

The Effectiveness of Aerobic Training on Psychological Well-Being of Children with ADHD

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Submitted: 2021-08-23; Accepted: 2021-12-19; Doi: <https://doi.org/10.22037/jcpr.v7i1.38499>

Abstract

Introduction: Children with attention-deficit/hyperactivity disorder (ADHD) face many psychological and social problems. This study aimed at investigating the effect of aerobic exercises on the components of psychological well-being of children with ADHD. **Materials and Method:** For this study, a sample of 30 children diagnosed with ADHD from Qum city was selected by simple convenience sampling and then divided into 2 fifteen-member groups of experimental and control. After that, aerobic exercise training was performed on the experimental group during an eight-week period, three-45 minute session per week. No exercise intervention was applied to the control group. Data analysis was performed using multivariate analysis of covariance via SPSS-22 software. **Results:** The results of comparing the psychological well-being scores in the post-test compared to the pre-test show a significant increase in the test group after performing aerobic exercises. **Conclusion:** Aerobic exercise seems to be a suitable treatment strategy without side effects to improve and enhance the psychological well-being of children with ADHD. This finding emphasizes the need for physical activity.

Keywords: ADHD; Aerobics; Psychological; Well-Being

Please cite this paper as: Shakib Z, Froumandi S, Nemati S, Khodadadi N, Gholamhoseinpour H, Akbari M. The Effectiveness of Aerobic Training on Psychological Well-Being of Children with ADHD. J Clin Physio Res. 2021; 7(1): e59. Doi: <https://doi.org/10.22037/jcpr.v7i1.38499>

Introduction

Attention deficits hyperactivity disorder (ADHD) is one of the most common neurodevelopmental disorders in children (1). The prevalence of this disorder among Iranian school-age children and adolescents is estimated between 4.2 to 6.3% (2). These children are not usually able to focus on a task, have a slow learning speed, and abnormally physical activity in comparison with their peers. This disorder is defined as impaired attention, impulse control (regardless of behavioral outcomes), and restlessness that are not due to neurological, sensory, motor, or emotional disorders (3). It is a chronic disorder which its symptoms often remain with age in children in a way that more than 50% of them still have some symptoms in adolescence. This

disorder is also recognized as a risk factor for many mental disorders that can negatively affect the mental health of these children (4).

ADHD is known as the most common mental disorder in children. Previous research has shown that children with this disorder have high-risk and critical psychological problems such as aggression, antisocial behaviors, self-harm, and substance abuse (5). Moreover, these children face many problems at school, such as not doing their homework, being easily distracted in class, dropping out of school, and being rejected by their classmates (6). Unfortunately, these problems endure in many of these children, and in adolescence and the youth. They face other problems such as not getting a good job, low socio-economic status, and lack of solidarity with other people (7).

Therefore, given the above-mentioned, these children not only have lower life satisfaction and psychological well-being compared to their normal peers in childhood (8), but also due to the chronic nature of this disorder and the persistence of its symptoms in adulthood, they have lower resilience, physical health, and psychological well-being (9).

Low psychological well-being is associated with depressive symptoms, violent behaviors, and social and psychological problems such as suicide, suicidal thoughts, low self-esteem, and poor interpersonal relationships (10). High psychological well-being in life is an important factor for growth, maintaining health, and prevention of many psychological disorders (11). Regarding to this, Ryff (12) considers six components for psychological well-being, including 1: self-acceptance (accepting different aspects of self and having a positive attitude towards oneself, life, and the past), 2: effective relationships with others (ability to love, sincere, and trusting relationships with others, and the ability to empathize), 3: independence (activity and action based on personal criteria and the ability to undergo deal with social pressure), 4: environment dominance (creating or selecting the environment according to the children mental condition and control of external activities), 5: purposeful life (having a purpose in life and finding meaning in life), and 6: personal growth (feeling of constant growth and trying to show existential capabilities in human). According to what have been said, it can be concluded that children with ADHD are prone to a wide range of mental disorders. Therefore, these children need different types of pharmacological and non-pharmacological treatments (12).

Although the most common type of treatment for reducing the symptoms of ADHD is using of medicines such as Ritalin (13), because of the side effects of such medicine including sleep disorders, irritability, unexplained emotional states, and mania accompanied by suicidal impulses, the use of non-drug therapies also seems necessary. One of these effective non-pharmacological interventions is doing exercise on a regular basis (14).

Aerobic exercise with its rhythmic movements is one of the most popular and low-cost exercises that causes freshness by doing daily exercises with music and rhythmic movements. This exercise improves the physical and mental health of children by its effect on cognitive processes as well as accurateness, perception, concentration, neuromuscular coordination, development of personal relationships, and social skills (15). Therefore, it seems to be one of the effective treatments in reducing the symptoms of the disorder in children with ADHD. Exercise has been considered a potential adjunctive intervention in improving cognitive-psychological well-being, functional

performance, emotional development, and motor development in people with ADHD (16). One of the assumptions involved in the etiology of this disorder is the hypothesis of low arousal, which leads to hyperactivity and lack of attention as the result of the failure of insufficient arousal by the stimulus to pay attention to them and regulate the level of activity (17). Based on this hypothesis, it may be argued that interventions such as aerobic exercise, which can increase the level of arousal and desire in these children, alleviate the symptoms of the disorder to some extent (18). As a result, it can be inferred that aerobic exercise can be an effective factor in increasing desire, reducing the symptoms of the disorder, and promoting the psychological well-being of these children (19). Because physical exercise is a pleasant factor in encouraging these children, satisfies the need for mobility of these adolescents to some extent, and also increases the secretion of neurotransmitters, it can be used as a complementary or even alternative treatment (20).

Because ADHD is one of the most common mental disorders and these are prone to a wide range of different types of other acute mental disorders associated with their disorder and have significantly lower psychological well-being and educational performance compared to normal children, it seems necessary to use treatments which help improve both their mental and educational status without side effects such as medication. Therefore, this study aimed to investigate the effect of aerobic exercise on the psychological well-being of children aged 12 to 15 years with ADHD.

Materials and Method

The present study was approved by the Ethics Committee of the Islamic Azad University, Qom Branch, with the ethics code of IR.IAU.QOM.REC.1399.033. The research method was quasi-experimental with a pretest-posttest design and one control group. For sampling, all families with children with ADHD in Qom were first invited by a public call through social networks such as Telegram, WhatsApp, and Instagram to come to a sports club, where 97 people volunteered to participate in the study. All children were assessed using the Raven IQ test and only children with a score above 100 were selected. After collecting, the children and their parents were informed about the aims and details of the research and were assured that all ethical criteria in the research, such as confidentiality and anonymity, would be observed and participants would have the right to give up the research at any stage they like.

Among the most important inclusion criteria in this study was having ADHD, absence of acute psychiatric disorders which

disrupts the research process like psychotic disorders, age range between 15-12 years, use of Swanson, Nolan, and Pelham Scale (SNAP), no orthopedic problems, the parent's and children's consent to participate in research, and living in the city of Qom. Also, the lack of accurate and complete answers to the questions of the questionnaires, and giving up participation were among the exclusion criteria of the study.

ADHD checklist and Raven IQ tests were performed on all volunteered children. Then, using a simple convenience sampling method, 30 children who showed symptoms of ADHD and had moderate intelligence was selected as the research sample. Random allocation in clinical trial studies refers to the process of dividing participants into different groups at random. Successful randomization requires that researchers and study participants be unable to predict the type of intervention received. The first step in performing a random process is to create a random sequence. The second step after creating a random sequence is to hide the generated sequence called random allocation hiding. The purpose of concealing random allocation is to prevent any prediction of future allocation by participants and researchers. This prevents children from assigning to each group based on the intervention prognosis or participants' inclinations by researchers. In the present study, 15 people were randomly assigned to each group.

After performing the pre-test and selecting the control and experimental groups, the participants in the experimental group were exposed to the aerobic exercise, but no intervention was applied to the control group. At the end of the project, the participants of the experimental and control groups were retested. The aerobic exercise program lasted eight weeks, three sessions per week, and each session lasted 45 minutes. In each session, first, the body was prepared by warming up and stretching movements, then the low-impact and high-impact blocks of aerobics were performed, and at the end, a few minutes were allocated to return to the initial state and the activity was terminated with stretching movements.

Outcome measures

Reef psychological well-being: This questionnaire has 18 items and its purpose is to evaluate psychological well-being in different dimensions (independence, environment dominance, personal growth, positive relationship with others, purpose in life, and self-acceptance). Its scoring is on a six-point Likert scale. To get the score of each dimension, the total score of that dimension is added up, and to get the total score of the questionnaire, the total score of each question is summed. Higher scores indicate higher psychological well-being in the

respondent and vice versa. In Khanjani's *et al.* study, the results of a one-group confirmatory factor analysis showed that six-factor model of this scale (self-acceptance, environment dominance, positive relationship with others, purpose in life, personal growth, and independence) had a good fit. Internal consistency of this scale using Cronbach's alpha in 6 factors of self-acceptance, environment dominance, positive relationship with others, purpose in life, personal growth, and independence were equal to 0.51, 0.76, 0.75, 0.52, 0.73, and 0.72, respectively, and for the whole scale was 0.71 (22). This questionnaire was first developed in 1989 by Ryff. Its reliability For ADHD community by Cronbach's alpha was 0.81 (23).

Raven IQ test: This test developed in the UK was designed to measure Spearman's general intelligence. Answering this test requires discovering the relationship between geometric shapes. Revised forms of this test are used to measure the intelligence of people with different levels of ability (children 5 years and older). This test consists of 36 colored images, each with a blank. At the bottom of each image, there are six options, one of which can fit the blank to complete the incomplete image. Raven test has a reliability coefficient of 0.80 to more than 0.90. The correlation coefficient of this test with the Stanford Binet test was 0.60, with Wechsler was 0.70, and with Wechsler verbal test was 0.58 (24).

Swanson, Nolan, and Pelham Scale (SNAP): This scale is used to screen ADHD. This scale was first developed in 1980 by three authors named Swanson, Nolan, and Pelham based on the diagnostic and statistical manual of mental disorders and is known by the initials of the test creators, namely SNAP. Concurrently, with the revision of the diagnostic guidelines and the editing of the fifth edition, the scale was rewritten and published in 2001. SNAP includes 18 items for ADHD, which fall into two sets of symptoms for ADHD. This scale uses a four-point scale (absolutely=0, little=1, somewhat=2, very much=3) (25). The first option states no psychological damage. In Iran, the validity and reliability of the parent version of this scale were performed on children aged 7 to 12 years in Tehran (Sadrosadat *et al.*). The findings of that study showed that the criterion validity of the test was 0.48 and the reliability coefficient of test-retest was 0.83, Cronbach's alpha was 0.90, and the split-half method was 0.76 (26).

Statistical analysis

Shapiro-Wilk test was used to check the normality of data distribution. According to their normal distribution, data analysis was performed using multivariate analysis of covariance using SPSS-22 software in significant level of 0.05.

Table 1. Demographic profile of participants

Variables	Sub-variable	Frequency	Percentage
sex	Boy	16	53.33
	Girl	14	46.66
Grade	Middle school	24	80
	High School	6	20
Range of Age	12-13	19	63.33
	14-15	11	36.66
Mental Disorder	Without Another Mental Disorder	21	70
	History of outpatient mental disorders	9	30

Table 2. Mean (SD) of descriptive information of psychological well-being by assessment stage in groups

Variables	Group	Pre-test	Post-test
Self-acceptance	Experimental	8.33(2.23)	13.13(2.56)
	Control	8.87(2.50)	8.67(3.70)
Positive relationship with others	Experimental	9.87(2.39)	12.80(2.11)
	Control	9.17(2.24)	8.27(3.51)
Independence	Experimental	8.33(2.44)	12.67(2.19)
	Control	7.20(1.57)	6.37(2.49)
Environment dominance	Experimental	10.33(2.69)	12.80(1.82)
	Control	9.53(2.03)	8.80(3.50)
Purpose in life	Experimental	9.33(2.53)	11.80(2.01)
	Control	9.13(2.17)	8.53(2.95)
Personal growth	Experimental	9.67(1.35)	14.13(2.56)
	Control	9.87(2.50)	9.67(3.70)
Intelligence	Experimental	100.40 (20.16)	121.20 (22.47)
	Control	101.20 (15.90)	117.34 (17.69)

Results

Based on the results of this study, sixteen boys and 14 girls participated in the study and its demographic characteristics are listed in Table 1. The assumption of homogeneity of regression slopes means that the regression coefficient of the dependent variable on the covariate variables is the same in the groups. According to the output of the analysis of covariance to examine the homogeneity of regression coefficients, it was observed that the interaction between the experimental and companion variables (pre-test) is not significant; therefore, the slope of the regression line is the same for both experimental and control groups. Also, the results of the F-Levene's test showed that the assumption of the equality of variances for all variables is valid ($P>0.05$). Descriptive data of the components of psychological well-being are presented in Table 2 for pre-test and post-test in experimental and control groups.

As observed in Table 2, the mean of the experimental

groups in the post-test showed a change compared to the pre-test. Based on the results, aerobic exercises has changed psychological well-being of children with ADHD compared to the control group.

Based on results of Table 2, after removing the pre-test effect by multivariate analysis of covariance, there was a significant effect for the intervention of aerobic exercise. This effect indicated that there was a significant difference between at least one of the components of psychological well-being in the experimental group (Wilkes lambda=0.42, $P<0.05$).

The results of Table 3 demonstrated that by eliminating the effect of the pre-test variable, the research hypothesis, there was a significant difference in the variables of self-acceptance, positive relationships with others, independence, environment dominance, purpose in life, and personal growth of children in the experimental group and control group, is confirmed. He results of Table 3 show that eliminating the effect of the pre-test variable which states that there is a significant difference in the

Table 3. Multivariate analysis of covariance of psychological well-being in two groups

Statistical index	Test	Value	F	Hypothesis df	Error df	Sig.	Eta coefficient
Differences between the two groups with control of the pretest effect	Pillai effect	0.991	35.249	12.000	4.000	0.002	0.991
	Lambda Wilkes	0.991	35.249	12.000	4.000	0.002	0.991
	Effect of Hotlling	105.748	35.249	12.000	4.000	0.002	0.991
	The largest root on	105.748	35.249	12.000	4.000	0.002	0.991

Table 4. One-way analysis of covariance in multivariate analysis of covariance

Statistical index	Change resource	Total squares	df	Mean squares	F	Sig.	Eta coefficient
Self-acceptance	Group	65.10	1.00	65.10	14.10	.0001	0.49
	Error	69.24	15.00	4.62			
Positive relations with others	Group	51.25	1.00	51.25	10.61	0.001	0.41
	Error	72.44	15.00	4.83			
Independence	Group	196.16	1.00	196.16	25.14	0.001	0.63
	Error	117.04	15.00	7.80			
Environment dominance	Group	85.06	1.00	85.06	19.85	0.001	0.57
	Error	64.26	15.00	4.28			
Purpose in life	Group	22.69	1.00	22.69	3.79	0.070	0.20
	Error	89.88	15.00	5.99			
Personal growth	Group	65.10	1.00	65.10	14.10	0.001	0.49
	Error	69.24	15.00	4.62			

variables of self-acceptance, positive relationships with independence, environment dominance, purpose in life, and personal growth of children in the experimental group and control group, is confirmed. As the results in Table 2 demonstrate, the level of significance obtained for self-acceptance, positive relationships with independence, environment dominance, and personal growth compared to the level of significance (0.003) obtained from Benfroni correction is smaller. As a result, according to the obtained mean, it can be said that with 95% confidence self-acceptance, independence, positive relationships with others, environment dominance, and personal growth of the experimental group have changed compared to the control group.

Discussion

This study investigated the effect of aerobic exercise on psychological well-being in children aged 12 to 15 years with ADHD. The results showed that 12 weeks of aerobic exercise had a significant positive effect on five components of psychological well-being in the experimental group. These results are in line with the findings of Hui and Choi, who showed aerobic exercise

had a positive effect on the psychological well-being of children with autism, and also with the results of Zargham and Shakib, Mendolsi *et al.*, and Christiansen *et al.*, who reported positive effects of aerobic exercise on psychological variables in children. (13, 15–17).

Christiansen *et al.* (16) found that athletic students in various sports achieve significant growth in psychological, emotional, and personality dimensions in addition to physical and body development. Also, sports and physical activities have a positive effect on personal curiosity and self-control, feeling of humour and hope, increased self-confidence, and healthily expressing emotions and feelings. In addition, regular exercise and physical activity create appropriate conditions to increase the sense of self-empowerment and self-worth, which helps increase psychological well-being, especially in children and adolescents (19).

Other influential reasons that may lead to the psychological well-being of children can be attributed to the non-competitive and non-threatening nature of this sport (27). Also, by doing this exercise, the hormone endorphins are produced in the body that causes vitality, the concentration of the mind, and increased intellectual creativity. In addition to a better feeling, endorphins may help strengthen new brain cells and prevent age-related disorders (27). Aerobic activities not only allow people to

communicate with each other in a happy environment, but also strengthen the self. Many of these activities have a playful aspect, which make people happy and communicate with the child inside. In addition, with many of these activities, inner feelings have the opportunity to emerge and people feel satisfied. The American Psychological Association noted that of the ADHD population, only 57% reported receiving treatment in the past 12 months, of which 80% received medication. Although drug therapy can improve some cognitive aspects of the disorder, important behavioral, emotional, and psychological dimensions of the disorder are not necessarily addressed. These findings confirm that people with ADHD have significantly lower levels of overall well-being (17).

Most studies examine the long-term effects of exercise on motor development and symptoms of ADHD. However, people with this disorder suffer significantly more from problems related to well-being and public health, including stress, sleep quality, sadness, anxiety, loneliness, alcohol use, drug abuse, and suicidal thoughts, which, unfortunately are largely ignored (8). Ghavamzadeh *et al.* in a study on women with AIDS found that aerobic exercise reduced the level of anxiety and depression in these people without disturbing the immune system and their psychological well-being was significantly improved. Therefore, doing these exercises can play a valuable role in increasing general health and reducing mental disorders in children (19).

This study had several limitations. One of the limitations was that the economic situation of parents was not considered. Also, the samples of this research were small. In addition, instead of using the clinical interview by a clinical psychologist or psychiatrist for a clinical diagnosis of ADHD, a questionnaire was used. Also, considering that this study only measured the effectiveness of aerobic exercise in children with ADHD, it should be used with caution in generalizing it to other groups. It is suggested that the economic and social status of parents be considered in future research. We also suggest that, other groups of children with different cultural, religious, and linguistic contexts are considered in future studies. Finally, for accurate diagnosis, in addition to the questionnaire, it is recommended to seek help from a mental health specialist such as a psychiatrist or clinical psychologist.

Conclusion

It can be said that aerobic exercise as a suitable treatment strategy without side effects seems necessary to improve and promote the psychological well-being of children with ADHD, which emphasizes the need for physical activity. Therefore,

physical activity such as aerobics can be one of the effective treatments to improve the mental health and well-being of children with ADHD. In this way, mental health providers can offer evidence-based physical activity interventions for people with severe mental illness. Consequently, it is suggested to use sports activities as a suitable alternative or complementary method along with many types of psychotherapy or medication.

Acknowledgement

Here, the authors consider it necessary to express their gratitude and appreciation to all people who participated in this research.

Ethical considerations

The present study has been approved by the Ethics Committee of the Islamic Azad University, Qom Branch with the ethics code number of IR.IAU.QOM.REC.1399.033.

Conflict of interest:

None

Funding support:

None

Authors' contributions:

All authors made substantial contributions to the conception, design, analysis, and interpretation of data.

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