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# Relationships between physical fitness, physical activity, smoking and metabolic and mental health parameters in people with schizophrenia

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ABSTRACT

Low physical fitness has been recognised as a prominent behavioural risk factor for cardiovascular diseases (CVD) and metabolic syndrome (MetS), and as an independent risk factor for all-cause mortality. No studies have systematically assessed physical fitness compared with a matched health control group in patients with schizophrenia. Eighty patients with schizophrenia and 40 age-, gender- and body mass index (BMI)-matched healthy volunteers were included. All participants performed an Eurofit test battery and filled out the International Physical Activity Questionnaire. Patients additionally had a fasting metabolic laboratory screening and were assessed for psychiatric symptoms. Patients with schizophrenia demonstrated significant differences from controls in whole body balance, explosive leg muscle strength, abdominal muscular endurance, and running speed. Inactive patients scored worse on most Eurofit items than patients walking for at least 30 min per day. Low physical fitness was associated with illness duration, smoking, the presence of MetS and more severe negative, depressive and cognitive symptoms. Less physically active patients who smoke and suffer from high levels of negative, depressive and/or cognitive symptoms might benefit from specific rehabilitation interventions aimed at increasing physical fitness.



## 1. Introduction

Increased rates of cardiovascular diseases (CVD) (De Hert et al., 2009, 2011a; Mitchell et al., 2011) and associated premature mortality (Hennekens, 2007; Capasso et al., 2008) have become a major concern in patients with schizophrenia. The metabolic syndrome (MetS) is a concept that brings together a collection of abnormal clinical and metabolic findings that are predictive for CVD. These abnormal findings include dysglycemia, increased blood pressure, elevated triglyceride levels, low high-density lipoprotein cholesterol levels, and central adiposity (Alberti et al., 2006). Underlying reasons for the development of MetS in patients with schizophrenia are complex and consist of genetic risk (van Winkel et al., 2010a,b), cardio-metabolic side-effects of antipsychotic treatment (Rummel-Kluge et al., 2010; De Hert et al., 2011b,c) and an unhealthy lifestyle. Unhealthy lifestyle choices include lack of sufficient physical activity (Vancampfort et al., 2010a), poor diet (Strassnig et al., 2003) and high rates of cigarette smoking (Bobes et al., 2010). In addition, patients with schizophrenia have limited access to general somatic health care (De Hert et al., 2011b,c; Mitchell et al., 2012).

In the general population, low physical activity is ranked as the fourth leading cause of global mortality (World Health Organisation, 2009) while low physical fitness has been recognised as a prominent behavioural risk factor for MetS and CVD and an independent risk factor of comparable importance with diabetes for all-cause mortality (Blair et al., 1996; Wei et al., 1999; Gill and Malkova, 2006). Physical fitness can be defined as a set of independent attributes which are related to the ability to perform physical activities. Some of these components (including cardio-respiratory fitness, muscular endurance, muscular strength and flexibility) are more closely related to health, while others (such as coordination and whole body balance) are more related to performance (Pate, 1998). It was demonstrated previously that in patients with schizophrenia cardio-respiratory fitness is poor

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(Deimel and Lohmann, 1983; Beebe, 2006; Strassnig et al., 2011). Compared to individual age-predicted maximal values, patients with schizophrenia only achieved $42 \pm 11\%$ of the maximal oxygen uptake (Strassnig et al., 2011). It is, however, not yet clear if and to what extent other health and performance related physical fitness parameters are impaired in patients with schizophrenia.

In addition, it still needs to be established if and to what extent the previously observed lack of physical activity participation (Faulkner et al., 2006; Lindamer et al., 2008) in patients with schizophrenia is associated with a reduced health and performance related physical fitness. Thirdly, it also remains to be investigated which health and performance related physical fitness components are impaired in those patients with schizophrenia having MetS. Research in the general population demonstrated that impaired muscular strength and low cardio-respiratory fitness have independent associations with MetS prevalence (Jurca et al., 2004, 2005). Identifying which health and performance related physical fitness components are impaired in patients with schizophrenia will help us in developing physical rehabilitation strategies to prevent or reduce the increased cardio-metabolic risk.

The primary objective of this study was to examine differences in health and performance related physical fitness between patients with schizophrenia and healthy controls matched for age, sex and body mass index (BMI). Secondary objectives were to assess differences in health and performance related physical fitness between (a) inactive, minimally active, and highly active patients, (b) between patients with and without MetS and (c) between recent onset, subchronic and chronic patients. A last aim was to investigate associations in schizophrenia patients between health and performance related physical fitness, smoking and psychiatric symptoms.

## 2. Methods

### 2.1. Participants and procedure

Over a 6-month period, in- and out-patients with schizophrenia of the University Psychiatric Centre of Kortenberg and the Brussels Nighthospital Belgium were invited to participate. Psychiatric diagnosis based on DSM-IV criteria was established by experienced psychiatrists responsible for the patients' treatment. Patients were included if (a) acute symptoms were (at least partially) remitted, and (b) patients were stable on antipsychotic medication, i.e. using the same dosage for at least 4 weeks before inclusion.

Patients were excluded if they had a DSM-IV diagnosis of substance dependence. Somatic exclusion criteria included evidence of significant cardiovascular, locomotor and endocrine disorders which, according to the American College of Sports Medicine (Donnelly et al., 2009), might prevent safe participation in exercise testing. All participants received a physical examination and baseline electrocardiogram (ECG) before testing.

Healthy control subjects were recruited among the personnel of the participating centres and their acquaintances. All control subjects were volunteers who received a general physical examination in the previous year and reported themselves to be free of significant cardiovascular, neuromuscular and endocrine disorders that might hinder safe participation. By selection, gender distribution and mean values for age and body mass index (BMI) did not differ significantly between healthy controls and schizophrenia patients. This matching was performed by an independent statistician blinded for the physical activity and physical fitness outcomes.

All participants filled out a physical activity questionnaire and performed afterwards a physical fitness test battery. Participants were requested to refrain from eating, drinking coffee or smoking during a 2-h period before the tests. Patients were also screened for psychiatric symptoms and side-effects of medication and received a fasting metabolic laboratory screening.

The study procedure was approved by the Scientific Committee of the University Psychiatric Centre of the Catholic University of Leuven, Belgium. All participants gave their written informed consent.

### 2.2. The Eurofit test battery

The Eurofit test battery (Oja and Tuxworth, 1995) included the assessment of the following measures: whole body balance, speed of limb movement, flexibility, explosive strength, static strength, abdominal muscular endurance and running speed. Whole body balance (flamingo balance) was measured as the number of trials needed by individuals to achieve a total duration of 30 s in balance on their preferred foot on a flat firm surface. While balancing on the preferred foot, the free leg is flexed at the knee and the foot of this leg held close to the buttocks. Lower body balance scores indicate a better whole body balance. Speed of limb movement (plate tapping) was assessed using a plate tapping table on which two discs at 80 cm distance had to be touched alternately with the preferred hand as fast as possible, completing 25 cycles. The higher the score, the lower the speed of limb movement. Flexibility was measured using the sit-and-reach test. Participants sat on the floor with straight legs and reached forward as far as possible. The knees were held in extended position by the investigator throughout the test. The feet were placed against a test box with a ruler placed on the top of the box. The ruler had to be pushed with the fingertips and this in a smooth and slow movement. Higher scores indicate better flexibility. Explosive strength was measured by a standing broad jump, using a tape measure on a foam mat. Participants were asked to stand behind a line drawn perpendicular to the tape measure and jump forward as far as possible using arm swing and knee bending before jumping. The distance jumped was recorded from the take-off line to the farthest point backward of the participant. Higher scores indicate a better explosive strength. Handgrip strength was assessed using a handgrip dynamometer (Lafayette Instruments Hand Dynamometer) to be squeezed as forcefully as possible with the preferred arm fully extended slightly away from the body, and palm facing inward. The higher the score, the better the handgrip strength. Abdominal muscle endurance was measured as the number of correctly completed sit-ups in 30 s. Sit-ups were performed with the hands placed at the side of the head, knees bent at 90°, and the feet secured by the investigator. A full sit-up is defined as touching the knees with the elbows and returning the shoulders to the ground. A higher number of sit-ups indicate a better abdominal muscle endurance. Running speed was assessed using a 10 by 5 m shuttle run. Each participant was required to sprint 10 times between two lines placed 5 m apart. The track was 1.3 m wide. The sprint was followed by immediately turning and running back. The lower the score, the better the running speed. Except for the flamingo balance, sit-ups and the shuttle run, each test was done twice and the better score was recorded.

The Eurofit test battery previously showed good reproducibility in patients with schizophrenia (Vancampfort et al., 2012).

### 2.3. International Physical Activity Questionnaire (IPAQ)—long version

Participants completed the interviewer-administered IPAQ (Craig et al., 2003) before performance of the Eurofit. A structured format that asked participants to recall activities for each of the 7 preceding days in morning, afternoon, and evening time periods was used. Data from the IPAQ were summarised according to walking, moderate (activities that take moderate physical effort and make you breathe somewhat harder than normal such as carrying light loads, bicycling at a regular pace, or easy swimming), and vigorous activities (e.g., activities that take hard physical effort and make you breathe much harder than normal such as heavy lifting, digging, aerobics, or fast bicycling) per week. On the basis of what activities participants self-reported, the interviewer also clarified the perceived intensity of that specific activity. A continuous indicator was calculated as a sum of weekly metabolic equivalent (MET)-minutes per week of walking, moderate- and vigorous-intensity exercise. The MET energy expenditure was estimated by weighting the reported minutes per week within each activity category by a MET energy expenditure estimate assigned to each category of activity. MET-levels were obtained from Ainsworth et al. (2000). The weighted MET-minutes per week were calculated as duration × frequency per week × MET intensity, which were then summed across activity domains to produce a weighted estimate of total physical activity from all reported activities per week.

A categorical analysis grouped the participants in three levels: (a) inactive, (b) minimally active, and (c) highly active patients. The inactive level is the lowest physical activity category. Those individuals do not meet criteria for minimally active and highly active-criteria. The minimally active group meets any one of the following three criteria: (a) 3 or more days of vigorous activity of at least 20 min per day, or (b) 5 or more days of moderate-intensity activity or walking of at least 30 min per day, or (c) 5 or more days of any combination of walking, moderate-intensity or vigorous intensity activities achieving a minimum of at least 600 MET-min/week. The highly active group meets any one of the following two criteria: (a) vigorous-intensity activity on at least 3 days and accumulating at least 1500 MET-min/week, or (b) 7 or more days of any combination of walking, moderate-intensity or vigorous intensity activities achieving a minimum of at least 3000 MET-min/week

Previous research (Faulkner et al., 2006) indicated that the IPAQ can be considered as a reliable surveillance tool to assess levels of physical activity in patients with schizophrenia.

### 2.4. Metabolic and anthropometric measurements

Body weight was measured in light clothing to the nearest 0.1 kg using a SECA beam balance scale, and height to the nearest 0.1 cm using a wall-mounted stadiometer. Waist circumference (WC) was measured to nearest 1 cm at the level of the umbilicus and at the end of expiration with the participant upright and