

## ORIGINAL RESEARCH

# Physical fitness in patients with bipolar disorder compared with a population-based sample

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**Abstract**

**Background:** This study aimed to evaluate physical fitness and body composition in a sample including hospitalized patients with bipolar disorder and to compare them with a population-based sample.

**Methods:** In this comparative observational study, 40 bipolar patients and 40 healthy subjects in Taleghani Hospital, Tehran, Iran, in 2019 were assessed. The physical fitness items such as body mass index (BMI), body fat, push-up test, curl-up test, VO<sub>2</sub> peak, and sit and reach test were compared across the groups. Young Mania Rating Scale for assessing the severity of bipolar disease and WHODAS2.0 for the estimation of global performance were done in the case group.

**Results:** The results of this study demonstrate that sit and reach test, body mass index (BMI), and body fat percent were similar across the studied groups. The push-up test, curl-up test, and VO<sub>2</sub> peak ( $P = .001$ ) were significantly lower in the case group. In the case group, only the push-up test was associated with the severity of bipolar disorder and decreased performance.

**Conclusion:** Lower push-up and curl-up can indicate an increase in both back and neck pains in these patients. Low VO<sub>2</sub> peak in these patients increases the risk of heart disease and mortality rates in bipolar patients. The push-up test can be used as a screen test to estimate the severity of the bipolar disorder.

**KEYWORDS**

anthropometry, bipolar disorder, body mass index, physical fitness

## 1 | INTRODUCTION

Bipolar disorder is a common type of mood disorder observed in 0.5% to 1% of the general population, which is accompanied by another psychiatric disorder.<sup>1,2</sup> The sex ratio is 1:1, which increases with aging.<sup>1</sup> The patients have a decreased quality of life that is also bothersome for their families and caregivers.<sup>3</sup> The most effective risk factor is a positive family history.<sup>4</sup> Regarding the chronic noncurable

status of bipolar disorder and lack of curative therapy, the determination of peripheral and genetic factors is important to reduce the burden of a problem.<sup>5</sup> Bipolar cases are exposed to further risks of cardiac morbidity and mortality. It is not only due to mental illness and related problems such as suicide but is also due to a sedentary lifestyle and cardiovascular risk factors. Among them, the fitness factors related to health are important. The use of sedative agents and those affecting the glucose and lipid metabolism may cause some problems

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in these patients.<sup>6,7</sup> Hence, the frequency of cardiovascular disorders in bipolar patients is similar to schizophrenia. Additionally, the frequency of metabolic syndrome is more in bipolar cases compared to the general population.<sup>7,8</sup> Accordingly, in treatment program for bipolar disorder, it is necessary to pay attention to all life aspects including fitness. Correspondingly, it can help in better rehabilitation programming to prevent cardiometabolic disorders. Improvement in physical health status can help to have better mental conditions, which improves the control of the disease.<sup>9</sup> In this study, the physical fitness factors were studied in a manic episode of bipolar patients vs healthy subjects and then compared by the other factors.

## 2 | METHODS

### 2.1 | Protocol and eligibility criteria

In this study, 40 consecutive bipolar patients and 40 healthy subjects in Taleghani Hospital, Tehran, Iran, in 2019 were assessed. The inclusion criteria were being bipolar in manic phase (by DSM-5); age between 20 and 60 years old; informed consent to participate in the study; the ability of cooperation; capability for fitness outworks; no neuroleptic use in the past month; risk-free status of doing exercise for a patient by physician's comment; motor disability; mental retardation; Alzheimer and dementia diagnosis; chronic diseases such as diabetes, musculoskeletal disorder, cardiac problems, lung disorders, and hypertension; and addiction. Noncooperative cases were excluded from the study.

### 2.2 | Assessments

The Young Mania Rating Scale (YMRS) for mood disorders was used to assess mood disorders. Moreover, WHODAS2.0 was used to assess disability intensity. Also, a fitness evaluation was done. These tests included body composition, fat percentage, curl-up, and push-up

test. All the participants underwent an assessment of body composition using a bioelectrical impedance device.

Fat percentage was detected by abdominal circumference measured by a tape meter. Both groups did push-up and curl-up tests, and the number of repetitions was counted in 1 minute. Both groups had been asked to abstain from food, tea, coffee, and cigarettes for 3 hours before the test. Sit and reach test was done. The sit and reach test is an assessment of flexibility of the hamstrings and lower back. Exercise testing provides information about exercise capacity and the risk of cardiovascular disease. The cardiovascular exercise stress test was performed in Bruce protocol mode.

The Bruce treadmill protocol is an exercise test that frequently used for adults the subjects performed the Bruce exercise test protocol on a motor-driven treadmill with the following 3-minutes stages: Stage I (2 mph, 10% grade), Stage II (2.5mph, 12% grade), Stage III (3.4 mph, 14% grade), and Stage IV (4.2 mph, 16%). Exercise stress test was maximal, and the subjects were motivated to do their best performance on the treadmill. During the exercise test cardiac monitoring was done with chest lead, to determine the intensity of exercise based on heart rate as well as controlling the risk of cardiac factors. The end-point criteria of the exercise test were RPE (Borg rating of perceived exertion) more than 18, reaching 85% maximal heart rate for age predict or exhaustion. Also, dyspnea, severe chest pain, severe dysrhythmia, or marked ST-segment changes were considered as an endpoint. The maximum volume of oxygen consumed to produce energy (maximal aerobic capacity or VO<sub>2</sub>max) was estimated by Bruce protocol.

All tests were controlled by the physicians. None of the tests were stopped early due to ECG changes and/or signs or symptoms of cardiovascular like chest pain. Heart rate, blood pressure, and RPE were recorded during the last 30 seconds of each test stage. VO<sub>2</sub>max values were calculated from the average of the last or highest two 30-seconds collections during exercise. Maximum heart rate was recorded as the highest heart rate during exercise, and exercise time to exhaustion was the time at which the test was ended by the subject. The Borg Rating of Perceived Exertion (RPE) is a way of

		Mean	SD	Sig.2-tailed
Push-up (number per min)	Case	12.95	7.77	0.000
	Control	18.71	9.69	
Curl-up (number per min)	Case	22.90	12.24	0.001
	Control	32.76	12.98	
VO <sub>2</sub> peak(ml/min)	Case	15.36	5.47	0.004
	Control	40.48	15.56	
Sit and reach (number per min)	Case	26.52	4.04	0.270
	Control	24.77	9.06	
Fat percent (abdominal circumference) (cm)	Case	15.36	5.47	0.201
	Control	40.48	15.56	
Body mass index (kg/m <sup>2</sup> )	Case	27.10	6.43	0.581
	Control	25.19	6.81	

**TABLE 1** Curl-up, push-up test and, VO<sub>2</sub> Peak in the cases with bipolar disease and control group

**TABLE 2** Relation of fitness tests and age and BMI in the cases with bipolar disease and control group

Group			Age	BMI
Bipolar disease patients	Fat percent	Pearson correlation	-.317	.571
		Sig. (2-tailed)	.047	.000
	VO2 peak	Pearson correlation	-.173	.145
		Sig. (2-tailed)	.286	.372
	Sit and reach	Pearson correlation	-.335	.187
		Sig. (2-tailed)	.035	.249
	Curl-up	Pearson correlation	-.174	-.101
		Sig. (2-tailed)	.283	.535
	Push-up	Pearson correlation	-.253	-.240
		Sig. (2-tailed)	.115	.135
	WHODAS2.0	Pearson correlation	-.062	-.100
		Sig. (2-tailed)	.703	.539
	Disease duration	Pearson correlation	.727	.030
		Sig. (2-tailed)	.000	.855
Young Mania rating scale	Pearson correlation	.026	.173	
	Sig. (2-tailed)	.874	.285	
Control	Fat percent	Pearson correlation	.379	.209
		Sig. (2-tailed)	.016	.196
	VO2 peak	Pearson correlation	-.199	.262
		Sig. (2-tailed)	.218	.103
	Sit and reach	Pearson correlation	-.316	-.213
		Sig. (2-tailed)	.047	.187
	Curl-up	Pearson correlation	.010	.054
		Sig. (2-tailed)	.952	.743
	Push-up	Pearson correlation	-.338	-.064
		Sig. (2-tailed)	.038	.702

calculating physical activity intensity level. Perceived exertion is how tough the patient senses he is working. Each patient was asked to give a subjective rating for each test to the easiness of the test. This rating was defined with a 6 to 20 scale, 6 means very light and 20 means very difficult.

### 2.3 | Statistical analysis

Data analysis was performed in the two groups each one consisting of 40 patients using SPSS version 27.0 software. The utilized tests for analysis were two-tailed independent *T*-test and multivariate analysis of variance. The *P* values less than .05 were considered statistically significant.

### 2.4 | Ethical considerations

In this study, participants were given enough explanation about the research. In case of dissatisfaction, people did not enter the study. All

written consent was received from all participants. Questionnaires were without a name and confidential information. This study was registered at the Ethics Committee of Shahid Beheshti University of Medical Sciences with a code of IR.SBMU.MSP.REC.1398.211.

## 3 | RESULTS

Totally, 40 consecutive bipolar patients and 40 healthy subjects were assessed. The mean age of bipolar and control cases was  $35.7 \pm 10.3$  and  $36.7 \pm 10.1$  years old ( $P > .05$ ). In addition, 52.5% of the subjects in each group were men. The mean of BMI in the bipolar group was 25.44 and had a SD of 3.57, comparing the control group that BMI mean was 25.00 and the SD = 3.55. Also, the fat percent in the bipolar group had a mean = 27.10% and SD = 6.43, while in the control group, the mean and SD of fat percent were 25.19% and 6.81. BMI and fat percent were not significantly different between groups.

Sit and reach mean and SD in bipolar group 25.52 and 4.06, respectively, also in control group mean and SD was 24.77 and 9.06. Results of the study showed that the sit and reach in bipolar group

**TABLE 3** Correlation between variables in the cases with bipolar disease and control group

Group			Fat Percent	VO2 Peak	Sit and Reach	Curl-up	Push-up	WHO DAS2.0	Disease Duration	Young Mania Rating Scale	
Bipolar disease patients	Fat percent	Pearson correlation	1	.081	.080	-.191	-.130	-.054	-.120	.133	
		Sig. (2-tailed)		.621	.622	.239	.423	.741	.461	.414	
	VO2 peak	Pearson correlation	.081	1	.247	.112	-.020	.175	-.077	-.084	
		Sig. (2-tailed)	.621		.125	.491	.901	.280	.636	.604	
	Sit and reach	Pearson correlation	.080	.247	1	-.135	-.090	-.062	-.411	.040	
		Sig. (2-tailed)	.622	.125		.408	.582	.703	.008	.804	
	Curl-up	Pearson correlation	-.191	.112	-.135	1	.149	.058	-.093	-.038	
		Sig. (2-tailed)	.239	.491	.408		.358	.722	.568	.818	
	Push-up	Pearson correlation	-.130	-.020	-.090	.149	1	.522	-.156	-.406	
		Sig. (2-tailed)	.423	.901	.582	.358		.001	.336	.009	
	WHODAS2.0	Pearson correlation	-.054	.175	-.062	.058	.522	1	-.120	-.908	
		Sig. (2-tailed)	.741	.280	.703	.722	.001		.460	.000	
	Disease duration	Pearson correlation	-.120	-.077	-.411	-.093	-.156	-.120	1	.173	
		Sig. (2-tailed)	.461	.636	.008	.568	.336	.460		.284	
	Young Mania rating scale	Pearson correlation	.133	-.084	.040	-.038	-.406	-.908	.173	1	
		Sig. (2-tailed)	.414	.604	.804	.818	.009	.000	.284		
	Control	Fat percent	Pearson correlation	1	-.351	-.297	-.194	-.387			
			Sig. (2-tailed)		.026	.063	.236	.016			
VO2 peak		Pearson correlation	-.351	1	.195	.110	.013				
		Sig. (2-tailed)	.026		.228	.504	.938				
Sit and reach		Pearson correlation	-.297	.195	1	.157	.490				
		Sig. (2-tailed)	.063	.228		.339	.002				
Curl-up		Pearson correlation	-.194	.110	.157	1	.251				
		Sig. (2-tailed)	.236	.504	.339		.129				
Push-up		Pearson correlation	-.387	.013	.490	.251	1				
		Sig. (2-tailed)	.016	.938	.002	.129					

was were not different between the two groups, but curl-up, push-up, and VO2 Peak had significant differences, which were lower in the case group (Table 1).

As demonstrated in Table 2, the age and BMI in the bipolar group were related to fat percent and sit and reach ( $P < .05$ ). While this was only seen for age in the control group ( $P < .05$ ).

The majority of numerical variables had no significant correlation with each other ( $P > .05$ ). As well, results were showed no significance in comparison to Young mania scale and WHODAS2.0 with curl-up, body composition, sit and reach, VO2 max, and fat percent. Only the push-up test had a significant difference with the Young mania scale and WHODAS2.0. (Table 3).

## 4 | DISCUSSION

In this study, the fitness factors were compared between the bipolar mania cases and healthy subjects. The results of this study demonstrate that sit and reach, BMI, and fat percent were similar across these two groups. Notably, the push-up, curl-up, and VO2 peak were

significantly lower in the case group. Lower push-up and curl-up can indicate an increase in both back and neck pains in these patients. This issue should be considered in future studies. Of note, a low VO2 peak in these patients increases the risk of heart disease and mortality rates. The push-up, WHODAS2.0, and Young scale results differed in terms of sex in the bipolar group. However, the VO2 Peak, fat percent, and BMI differed in the control group. As demonstrated in Table 3, the age and BMI in the bipolar group were related to fat percent and sit and reach, while this was only seen for age in the control group. The majority of numerical variables had no significant correlation with each other.

Sylvia et al in their study compared two groups consisting of bipolar patients with conventional treatment plus exercise and special diet vs a single conventional group.<sup>10</sup> Accordingly, function improvement was significantly greater in the plus exercise and diet group, but no difference was found in mental status between these two groups as same as the amount of weight reduction and cardiac status. However, this study has not considered other physical health status body weight of participants. A study by Huang et al. in China assessed 113 cases with bipolar disorder and found that nutrition and dietary regimen

patterns affect the type and severity of symptoms.<sup>11</sup> As a result, they recommended using the diet for better controlling bipolar disorder. One of the possible causes for the difference in results of our study is the role of dietary factors that may act as a confounding factor.

Another study by Almeida et al among 12 203 male cases in Australia demonstrated that 69 cases experienced bipolar disorder in a long time, including alcohol use, smoking, and low physical activity.<sup>12</sup> The rate of healthy behaviors among them was lower and also they had higher morbidity and mortality rates. However, we did not assess mortality and morbidity in the current study due to some limitations, which may be appropriate issues for further studies.

Vancampfort et al. in a review study reported a 1.5-fold higher risk of low physical activity and nonhealthy behaviors in bipolar cases compared to the general population.<sup>13</sup> Male subjects, unmarried subjects, nonemployed subjects, low-literacy patients, high-BMI cases, low physical fitness, and those with longer duration of disease were more probable to have inappropriate health habits. In our study, age, BMI, and sex in the patients affected some factors. Feli et al compared Iranian patients with bipolar disorder and schizophrenia and reported inappropriate physical activity in 37% and 30% of them, respectively.<sup>14</sup> Additionally, the amount and length of physical activity were lower in the schizophrenia group. Correspondingly, in our study, low physical activity was seen in bipolar cases.

Many modifiable lifestyle factors increase the risk of metabolic syndrome among patients with bipolar disorder.<sup>15</sup> Physical activity was low in 43% and 29% of bipolar cases and the general population, respectively; however, no significant difference was observed. A limitation in our study was no assessment of dietary habits. Vancampfort et al. compared 30 bipolar and 30 healthy subjects and reported that speed of limb movement, explosive leg muscle strength, and abdominal muscular endurance were lower in bipolar subjects.<sup>16</sup> In addition, those with a longer duration of disease and higher BMI were more probable to have inappropriate physical activity. In our study, the somatic abilities in the bipolar cases were low, which can be affected by body mass index. This study demonstrated that fat percent and BMI do not differ with healthy subjects, but the physical fitness factors are worse in bipolar cases.

Hence, using preventive approaches, the risk of cardiovascular disorders may be decreased and the prognosis may be improved. In our study, some confounding factors were not assessed due to some limitations, but there was a good predictive ability that may be divided on various variables. However, performing further studies with a larger sample population and multicenter sampling can help in attaining more definite results as well as higher power for generalizing the results.

Also, the results showed that push-up was associated with the severity of the disease and decreased performance. Therefore, the severity of the bipolar disorder can be determined by performing this exercise test. In other words, push-up test can be used as a screen test to estimate the severity of the bipolar disorder.

The push-up test requires proper contraction in postural muscles. Postural muscles are composed of Type1 fibers that are degraded and decreased in chronic diseases. So, the results of push-up test in

bipolar patients can be considered as a reduction in this group of muscles. With the reduction of these muscles, a decrease in daily function is also seen.

## 5 | CONCLUSION

Bipolar disorder is a common type of mood disorder. Bipolar patients are exposed to further risks of cardiac morbidity and mortality. It is not only due to mental illness and related problems but also due to a sedentary lifestyle and cardiovascular risk factors. Physical fitness and body composition are measured for cardiovascular risk factors. Body composition was analysed by a bioelectrical impedance device. The physical exercise stress test was performed using Bruce protocol. The Bruce treadmill protocol is an exercise test frequently used for adults by a motor-driven treadmill with the following 3-minutes stages. Sit and reach test, BMI, and fat percent in bipolar patients were not different compared with the healthy population. The push-up test, curl-up test, and VO<sub>2</sub> peak ( $P = .001$ ) were significantly lower in the bipolar patients. Lower push-up and curl-up can indicate an increase in both back and neck pains in these patients. This issue should be considered in future studies. Of note, a low VO<sub>2</sub> peak in these patients increases the risk of heart disease and mortality rates in bipolar patients.

Also, the push-up test can be an indicator of the severity of the bipolar disorder. In other words, push-up test can be used as a screen test to estimate the severity of the bipolar disorder.

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## CONFLICT OF INTEREST

The authors had no actual or potential conflicts of interest.

## AUTHOR CONTRIBUTIONS

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All authors have read and approved the final version of the manuscript.

Dr Ali Kheradmand and Amir Hossein AbediYekta had full access to all of the data in this study and takes complete responsibility for the integrity of the data and the accuracy of the data analysis.

## TRANSPARENCY STATEMENT

Amir Hossein AbediYekta affirms that this manuscript is an honest, accurate, and transparent account of the study being reported; that

no important aspects of the study have been omitted; and that any discrepancies from the study as planned (and, if relevant, registered) have been explained.

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