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Schizophrenia Research

How sedentary are people with psychosis? A systematic review and meta-analysis

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Running head: Sedentary behavior and psychosis

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Abstract

Objective

Sedentary behaviour (SB) is an independent risk factor for cardiovascular disease and mortality. We conducted a meta-analysis to investigate SB levels and predictors in people with psychosis.

Method

Major electronic databases were searched from inception till 09/2015 for articles measuring SB with a self-report questionnaire (SRQ) or objective measure (e.g. accelerometer) in people with psychosis, including schizophrenia spectrum and bipolar disorders. A random effects meta-analysis and meta regression analysis were conducted.

Results

Thirteen studies were eligible including 2,033 people with psychosis (mean age 41.3 years (range 25.1-60), 63.2% male (range 35-89%), body mass index 28.7 (range 25.9-32.1). The trim and fill analysis demonstrated people with psychosis spent 660.8 minutes (95% CI 523.2-798.4, participants=2,033) or 11.0 hours (95% CI 8.72-13.3) per day being sedentary. Objective measures of SB recorded significantly higher levels ($p < 0.001$) of SB (12.6 hours per day, 95% CI 8.97-16.2, studies=7, participants=254) compared to self-report SB (6.85 hours per day, 95% CI 4.75-8.96, studies=6, participants=1,779). People with psychosis engaged in significantly more SB than controls ($g=1.13$, 95% CI 0.496-1.77, $P < 0.001$, n psychosis = 216, n controls=159) equating to a mean difference of 2.80 (95% CI 1.47-4.1) hours per day. Multivariate meta-regression confirmed that objective measurement of SB predicted higher levels of sedentariness.

Conclusions

People with psychosis engage in very high levels of sedentary behavior in their waking day and current SRQ may underestimate SB. Given that SB is an independent predictor of cardiovascular disease, future interventions specifically targeting the prevention of SB are warranted.

Systematic review registration - PROSPERO registration number CRD42015026159

Keywords: sedentary behaviour, cardiovascular disease, lifestyle, psychosis, schizophrenia

Introduction

People with psychosis experience a premature mortality gap of between 10 and 20 years from the general population (Walker et al., 2015), largely attributable to cardiovascular disease (Lawrence et al., 2013). The increased prevalence of metabolic syndrome (Vancampfort et al., 2015), type two diabetes (Stubbs et al., 2015b) and cardiovascular disease (Gardner-Sood et al., 2015) in people with psychosis are of great concern. In the general population there is evidence that physical activity and exercise are broadly as effective as pharmacological interventions in preventing cardiovascular disease and mortality (Naci and Ioannidis, 2013). However, people with psychosis experience a range of barriers to engage in physical activity such as negative symptoms, pain and the side effects of medication (Soundy et al., 2014a; Vancampfort et al., 2012a; Vancampfort et al., 2011).

Recently, interest has developed in the importance of preventing prolonged periods of sedentary behavior in order to tackle cardiovascular disease and mortality. Sedentary behaviour is defined as an energy expenditure ≤ 1.5 metabolic equivalents of task (METs), while in a sitting or reclining posture during waking hours (Sedentary Behaviour Research, 2012). A large meta-analysis (Biswas et al., 2015) in the general population demonstrated that sedentary behaviour is independently associated with an increased risk of developing cardiovascular disease, type two diabetes, cardiovascular and all-cause mortality (all $p < 0.01$). Despite the knowledge that cardiovascular disease is the leading cause of premature mortality in people with psychosis (Lawrence et al., 2013), relatively little attention has been attributed to sedentary behaviour in this population. Nonetheless, some recent research has demonstrated that higher levels of sedentariness are associated with increased risk of metabolic syndrome (Vancampfort et al., 2012b) and elevated C-reactive protein levels (CRP) (Stubbs et al., 2015a).

Given that sedentary behaviour is related to cardiovascular disease and modifiable, understanding sedentary behaviour levels and predictors among people with psychosis is important. To our knowledge, only one preliminary review has considered sedentary behaviour (Soundy et al 2013) in people with psychosis. Specifically Soundy et al (Soundy et al., 2013) focussing only on outpatients with schizophrenia found that across two studies, people with schizophrenia were more sedentary than controls (standardised mean difference 1.1 (95% CI=0.2–1.9)). Since this time, interest has grown in understanding and preventing sedentary behaviour and several important questions remain unanswered. For instance, it remains unclear exactly how much time people with psychosis spend being sedentary and what factors may influence sedentary behaviour. Moreover, some studies have utilised self-report questionnaires (SRQ) to measure sedentary behaviour and other have used objective measures such as accelerometers (the gold standard; (Soundy et al., 2014b; Soundy et al., 2013)). Since there are concerns that SRQ may underestimate sedentary behaviour, research is required to investigate if SRQ report lower levels of SB compared to the gold standard objective measurements. In addition, it remains unclear if people with psychosis are more sedentary than controls.

Given the aforementioned, we set out to conduct a systematic review with the following aims 1) establish the mean time of sedentary behaviour in people with psychosis per day. 2) Investigate differences in sedentary behaviour in SRQ and objective measures. 3) Investigate predictors of sedentary behaviour in Meta regression analyses. 4) Investigate differences in sedentary behaviour in people with psychosis versus controls.

Method

This systematic review adhered to the MOOSE guidelines (Stroup et al., 2000) and PRISMA statement (Moher et al., 2009), following a predetermined published protocol (PROSPERO registration number CRD42015026159).

Inclusion criteria

We included studies that: (a) Included adult participants with a diagnosis of psychotic illness including schizophrenia spectrum and bipolar disorders according to established criteria (e.g., DSM-IV, (Association, 2000) or ICD-10, (organisation, 1993)). If we encountered studies conducted including mixed samples of mental illnesses (e.g. anxiety disorders) we attempted to extract the data for those with psychosis. (b) Measured sedentary behavior with either a SRQ (e.g. IPAQ, (Craig et al., 2003)) or objective measure (e.g. accelerometer). Sedentary behaviour was defined as a behaviour with an energy expenditure ≤ 1.5 metabolic equivalents of task (METs), while in a sitting or reclining posture during waking hours and not simply the absence of physical activity (Sedentary behaviour research network 2012). Studies classifying sedentary behaviour as lower levels of physical activity and/ or lack of physical activity/ or physical inactivity were excluded as this is not an adequate measure of sedentary behaviour. (c) Were interventional (RCTs, CCTs) and observational (prospective or cross sectional) studies conducted in any setting (inpatients or outpatients). (d) Were published in an international peer-reviewed English language journal.

Exclusion criteria were i) Non quantitative study, ii) did not include people with psychosis, iii) did not measure sedentary behavior and iv) not published in English.

Information sources and searches

Two independent authors searched Academic Search Premier, MEDLINE, Psychology and Behavioral Sciences Collection, PsycINFO, SPORTDiscus, CINAHL Plus and Pubmed without language restrictions

from inception till 21st September, using the key words: 'schizophrenia' OR 'psychosis' OR 'bipolar' OR 'depression' OR 'mental illness' OR 'serious mental illness' OR 'severe mental illness AND 'sedent*' OR 'sitting' OR 'lying' OR 'screen time' OR 'accelerometer' OR 'physical activity'. In addition, reference lists of all eligible articles and related systematic reviews were screened to identify potentially eligible articles (Soundy et al., 2013).

Study selection

After removal of duplicates, one reviewer screened titles and abstracts of all potentially eligible articles. A second author double checked included studies and a final list of included studies was developed.

Outcomes

The primary outcome was the mean time (minutes) per day that people with psychosis engaged in sedentary behaviour. We also collected data on sedentary behaviour among healthy controls where possible.

Data extraction

One author (BS) extracted data using a predetermined data extraction form, which was subsequently validated by a second author (JW). The data extracted included first author, country, setting, population, type of the study (prospective, controlled or randomized controlled trial), number of studies and participants included in the article (including mean age, % female), details of the intervention (including duration), type and definition of SB (objective or self-report, reference period), and results.

Meta-analysis

Due to the anticipated heterogeneity across studies, we conducted a random effects meta-analysis with Comprehensive Meta-Analysis software (CMA, Version 3). The meta-analysis was conducted in

the following sequence. First, we calculated the mean amount of time spent in sedentary behavior per day (minutes per day) among people with psychosis together with the 95% confidence intervals (CI). Second, we calculated the subgroup differences in sedentary behavior according to the measurement (self-report versus objective measurement) and diagnosis (mixed psychosis, schizophrenia spectrum and bipolar disorder spectrum separately). Third, we investigated potential moderators of sedentary behavior in people with psychosis with Meta regression analyses. The potential moderators of interest were mean age, % of males, sedentary behavior measurement (objective versus self-report), illness duration, BMI and psychiatric symptoms, defined as the symptoms of psychotic disease severity measured with a validated scale. Fourth, we conducted a comparative meta-analysis investigating differences in sedentary behavior among people with psychosis and healthy controls calculating hedges g and the 95% CI as the effect size. In addition, we calculated the mean difference in minutes per day together with the 95% CI in sedentary behavior. Heterogeneity was assessed with the I^2 statistics for each analysis (Higgins et al., 2003). Publication bias was assessed with the Begg-Mazumdar Kendall's tau (Begg and Mazumdar, 1994). For all analyses we calculated the trim and fill adjusted analysis (Duval and Tweedie, 2000) to remove the most extreme small studies from the positive side of the funnel plot, and recalculated the effect size at each iteration, until the funnel plot was symmetric about the (new) effect size.

Results

Study selection

The initial electronic database searches identified 760 non duplicated articles which were considered at the title and abstract level. Ninety eight full texts were reviewed and 85 were excluded with reasons (see figure 1), with 13 unique studies meeting the eligibility criteria (Baker et al., 2014; Gomes et al., 2014; Hahn et al., 2014; Janney et al., 2014; Janney et al., 2013; Leutwyler et al., 2014; Lindamer et al., 2008; Snethen et al., 2014; Strassnig et al., 2012; Stubbs et al., 2015a; TW, 2008; Vancampfort et al., 2014; Vancampfort et al., 2012b). Full details of the search results are summarized in figure 1.

Figure 1 here

Details of included studies and participants characteristics

Full details of the included studies and participants are presented in table 1. Briefly, there were 2,033 individuals with psychosis with a mean age of 41.3 years (range 25.1-60 years), 63.2% male (range 35-89%), BMI of 28.7 (range 25.9-32.1) and a mean illness duration of 10.9 years (range 10.3 months – 17.9 years). One study recruited participants with bipolar disorder (Janney et al 2014), two recruited a mixture of people with psychosis (Hahn et al 2014, Baker et al 2014) whilst the remainder recruited people with schizophrenia spectrum disorders. Seven studies measured sedentary behavior with an objective measure (Gomes et al 2014, Janney et al 2013, Janney et al 2014, Leutwyler et al 2014, Lindamer et al 2008, Snethen et al 2014, Scheewe et al 2008) while the remaining studies utilized a SRQ. All of the studies provided a cross sectional analysis of sedentary behavior levels, whilst one study (Baker et al 2014) was a pre and posttest study looking at self-report sedentary behavior levels before and after a lifestyle intervention. Full details of the included studies are summarized in table 1

Table 1 here

Meta-analysis of total time spent being sedentary

Across all 13 studies, people with psychosis spent 599.2 minutes (95% CI 466.3-672.0, n=2,033) or 9.5 hours (95% CI 7.77 -11.2 hours) engaging in sedentary behavior. Although no significant publication bias was observed (Begg=0.15, p=0.5) the time in sedentary behavior was corrected to 660.8 minutes (95% CI 523.2-798.4) or 11.01 hours per day (95% CI 8.72-13.3) after the trim and fill adjusted analysis.

Subgroup analyses

Differences in Sedentary behavior in self-report and objective measurement

The pooled time in sedentary behavior in objective measures of sedentary behavior was 705.4 minutes per day (95% CI 588.3-822.3, n=254) or 11.75 hours per day (95% CI 9.8-13.7) which was significantly higher ($p<0.001$) than self-report sedentary behavior time 411.5 minutes (95% CI 285.2-537.7). Following the trim and fill analysis the sedentary behavior time in objective measures increased to 754.4 minutes per day (95% CI 538.5-970.2) or 12.6 hours per day (95% CI 8.97-16.2) (table 2).

Primary psychiatric diagnosis

Full details are presented in table 2. Briefly, the pooled time of sedentary behavior among 733 people with schizophrenia spectrum was 673.9 minutes per day (528.4-819.3) or 11.2 hours (95% CI 8.80-13.6). The time spent sedentary among two studies in people with psychosis was 344.2 minutes per day (95% CI 52.2-636.2) whilst one study (Janney et al., 2014) found that the mean time of sedentary behavior was 812 minutes per day among people with bipolar disorder.

Table 2 here

Meta regression of sedentary behavior time

Older age ($\beta=17.1582$, 95% CI 3.9747-30.3416, $p=0.01$, $R^2=0.33$) and the use of objective measures of sedentary behavior predicted higher levels of sedentary behavior ($\beta=293.7173$, 95% CI 65.781-521.653, $p=0.01$, $R^2=0.36$). Illness duration and BMI were not related to sedentary behavior (see table 3). A multivariate model found that objective measurement of sedentary behavior was a

significant predictor ($\beta=229.4$, 95% CI 3.6371-462.4821, $p=0.04$) and the model explain half the in between study heterogeneity $R^2=0.51$).

Table 3 here

Differences in sedentary behavior in people with psychosis and controls

People with psychosis engaged in significantly more sedentary behavior than controls ($g=1.13$, 95% CI 0.496-1.77, $P<0.001$, $I^2=80\%$, n psychosis = 216, n controls=159) equating to a mean difference of 167.9 minutes (95% CI 88.6-247.2) or 2.80 (95% CI 1.47-4.1) hours per day. When restricted to 3 studies using objective measurements of sedentary behavior (Scheewe et al 2008, Lindamer et al 2008, Janney et al 2014) the difference in sedentary behavior between people with psychosis and controls increased ($g=1.32$, 95% CI 0.66-1.98) or 174.8 (95% CI 70.7-278.5) minutes or 2.9 (95% CI 1.2-4.6) hours per day more than controls.

Discussion

The current study is, to our knowledge, the first to Meta-analyze data on sedentary behaviour levels and predictors in people with psychosis. We found that people with psychosis spend 11 hours of their waking day being sedentary. Objective measurement of sedentary behaviour demonstrated this may in actual fact be at least 12 and a half hours per day, with SRQ reporting significantly lower levels of sedentary behavior. Meta-regression analyses demonstrated that older age and the use of objective measurement predict higher levels of sedentary behaviour. The difference in sedentary behavior levels in people with psychosis and the general population is approaching 3 hours per day. Research in the general population has established that self-reported sedentary behavior of 3 hours or more a day is associated with a reduced life expectancy by two years, independent of physical activity participation (Katzmarzyk and Lee, 2012). The time people with psychosis spend engaging in sedentary behavior is among the highest reported in the literature among prior systematic reviews. For instance, a recent meta-analysis found that older adults in the general population spent 5.3–9.4 hours per day being sedentary (Harvey et al., 2015). **Whilst our data is novel, there was limited data on sedentary behavior in people with bipolar disorder and those experiencing their first episode of psychosis.**

Given that prolonged sedentary behaviour is independently associated with diabetes, cardiovascular disease, cancer and mortality (all $p < 0.01$) (Biswas et al., 2015) the high levels of sedentariness among people with psychosis are concerning. A recent study by Stubbs et al (2015) demonstrated that individuals with psychosis who had higher levels of CRP spent approximately 1.5 hours per day more being sedentary than those with normal levels of CRP. Thus, addressing excess sedentary behavior may offer a unique opportunity to reduce inflammation and cardiovascular disease among people with psychosis. The increased inflammation from excess sedentary behaviour may also have an adverse impact on an individual's mood. A recent RCT demonstrated that an increase of sedentary behaviour of 32 min/ day among healthy controls over two weeks resulted in mood

disturbances independent of physical activity with greater stress-induced inflammatory interleukin-6 (IL-6) responses (Endrighi et al., 2015). Such changes could quite easily occur during an inpatient admission and it remains to be explored if adopting strategies to reduce sedentary behavior prevent the onset of negative mood changes. Nevertheless, it may be reasonable to assume that reducing sedentary behaviour may not only reduce cardiovascular disease burden but also improve mood.

Our Meta regression analysis found the older age was a significant predictor of higher levels of sedentary behaviour ($\beta=17.1582$, 95% CI 3.9747-30.3416, $p=0.01$). This is a relationship also seen in the general population (Harvey et al 2015) and of little surprise. Surprisingly, we did not find that illness duration or BMI moderated sedentary behaviour levels. These results are encouraging, and suggest that older people with SMI may need particularly targeting to reduce sedentary behaviour, but that higher BMI should not necessarily be a barrier in efforts to reduce sedentary behaviour. However, older age might serve as a confounder for illness duration. Moreover, the absence of a relationship between illness duration and sedentary behavior could also be due to the limited number of studies adequately reporting sufficient data (N=4).

Within our meta-analysis, we found evidence demonstrating that people with psychosis spend approximately double the length of time engaging in sedentary behaviour when measured with objective methods versus SRQ (12.6 versus 6.8 hours per day, $p<0.01$). Thus, our results suggest that current SRQ questionnaires do not accurately collate data on sedentary behaviour among this at risk group. Some of this may be due to the cognitive deficits associated with psychosis leading to an underestimation within self-report measures (Harvey, 2011). This discrepancy has been reported in previous reviews in other populations. For instance, Harvey et al., (2015) found that older adults in the general population reported self-report sedentary behaviour levels of 5.3 hours versus 9.4 from objective measures. Nonetheless, future research should seek to prioritize the objective measurement of sedentary behavior in people with psychosis to circumvent concerns about

cognitive impairment and the lack of rigor and suitability of current general SRQ for people with psychosis.

To our knowledge, only one pre and posttest study (Baker et al., 2014) has considered changes in self report sedentary behavior among people with psychosis following an overall telephone lifestyle intervention. The authors (Baker et al., 2014) found that self-report leisure screen time reduced after the intervention, and whilst encouraging the lack of a random sampling, absence of a control group and reliance upon self-report sedentary behavior are clear limitations. Recent research has established that walking is a preferred method of physical activity among people with psychosis (Fraser et al., 2015; Soundy, 2014). Thus, walking may be a strategy to not only increase physical activity but also to reduce prolonged sedentary behaviors. Recent research in the general population has found that interventions specifically targeting disruptions and reductions in sedentary behaviour are most effective in reducing overall sedentary behaviour (Gardner et al., 2015). To our knowledge, no RCT exists with the primary aim of reducing sedentary behaviour among people with psychosis, which is warranted given the alarming levels of sedentariness among this group and the plethora of evidence linking this to cardiovascular disease burden and mortality (Biswas et al., 2105).

Several limitations of this meta-analysis should be noted. First, almost half of the included studies relied on data drawn from SRQ. Second, we encountered heterogeneity in the meta-analysis but explained approximately half of this with Meta regression. **Third, there was a paucity of data on sedentary behavior among people with bipolar disorder and people at earlier stages of their illness (e.g. first episode of illness). Thus, our results are clearly not generalizable to these populations and it is important that future research should seek to investigate sedentary behavior in these groups.** Finally, there was inadequate information on antipsychotic medication or psychopathological symptoms, thus precluding meta-analytical or Meta regression analysis. Future research is required

to understand the impact of these factors on sedentary behaviour. Nevertheless, allowing for these caveats, the results provide important information for clinicians and researchers. Given the very high levels of sedentary behaviour among people with psychosis and overwhelming deleterious impact of this on cardiovascular health, future interventions specifically targeting sedentary behaviour are warranted as a priority in this at risk group.

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Declaration of interests

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