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Sedentary behaviour, physical activity, cardiorespiratory fitness and cardiometabolic risk in psychosis: The PsychiActive project

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ABSTRACT

This study aimed to explore the possible independent associations of sedentary behaviour (SB), physical activity (PA), and cardiorespiratory fitness (CRF) with clustered (CCRS) and individual cardiometabolic risk (waist circumference [waist], systolic/diastolic blood pressure, triglycerides, high-density lipoprotein-cholesterol, and fasting blood glucose) in patients with psychosis. In 43 outpatients with psychosis (mean age ± SD: 42.3 ± 8.5 years, 86% men), SB and light, moderate-to-vigorous, and total PA were measured with the SenseWear Pro3 Armband, and CRF with the 6-minute walking test. Multiple linear regression models adjusted for multiple confounders were applied. High SB, low PA and low CRF levels were associated with an unfavourable cardiometabolic risk profile (increased presence of metabolic syndrome and number of cardiometabolic abnormalities, as well as worse values and elevated presence of abnormalities for all individual cardiometabolic risk factors). SB was associated with CCRS, number of cardiometabolic abnormalities, waist, and fasting blood glucose (all $p < 0.05$). After adjusting for PA and CRF, waist and fasting blood glucose remained significant. Light PA was associated with waist, moderate-to-vigorous PA with CCRS, and total PA with CCRS and waist (all $p < 0.05$). These results became non-significant after adjusting for SB and CRF. CRF was associated with CCRS, waist, and systolic blood pressure (all $p < 0.05$). The associations with CCRS and waist remained significant after adjusting for SB and PA. Together, these results suggest the importance of considering SB and CRF, regardless PA, in the prevention and treatment of cardiometabolic disorders among patients with psychosis.

1. Introduction

Patients with psychosis, including schizophrenia and bipolar disorders (World Health Organization, 1992), have a greatly reduced life expectancy, up to 15 years, compared to the general population (Lawrence et al., 2013), with cardiometabolic disease being the main contributor (Correll et al., 2017). The increased prevalence of metabolic syndrome and cardiometabolic abnormalities is also evident (Vancampfort et al., 2015b), and has become a major health challenge. Of concern, a recent study (Bruins et al., 2017) revealed that cardiometabolic risk factors remain seriously undertreated in people with psychosis and, therefore, better prevention and treatment of metabolic disorders are imperative for reducing the overwhelming risk of premature mortality.

In general population, there is an established-evidence base indicating that, independently, less sedentary behaviour (SB) and greater physical activity (PA) decrease cardiometabolic risk (Biswas et al., 2015). Two meta-analyses (Stubbs et al., 2016a; Stubbs et al., 2016b) highlighted that patients with psychosis engage in more SB and in less PA than the general population. To date, some studies (e.g., (Nyboe et al., 2015; Stubbs et al., 2015; Vancampfort et al., 2015a)) have suggested associations of SB and PA with cardiometabolic risk in patients with psychosis. While helpful, almost all of these studies have relied upon self-report measures, which introduce bias (Soundy et al., 2014), and only one study examined the independent associations of SB and PA with cardiometabolic risk (Stubbs et al., 2017). In this regard, more research, as well as the preferential use of objective measures, is necessary to improve our understanding of the independent effects of these two exposures on cardiometabolic health in this population.

There is also a firmly established-base indicating that a low cardiorespiratory fitness (CRF) level is a strong independent predictor of all-cause and cardiovascular mortality (Harber et al., 2017), with two recent studies (Knaeps et al., 2016a; Knaeps et al., 2016b) finding that CRF mediates the association of SB and PA with clustered-cardiometabolic risk and its individual-components. Patients with psychosis have significantly lower CRF compared with controls (Vancampfort et al., 2017), and the independent associations of SB, PA, and CRF with clustered-cardiometabolic risk and individual-cardiometabolic risk factors remain unexplored.

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The aim of this study was to explore the possible independent associations of SB, PA, and CRF with clustered-cardiometabolic risk and individual-cardiometabolic risk factors in patients with psychosis (schizophrenia and bipolar disorders).

2. Methods

2.1. Participants and setting

Adults with a diagnosis of psychotic illness including schizophrenia and bipolar disorders according to ICD-10 criteria and stabilized on antipsychotic medication was recruited from 11 different outpatient mental healthcare settings in southern Spain. Patients were excluded if they had clinical instability, co-morbid substance abuse, or evidence of uncontrolled cardiovascular, neuromuscular and endocrine disorders. Participants received a full-fasting laboratory screening and anthropometric measurement, performed a walk test, wore a multisensor armband, and completed questionnaires about sociodemographic characteristics and symptomatology. Patient's medical records were also registered. The study procedure was approved by the Universidad Pablo de Olavide Ethics Committee. All patients gave their informed written consent prior to enrolling in the study and after receiving information about the aims and protocol. There was no compensation for participation.

2.2. SB and PA

SB and PA were obtained with a SenseWear Pro3 Armband (BodyMedia Inc., Pittsburgh, PA, USA), a device to accurately estimate energy expenditure (Johannsen et al., 2010). Patients were required to wear the SenseWear on their left arm triceps muscle for nine consecutive days, 24 h/day, except when showering or swimming. The first and last days were excluded from the analysis to minimize the Hawthorne effect (i.e., "a general scientific fact that the process of observation alters the phenomenon being observed") (Corder et al., 2008). Seven days of recordings with a minimum of 1368 min of registration per day was necessary to be included in the analysis. Energy expenditure was estimated using data recorded from multiple sensors and using specific-algorithms developed by the manufacturer (SenseWear Professional software, version 8.1). Time spent in SB ($1.0 < MET \leq 1.5$) and PA intensities (light, $1.5 < MET \leq 3.0$; moderate-to-vigorous, >3.0 MET; and total >1.5 MET) was derived using the measured MET values during waking hours.

2.3. CRF

CRF was assessed using the 6-minute walking test according to Rikli and Jones (1999) in an indoor course with a flat, firm surface and with minimal external stimuli. Patients were instructed to walk as far as possible during a 6-minute period around a 45.7-meter rectangular course delimited by cones, without running or jogging. Resting was allowed if necessary, but walking was to be resumed as soon as possible. Standardized-encouragements were used at recommended intervals (Rikli and Jones, 1999). The same trained instructor explained the protocol, gave a demonstration prior to the start, supervised the test and recorded the total distance walked to the nearest 0.1 m for each patient. The 6-minute walking test has been shown to be a reliable and valid method to assess CRF in patients with psychosis (Gomes et al., 2016).

2.4. Cardiometabolic risk

The cardiometabolic risk factors were collected by trained-staff in the morning after an overnight fast including waist circumference (waist), systolic/diastolic blood pressure, triglycerides, high-density lipoprotein-cholesterol, and fasting blood glucose. Waist was measured to the nearest 0.1 cm using a measuring tape (Harpenden Anthropometric Tape; Holtain, Dyfed, UK) placed at the midpoint between the last rib and the iliac crest. Blood pressure was measured in a seated position after 10-minute rest period with an electronic monitor (Omron Healthcare Europe BV, Hoofddorp, The Netherlands) placed on the left arm wrist. The mean of the two measures was used for analysis. If the two measures differed by >1% for waist, >20 mm Hg for systolic and >10 mm Hg for diastolic blood pressure, a third measure was taken, and the median of the three was used for analysis (Ward and Anderson, 1998). The presence of metabolic syndrome and cardiometabolic abnormalities was assessed using the International Diabetes Federation criteria (Alberti et al., 2006). Additionally, a clustered-cardiometabolic risk score (CCRS) was constructed. The standardized-normalized indexes (z-score = [value − mean] / standard deviation) for blood pressure ([systolic + diastolic blood pressure] / 2), triglycerides, fasting blood glucose, waist, and the inverse of high-density lipoprotein cholesterol were summarized and divided by the number of variables included ($x = 5$) to generate the CCRS. Scores above zero represent higher cardiometabolic risk.

2.5. Severity of psychiatric symptoms

Severity of psychiatric symptoms during the previous week was assessed using the Brief Symptoms Inventory-18 (Derogatis, 2001), which has been recommended in patients with mental illness (Prinz et al., 2013). Scores range 0–72, with higher scores indicating a higher severity.

2.6. Demographic, illness-related, and medication data

Marital, educational, occupational and smoking status were self-reported. Weight and height were measured with to the nearest 0.1 kg and 0.1 cm using a scale (TANITA BC-420; Tanita, Tokyo, Japan) and stadiometer, respectively, and body mass index was calculated. Age, diagnosis, illness duration, and medication were retrieved from the patients' medical records, and antipsychotic medication was converted into daily equivalent dosages of chlorpromazine (Gardner et al., 2010).

2.7. Statistical analysis

Due to the skewed distributions, the analyses included the logarithmically transformed data of moderate-to-vigorous PA, triglycerides, and illness duration, as well as the reciprocally transformed data of fasting blood glucose and the square root-transformed data of chlorpromazine and severity of psychiatric symptoms. Differences in SB, PA, and CRF between metabolic syndrome presence were tested using Student's *t*-test. Patients were divided into groups according to high or low levels of SB, PA (light, moderate-to-vigorous and total), and CRF using the median splits, while Student's t, Chi-square, and Fisher exact tests were applied to establish differences. Pearson correlation coefficients were calculated between SB, PA, CRF, and cardiometabolic risk. Multiple linear regression analyses were performed with the cardiometabolic risk outcomes as dependent variables and SB, PA, and CRF as the independent variables. Model-1 was adjusted for gender, age, smoking, education, severity of psychiatric symptoms, illness duration, and chlorpromazine dose. Waist was added in Model-2. Additionally, SB, PA, and CRF, as applicable, were added in the fully adjusted models. Only patients with a complete dataset were included in the regression analysis. Residuals were tested for homoscedasticity, linearity and independence. Other than when light and total PA were simultaneously used as independent variables, the variance inflation factor never exceeded five, indicating that multi-collinearity was not a concern (Montgomery et al., 2012). The data were analysed using SPSS Statistics for Windows, Version 22.0 (Armonk, NY: IBM Corp), with statistical significance set at p-value < 0.05. Statistical comparisons between the two psychiatric

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