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Can exercise increase fitness and reduce weight in patients with schizophrenia and depression?

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INTRODUCTION

There is a known increased morbidity and mortality due to illnesses among people with mental disorders. A large Nordic study has recently shown that psychiatric patients have a reduced life expectancy of 15–20 years compared to the general population (1). This excess mortality is to some extent explained by suicide and accidents, but most of lost year of life is due to excess mortality from somatic disease (2). Detailed analysis of mortality from specific causes of death shows that this excess mortality is caused by virtually any physical illness (3).

A study of patients treated with antipsychotic medication in outpatients’ services in Copenhagen has shown that the prevalence of metabolic syndrome is twice as high in these patients compared with the general population (4). The metabolic syndrome is a cluster of symptoms related to increased risk of cardiovascular events, type II diabetes, and all-cause mortality. The definition of metabolic syndrome varies, but most includes central obesity, raised blood pressure, high fasting glucose levels, and dyslipidemia (raised triglycerides and lowered high-density lipoproteins) (5). The high prevalence of metabolic syndrome among mentally ill is presumably partly due to weight gain and impaired glucose tolerance, which can be side effects of antipsychotic medication (6). Another reason for the high morbidity and mortality may be the lacking treatment of physical illnesses (7). However, there is also reason to believe that lifestyle factors such as smoking, diet, and exercise habits play a role in the excess mortality, morbidity, and high rates of illnesses. Sedentary lifestyle and poor diet is also more frequent than in the general population (8, 9). Low levels of physical activity are associated with increased risk of cardiovascular disease, diabetes, and all-cause mortality (10, 11). However, adherence to behavioral interventions in both the general population as well as in patients with mental illness is a major issue (12). The excess morbidity in patients with severe mental illness can be attributed to unhealthy lifestyle, medication, and that patients with
mental illness do not receive same treatment for physical illnesses as mentally healthy patients. In theory, these are all modifiable factors.

With our current knowledge, there is no reason to believe that the physiological benefit of exercise should be different in mentally ill compared to healthy subjects. However, psychiatric symptoms (e.g., anxiety and lack of energy), medication adverse events (e.g., weight gain and sedation), and factors such as social isolation and difficulties in planning, are issues for many patients with either depression or schizophrenia. Due to these challenges, results from lifestyle interventions in the mentally healthy populations cannot be extrapolated to mentally ill populations.

Exercise, which has a low number of side effects, is affordable for most health care systems and is increasingly an objective for research in this patient group. Furthermore, isolated exercise interventions are simple to implement, less costly, and demands less education of staff compared to more complex interventions. The aim of this study was to review the literature on the effect of exercise interventions on fitness variables such as maximal oxygen uptake and strength. Secondly the aim was to assess the effect of exercise interventions on weight and body mass index (BMI). Also, adherence to exercise interventions will be reviewed.

METHODS

This study was as a systematic review for the primary aims. We included randomized clinical trials allocating patients diagnosed with schizophrenia, bipolar disorder, or depression according to a diagnostic system (i.e., DSM or ICD) to an exercise intervention or a control group/treatment as usual or to an exercise intervention as add-on treatment. The trials had to report outcomes on change in maximal oxygen uptake, repetition maximum or similar in order to be included. We also searched references in relevant papers for additional trials. Secondly, we included studies aiming to identify adherence to exercise interventions.

SEARCH STRATEGY

We searched PubMed, Embase, and PsycINFO using the following text word terms: (mental disorders) AND (health promotion OR exercise physical OR physical therapy OR physical activity OR sports OR "life style intervention" OR life style OR food intake OR diet OR dietary OR nutrition OR nutritive OR nutrition therapy OR cognitive therapy OR behavioral therapy) AND (bipolar disorder OR schizophrenia OR psychoses OR depression OR depressive disorder OR "severe mental disorder") AND (physical fitness OR physical health OR metabolic syndrome OR cardiometabolic OR cardiovascular OR BMI OR body mass index OR body fat OR weight loss OR weight maintenance OR waist to hip ratio OR "study outcome" OR "study intervention"). The main search was conducted in the summer of 2012 and a follow-up search was conducted in March 2014 in PubMed.

DATA EXTRACTION

Data of participants' baseline characteristics, type of intervention, attendance, and effect on aerobic fitness or strength, and metabolic variables. We expected high heterogeneity of trial interventions, in reporting of effects, and chosen effect estimates and a priori abstained from performing a meta-analysis.

RESULTS

The updated search in March 2014 resulted in 5742 hits. Five (13–17) trials reporting the effect of exercise interventions for schizophrenia fulfilled the inclusion criteria and were included. Nine trials (18–26) reporting the effect of exercise in patients with depression fulfilled the inclusion criteria and were included. No trials including patients with bipolar disorder fulfilled the inclusion criteria.

THE EFFECT OF EXERCISE ON FITNESS OR STRENGTH IN PATIENTS WITH SCHIZOPHRENIA

Five trials allocating a total of 141 patients to an exercise intervention or a control group reported the effect on fitness. A summary of these trials can be seen in Table 1. Four studies used aerobic exercise (15–17) and one was a mixed intervention of both strength training as well as aerobic training (14). The vast majority of included participants were outpatients with a mean age between 29 and 52 years. Of the five trials, a recent Dutch study (13) is the most interesting due to its size. In that study, 63 patients were randomly assigned to a training (n = 31) or occupational therapy (n = 32). The training program consisted mainly of exercises that were intended to increase cardiovascular fitness. There was supervised training twice a week for 6 months. After 6 months, the fitness in the exercise group was significantly higher compared with the control group. This difference was not due to an increase in fitness as a result of training, but a decrease in fitness observed in the control group. However, participants who had an attendance of <50% were excluded from this calculation. The authors conclude that the intervention helped maintain an otherwise declining fitness. The remaining four trials included between 12 and 30 participants. None of these trials found a significant effect of exercise on fitness or strength. It should be noted, however, that all four trials reported a non-significant increase in aerobic fitness.

THE EFFECT OF EXERCISE ON BODY WEIGHT IN PATIENTS WITH SCHIZOPHRENIA

As illustrated in Table 1, four of five trials did not find that exercise reduced weight or BMI. However, one study with soccer intervention found a significant reduction of 4.6% in weight and BMI (15) and another trial found a 3.7% decrease in body fat (17).

PARTICIPATION IN EXERCISE INTERVENTIONS IN PATIENTS WITH SCHIZOPHRENIA

Four of five trials report on attendance. In the Dutch study (13), only participants attending more than 50% of sessions are included in the assessment. In this “completers” group, the average attendance is 1.5 session/week. In Battaglia et al. (15) using soccer, training 83% participated in more than 80% of the 24 offered sessions. In the remaining trials, the mean participation ranged between 1.4 and 2.6 session/week. In the trial by Marzolini et al. (14), they registered barriers for two attendances based on participants' feed-back and found the top four reasons to be unknown (47%), medical issues including hospitalization (27%), supervised trip or family visit (8%), and medical appointment (4%).
Table 1 | Randomized clinical trials investigating the effect of exercise interventions in patients with schizophrenia.

<table>
<thead>
<tr>
<th>Trial</th>
<th>Participants</th>
<th>Number of participants randomized</th>
<th>Number of participants included in final analysis</th>
<th>Intervention</th>
<th>Attendance</th>
<th>Results fitness</th>
<th>Results weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scheewe et al. (13)</td>
<td>Outpatients</td>
<td>Mean age: 29.7</td>
<td>E = 31</td>
<td>Supervised aerobic exercise. Two sessions/week for 6 months</td>
<td>E = 17</td>
<td>Change in aerobic fitness was significantly higher in E-group</td>
<td>No significant effect on BMI or waist circumference</td>
</tr>
<tr>
<td></td>
<td>Female: 17/63</td>
<td>(27%)</td>
<td>C = 32</td>
<td>Mean attendance was for these 20 participants was 1.5 session/week</td>
<td>C = 16</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Battaglia et al. (15)</td>
<td>Outpatients</td>
<td>Mean age: 35.5</td>
<td>E = 12</td>
<td>Supervised soccer training. Two sessions/week for 3 months</td>
<td>E = 10</td>
<td>Exercise group: 83% participated in &gt;80% of sessions</td>
<td>No significant effect on 30 m sprint performance</td>
</tr>
<tr>
<td></td>
<td>Female: 0/23</td>
<td>(0.0%)</td>
<td>C = 11</td>
<td>Mean attendance was for these 20 participants was 1.5 session/week</td>
<td>C = 8</td>
<td></td>
<td>Significant reduction in weight and BMI of 4.6%</td>
</tr>
<tr>
<td>Marzolini et al. (14)</td>
<td>Outpatients</td>
<td>Mean age: 44.9</td>
<td>E = 7</td>
<td>Supervised mixed aerobic and strength training. Two sessions/week for 3 months</td>
<td>E = 7</td>
<td>Exercise group: mean attendance was 1.44 sessions/week</td>
<td>No significant effect on weight or waist circumference</td>
</tr>
<tr>
<td></td>
<td>Female: 7/15</td>
<td>(47%)</td>
<td>C = 6</td>
<td>Mean attendance was for these 20 participants was 1.5 session/week</td>
<td>C = 6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Beebe et al. (17)</td>
<td>Outpatients</td>
<td>Mean age: 52</td>
<td>E = 6</td>
<td>Supervised aerobic exercise. Three sessions/week for 4 months</td>
<td>E = 4</td>
<td>E-group could walk 29 m longer in a 6-min test. Not significant</td>
<td>No significant effect on BMI. A significant decrease in body fat of 3.7% in E-group</td>
</tr>
<tr>
<td></td>
<td>Female: 2/10</td>
<td>(20%)</td>
<td>C = 6</td>
<td>Mean attendance was for these 20 participants was 1.5 session/week</td>
<td>C = 6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Skrinar et al. (16)</td>
<td>Outpatients and in-patients</td>
<td>Mean age: 38</td>
<td>E = 15</td>
<td>Supervised aerobic exercise. Four sessions/week for 3 months</td>
<td>E = 9</td>
<td>Exercise group: mean attendance was 2.6 sessions/week</td>
<td>E-group increased exercise performance from 153 to 161 W on bicycle test. Not significant</td>
</tr>
<tr>
<td></td>
<td>Female: 20/30</td>
<td>(66.7%)</td>
<td>C = 15</td>
<td>Mean attendance was for these 20 participants was 1.5 session/week</td>
<td>C = 11</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

E, exercise group; C, control group.

*Significant* refers to between-group differences.

*Age and gender is only reported for completers.

THE EFFECT OF EXERCISE ON FITNESS OR STRENGTH IN PATIENTS WITH DEPRESSION

As reported in Table 2, nine trials reporting on the effect of exercise on fitness or strength was identified. These 9 trials included a total of 950 patients. Six trials used aerobic interventions (19–22) and two trials investigated the effect of strength training (18, 23). In one trial (27), the participants were encouraged to engage in preferred exercise activities offered in the community. The range of mean age was between 36 and 71 years of age. Two of nine trials investigated the effect of exercise in inpatients (24, 26).

Five of six trials offering aerobic exercise found a positive and significant effect on fitness levels in the range of 11–30% in maximal oxygen uptake. The two trials investigating the effect of strength training both found an increase in strength between 33 and 37%.

The largest study to date is the British TREAD study (25) using motion advisors trying to facilitate more physical activity in daily life in patients. Patients could choose how they wanted to increase their physical activity, and were supported in their attempt to this lifestyle change through meetings or telephone conversations with their exercise counselor. In Great Britain, authorities recommend that adults are active approximately 150 min/week, and the TREAD study could, on the basis of questionnaires, assess the number of participants, respectively exercise and the control group that met these requirements after intervention. It turned out that the chance of a participant in the exercise group met the official recommendation for physical activity after the intervention was twice higher (OR 2.27, 95% CI 1.32–3.89, \( p = 0.003 \)) compared to a participant from the control group.

THE EFFECT OF EXERCISE ON BODY WEIGHT IN PATIENTS WITH DEPRESSION

Only one trial reports the effect of exercise on body weight (19) and it found no effect on weight or BMI. However, the
Table 2 | Randomized clinical trials reporting effect of exercise interventions on physical fitness or strength in patients with depression.

<table>
<thead>
<tr>
<th>Trial</th>
<th>Participants</th>
<th>Number of participants randomized</th>
<th>Number of participants included in final analysis</th>
<th>Intervention</th>
<th>Attendance</th>
<th>Results fitness</th>
<th>Results weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Krogh et al. (19)</td>
<td>Outpatients</td>
<td>E = 56</td>
<td>E = 56</td>
<td>Supervised aerobic exercise. Three sessions/week for 3 months</td>
<td>Average number of attended sessions 1.1/week</td>
<td>Significant increase in maximal oxygen uptake by 13% in E-group compared to C-group</td>
<td>No effect on weight or BMI. Significant reduction in waist circumference – 2 cm</td>
</tr>
<tr>
<td>Chalder et al. (25, 27)</td>
<td>Outpatients</td>
<td>E = 182</td>
<td>E = 151</td>
<td>Exercise coaching face to face and by telephone during an 8-months period</td>
<td>Not reported</td>
<td>Significant effect of intervention: in E-group 63% of participants were physically active &gt; 150 min/week compared to 49% in C-Group</td>
<td>Not reported</td>
</tr>
<tr>
<td>Krogh et al. (20)</td>
<td>Outpatients</td>
<td>E = 55</td>
<td>E = 55</td>
<td>Supervised aerobic exercise. Two sessions/week for 4 months</td>
<td>Average number of attended sessions 1.0/week</td>
<td>Significant increase in maximal oxygen uptake by 11% in E-group compared to C-group</td>
<td>Not reported</td>
</tr>
<tr>
<td>Knubben et al. (24)</td>
<td>Inpatients</td>
<td>E = 20</td>
<td>E = 20</td>
<td>Daily supervised aerobic exercise sessions for 10 days</td>
<td>Not reported</td>
<td>No difference in maximal oxygen uptake</td>
<td>Not reported</td>
</tr>
<tr>
<td>Blumenthal et al. (22)</td>
<td>Outpatients</td>
<td>E = 51</td>
<td>E = 51</td>
<td>Supervised aerobic exercise. Three sessions/week for 4 months</td>
<td>Median number of attended sessions: 2.3/week</td>
<td>Significant increase in maximal oxygen uptake in E-group compared to C-group 9.1%</td>
<td>Not reported</td>
</tr>
<tr>
<td>Singh et al. (23)</td>
<td>Outpatients</td>
<td>E = 20</td>
<td>E = 18</td>
<td>Supervised strength training. Three sessions/week for 2 months</td>
<td>Median number of attended sessions: 3.0/week</td>
<td>Significant increase in muscle strength by 37% in E-group</td>
<td>Not reported</td>
</tr>
<tr>
<td>Blumenthal et al. (21)</td>
<td>Outpatients</td>
<td>E = 55</td>
<td>E = 55</td>
<td>Supervised aerobic exercise. Three sessions/week for 4 months</td>
<td>Average number of attended sessions: 2.7/week</td>
<td>Significant increase of maximal oxygen uptake by 11% in E-group</td>
<td>Not reported</td>
</tr>
<tr>
<td>Singh et al. (18)</td>
<td>Outpatients</td>
<td>E = 17</td>
<td>E = 15</td>
<td>Supervised strength training. Three sessions/week for 2.5 months</td>
<td>Median number of attended sessions: 3.0/week</td>
<td>Significant increase in muscle strength by 33% in E-group</td>
<td>Not reported</td>
</tr>
<tr>
<td>Martinsen et al. (26)</td>
<td>Inpatients</td>
<td>E = 28</td>
<td>E = 24</td>
<td>Supervised aerobic exercise. Three sessions/week for 9 weeks</td>
<td>Not reported</td>
<td>Significant increase in maximal oxygen uptake by 30% in the E-group</td>
<td>Not reported</td>
</tr>
</tbody>
</table>

E, exercise group; C, control group. Authors estimate based on graph in original report.
These results suggest that even in mentally healthy populations and total cholesterol with 1.54 mg/dl for 6 month programs (30). Cumference of 2.1 cm, diastolic blood pressure with 1.8 mmHg, and an isolated aerobic intervention is not likely to induce dramatic changes in weight or waist circumference.

These findings open a discussion whether multiple interventions should be employed, i.e., combined exercise and diet interventions. In mentally healthy populations, the combination of exercise and diet interventions for weight loss has been shown to be superior to exercise alone (31). A trial of patients with severe mental illness allocated to an intervention containing both of advice on diet as well as exercise obtained a weight loss of 3.2 kg after 18 months duration (32). A meta-analysis of 17 non-pharmacological interventions in patients with severe mental illness supports these findings with an overall weight reduction of 3.12 kg (33). However, only five trials reported the effect beyond the intervention with conflicting results on weight and BMI (33).

For schizophrenia, only a few and mainly very small trials fulfilled the inclusion criteria for this review. The main reasons for exclusion of trials were lack of diagnosis (e.g., not specifying diagnostic instrument) and the use of mixed interventions (e.g., exercise and diet versus treatment as usual). The results from this review should be interpreted in that context. Taken together, isolated exercise interventions in patients with schizophrenia or depression are unlikely to induce clinically relevant weight loss. On the other hand, there is evidence in favor of mixed interventions for weight loss.

Regarding adherence to exercise intervention in patients with schizophrenia, there was a trend for high attendance in small trials whereas larger trials had lower attendance. Previous studies have tried to identify barriers to physical activity and limited experience of physical, activity engagement, impact of the illness and effects of medication, and anxiety is mentioned by one study (34) and partially confirmed in a smaller study (35). The authors have recently investigated predictors of adherence in exercise trials including patients with depression and found that age and satisfaction with the intervention was associated with higher adherence (36). The age aspect could explain some of the variation observed in attendance in trials with depressed patients. Unfortunately, the majority of included trials do not mention considerations regarding attendance.

Based on the current evidence isolated exercise interventions are unlikely to improve cardiovascular fitness or induce weight loss in patients with schizophrenia, but there are few studies and thus a rather small evidence base. In patients with depression, exercise interventions are likely to induce clinically relevant short term effects, however, due to lack of reporting, little is known about the weight reduction. Future exercise trials in patients with mental illness should preferably measure changes in cardiovascular strength, repetition maximum, and anthropometric outcomes. Ideally, participants should be assessed beyond the intervention to obtain knowledge on lasting effects.

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3. Laursen T, Munk-Olsen T, Nordenfelt M, Mortensen P. Increased mortality among patients admitted with major psychiatric disorders: a register-based study


Conflict of Interest Statement: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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