Gyllensten A, Parker A, Mulders N et al: International Organization of Physical Therapy in Mental Health consensus on physical activity within multidisciplinary rehabilitation programmes for minimising cardio-metabolic risk in patients with schizophrenia. *Disabil Rehabil* 2012; 34:1-12.
49. Vancampfort D, Probst M, Skjaerven L, Catalán-Matamoros D, Lundvik-Gyllensten A, Gómez-Conesa A et al.: Systematic Review of the Benefits of Physical Therapy within a Multidisciplinary Care Approach for People with Schizophrenia. *Physical Therapy* 2012; 92:11-23.
50. Vancampfort D, De Hert M, De Herdt A, Vanden Bosch K, Soundy A, Bernard PP et al.: Associations between physical activity and the built environment in patients with schizophrenia: a multi-centre study. *Gen Hosp Psychiat* 2013; 35:653-8.
51. Vancampfort D & Faulkner G: Physical activity and serious mental illness: A multidisciplinary call to action. *Ment Health Phys Act* 2014; 7:153-4.
52. Vancampfort D, Probst M, De Hert M, Soundy A, Stubbs B, Stroobants M et al.: Neurobiological effects of physical exercise in schizophrenia: a systematic review. *Disabil Rehabil* 2014; 36:1749-54.
53. Warren KR, Ball MP, Feldman S, Liu F, McMahon RP & Kelly DL: Exercise program adherence using a 5-kilometer (5K) event as an achievable goal in People with schizophrenia. *Biol Res Nurs* 2011; 13:383-90.
54. World Health Organization. *The ICD-10 classification of mental and behavioural disorders – diagnostic criteria for research*. World Health Organization, Geneva, 1993.

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