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Health benefits of a physical exercise program for inpatients with mental health; a pilot study

Z. Mazyarkin[a], T. Peleg[a], I. Golani[b], L. Sharony[a], I. Kremer[a,c], A. Shamir[a,c,*]

[a] Psychobiology Research Laboratory, Mazor Mental Health Center, Akko, Israel
[b] Department of Biotechnology Engineering, ORT Braude College, Karmiel, Israel
[c] The Ruth and Bruce Rappaport Faculty of Medicine, Technion – Israel Institute of Technology, Haifa, Israel

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ABSTRACT

The positive effect of exercise on human health and the relationship between physical activity, health, and wellbeing are well studied and extensively documented in the literature. However, considerably less attention is devoted to the impact of exercise on mental health and wellbeing for people experiencing a mental illness, in general, and in particular for inpatients in the mental health care system. Here, we determine the clinical feasibility and effects of short-term (up to three months) vs long-term (up to six months) group-based exercise program for inpatients with chronic mental health. Changes in psychiatric symptoms, well-being, empathy, and physiological fitness factor (e.g., fasting blood glucose, lipid profile, hemoglobin A1C, and BMI) were monitored before, during and following the physical exercise program. Here, we demonstrated that long-term physical activity improved negative symptoms, but not positive symptoms, while improvement in the severity of the illness as measured by the BPRS questionnaire was found to be independent of the training time. We additionally showed that the empathic ability of patients who exercised for more than three months was significantly improved as compared to the other experimental groups. No significant differences were found in wellbeing, mood, satisfaction, and functioning between exercise groups and the control group. Furthermore, physical activity did not improve any of the physiological parameters that were measured in this study. Together, these data indicate that exercise for at least 3 months seems to improve the overall patient mental state, but not his or her physiological parameters, while improvement in negative symptoms and patient's empathy may occur only after a long-term physical exercise activity.

1. Introduction

Major psychiatric disorders are chronic, severe and lifetime illnesses (Pankevich et al., 2014). For example, 1% of the world‘s population suffers from schizophrenia, and more than 70% of patients in psychiatric hospitals are diagnosed with schizophrenia. In most cases, the disease occurred during adolescence or early adulthood, and resulted in day-by-day personal dysfunction, with an enormous economic impact and social burden (Keshavan et al., 2011; Trautmann et al., 2016). In addition to the chronic mental condition, the individuals with mental illness struggle with a spectrum of physical disorders such as hypertension, type II diabetes mellitus, cardiac, and infectious diseases. Thus, morbidity with physical illness persistent, medication adverse effects, cognitive decline, and a reduction in the patient's well-being usually lead to long-term hospitalization and special needs. In recent years, many studies reported that there is a much higher rate of mortality and morbidity in people with mental health disorders compared to the general population of all ages, especially in schizophrenia, and in between the ages of 65–80 (Hayes et al., 2017; Hoang et al., 2011; Morden et al., 2012; Nielsen et al., 2013). This is due to fragmentation of care, adverse effects of lifelong medication, particularly antipsychotics, and probably unhealthy lifestyles, especially lack or reduced physical activity and exercise (Correll et al., 2013; De Hert et al., 2012).

Physical inactivity has been described as the leading risk factor for global mortality. The World Health Organization (WHO) reported that physical inactivity accounts for 27% of diabetes and 30% of ischemic heart diseases (World Health Organization, 2011). However, an active lifestyle reduces the risk to develop these diseases, largely improving general health, wellness, and life expectancy (G. G. Li et al., 2014a;

* Corresponding author. Psychobiology Research Laboratory, Mazor Mental Health Center and the Ruth and Bruce Rappaport Faculty of Medicine, Technion – Israel Institute of Technology, D.N. Oshrat, Akko, 25201, Israel.
E-mail address: alons@mazor.health.gov.il (A. Shamir).

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Warburton et al., 2006). Furthermore, physical activity in healthy aging populations is associated with improvement in cognitive functioning and depressive symptoms, delay in age-related cognitive decline and neurodegeneration. These data led to a growing interest in the effectiveness of exercise programs on persons with psychiatric illnesses. Epidemiological studies have shown that exercise and physical activity can prevent or delay the onset of different mental disorders, and have therapeutic benefits when used as sole or adjunct treatment in mental disorders (Knapen et al., 2015; Vancampfort et al., 2015). Low levels of physical activity participation have been associated with negative body attitude in adults with binge eating disorder, while low self-efficacy and medical co-morbidities have been associated with adults with bipolar disorder (Vancampfort et al., 2013). Engaging in exercise improves cardiorespiratory fitness, body image, and sleeping quality in people with schizophrenia (Leone et al., 2015; Vancampfort et al., 2015). For example, individuals diagnosed with schizophrenia who participated in a three-month physical conditioning program showed improvements in weight control and reported increased fitness levels, exercise tolerance, reduced blood pressure levels, increased perceived energy levels, and increased upper body and hand grip strength levels (Fogarty et al., 2004). In clinically depressed individuals exercise improved depression symptoms, reduced the dose of medication (during exercise), and found to be less likely to relapse (Knapen et al., 2015; Ranjbar et al., 2015; Rethorst et al., 2009). Moreover, physical exercise improves mental health by enhancing cognitive functioning (Firth et al., 2015; Pajonk et al., 2010). On the brain level, exercise induces neurogenesis (Kempermann, 2002), modulates synaptic plasticity (L. L. Li et al., 2014b), influences the hypothalamic-pituitary-adrenal (HPA) axis (Sharma et al., 2006), and increases several growth factors such as brain-derived neurotrophic factor (BDNF) (Tsai et al., 2014). Pajonk and his colleagues (2010) reported increased hippocampal plasticity in response to a 12-week aerobic exercise intervention in patients with schizophrenia attending a day hospital program or an outpatient clinic, which was linked short-term memory improvement. Although recent findings confirm the positive effect of exercise on adults with mental illness such as schizophrenia and depression, there are no clear guidelines regarding advice on exercise for persons with mental disorder, and the importance of exercise is not adequately understood or appreciated by patients and mental health professionals alike. Additionally, research on the physical activity attitudes and preferences of adults with mental illness has predominantly been conducted among those living in the community and not among inpatients adults with mental health.

The current study aims to examine the feasibility and sustained effects of physical activity and exercise on both mental and physical health of inpatients with severe mental disorders. Here, we provide a systemic work to understand the mental and physical health benefits associated with exercise in inpatients adult persons with chronic and severe mental health disorders. Specifically, we monitored changes in clinical symptoms and physiological fitness factor (e.g., fasting blood glucose, lipid profile, hemoglobin A1C, and BMI) during and following the physical exercise program. In addition, we investigated the effects of physical exercise on the patient's well-being, empathy, mood, function, and quality of life.

2. Material and methods

2.1. Subjects

"Healthy Mind in a Healthy Body" is a program aimed to improve the health and fitness of patients in Mazor Mental Health Center (MHC), Akko, Israel. The program is open to all patients hospitalized in Mazor MHC. This study approved by the Mazor MHC (MZR-0002-16) and all participants gave informed consent to take part in the study.

Overall, thirty-three patients were recruited from the open and closed wards of Mazor MHC. Twenty-three patient were included in the exercise group, while ten matched patients for *age, illness duration, gender and year of education* served as a control group (Tables 1 and 2). Patient in the control group participated in the motivation group (see below) but did not take part in the exercise program. All of the patients except one patient with bipolar disorder, diagnosed with schizophrenia or schizoaffective disorder according to the DSM-V criteria. Inclusion criteria were: 1) Patients of both genders, 2) Age 18–60 years, and 3) On prescribed medications. Exclusion criteria were: 1) Current active and persistent substance and/or alcohol abuse; 2) Have symptoms or illnesses that limit physical activity; 3) Organic brain pathology or severe head trauma; 4) History of angina, heart attack, or transient ischemic attacks; 5) Non-independent mobility or limb prostheses.

After receiving informed consent, all subjects participated once a week in a sports motivation group. The motivation group consisted up to 10 patients and was held for half an hour. The group was guided by one of the researchers, with an emphasis on motivation to engage in sports and maintain a healthy lifestyle. The group was open to all patients in the ward and was not restricted to patients who had agreed to participate in the study. The presence of the subjects was recorded.

2.2. Physical exercise program intervention

Subjects trained for up to six months, twice a week for 45 min, in small groups of 6–10 people. The class attended by physical fitness instructors who guide the subjects to ensure that the proper exercise intensity was maintained and to reduce the dropout rates. Recruitment from the open ward exercise in the open spaces and sports facilities

Table 1
Demographic characterization of the study population.

	Control	Up to 3 months	Over 3 months	p-value
*Age (Years)	39.5 ± 1.7 (33–50)	35.5 ± 2.7 (20–48)	32.5 ± 2.4 (22–53)	0.113
Gender				
Men	10 (100%)	10 (91%)	12 (100%)	
Female	–	1 (9%)	–	
Employment				
Not working	10	11	12	
working	–	–	–	
***Education (Years)**	12.9 ± 1.02	13.1 ± 0.7	10.6 ± 0.8	0.108

* Data analyzed using one-way ANOVA. Results presented as mean ± SEM. n = 10 patients (control); n = 11 patients (up to three months); n = 12 patients (up to six months).

Table 2
Clinical data, empathy, and wellbeing of the study population.

	Control	Up to 3 months	Over 3 months	p-value
Age of onset	25.4 ± 2.09	23.4 ± 1.3	22.2 ± 1.5	0.369
Illness duration (Years)	14.0 ± 1.5	11.7 ± 2.5	10.3 ± 2.8	0.537
PANSS				
Positive	17.0 ± 7.3	14.8 ± 1.5	12.27 ± 0.96	0.140
Negative	18.0 ± 2.4	18.0 ± 2.2	20.1 ± 1.7	0.797
General	35.5 ± 4.5	37.0 ± 3.3	29.8 ± 2.1	0.276
Total	70.6 ± 7.9	65.8 ± 5.8	62.2 ± 5.9	0.583
BPRS	51.1 ± 6.6	51.6 ± 4.1	42.3 ± 3.0	0.268
Empathy	35.7 ± 3.0	44.3 ± 3.0	37.8 ± 3.1	0.149
Wellbeing	74.1 ± 9.05	#**58.3 ± 5.3**	83.5 ± 3.3	**0.029**
*Mood (VAS)	8.0 ± 0.6	5.9 ± 0.9	7.6 ± 0.7	0.149
*Functioning (VAS)	8.1 ± 1.1	7.4 ± 0.8	6.8 ± 0.1	0.611
*Satisfaction (VAS)	8.6 ± 0.5	6.0 ± 0.7	6.5 ± 0.9	0.052

Data analyzed using one-way ANOVA. Results presented as mean ± SEM. *Visual Analogue Scale (VAS) score is determined by measuring in millimeters from the left end of the line to the point that the patient marks. High score presents a better functioning and satisfaction, and elevated mood. #$p < 0.05$. n = 10 patients (control); n = 11 patients (up to three months); n = 12 patients (up to six months).

available at the Mazor MHC. While the exercise classes in the closed wards took place in the department hall or yard. Exercise classes were accompanied and supervised by the ward staff. The training program is gradual and includes both aerobic and resistance training. Aerobic exercise consists of long walks, jogging, and short running intervals, while resistance training involves a combination of TRX-straps-workout, push-ups, pull-ups, and sit-ups. A detailed training program cycles by weeks described in Supplementary Table 1. It is important to note that the level of difficulty was increased from week to week. However, and if necessary, the intensity was adjusted and adapted to the subject's abilities.

2.3. Assessments of clinical symptoms, empathy, and wellbeing

Clinical and sociodemographic data were collected from the electronic medical records of the recruited patients and included the following variables: age, sex, education, employment, ethnicity, the age of onset, and duration of the illness. Positive and Negative Symptom Rating Scale (PANSS) and the Brief Psychiatric Rating Scale (BPRS) were used to monitor the subjects' clinical symptoms. The empathy quotient scale (EQ SCALE) was used to study the subject's ability to empathize. This questionnaire is intended to measure how easily the subject picks up on other people's feelings and how strongly the subject is affected by other people's feelings (Baron-Cohen and Wheelwright, 2004). The general wellbeing scale (GWBS) was used to estimate the subject's well-being. This questionnaire includes 18 questions total: fourteen questions with a rating from 0 to 5, and four questions with a rating scale from 0 to 10. In addition, subject's mood during the past week, his or her general level of satisfaction (low to high), and his or her level of functioning in the ward (low and high) were measured using Visual Analogue Scale (VAS). VAS is usually a horizontal line, 100 mm in length anchored by word descriptors at each end such as depressed mood (left end) to good mood (right end). The patient marks on the line the point that they feel represents their perception of their current state. The VAS score is determined by measuring in millimeters from the left end of the line to the point that the patient marks. All the subjects were evaluated at baseline, every month until the end of the study or in case of leaving the program before its termination.

2.4. Physiological measurements

Body mass (kg) and standing height (cm) were measured according to standard procedures (via calibrated weight and height scales) and body mass index (BMI) was calculated. In addition, a whole blood sample was collected in vacutainer tubes containing gel. Levels of fasting blood glucose, hemoglobin A1C, total cholesterol, triglycerides, HDL, and LDL were analyzed at the Clinical Biochemistry Laboratory in the Medical Center of the Galilee, Nahariya, Israel. All the subjects were evaluated at baseline, every three months, and at the end of the study or in case of leaving the program before its end.

2.5. Statistical analysis

Statistical analysis was carried out using the GraphPad Prism 5 program. Changes in demographic data, clinical data (PANSS and BPRS scores), well-being, empathy, Visual Analogue Scale data, and psychological data (Glucose, cholesterol (Total, LDL, HDL), triglycerides, BMI, weight, Hemoglobin A1C) were analyzed with one-way ANOVA. All results presented as a mean ± standard error of the mean (SEM). Correlation between clinical data (PANSS and BPRS scores), Visual Analogue Scale data (mood, satisfaction and functioning), empathy, wellbeing and physiological parameters (BMI, Glucose and total cholesterol) were tested using Pearson Correlation coefficients.

3. Results

3.1. Socio-demographic and clinical characterization

A six-month two arms clinical trial was performed. Thirty-two individuals with schizophrenia and one patient with bipolar disorder were recruited to the current study. Twenty-three participated in the exercise group and ten individuals served as control groups. The duration time in the exercise group ranged from one to six months, therefore, the exercise group was divided into two: subjects who participated in the program for up to 3 months, (total of 11 individuals), and patients who participated in the program over 3 months (total of 12 subjects). Tables 1 and 2 presents the demographic and clinical characteristics of the study population, respectively (see Supplementary Table 2 *for demographic and clinical data of all the study population)*. Overall, the majority of the study participants are men between the ages of 20–53, do not work and have an average of 11 years of education. On average, the age of onset was in the early 20s and the duration of the illness was over 10 years. No statistically significant differences were found between the study groups (physical activity up to 3 months, physical activity over 3 months and control) in all demographic and clinical variables measured at the time of entry into the study, except for the wellbeing index. The wellbeing index was measured using the well-being questionnaire, and found to be low in the group that was engaged in a physical activity for up to 3 months compared with the group of activity over 3 months, but not with the control group (one way-ANOVA group, $F = 4.1$, $df = 2,25$, $p = 0.03$). It is important to note that although no significant effect was found ($p = 0.052$), the satisfaction score as measured on an analogue scale was low in the exercise group (independent of training time) compared to the control group. A significant correlation between BPRS and PANSS items was found in all study groups (Table 3). In controls, significant negative correlations were found between BPRS score and empathy, between BPRS and satisfaction score, between BPRS and mood score, and between BPRS and functioning score. No significant correlation were identified between physiological parameters and mood, wellbeing, satisfaction and functioning score in all the study groups (Table 3).

3.2. The effect of physical exercise on mental health

An improvement in the patient's mental state was examined using the PANSS and BPRS questionnaires. The PANSS questionnaire is used monitor the severity of the positive and the negative symptoms of individuals with schizophrenia, whereas the BPRS monitor the severity of the illness and other psychopathological symptoms such as anxiety, depression, and mania. The improvement in mental state is presented as a change in the mean score of PANSS and BPRS questionnaires at the end of the training program relative to the baseline measurement. Fig. 1 shows the level of change for the PANSS index. Improved in negative symptoms (Fig. 1A), but not in positive symptoms (Fig. 1B), was observed in the physical activity over 3 months group compared with the physical activity up to 3 months and control groups (one-way ANOVA, $F = 3.3$, $df = 2.28$, $p = 0.049$). The PANSS total score was also improved in the physical activity over 3 months group compared with the other study groups (one way-ANOVA, $F = 6.6$, $df = 2,228$, $p = 0.0045$; Fig. 1D). On the other hand, improvement in the PANSS general score (one-way ANOVA, $F = 4.9$, $df = 228$, $p = 0.018$) was observed in both exercise groups compared with the control group (Fig. 1C). An improvement in the severity of the illness as measured by the BPRS questionnaire was found in the exercise group (independent of training time) compared to the control group (one-way ANOVA, $F = 4.9$, $df = 2.28$, $p = 0.018$, Fig. 2). Furthermore, significant correlations were found between PANSS-P and BPRS score, between PANSS-G and BPRS score and between PANSS-T and BPRS score in the over 3-months group. In controls, a significant correlation between BPRS and PANSS

Table 3
Correlation between symptoms, mood, wellbeing and physiological parameters at baseline.

Variable	Control		Up to 3 months		Over 3 months	
	r	p	r	p	r	p
PANSS P-BPRS	0.81	**0.004**	0.71	**0.016**	0.75	**0.006**
PANSS N-BPRS	0.63	**0.049**	0.93	**$3.4X10^{-5}$**	0.48	0.12
PANSS G-BPRS	0.96	**$3.7X10^{-5}$**	0.93	**$3.4X10^{-5}$**	0.90	**$6.1X10^{-5}$**
PANSS T-BPRS	0.98	**$9.7X10^{-7}$**	0.89	**$3.5X10^{-4}$**	0.92	**$2.3X10^{-5}$**
BPRS - Empathy	−0.83	**0.003**	−0.43	0.21	−0.50	0.10
BPRS - Wellbeing	−0.17	0.70	−0.21	0.67	−0.54	0.07
BPRS – Satisfaction	−0.68	**0.032**	−0.04	0.91	−0.38	0.22
BPRS - Mood	−0.85	**0.002**	0.15	0.63	0.03	0.93
BPRS - Functioning	−0.70	**0.024**	−0.46	0.15	−0.30	0.35
BMI - Wellbeing	0.14	0.74	−0.27	0.52	0.17	0.58
BMI - Satisfaction	−0.12	0.75	−0.13	0.70	0.04	0.89
BMI - Mood	−0.20	0.58	−0.73	**0.01**	0.33	0.30
BMI - Functioning	−0.40	0.26	−0.03	0.93	−0.42	0.18
Glucose - Wellbeing	0.40	0.30	−0.65	0.08	0.50	0.10
Glucose - Satisfaction	−0.72	**0.029**	−0.47	0.15	0.34	0.28
Glucose - Mood	−0.091	0.82	−0.65	**0.034**	0.36	0.25
Glucose -Functioning	−0.20	0.62	−0.37	0.27	−0.51	0.10
Cholesterol T -Wellbeing	−0.60	0.17	−0.70	0.06	0.15	0.64
Cholesterol T- Satisfaction	0.71	0.077	−0.07	0.84	0.04	0.89
Cholesterol T - Mood	0.15	0.75	−0.49	0.13	−0.38	0.22
Cholesterol T - Functioning	0.55	0.21	−0.13	0.71	−0.39	0.21

PANSS P = positive symptoms; PANSS N = negative symptoms; PANSS G = general symptoms; PANSS T = Total PANSS; r = person correlation coefficients. n = 10 patients (control); n = 11 patients (up to three months); n = 12 patients (up to six months).

items was found (Supplementary Table 3). These results indicate that the severity of the illness (as measured by BPRS and PANSS general questionnaires) was improved by exercise regardless of the training period. On the other hand, improvement in negative symptoms may depend on the period the subject engage in the sports program.

3.3. The influence of the exercise program on mood, satisfaction, function, empathy, and wellbeing

An analysis of variance showed that the empathic ability of patients who exercised for more than three months (mean change in empathy: 8.10 ± 2.7) was significantly improved (one-way ANOVA, F = 5.8 df = 2,28, p = 0.008) as compared with the physical activity up to 3 months (Mean change in empathy: 2.7 ± 2.4) and control groups (mean change in empathy: 1.2 ± 0.8). No significant differences were found in wellbeing, mood, satisfaction, and functioning between exercise groups and the control group (Table 4). No significant correlation were identified between mood, wellbeing, satisfaction and functioning scores and BPRS in the exercise groups (Supplementary Table 3).

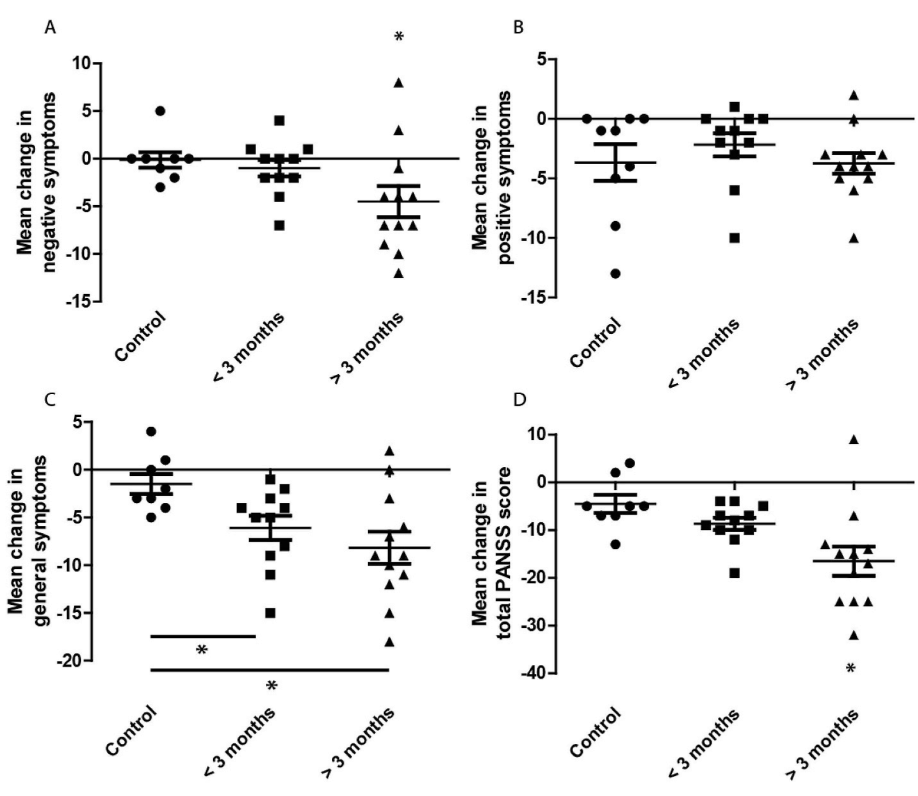

Fig. 1. Changes in PANSS scores: Change in the mean score of (A) negative symptoms, (B) positive symptoms, (C) general symptoms and (D) PANSS total at the end of the training program relative to the baseline measurement. Results displayed as mean ± SEM. *p < 0.05. n = 9–10 patients (control); n = 11 patients (up to three months); n = 12 patients (up to six months).

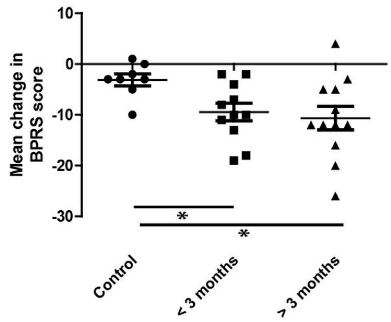

Fig. 2. Changes in BPRS scores: Change in the mean score of BPRS score at the end of the training program relative to the baseline measurement. Results displayed as mean ± SEM. *$p < 0.05$. n = 9 patients (control); n = 11 patients (up to three months); n = 12 patients (up to six months).

3.4. The effect of physical training on physiological measures

In order to assess the effect of physical activity on physiological measures, we examined the extent change from baseline of the following parameters: weight, BMI, fasting glucose, triglycerides, Total cholesterol, LDL, HDL, and hemoglobin A1C levels (Table 5). In general, at bassline fasting glucose, triglycerides, total cholesterol, and hemoglobin A1C levels were found to be at the normal range. However, HDL and LDL values pinpoint an increased risk of cardiovascular disease, while BMI scores indicate mild to moderate overweight, but not obesity. However, physical activity did not improve any of the physiological parameters that were measured in this study (Table 5).

4. Discussion

Recent studies have shown the importance of physical activity in people with mental illness (Dauwan et al., 2016; Ranjbar et al., 2015). However, the predominant studies conducted among people with mental disorders living in the community and treated in the mental health clinics. Moreover, there is a lack of knowledge regarding the beneficial effects of exercise in mental health hospitals. In this pilot work, we examined the effect of physical activity on mental and physical health in people with schizophrenia spectrum disorders. Our findings showed that patients who participated in a physical activity program displayed an improvement in the severity of the symptoms as measured by the BPRS. In addition, this group showed an improvement in PANSS general scores compared to controls. However, improvement in negative symptoms, empathy, and overall score of the PANSS questionnaire was found only in patients that were exercised more than three months and up to six months. There was no improvement in the positive symptoms, mood, function, and overall satisfaction as reported by the patients. These data indicate that exercise for at least 3 months seems to improve the overall patient mental state, while improvement in negative symptoms and patient's empathy may occur only after a long-term physical exercise activity (over 3 months–6 months). Improved symptoms were observed in a group of patients with schizophrenia who participated in a 6-min walk program for 16 weeks in patients who were not hospitalized (Beebe et al., 2005). In addition, in a meta-analysis study, positive and negatives symptoms were improved due to short or long-term physical training (Dauwan et al., 2016). Thus, our work supports the notion that short or long-term physical activity may have a beneficial effect on clinical symptoms in individuals with schizophrenia spectrum disorders. Interestingly, although exercise improved the patients' symptoms, as assessed by structured clinical questionnaires, their mood, functioning, and overall satisfaction were not improved. It is important to note that these parameters were measured using self-report questionnaires, and therefore, it is possible that there is a considerable difficulty for the subjects to express their feeling due to cognitive dysfunction and long-term of hospitalization.

It is know that exercise is recommended as part of the treatment program, among other things, for individuals who suffer from metabolic and cardiovascular diseases, diabetes, obesity, and stroke. For example, aerobic exercise combined with strength training led to reduce hemoglobin A1C and triglycerides levels and to improve the lipid profile of people diagnosed with type 2 diabetes (Colberg et al., 2016). BMI, blood pressure, and lipid profile found to be improved following physical activity in people at risk of developing cardiovascular disease and diabetes (Duncan, 2006). Moreover, eight weeks of exercise three times a day led to improved aerobic fitness in hospitalized schizophrenic patients, but without improvement in positive and negative symptoms (Stanton and Happell, 2014). In this study, we did not find any improvement due to physical activity in BMI, LDL and HDL values, which found above the normal range at entry to the study, or in any other physiological parameters that were measured in the current work. The lack of improvement of these measures can be attributed to the intensity of the physical activity, the lack of healthy eating habits and to the antipsychotic medication. Many studies link second-generation antipsychotic drug therapy to metabolic syndrome. For example, drugs such as olanzapine and clozapine increase the risk of hyperglycemia, obesity, and low levels of HDL (Hirsch et al., 2017; Reynolds and Kirk, 2010). Therefore, additional studies that include physical activity with a proper nutrition program and motivation groups that emphasize the importance of a healthy lifestyle are needed.

4.1. Limitations of the study

To properly interpret the research findings, it is important to address its limitations. This initial study included a small number of patients in each study group. Although statistically significant differences were found, this study should be repeated in a larger group of subjects. Second, the duration of physical activity within the groups was not uniform, and there was no control of the subject nutrition and on a healthy lifestyle. It is possible that homogenous groups and healthy diet during the study would have yielded more significant results and conclusions. Third, we cannot rule out that part of the changes in negative symptoms and empathy may simply be due to an increased amount of interactive time spent with the physical fitness instructors and other patients. Finally, the present study was not designed as a one-blind

Table 4
Effect of exercise program on mood, functioning and Satisfaction.

	Control			Up to 3 months			Over 3 months		
	Baseline	End	Δ	Baseline	End	Δ	Baseline	End	Δ
Mood (VAS)	8.0 ± 0.6	8.5 ± 0.5	0.5 ± 0.5	5.9 ± 0.9	7.1 ± 1	1.2 ± 1	7.6 ± 0.7	7.8 ± 0.6	0.2 ± 0.7
Functioning (VAS)	8.1 ± 1.0	7.4 ± 0.9	−0.7 ± 1.1	7.4 ± 0.8	7.7 ± 0.8	0.3 ± 1.1	6.8 ± 1	8.2 ± 0.5	1.4 ± 0.8
Satisfaction (VAS)	8.7 ± 0.5	8.4 ± 0.5	−0.3 ± 0.3	6.0 ± 0.7	7.0 ± 0.7	1.0 ± 0.5	6.5 ± 0.9	8.0 ± 0.7	1.5 ± 0.8

Data analyzed using one-way ANOVA. Results presented as mean ± SEM. Visual Analogue Scale (VAS) score is determined by measuring in millimeters from the left end of the line to the point that the patient marks. High score presents a better functioning and satisfaction, and elevated mood. n = 9 patients (control); n = 11 patients (up to three months); n = 12 patients (up to six months).

Table 5
Effect of exercise program on physiological fitness factor.

	Control			Up to 3 months			Over 3 months		
	Baseline	End	Δ	Baseline	End	Δ	Baseline	End	Δ
Weight (kg)	91.9 ± 6	93.2 ± 6	1.2 ± 1	82.9 ± 6	82.3 ± 6	−0.6 ± 0.4	81.0 ± 4	81.9 ± 4	0.9 ± 0.9
BMI	29.2 ± 1	29.5 ± 1	0.3 ± 0.4	26.9 ± 2	26.9 ± 2	−0.04 ± 0.2	26.9 ± 1	27.2 ± 1	0.3 ± 0.3
Glu (mg/dL)	88 ± 5	93.4 ± 5	5.4 ± 9	83.4 ± 3	–	–	85.7 ± 5	86.6 ± 5	0.9 ± 6
TRIG (mg/dL)	201 ± 38	194 ± 35	−6.8 ± 13	150 ± 16	–	–	169 ± 22	138 ± 16	−31 ± 20
LDL (mg/dL)	116 ± 10	112 ± 7	4 ± 6	125 ± 9	–	–	127 ± 6	124 ± 5	3 ± 7
HDL (mg/dL)	36 ± 3	35 ± 3	1 ± 2	35 ± 3	–	–	41 ± 10	32 ± 2	−8 ± 10
Total Chol (mg/dL)	193 ± 12	189 ± 13	−4 ± 5	189 ± 7	–	–	193 ± 5	186 ± 6	−7 ± 8
A1C (%)	5.2 ± 0.1	5.2 ± 0.1	0 ± 0.1	5.1 ± 0.1	–	–	5.7 ± 0.6	4.9 ± 0.1	−0.8 ± 0.7

Data analyzed using one-way ANOVA or Student's t-test. Results presented as mean ± SEM.
Glu = glucose, TRIG = triglyceride, Chol = total cholesterol, A1C = hemoglobin A1C. n = 10 patients (control); n = 11 patients (up to three months); n = 12 patients (up to six months).

study, in which the investigator did not know the group the patient belongs to, but as an open study. In summary, here we provide evidence for the beneficial effect of physical exercise on clinical symptoms, but not on physiological parameters as BMI, lipid profile, and hemoglobin A1C. Providing an adequate exercise program, which includes physical activity, knowledge, and awareness of the importance of healthy life and motivation, will probably lead to lifestyle modifications and improvement of the mental symptoms and rehabilitation.

Contributors

A.S and L.S designed this project. Z.M and T.P performed the experiments. A.S and I.G analyzed the data. A.S wrote the paper. I.K. assisted with interpretation of the results. All the authors have contributed to and approved the final manuscript for publication.

Conflicts of interest

The authors declare no conflict of interest.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jpsychires.2019.03.002.

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