

# Effects of a multimodal physical exercise program on physical and mental health indicators in males with substance use disorder

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## ABSTRACT

**Introduction:** Substance use disorder (SUD) is seen as a serious and growing public safety and health problem worldwide. Long-term sequelae may involve permanent damage to physical fitness, body balance, and coordination skills, with a severe motor, functional, and emotional consequences. **Objective:** To verify the effect of 16 sessions of a multimodal physical exercise program on physical fitness, body balance, and internalized stigma of inpatients for the treatment of Substance use disorder. **Methods:** Forty-three males with Substance use disorder (aged 33.9±12.4 years) were divided into an Intervention Group (IG, n=21) and Control Group (CG, n=22). The IG was submitted to eight weeks of training with physical exercises. Participants were submitted to the evaluation of internalized stigma, body balance, agility, and flexibility, before and after the intervention period. **Results:** Positive results were observed in physical fitness (agility,  $p=0.001$ ) and body balance variables (center of pressure path with closed eyes,  $p=0.050$ , and ellipse area with closed eyes,  $p=0.031$ ). The time of substance use correlated with lower performance in agility and body balance tests. **Conclusion:** The data seem to support the potential benefit of physical exercise as an adjunct in Substance use disorder rehabilitation process, particularly for physical fitness and body balance variables.

**Keywords:** substance-related disorders; physical exercise; physical fitness; stereotypic movement disorder; social stigma.

## INTRODUCTION

Alcohol and illicit drug addiction is a severe public health problem, reaching 0.6% of the global adult population<sup>1,2</sup>. The problems arising from substance abuse can lead to chronic health problems<sup>3</sup>, which are also influenced by the type of substance consumed, time and patterns of use/abuse, age, sex, nutritional status, and biological individuality<sup>4,5</sup>.

The long-term impact of substance use disorder (SUD) can lead to a significant decrease in fitness levels that is related to the quality of life and general health of these individuals<sup>6,7</sup>, affecting cardiorespiratory and muscular fitness<sup>8</sup> and body composition<sup>9</sup>.

Additionally, coordination skills can be negatively impacted by long-term alcohol and illicit drug use, such as reaction time, hand-eye coordination, and body balance<sup>10,11</sup>.

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Alterations in the vestibular apparatus and cerebellum function due to the consumption of these substances could cause symptoms such as vertigo, dizziness, and loss of balance, impairing autonomy and quality of life<sup>12</sup>.

SUD can also have negative effects on mental health as it is consistently associated with a higher prevalence of psychiatric comorbidities such as mood disorders, anxiety, depression, and an increased risk of suicide<sup>13</sup>. One indication of mental health status is the internalized stigma, which reflects the individual's perception of devaluation, loss of nutritional status, and consequent discrimination triggered by the attribution of negative stereotypes related to their physical and personal characteristics, which are considered socially unacceptable<sup>14</sup>. The internalization of stereotypes can damage the individual's rehabilitation, generating limited prospects for recovery, thereby reinforcing social isolation and hesitation to seek professional help and appropriate treatment for their condition<sup>15</sup>.

There is strong evidence that exercise can be an effective adjunctive treatment method for patients abstaining from alcohol, nicotine, and illicit drugs, aiding recovery and reducing relapse rates<sup>5,13,16,17</sup>. Physical exercise, in this sense, would act beneficially by increasing abstinence rates, attenuating the symptoms of craving caused by the abrupt withdrawal of the substance, as well as reducing anxiety attacks and depressive symptoms<sup>18</sup> and improving treatment adherence<sup>19</sup>. In addition to promoting substantial mental health benefits, exercise also works to improve indicators of physical fitness and attenuate body balance disorders<sup>7,20-22</sup>.

Thus, the aim of the present study was to analyze the influence of an eight-week multimodal exercise program on body balance variables, indicators of physical fitness, and internalized stigma in inpatients treated for Substance use disorder. The data obtained were also related to some intervening variables, such as type of substance consumed and time of substance use.

## METHODS

### Participants

The study included 43 males (33.9±12.4 years) who were undergoing a therapeutic process of voluntary hospitalization for the treatment of SUD in two institutions in a city located in south Brazil. Participants were divided into two groups: Intervention Group (IG), with 21 individuals (35.57±16.64 years) and, Control Group (CG), composed of 22 individuals (32.36±11.26 years). The division of individuals into groups occurred for convenience; those hospitalized in the institution that offered a regular physical exercise program within the therapeutic program were considered for the IG. A sample size of 38 individuals was estimated by the G\* Power 3.1.9 software for a power (1-β) of 80%, a one-tailed significance level (α) of 0.05, and a high effect size (d=0.8).

Participants were consulted and subsequently released by the institution's psychiatrist for participation in the tests and exercise program through standardized medical evaluation criteria. Individuals with motor or cognitive impairment were excluded from the study. Participants were evaluated after the first two weeks of hospitalization to avoid acute withdrawal symptoms. After being informed about the research procedures, the participants signed an informed consent form agreeing to participate. The study was approved by the Institutional Human Research Ethics Committee (Process 2.125.747/2017).

### Procedures

Evaluations were performed on two successive days, at two moments, immediately before and after an intervention period of eight weeks. On the first day all, subjects answered an anamnesis with information on age, education, type of substance consumed [Alcohol, Illicit Drugs, or Polysubstances (alcohol + illicit drugs)], time of abuse, use of medication, and regular participation in any program of physical exercise before hospitalization. To assess internalized stigma, the ISMI-BR *Internalized Stigma of Mental Illness*, the Brazilian version, was used. The scale consists of 29 items, ranging from totally disagree (1) to totally agree (4)<sup>15</sup>. The higher the score, the higher the level of internalized stigma, with average scores above 2.5 denoting high internalized stigma<sup>23</sup>. On the second day, anthropometric variables were measured: body weight, height, and waist circumference. From the body mass and height values, the BMI (body mass index) was calculated.

Subsequently, participants performed the balance test in a static position using a myoPressureNoraxon<sup>®</sup> plantar pressure platform. During the test, the subjects remained in the bipedal support position for 30 seconds in two distinct conditions - open (OE) and closed (CE) eyes. Data were recorded, stored, and analyzed with Noraxon<sup>®</sup> myoRESEARCH 3.10 software. To assess balance, we considered the COP (Center of Pressure) path length (i.e., the distance covered by the COP in mm during the test), the COP velocity (variation in the displacement of the COP mm/s), and the ellipse area (area covered by the COP in mm<sup>2</sup> on the mid-lateral and anteroposterior axes, using an ellipse to adjust the data). The lower the values recorded in the variables, the better the balance.

After the balance test, participants performed a sit-and-reach test (SRT) using a specific bench<sup>24</sup> to verify the flexibility of the posterior kinematic chain. They also completed the T-test for agility, proposed by Pauole *et al.*<sup>25</sup>. The total course of the test is 40 meters covered in a T format, and the shortest time of two attempts performed was considered (in seconds).

The IG completed a physical exercise intervention for eight weeks, thus totaling 16 sessions of a multimodal program, with each session lasting approximately 50 minutes. Only

individuals who participated in the 16 exercise sessions were included in the study. The sessions focused on the development of localized muscular strength, flexibility, balance, general motor coordination, relaxation, memorization and concentration exercises, body awareness, laterality, and spatial perception. Cooperative, competitive, and recreational games were used as strategies and localized physical exercises, performed individually and in groups. The CG was instructed to carry out their usual routine activities, without any regular physical activity practice.

### Statistical Analysis

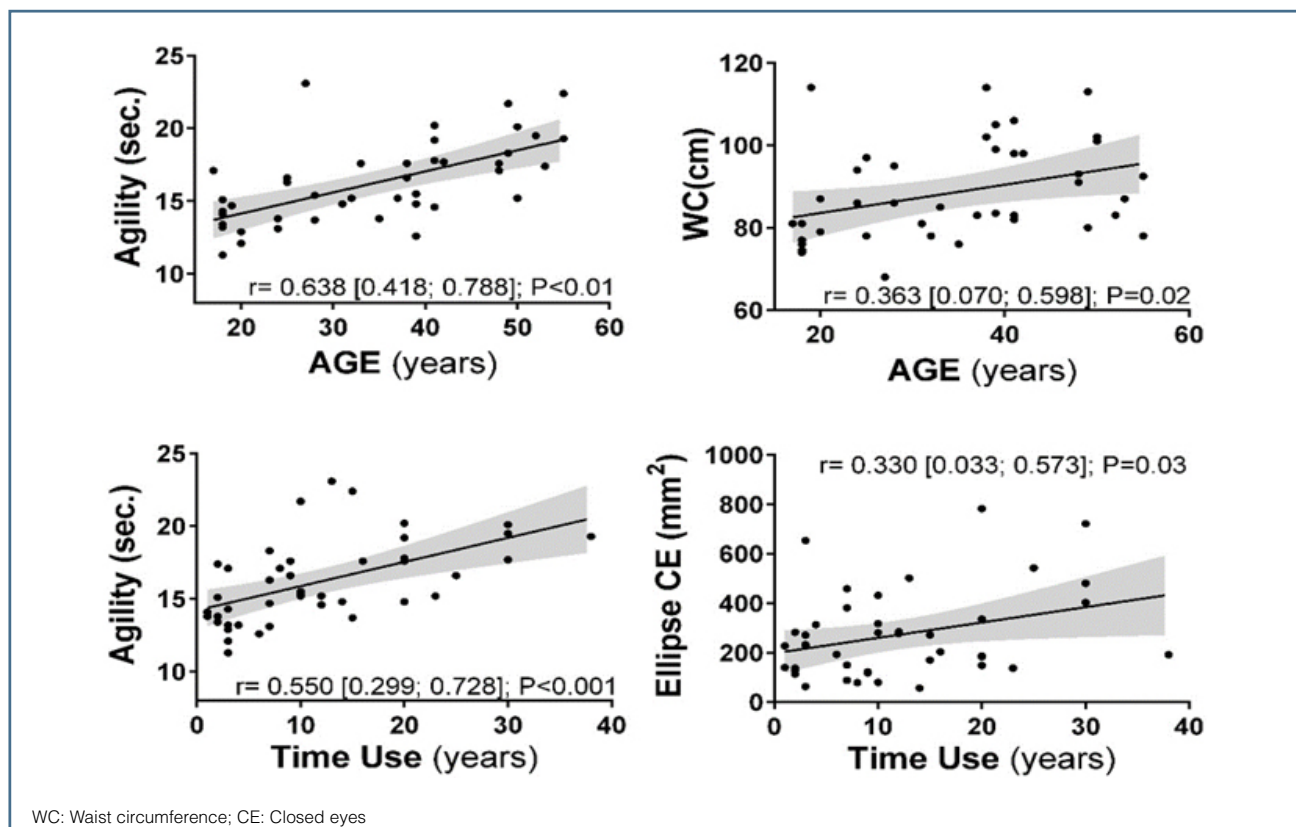
Descriptive statistics were calculated. The independent t-test was used to compare groups before the intervention. Data between groups were compared using two-way repeated-measures analysis of variance (time x group). To correct the initial difference in the Ellipse OE variable, a two-factor repeated-measures covariance analysis (time x group) was applied, considering baseline values as covariates. The effect size between groups (Cohen's *d*) was calculated and interpreted as follows:  $d < 0.20$  trivial,  $d = 0.20-0.59$  small,  $d = 0.60-1.19$  moderate,  $d = 1.20-1.99$  large,  $d = 2.00-3.99$  very large, and  $d \geq 4.0$  almost perfect. The Spearman correlation test was also performed. A level of significance of  $< 0.05$  was adopted.

### RESULTS

The larger part of the sample (48.8%) was constituted by individuals with polysubstance abuse (alcohol + illicit drugs) 51.2% presented drug consumption longer than 10 years, and 48.9% had low education (incomplete elementary 16.3%, complete elementary 32.6%). The great majority (81.4%) did not practice regular physical exercise before hospitalization. No differences were observed at baseline between the intervention and control groups, except for the ellipse area with closed eyes ( $p = 0.005$ ).

Positive relationships (Figure 1) were found between age and time in the agility test ( $r = 0.638$ ;  $p < 0.001$ ) and waist circumference ( $r = 0.363$ ;  $p < 0.02$ ), indicating that advancing age is related to an increase in both variables. The time of substance use showed a positive relationship with time in the agility test ( $r = 0.550$ ;  $p < 0.001$ ) and the ellipse area with closed eyes ( $r = 0.330$ ;  $p < 0.005$ ), indicating a worse result for those who presented a more significant time of substance use (Figure 1).

Table 1 illustrates the pre- and post-intervention data of the IG and CG, highlighting the significant differences observed between the groups and between the measures. It is noteworthy that at baseline, the two groups were homogeneous, presenting differences only in the variable ellipse area with closed eyes, with the best results at that moment displayed by the control group. After the intervention period, significant differences were found only for the IG in



**Figure 1:** Correlations between variables at baseline [ $r$  ( $p$ )]

waist circumference, agility, flexibility, COP path, and ellipse area with closed eyes. Additionally, a reduction was observed in COP Path (ES=-1.99, p=0.38) and COP Vel with closed eyes (ES=-1.48, p=0.35), with a large magnitude only for the intervention group.

The variance analysis did not reveal any significant difference when comparing individuals who practiced and those who did not practice physical activity in the month preceding hospitalization and those who used or did not use psychotropic medication.

When compared according to the type of substance consumed, only the agility variable showed significant differences both pre- and post-moments, always with the group who consumed only alcohol presenting the worst results (Pre: Alcohol - 18.4±3.0 s; Cocaine/crack - 14.9±2.1 s; Polysubstances - 15.4±2.2 s, Post: Alcohol - 17.7±2.7 s; Cocaine/crack -14.5±2.1 s; Polysubstances - 14.9±2.3 s) (Table 1).

## DISCUSSION

The aim of the study was to verify the influence of a physical exercise program on physical fitness variables and the internalized stigma of individuals hospitalized for the treatment of Substance use disorder. It was the observed possible beneficial effect of exercise on body balance and flexibility and a negative relationship between substance use time and body balance. Next, the study's descriptive data will be discussed, followed by inferential data.

Among the study participants, there was a prevalence of normal-weight individuals with low education who used polysubstances (alcohol + illicit drugs). As in many cases, the onset of SUD begins at an early age<sup>2</sup>, and there is a general tendency for

individuals to wait a long time before seeking treatment. This fact is more frequently verified among alcohol users since this substance is considered legal and socially well accepted in our society<sup>6</sup>. Another fact that may be triggered by the early onset of substance use is low education since in these situations disinterest and dropping out of school at younger ages are common<sup>9</sup>.

Regarding BMI and waist circumference data, the study participants were generally classified as average weight, consistent with other data obtained in the literature in studies involving individuals with chemical dependence<sup>9</sup>. Especially in the early stages of the rehabilitation process, the manifestation of dysfunctional eating patterns and excessive weight gain due to abstinence are common, a process known as rebound hyperphagia<sup>7</sup>, which could be a strategy to reestablish the brain reward mechanism. For this reason, physical exercise would be indicated to prevent possible excessive weight gain, which could negatively affect individuals' health<sup>7</sup>.

The literature points to a relationship between SUD and neurological damage due to cerebellar atrophy and reduced activity in the pre-frontal cortex, especially for individuals with longer dependence and more excessive drinking patterns<sup>12</sup>, negatively interfering with motor and cognitive abilities. In addition, Flemmen and Wang<sup>8</sup> underlined that many drugs, including alcohol, cause dizziness as a side effect, negatively influencing motor skills, encompassing tasks that involve simple reaction time, motor coordination, and body balance.

Exercise is suggested to improve brain mechanisms responsible for inhibitory control, reducing craving by substance use<sup>26-28</sup>. In addition, exercise can act to attenuate possible cognitive losses resulting from chronic substance abuse and positively influence the coordinative capacities of individuals with SUD<sup>6</sup>.

**Table 1:** Group comparisons at pre- and post-intervention moments

	Control				Intervention			
	Pre	Post	p	ES (SE)	Pre	Post	P	ES (SE)
BMI	25.16±4.53	25.61±4.52	0.269	0.10 (0.30)	23.59±4.19	24.13±3.57	0.195	0.14 (0.31)
WC	89.45±2.52	90.82±2.32	0.114	0.56 (0.31)	87.21±2.58	89.17±2.37	0.035	0.78 (0.32)
Flexibility	21.36±7.97	21.82±8.3	0.401	0.05 (0.30)	23.1±7.1	24.67±6.37	0.007	0.22 (0.30)
Ellipse OE	169.2±23.4	134.09±27.3	0.200	-1.36 (0.33)	236.5±28.9	189.38±28.1	0.095	-1.63 (0.36)
COP Path OE	222.5±21.7	201.2±26.0	0.367	-0.88 (0.32)	230.9±22.2	224.67±26.7	0.797	-0.25 (0.31)
COP Vel OE	7.5±0.73	6.86±0.83	0.365	-0.80 (0.31)	7.57±0.75	7.33±0.85	0.739	-0.29 (0.31)
Ellipse CE	271.1*	266.5±24.8	0.852	-0.25 (0.30)	271.1*	261.2±25.5	0.031	-0.54 (0.31)
COP Path CE	324.4±36.21	292.0±23.1	0.299	-1.04 (0.32)	346.3±37.4	282.8±23.7	0.050	-1.99 (0.38)
COP Vel CE	10.86±1.28	9.95±0.87	0.373	-0.82 (0.31)	12.1±1.29	10.43±0.89	0.114	-1.48 (0.35)
Agility	15.86±2.26	15.47±2.27	0.058	-0.17 (0.30)	16.49±3.35	15.78±3.13	0.001	-0.21 (0.31)
ISMI-BR	2.59±0.33	2.6±0.35	0.869	0.03 (0.30)	2.56±0.42	2.55±0.47	0.940	-0.02 (0.31)

BM: body mass; BMI: body mass index; WC: Waist Circumference; ISMI-BR: OE: open eyes; CE: closed eyes; ANOVA repeated measurements (time\*group); P: time comparisons for each group; P (C<sup>1</sup>) group comparisons for each moment; ES: effect size; SE: standard error. \*Covariance analysis for pre-set values adjustment

Recent reviews involving intervention studies reinforce the beneficial effects of physical exercise in individuals with SUD<sup>14,29-31</sup>. Although the authors carefully analyzed the results due to the heterogeneity of the proposed interventions, it is possible to highlight improvements in cardiorespiratory fitness, muscle strength, anxiety levels, and depressive symptoms<sup>32</sup>. A trend towards a reduction in long-term consumption, increase in abstinence, and improvement in treatment adherence were also verified<sup>19,26,33</sup>.

In this sense, exercise is seen as a potentially beneficial and cost-effective non-pharmacological adjuvant strategy for the treatment of SUD<sup>7,13,21,30,34,35</sup>. However, in practice, a highly medicalized rehabilitation process from SUD is still observed<sup>21,34</sup>, often not including the practice of physical exercise as a therapeutic routine.

The data from the present study reinforce the beneficial potential of physical exercise in a therapeutic program for SUD. It could be speculated that withdrawal from the drug alone could already have generated the observed benefits. However, the control group, with the same period of abstinence, did not demonstrate significant improvements in the evaluated variables, which seems to reinforce the potentially beneficial role of physical exercise. These data are particularly positive considering the relatively short intervention period (only eight weeks). Thus, it is noteworthy that a physical exercise program included in the usual residential treatment of patients could bring relevant improvements in variables related to physical fitness and body balance, especially in abilities more dependent on neurological controls, such as agility and body balance.

No studies were found involving the influence of exercise programs in individuals with SUD on the variables considered in the present study. However, the cross-sectional study by Malagodi *et al.*<sup>6</sup> showed a positive association between regular exercise in the 30 days prior to hospitalization for the treatment of SUD and the agility test results, suggesting that a physically active lifestyle may be beneficial for this variable. Furthermore, studies conducted with individuals with no history of SUD but with deficits in body balance also demonstrate beneficial effects of supervised exercise programs on this variable, especially those involving exercises for muscle strength, motor coordination, and static and dynamic balance<sup>36,37</sup>.

Correlation analyzes showed significant relationships between age, substance use time, and agility test time. Thus, older individuals with a longer time of SUD demonstrated worse results in this variable since the shorter time obtained in the test refers to the best performance. However, the only variable that was significantly related to body balance (ellipse area with closed eyes) was the time of substance use. The data showed that the longer the use of substances, the worse the performance in body balance tests. Other studies with individuals with SUD have also pointed out that longer substance abuse time is related to higher deficits in body balance<sup>12,27,28</sup>, which indicates the importance of effective therapeutic interventions that reduce the risk of relapse and prevent permanent damage to the individual's health.

Regarding the results obtained in the application of the ISMI, 67.4% of the participants reported high levels of internalized stigma. This fact should be carefully considered by the rehabilitation team, as it can negatively impact treatment adherence, quality of life, and the process of social reintegration<sup>14</sup>. The mean values of internalized stigma obtained in the present study are higher than others which analyzed patients with schizophrenia<sup>38,39</sup> and with other psychiatric diseases<sup>40</sup>, probably because that SUD is still seen by many people not as a disease, but as inappropriate behavior, product of dysfunctional habits, or lack of character<sup>15</sup>. In addition, individuals with SUD are viewed socially as dangerous, violent, and unpredictable, which ultimately restricts opportunities and social networks as they anticipate rejection, which evokes feelings of shame, guilt, and perceived discredit<sup>15,40</sup>.

The present study has clinical implications that deserve to be highlighted. Most clinics for the treatment of SUD in Brazil still do not offer physical exercise programs in their service. The data collected in the study demonstrate that a short-term exercise program can promote beneficial changes in agility and body balance, which can have a very positive impact on the quality of life of individuals.

Despite this, the study has some limitations that must be mentioned, such as the small number of participants, especially when subdivided by type of drug consumed. In addition, body balance was evaluated only in a bipedal support position, and it is known that this type of test presents considerable variability between attempts. However, the data found here can be considered new since no other studies analyzing the effect of exercise intervention programs on the agility, balance, and internalized stigma of individuals hospitalized for SUD treatment were found in the literature. Thus, the information presented may offer subsidies to reinforce the need to create specific intervention programs involving the practice of physical exercises.

## Conclusion

Data collected in this study indicate that an eight-week physical exercise program can provide positive results in selected fitness and body balance variables. In addition, the time of substance use was shown to be related to poor performance in agility and body balance, which once again underlines the need for early and effective treatment interventions.

The increasing number of SUD cases worldwide, associated with the negative sequelae entailed in the health of individuals, highlights the demand for further studies involving the effects of exercise programs on the physical and mental health of this population. Combined with conventional therapy, physical exercise can represent a safe and effective short-term alternative, both for alleviating the physical, psychological, and cognitive sequelae related to SUD, as well as for prolonging abstinence and incorporating a healthier lifestyle, increasing the chances of treatment success.

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