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Effects of aerobic interval training on metabolic complications and cardiorespiratory fitness in young adults with psychotic disorders: A pilot study

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ABSTRACT

Aim: To assess the feasibility of implementing a 14-week aerobic interval training (AIT) program within a first-episode psychosis (FEP) service and its efficacy in improving metabolic outcomes and cardiorespiratory fitness.
Method: Twenty-five male subjects participated in 30-minute sessions of AIT twice a week.
Results: Sixteen of 25 subjects completed the training program. There was a significant decrease in waist circumference (WC; −4.3 cm; $p = 0.015$), resting heart rate (−8.6 bpm; $p < 0.05$) and a 38% increase in VO_2max ($p < 0.001$). The decrease in WC (−5.6 cm; $p < 0.01$) was more pronounced for subjects who completed at least 64% of the planned sessions.
Conclusion: An AIT program could be implemented in FEP patients and improve WC and cardiorespiratory fitness over a relatively short period.

1. Introduction

Patients afflicted by severe mental illnesses, particularly schizophrenia, have a 2 to 3-fold increased mortality rate compared to the general population (Brown, 1997; Leucht et al., 2007; Saha et al., 2007; Brown et al., 2010). A significant portion of that mortality has been associated with metabolic complications and premature cardiovascular disease (CVD). Indeed, psychotic patients are more likely to suffer from obesity and type 2 diabetes (De Hert et al., 2011). This vulnerability appears to be driven by patient-specific characteristics, such as genetic predisposition, lifestyle (physical inactivity, smoking, unhealthy diet) and early adverse effects of antipsychotic medications (AP) (Zipursky et al., 2005; Alvarez-Jimenez et al., 2008). Therefore, early interventions are necessary against these risk factors.

Studies have shown that it is possible to manage weight gain and improve metabolic profile of schizophrenic patients with behavioral intervention, mainly through psychoeducation and light to moderate physical training, either alone or in combination (Littrell et al., 2003; Alvarez-Jimenez et al., 2006; Kwon et al., 2006; Poulin et al., 2007; Marzolini et al., 2009). Only one published study had reported the effect of a multimodal program (using non-standardized exercise training) in first episode psychosis (FEP) patients (Alvarez-Jimenez et al., 2006). For the first 3 months following the introduction of AP, the magnitude of weight gain was less pronounced in the intervention group. However, the multimodal nature of the program made it difficult to distinguish the relative impact of each of its interventional component (i.e. education, exercise, diet, etc.).

Aerobic interval training (AIT) consists of high intensity exercise training of shorter duration and offers an alternative to engage patients in a potentially more efficient exercise intervention. Studies have shown that AIT is more effective in reducing metabolic complications and enhancing cardiorespiratory fitness (CF) than continuous, moderate exercise in non-psychiatric populations (Tjonna et al., 2008; Hwang et al., 2011; Kessler et al., 2012) and may be beneficial in middle-aged psychotic patients (Heggelund et al., 2011).

To date, no published study investigated the impact of AIT in young FEP patients. In response, this pilot study assessed the feasibility of implementing an AIT program and measured its impact on metabolic outcomes in young FEP patients concurrently taking AP. We hypothesized that AIT would improve subject metabolic profile (waist circumference (WC) as a primary outcome) and CF levels.

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2. Method

2.1. Participants

Of 46 patients approached, 21 refused and 25 consented to participate. They were recruited between July 2010 to August 2011 from FEP 'Clinique JAP' of the Centre Hospitalier de l'Université de Montréal (CHUM), Canada. The inclusion criteria were: DSM-IV diagnostic of psychotic disorder, male between 18 and 35 years old, sedentary lifestyle (less than two hours of structured exercise per week), body mass index (BMI) between 25 and 35 kg/m^2 and a WC ≥ 94 cm, low alcohol intake, psychotic symptoms stable for at least 1 month and no medication changes planned during the 14 weeks of the AIT program. The exclusion criteria were: CVD, diabetes, orthopedic limitation, eating disorder, uncontrolled thyroid or pituitary disease and taking medications that affect metabolic or cardiovascular functions (excluding psychotropic drugs). This study was approved by the CHUM ethic and scientific committees, and a written informed consent was obtained from all subjects.

2.2. Procedure

Each 30-minute session of AIT on a treadmill included the following sequentially: a 5-minute low intensity walking to warm up, 10 intervals of 30-second running at 80 to 95% of maximal heart rate with 90-second active recovery walks at 50 to 65% of maximal heart rate between intervals and a 5-minute cool-down period of low intensity walking. Heart rate was measured using a Polar watch monitor. A kinesiologist or kinesiology student provided one-on-one supervision training, and effort intensity was calibrated according to the tolerance of each subject throughout the study. The patients were instructed to maintain their usual lifestyle habits for the duration of the study. VO_2max was estimated with the single treadmill walking test (Ebbeling et al., 1991).

2.3. Data collection and measures

Subjects were assessed in a standardized setting at the beginning and at the end of the 14-week training program using: anthropometric measures, metabolic profiles (fasting blood work), blood pressure, CF, psychiatric disorder severity and functional level (Table 1). Body composition was estimated by bioelectric impedancemetry analysis (BIA; Omron HBF-500CAN, USA) in the early morning after an overnight fasting. Psychiatric assessment included the Clinical Global Impression Severity Subscale (CGI-S), Global Assessment of Functioning Scale (GAF) as well as Social and Occupational Functioning Assessment Scale (SOFAS), which were performed by a research psychiatrist.

2.4. Statistical analysis

Statistical analyses were performed with Statistical Package for Social Sciences software (v.16.0, SPSS inc., Chicago, IL, USA), using paired samples Student's *t*-test to compare means before and after the intervention. Analyses were performed on the 14-week study completers (n = 16), and the subgroup of subjects who participated in at least 64% of the training sessions (n = 12). Independent samples t-tests were used to search baseline differences between completers (n = 16) and non-completers (n = 9). The significance level was set at $p < 0.05$ (two-tailed).

3. Results

Seven subjects had a diagnosis of schizophrenia, 9 of schizoaffective disorder, 7 of bipolar disorder and 2 of psychotic disorder not otherwise specified. Subjects were taking AP, mainly atypicals (Risperidone OR/IM, Clozapine, Olanzapine, Quetiapine, Haloperidol OR/IM). The mean dose of chlorpromazine equivalence was 279.5 mg (SD = 292.9; median = 200 mg). Thirty-six percent of the subjects were taking more than one AP; half were taking AP and mood stabilizer, (Lithium, Carbamazepine, Valproate, Lamictal) and/or antidepressant (Bupropion, Venlafaxine, Desvenlafaxine). The majority had no medication change, while the others had very slight dosage reduction during the 14 week study.

Table 1
Comparison of baseline anthropometric, cardiovascular and clinical characteristics between subjects that completed the study (n = 16) and those that were lost to follow-up (n = 9).

	Completers (n = 16)	Non completers (n = 9)	p-Value
Age	25.9 ± 3.9	22.8 ± 3.5	0.062
Duration of AP treatment	4.2 ± 3.0	2.5 ± 2.0	0.144
Anthropometrics			
WC (cm)	108.5 ± 10.4	110.4 ± 11.7	0.698
Weight (kg)	98.4 ± 13.4	101.2 ± 8.8	0.613
BMI (kg/m^2)	31.4 ± 3.8	33.4 ± 3.4	0.283
% fat mass	31.5 ± 4.4	34.1 ± 5.7	0.263
% muscular mass	32.6 ± 2.6	32.2 ± 3.1	0.728
Cardiovascular			
RHR (bpm)	92.2 ± 15.5	100.5 ± 19.7	0.312
VO_2max (ml/kg·min)	37.3 ± 12.6	35.9 ± 12.9	0.832
Blood pressure			
Systolic (mmHg)	121.6 ± 13.0	124.7 ± 13.6	0.610
Diastolic (mmHg)	74.3 ± 10.4	80.0 ± 10.1	0.237
Clinical data			
GAF	50.9 ± 12.8	45.6 ± 10.1	0.291
SOFAS	57.2 ± 10.8	47.2 ± 8.7	**0.027**
CGI-S	3.2 ± 1.2	4.1 ± 0.8	**0.038**

Summary statistics are presented as mean ± standard deviation.
Abbreviations: AP = Antipsychotic; WC = Waist circumference; BMI = Body mass index; RHR = Resting heart rate; VO_2 = Oxygen uptake; GAF = Global Assessment of Functioning Scale: SOFAS = Social and Occupational Functioning Assessment Scale; CGI-S = Clinical Global Impression Severity Subscale.

Of the 25 subjects enrolled, 16 completed the 14-week AIT program (mean participation = 68.5%, median = 82.1%, SD = 32.1) and 12 completed at least 64% of the training sessions (mean participation = 85.4%, median = 85.7%; SD = 9.9). The reasons of dropping out were: physical discomfort (n = 3), lack of motivation (n = 4), interest for resistance training instead of AIT (n = 2) and feeling that the exercise training was too demanding (n = 2). At baseline, non-completers (n = 9) were more severely ill (higher CGI-S score ($t = -2{,}20$, $df = 23$, $p < 0.05$)) and had a lower level of functioning (lower SOFAS score ($t = 2.36$, $df = 23$, $p < 0.05$)) compared to the completers (n = 16). There was also a tendency toward a significant difference in age between groups (Table 1).

After 14 weeks of AIT, the completers (n = 16) had a 4.3 cm reduction in WC ($t = 2.74$, $df = 15$, $p = 0.015$) (Effect Size (ES): 0.4). Their resting heart rate (RHR) was reduced by 8.6 bpm ($t = 2.35$, $df = 14$, $p < 0.05$) (ES: 0.6) and VO_2max increased by 38% ($t = -5.68$, $df = 12$, $p < 0.001$) (ES: 1.2). In the subgroup that completed at least 64% of the training sessions (n = 12), WC decreased by 5.6 cm ($t = 3.61$, $df = 11$, $p < 0.01$) (ES: 0.5), RHR was reduced by 10 bpm ($t = 2.42$, $df = 11$, $p < 0.05$) (ES: 0.7) and VO_2max increased by 34% ($t = -5.38$, $df = 11$, $p < 0.001$) (ES: 1.1) (Table 2). There was no significant change in blood pressure, lipid profile, glucose metabolism or psychiatric measures following AIT.

4. Discussion

This is the first study to demonstrate the effective integration of AIT into a FEP program, and that it had improved one of the metabolic risk factor (i.e. WC) and CF over a relatively short period (14 weeks).

As hypothesized for the primary outcome, WC (an obesity index that reflects fat distribution more accurately and possibly better predicts subsequent incidence of CVD and mortality (Chrysant and Chrysant, 2013; Mitchell et al., 2013)) was significantly decreased at the end of