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The impact of aerobic and balance exercises on anxiety and dizziness in post-COVID-19 patients: a randomised clinical trial

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Mohamed Ibrahim Mabrouk[1], Sahar Ahmed Abdalbary[2], Asmaa Foad Abdelmonem[3], Nadia Mohamed Abdelhakiem[4], Alaa Anwar Ahmed[5], Fathia Mostafa Gelany[6], Ahmed A. Abd El Rahim[7]

[1] Department of Physiotherapy, Faculty of Allied Medical Sciences, Applied Science Private University, Amman, Jordan
[2] Department of Orthopaedic, Faculty of Physical Therapy, Nahda University, Beni Sueif, Egypt
[3] Department of Biomechanics, Faculty of Physical Therapy, Cairo University, Galala University, Cairo, Egypt
[4] Department of Neuromuscular Disorders and its Surgery, Faculty of Physical Therapy, Deraya University, Minia, Egypt
[5] Department of Physical Therapy for Integumentary, Faculty of Physical Therapy, Egyptian Chinese University, Cairo, Egypt
[6] Department of Growth and Development Disorders in Children and its Surgery, Faculty of Physical Therapy, Merit University, Sohag, Egypt
[7] Department of Basic Science, Faculty of Physical Therapy, Merit University, Sohag, Egypt

Abstract

Introduction. Examine how aerobic exercises, relaxation techniques, and balance exercises affect patients' anxiety and dizziness post-COVID-19 patients.

Methods. Thirty participants post-COVID-19, complaining of anxiety and dizziness, aged 45–65 years, of both sexes, selected from the outpatient clinic of our hospital, were enrolled in the study after a COVID-19 infection. Treatment sessions were 3 times weekly for 4 weeks, and the patients were treated separately in group therapy. The 15 patients in group A were given aerobic, balancing, and relaxation techniques. The 15 patients in the control group (group B) were given only relaxation exercises. Assessments of the two groups were completed both before and after the course of treatment by the Hamilton Anxiety Scale (HAMA) and the Berg Balance Scale. Respiratory function was also assessed using maximum voluntary ventilation.

Results. There were significant differences between the two groups after the treatment. The mean values of the HAMA after treatment were 17.2 ± 1.7 and 21.7 ± 1.4 in groups A and B, respectively. After treatment, the mean values of the Berg Balance Scale were 26.7 ± 5.7 and 22.2 ± 3.6 in groups A and B, respectively. The mean values of maximum voluntary ventilation were 117.2 ± 16.7 and 108.1 ± 16.3 in groups A and B, respectively. Both groups showed a significant decrease in anxiety and dizziness and a significant increase in maximum voluntary ventilation at the end of the 4 weeks of the training program. Participants in group A showed a significantly greater decrease in anxiety and dizziness and a significantly greater increase in maximum voluntary ventilation ($p < 0.05$) after the training program.

Conclusions. Ultimately, it can be said that aerobic exercises, balance exercises, and relaxation techniques can raise maximal voluntary breathing and lessen anxiety and dizziness in post-COVID patients. Therefore, it might be regarded as a successful, secure, cost-effective, and efficient supplementary treatment method for lowering anxiety and vertigo in COVID-19 patients.

Key words: aerobic exercises, balance exercises, anxiety disorder, dizziness

Introduction

Coronaviruses are positive-sense single-stranded RNA viruses that, when viewed under an electron microscope, resemble crowns because the envelope contains spiked glycoproteins. The most typical symptoms of COVID-19 include fever, dyspnoea, dry cough, and severe respiratory distress. Many infected people may be asymptomatic or have mild symptoms like headaches, dizziness, a non-productive cough, fatigue, myalgia, and insomnia [1].

A study by Hu et al. (2020) evaluated patients with a median age of 47 years old, with 41.9% of them being female. Sixty-seven patients (6.1%) completed a primary composite outcome measure, which included 1.4% death, 2.3% invasive mechanical ventilation, and 5.0% ICU admission [2].

Delving into the underlying mechanisms through which aerobic and balance exercises exert their effects on anxiety and dizziness in post-COVID-19 patients. Understanding these mechanisms can help refine exercise interventions and tailor them to target specific pathways implicated in post-COVID-19 symptomatology.

Many patients who have been diagnosed with COVID-19 they developed anxiety, dizziness, sleep disturbances, and a negative impact on their physical health with clinical observation. Anxiety, a form of psychological stress, induces several physiological reactions and reduces immunity after isolation treatment [3]. Anxiety symptoms are commonly reported among COVID-19 patients during both the acute infection phase and the post-recovery period. Anxiety symptoms may persist or emerge during the post-COVID-19 phase, contributing to a reduced quality of life and functional impairment. Addressing anxiety symptoms in COVID-19 patients is essential not only for their psychological well-being but also for optimising overall recovery and rehabilitation outcomes [3].

Dizziness is a common symptom reported by COVID-19 patients, both during the acute phase of the illness and in the post-recovery period. The aetiology of dizziness in COVID-19 patients is multifactorial and may involve viral-induced ves-

Correspondence address: Sahar Abdalbary, Faculty of Physical Therapy, Nahda University, University street, Beni Sueif, Egypt, e-mail: saharabdalbary@yahoo.com; https://orcid.org/0000-0003-1346-6750

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tibular dysfunction, inflammation of the inner ear structures, neurovascular complications, or deconditioning secondary to prolonged illness and bed rest. Effective management of dizziness in COVID-19 survivors is crucial for restoring vestibular function, improving balance and gait stability, and enhancing overall post-recovery rehabilitation outcomes. Numerous health outcomes have been demonstrated to be improved by regular physical activity [4].

This virus can cause a wide range of symptoms, from neurological symptoms like headaches, dizziness, anxiety, vertigo, and brain fog to general symptoms like fever, nausea, vomiting, difficulty breathing, coughing, muscle aches, and exhaustion [5].

The sessions that combined physical exercises with educationally oriented conversations about mental complaints proved improvements in physical and cognitive abilities related to anxiety and dizziness [6].

Dizziness has also been connected to a partial or total incapacity to carry out social, professional, and familial activities – all of which have a detrimental effect on an individual's quality of life. Still, determining whether psychological issues existed before or as a result of vestibular disorders is difficult [7].

It has been shown that COVID-19 has different effects on athletes compared to amateurs, according to their different lifestyle behaviours. The importance of great sportsmen maintaining healthy eating habits and high levels of physical activity is important, because of the moderating effect that these behaviours have on sleep quality [8].

Anxiety disorders and balance problems share fundamental brain circuits containing monoaminergic components, which is why anxiety is frequently linked to changes in balance. The parabrachial nucleus network (vestibular system and visceral information processing convergence point) is where these neural networks come together and have a role in the symptoms of avoidance, anxiety, and terror. Psychological uncertainty, anger, low self-esteem, anxiety, panic attacks, sadness, depersonalisation, and a sense of being outside of reality are all brought on by dizziness and imbalance [9].

During COVID-19, eating healthier was associated with physical activity. When athletes participated in high-intensity physical exercise during COVID-19, their psychological moods improved as opposed to low-intensity exercise, which showed negative psychological impacts. (such as tension, anxiety, and depression). Elite athletes with low levels of physical activity have been linked to eating problems and poor psychological status [10].

Aerobic exercises and endurance exercises are physical activities that improve heart and lung function. Furthermore, it is thought to improve well-being and lessen negative mood states, including worry and depression. As one engages in aerobic exercise, large muscles contract in a repetitive pattern to propel the body against gravity. Respiratory and pulse rates will increase slightly at a moderate level, while both will increase dramatically at a vigorous level [11].

This study looked at the effects of aerobic exercise and balance on anxiety symptoms and dizziness in post-COVID-19 patients.

Subjects and methods

Patient characteristics and general experimental design

Patients

Using the "PLUS module" sample size calculator from Statistica 13.3 software, we calculated the minimal sample size needed for the population under study to arrive at this sample. A sample size of 30 people was determined by sample size calculations using a power of 80% and an α of 0.05. A total of 30 people were recruited for the study. Thirty individuals with COVID-19 diagnoses were enrolled from our hospital's outpatient clinic. Two equal groups were randomly selected from among the patients. The ages of the participants, who were referred by doctors, varied from 45 to 65. A moderate COVID-19 infection with symptoms including cough, low-grade fever, taste disturbance, anosmia, or myalgia but no pulmonary involvement or dyspnea met the inclusion criteria for the COVID-19 group. Additional inclusion criteria included no treatment in critical care units; no steroid or antibiotic therapy received for COVID-19; a minimum of one month passed since the COVID-19 infection; no lower limb injuries during the twelve months prior to study enrolment; no orthopaedic disorders affecting the lower limbs, including reduced limb length; no neurological diseases or disorders that have been diagnosed; and no long-term medication or chronic conditions that may affect balance. The criteria for exclusion included not having a confirmed COVID-19 infection, having a severe case of COVID-19 with pulmonary involvement, receiving treatment in an intensive care unit, having chronic conditions confirmed, and having psychological or balance issues. Patients with active infections, pregnant women, cancer patients, smokers, people who have cognitive or physical impairments, and chronic heart disease patients were also excluded.

Due to COVID-19, which is characterised by psychiatric sequelae, the participants were checked by a psychologist to decrease the discrepancy between participants. Every participant underwent testing in a lab environment free from aural distractions and with continuous artificial lighting. The Montreal Cognitive Assessment was used to assess executive function and global cognition (MoCA) [12].

Allocation and randomisation

After meeting the eligibility requirements, participants were randomised into one of two intervention-based groups: group B (n = 15) or group A (n = 15). An impartial researcher not involved in this study carried out the randomised allocation to guarantee blinding. A straightforward 1:1 randomisation method was used. Each participant was given a distinct, computer-generated random code using the statistical program SPSS (version 23.0, New York, USA). Before the researchers applied the allocated interventions, they were given opaque, sealed envelopes containing the allocation. For the course of the trial, the treatment assignment was kept a secret from both study staff and volunteers. The study's Ethical Approval was obtained from Merit University Hospital's ethical committee, reference number RE CMU 140.

All procedures for the two groups of participants were performed in uniform conditions, face-to-face, using the same measurement devices, and under the same environmental conditions. The treatment period continued for 4 weeks.

Treatment sessions were 3 times weekly for 4 weeks, and the patients were treated separately, not in group therapy. The 15 patients in group A were given aerobic, balancing, and relaxation exercises. The 15 patients in the control group (group B) were given only relaxation exercises in the form of physical relaxation exercises. Assessment of both groups was carried out before and after the treatment program with HAMA and the Berg Balance Scale. Respiratory function was also assessed using maximum voluntary ventilation (MMV). We took care of the stability of repeated maximum performance measurements for reliability by using a similar day and time of testing, and patient motivation was achieved during the treatment by good command.

The patients were instructed not to change their lifestyle during the time of treatment.

Evaluated parameters

Hamilton Anxiety Scale (*HAMA*) [13]

The HAMA rating scale was developed to measure the intensity of anxiety symptoms and is widely used while evaluating psychotropic medications. There are fourteen elements in all, and each one is accompanied by a set of symptoms. Every item has a 5-point rating system, with 0 denoting no anxiety and 4 extreme anxiety. The overall score range is 0–56, with < 17 denoting mild severity, 18–24 denoting mild to moderate severity, 25–30 denoting moderate to severe, and 30–56 denoting severe anxiety.

Berg Equilibrium Scale [12]

For patients with multiple sclerosis, the Berg Balance Scale provides an outstanding test-retest reliability assessment of both static and dynamic balance abilities. It has 14 items total, ranging in difficulty from 0 to 4, and each item has a five-point Likert scale score. With a maximum score of 56, lower scores denote a more compromised balance.

The maximum quantity of air that a participant may inhale and exhale is known as MMV, during a 12–15 s period with maximum voluntary effort. Spirometry was used to assess pulmonary function, especially MVV, using Neurosoft SPIRO-SPECTRUM (high-accuracy PC-based spirometer), high accuracy for low flows (3-liter calibration syringe), and high accuracy of measures of lung volume and airflow rate. High-quality sensors and electronic parts used in the spirometer, individual device calibration on a special stand, and the use of integrated temperature, atmospheric pressure, and humidity sensors to automatically correct the measured flow and volume values (bringing to BTPS standard) all contribute to the high accuracy of lung volume and airflow rate measurements.

It has 43 spirometric parameters and automatic control of reproducibility and breathing manoeuvre performance. It also contains a demountable flow converter. The demountable break-resistant flow converter simplifies the cleaning and disinfection of components contacting the patient's mucous membranes and airflow. It has a 3-liter calibration syringe. The syringe volume approximately equals the average vital lung capacity of a human. It is calibrated with a 3-liter syringe spirometer. It measures the external respiration functions more accurately and correctly.

Throughout the test, participants were instructed to breathe strongly and quickly. During the test's fifteen seconds, every volunteer received identical encouragement. A minimum of three manoeuvres were assessed, with a 60-second gap between each attempt. A difference of less than ten between the two highest MVV readings met the repeatability criteria [13].

Treatment procedures

All sessions were supervised and participation was assessed. Although every patient had the option to leave the research at any moment, no one did so. An informed written consent form was given to each participant, and the study's specifics were presented. If any side effects occurred, the trial was stopped, and the Human Subjects Ethical Review Board of the Hospital was informed. However, no side effects happened, and the data of all participants has been included in the results. The treatment programs were as follows.

Group A (study group): The 15 patients received three sessions a week of aerobic and balance activities for four weeks. Since it has been demonstrated that at least six weeks of exercise training are required for exercise to improve muscular strength, we deliberately choose a 4-week experiment to prevent influencing the outcome with a muscle-strengthening exercise program [14]. In addition, relaxation exercises were given.

Aerobic exercise program [15–17]

Aerobic training consisted of warm-up exercises for 2–3 min (at a low speed to protect the muscles and prepare the cardiovascular system). Before the active phase, each patient's maximum heart rate (MHR) was calculated using this formula: MHR = 220 – age of the patient. The first-stage pulse rate was 65%–75% of the MHR (15–20 min). The end-stage pulse rate did not exceed 85% of the MHR. Then 58% of the MHR of the patient was identified, to not be exceeded during exercise.

The patients were treated separately, not in group therapy, and the heart rate was monitored by having each patient wear a chest heart rate monitor. The treatment program was on the same day.

The active training phase ended when the patient reached approximately 85% of their MHR or the time for the active phase had expired. Patients were instructed to press the safety key if they felt tired or dizzy. Motivating the patient while walking on the treadmill (30 min) helped release more mood-improving brain chemicals. At the end of the session, the participants cooled down for 5 min in the form of the same exercise of the active phase, but with a gradual decrease in speed until reaching a zero point.

A specialised physician screened all patients for the presence of any necessary steps to deal with any possible hazards due to hypertensive patients.

Balance exercise program [18–20]

Standing on one leg was a personal practice. The subject was asked to stand on one leg close to a table or support surface and to stand up and bend down on the other leg. Next, the patient's ability to balance while standing on one leg was evaluated. The patient repeated this exercise by standing on two legs for a short while, then standing on the other leg until the person was unable to maintain their balance. It took place for 2 min.

Stepping: For thirty repetitions, each leg was used to step forward, backward, and to the sides. The participants also completed double-sided mini-squats with a knee flexion angle of 15–30 degrees in the pain-free zone in addition to this 30-rep activity using pain-free range to improve the muscles of the quadriceps.

The following were the elements of this balance exercise:

1) Thirty repetitions of stepping forward and backward with the left leg.

2) Mini-squats with two sides (10 repetitions).

3) Using the right leg to step forward and backward (30 repetitions).

4) Ten repetitions of the two-sided mini squat.

5) Making 30 repetitions of a leftward step.

6) Ten repetitions of the two-sided mini-squat.

7) Making 30 repetitions of steps to the right.

Physical relaxation: Diaphragmatic breathing Technique [17, 20]

For four weeks, physical relaxation techniques were administered to both groups A and B. To earn their trust and cooperation, each patient received a thorough and concise explanation of the treatment process prior to the start of the first therapy session. Tight clothing was taken off of patients, and they were told to relax. In a warm, cosy setting, patients sat in a comfortable, relaxed half-lying position with their hands resting by their sides.

Beginning 5 min

Sitting

Flatten the shoulders, open the legs, and place your arms at your sides naturally.

Close your eyes and focus on your present feelings.

Relaxation 20 min

Abdominal breathing

– Inhale deeply through the nose and exhale slowly through the mouth.

– Inspiration: contract the diaphragm, relax the abdominal muscles, and bulge the abdomen.

– Expiration: relax the diaphragm, contract the abdominal muscles, and retract the abdomen.

8–10 times/min

Ending 5 min

Close your eyes and focus on your present feelings.

Relax the whole body.

One session of the program was carried out under the remote supervision of a physiotherapist as telerehabilitation and the other sessions were carried out as a home program.

Statistical analysis

Utilizing SPSS for Windows, version 22 (SPSS Inc., Chicago, Illinois, USA), statistical analysis was carried out. The Shapiro–Wilk *W*-test was utilised to assess the normality of the studied variables' distributions. To compare the mean values, a paired *t*-test was employed to various parameters in the two groups as well as pre- and post-treatment data for maximum voluntary breathing in the same group. The mean age, weight, height, and BMI were compared between the two groups using descriptive statistics and the unpaired *t*-test. The significant differences between the groups on the HAMA and the Berg Balance Scale, both before and after therapy, were assessed using the Mann–Whitney *U*-test. The significance level is shown by the *p*-value. A p-value ≤ 0.05 was considered significant.

Results

An unpaired *t*-test was used to compare both groups with a $p < 0.05$ being considered significant.

Table 1 presents the demographic characteristics of the participants. There was no significant difference between the two groups in mean age, weight, height, BMI, or time from infection, in months ($p < 0.05$).

Our participants had no comorbidities like heart or circulation, chest or breathing, musculoskeletal, brain or nervous system, or other health problems.

A *t*-test was used to compare between the same group before and after treatment and between group A and group B with a $p < 0.05$ being considered significant.

Table 2 presents the mean values for the HAMA before and after treatment for both groups. For group A, the pre-treatment HAMA mean values were 35.7 ± 3.3, and after

Table 1. Descriptive statistics for the mean age, weight, height, BMI, and time from infection of both groups

Character	Group A (mean ± *SD*)	Group B (mean ± *SD*)	*t*-value	*p*-value
Age (years)	47.4 ± 2.1	46.6 ± 3.7	0.89	0.38
Weight (kg)	72.5 ± 10.1	75 ± 7.1	0.64	0.52
Height (cm)	164.8 ± 9.6	166.9 ± 6.6	0.56	0.58
BMI (kg/m^2)	26.65 ± 2.7	26.87 ± 1.1	0.23	0.81
Time from infection (months)	2.2 ± 0.7	2.4 ± 0.4	0.86	0.49
Male	9	8		
Female	6	7		
Total	15	15		

BMI – body mass index

Table 2. Hamilton Anxiety Scale before and after treatment for both groups and between groups.

Hamilton Anxiety Scale	Group A (mean ± *SD*)	Group B (mean ± *SD*)	*t*-value	*p*-value
Pretreatment	35.7 ± 3.3	36.3 ± 6.4	0.22	0.745
Post-treatment	17.2 ± 1.7	21.7 ± 1.4	6.33	0.005*
Mean difference	+18.5	+14.5		
Z	26.4	8.5		
p-value	0.0001*	0.0001*		

* significant (p < 0.05)

Table 3. Berg Balance Scale before and after treatment for both groups

Berg Balance Scale	Group A (mean ± *SD*)	Group B (mean ± *SD*)	*t*-value	*p*-value
Pretreatment	26.7 ± 5.7	22.2 ± 3.6	2.45	0.026
Post-treatment	45.5 ± 8.8	35.1 ± 3.2	4.1	0.002**
Mean difference	18.8	12.9		
Z	5.9	12.1		
p-value	0.0001*	0.0001*		

* significant ($p < 0.05$), ** significant

Table 4. Maximum voluntary ventilation before and after treatment for both groups

Maximum voluntary ventilation	Group A (mean ± *SD*)	Group A (mean ± *SD*)	*t*-value	*p*-value
Pretreatment	103.3 ± 16.97	99.3 ± 25.4	0.61	0.22
Post-treatment	117.2 ± 16.7	108.1 ± 16.3	1.68	0.0002**
Mean difference	+13.87	+8.87		
Z	8.97	2.28		
p-value	0.0001*	0.0001*		

* significant ($p < 0.05$), ** significant

treatment, it was 17.2 ± 1.7. For group B, the pretreatment HAMA mean values were 36.3 ± 6.4, and after treatment, it was 21.7 ± 1.4. There were significant differences between both groups after treatment ($p < 0.005$).

A *t*-test was used to compare between the same group before and after treatment and between group A and group B with a $p < 0.05$ being considered significant.

An unpaired *t*-test was used to compare both groups with a $p < 0.05$ being considered significant.

Table 3 presents the mean values for the Berg Balance Scale before and after treatment for both groups. For group A, the pretreatment Berg Balance Scale mean value was 26.7 ± 5.7, and after treatment, it was 45.5 ± 8.8. For group B, the pretreatment Berg Balance Scale mean value was 22.2 ± 3.6, and after treatment, it was 35.1 ± 3.2. There were significant differences between both groups after treatment ($p < 0.005$).

A paired *t*-test was used to compare the same group before and after treatment for group A and group B with ($p < 0.05$) being considered significant.

Table 4 presents the mean values for MMV before and after treatment for both groups. For group A, the pretreatment MMV mean value was 103.3 ± 16.97, and post-treatment, it was 117.2 ± 16.7. For group B, the pretreatment MMV mean value was 99.3 ± 25.4, and after treatment, it was 108.1 ± 16.3. There were significant differences between both groups after treatment ($p < 0.005$).

Discussion

This study aimed to determine how the combined effect of aerobic exercises with balance exercises and diaphragmatic breathing as a relaxation technique affected post-COVID-19 patients' anxiety and dizziness. This study included 30 patients aged 45 to 65 years; they were included in two groups of equal numbers. In post-COVID patients, aerobic exercise, balance exercise, and relaxation exercise reduce anxiety and dizziness and promote MMV.

Aerobic exercises produce similar neurophysiological effects as those observed from antidepressant drugs. Some of these possible mechanisms are associated with neuroplasticity, neuroendocrine responses, inflammation, and oxidative stress. On the other hand, strength exercises can produce positive effects on mental health by improving muscular strength, functional capabilities, self-esteem, social support, and self-efficacy. It has shown that muscle strength and cardiorespiratory fitness have an inverse relationship with depressive symptoms, however, the exact physiological mechanisms and the effectiveness of each kind of exercise (aerobic or strength) are uncertain. The effects of aerobic and strength training on mental health are difficult to compare because most studies were carried out only with aerobic exercise and the results of studies on strength exercises are contradictory [11].

These balance exercises challenge the sensory, cognitive, and musculoskeletal systems while addressing balance constraints such as orientation in space, changes in direction, and the speed or height of the centre of mass during static and dynamic situations resembling daily living activity. The elements can be dealt with through a combination of balance and coordination exercises that challenge the postural control systems through multiple dimensions – including vertical and horizontal changes of the centre of mass, standing on unstable surfaces with a reduced base of support, and changing body directions. Consequently, such exercises require environmental information processing. The combination of dual-task, function-oriented challenges while controlling balance stimulates the sensory and neuromuscular control mechanisms [21].

The ventilatory response increases disproportionately, accelerating the decrease in CO_2. The primary drive to breathe during exercise results from a feed-forward mechanism, and is restrained by inhibitory chemoreceptor feedback to prevent excessive hypocapnia during exercise [15].

A study by Cattadori et al. [22] stated that exercise training in post-COVID-19 patients should include balance exercises with a frequency of 2–3 days/week and a similar duration among the different training days. This agrees with our program's frequency, intensity, and duration.

The same study used aerobic exercises with the frequency of walking or cycling being 2–5 days/week or 150–300 min/week and this agrees with our program.

Through the persistent rhythmic contraction of vast muscle groups, aerobic exercise boosts the body's capacity to take up and use oxygen. It can also be used to enhance pulmonary function, primarily spirometry parameters and many researchers believe it is important [16–21]. Aerobic exercise can be utilised as a low-cost therapy to aid people with anxiety and boost their chances of advancement in school and the workplace, especially if they have significant traits and states of anxiety and other psychiatric issues [22].

Activity has been shown to improve mood, especially moderate aerobic activity. Exercise that is somewhat strenuous reduces anxiety, tension, melancholy, and rage [23].

Owing to its many advantages for both physical and mental health, exercise is becoming more and more recognised as a therapeutic intervention for individuals with a range of psychiatric conditions. Regular physical activity was found to have significant anxiolytic and antidepressant effects in a recent study [24].

Gaudlitz et al. [23] found that additional benefits for reducing anxiety include the lowering of anxiety when aerobic exercise is combined with cognitive behavioural therapy. Additionally, it was shown that having individuals with panic disorder do 30 min of aerobic exercise on a treadmill set at 70% VO_2 max decreased their anxiety levels and the frequency of panic attacks [25–27].

Numerous studies have shown that, when compared to other kinds of treatment, aerobic exercise was unsuccessful in reducing anxiety symptoms in people with panic disorders. Medications such as dexamethasone, immune-based therapy, antiviral medications, and anti-inflammatory therapy have been shown to be the most effective forms of treatment [28]. On the other hand, cognitive-behavioural therapy is also thought to be beneficial [29].

After doing a meta-analysis, Bartley et al. [26] discovered no evidence to bolster the use of aerobic exercise as a successful treatment for individuals experiencing symptoms of anxiety. Our study's findings supported this by showing that the group that engaged in aerobic activity improved more than the other group. These results might have been affected by the absence of a standardised aerobic exercise routine. Against these findings, however [30], it was found that aerobic exercises (i.e., 30 min at 70% VO_2 max, 3 times a week) combined with cognitive-behavioural therapy reduced anxiety levels. In another study, aerobic exercises (20-min sessions at 70% of MHR) reduced anxiety sensitivity compared to non-exercise controls. Our results in group A which were treated with aerobic exercises and balancing exercises beside physical relaxation exercises led to an improvement in MMV by 77.3%.

Exercise has been shown to be useful in modulating anxiety, and both physiological and psychological paths have been proposed in previous studies [31, 32]. Physiological changes could include alterations in the serotonergic and noradrenergic pathways [33] and it was observed that physical exercise increases 5-hydroxytryptamine turnover, while other researchers have correlated increases in atrial natriuretic peptide with lower anxiety levels.

Some people experience anxiety when they are exposed to the physiological impacts of exercise. That is why many anxiety patients are afraid of exercise (anxiety sensitivity). According to some research, physical exercise may enhance tolerance to these symptoms and reduce anxiety sensitivity [32, 34]. In this study, the improvement of balance was significant after balancing exercises, aerobic exercises, and physical relaxation exercises.

A theory that supports the psychological aspect is known as the 'emotion action tendencies theory'. Incorporating exercise signifies a change in social contact for patients with anxiety difficulties, who often withdraw from social situations. Finally, exercise can give time away from everyday routines and lessen nervous rumination, allowing the patient to concentrate on anxiolytic thoughts instead, according to the notion of distraction [35].

An increasing body of research suggests that engaging in regular aerobic exercise, such as swimming, cycling, or running, is associated with better psychological health. While most research has been conducted on depression, anxiety disorders, and OCD, there is some evidence that exercise can also aid in social anxiety. It has been shown that both one-time aerobic exercise sessions and regular aerobic exercise programs can enhance psychological well-being [36].

On the other hand, cardiovascular activity for five to 10 min can improve anxiety and mood. Frequent routines that last 10 to 15 weeks can enhance a person's overall mental health. Aerobic exercise may lower sympathetic nervous system hyperactivity noted in anxiety disorder patients and promote parasympathetic function [37].

There are several theories explaining how physical exercise stimulates the endocannabinoid system and modifies adenosine receptors to provide anxiolytic effects. Anandamide is the main endocannabinoid that is produced in the blood when one is physically active. By regulating the signalling of other neurotransmitters (dopaminergic and glutamatergic transmission) and lowering metabolism in the pre-frontal cortex, these neuromodulators in turn support antianxiety and antidepressive actions [27].

Numerous researchers such as Schuch et al. [36], Meyer et al. [37], and Lakhan et al. [38] found no appreciable difference in the prevalence of dizziness between older adults who exercised and those who did not. The expectations and findings of the authors were not met by these results. Consequently, it was discovered that older adults who exercise report feeling less lightheaded. It is feasible to verify, nevertheless, that individuals who do not exercise are 2.2 times more likely to feel dizzy compared to people who work out regularly using modified logistic regression.

COVID-19 is characterised by a sequela of clinical symptoms that concern different organs and tissues. The main common molecular cause for all long COVID-19 facets appears to be related to immune dysregulations, the persistence of an inflammatory state, epigenetic modifications, and alterations of neurotrophin release. The prevention and management of long COVID-19 are still inappropriate because many aspects need further clarification. Exercise is known to exert a deep action on molecular dysfunctions elicited by long COVID-19 depending on training intensity, duration, and continuity. Evidence suggests that it could improve the quality of life of long COVID-19 patients.

According to a Guzik et al. study [12], the results stated that aerobic exercise, balance exercises, and relaxation techniques can raise maximal voluntary breathing and lessen anxiety and dizziness in post-COVID patients. Young people with moderate COVID-19 may have balance issues. The findings show statistically significant variations in postural stability between those who recovered from mild COVID-19 and healthy controls.

The framework recommended by the American College of Sports Medicine (ACSM's Guidelines for Exercise Testing and Prescription on Frequency, Intensity, Time, and Type [FITT]) can be applied in pulmonary rehabilitation. Endurance exercise training in individuals with chronic respiratory disease is prescribed at the same frequency: three to five times per week. A high level of intensity of continuous exercises (60% maximal work rate) for 20 to 60 min per session maximises physiologic benefits (i.e., exercise tolerance, muscle function, and bioenergetics) [39].

The studies on falling and how it relates to tests of balance and mobility indicated a moderate association. The stability required to sustain a standing position, according to the authors, is provided by movement and balance. Consequently, maintaining optimal levels of these competencies lowers the chance of falls, which are highly associated with levels of physical activity [39]. The amount of physical activity in the elderly is negatively imposed with some limitations [31]. This supports our results for the improvement of 70.5% in group A which did balance and aerobic exercises along with physical relaxation exercises.

Several studies [32–35] have demonstrated the beneficial effects of exercise on anxiety and identified distinct physiological pathways that account for the increase in mental health brought about by strength and aerobic training. The neurophysiological effects of aerobic exercise resemble those of medications. A few of these potential pathways are linked to oxidative damage, inflammation, neuroendocrine response, and neuroplasticity. Strength training, on the other hand, can enhance mental health by enhancing muscle strength and functional ability. In our study, aerobic exercise had a favourable impact on anxiety.

During COVID-19, regular high-intensity training is still a viable way to improve the overall health of elite athletes [10].

Our findings imply that further investigation on the postural effects of COVID-19 on life is warranted. The real-world applications of our trial show that creating balance training programs is crucial to reducing the chance of falls and preventing the negative effects they have on health, including fractures and functional issues with the human body. Since balance and postural training are often neglected [34], respiratory exercises, breathing exercises, and general exercise were the exclusive focus of post-COVID-19 therapy initially [40]. Our findings, however, clarify that post-COVID-19 rehabilitation programs urgently need to investigate this issue and, at least in part, focus on balance training.

The therapy was administered by the same individual to both groups in a blinded research manner.

Due to the small sample size and lack of follow-up research, this study was unable to offer information regarding the long-term effects of the study intervention results.

Conclusions

Ultimately, it can be said that aerobic exercise, balance exercises, and relaxation techniques can raise maximal voluntary breathing and lessen anxiety and dizziness in post-COVID patients. Therefore, it might be regarded as a successful, secure, cost-effective, and efficient supplementary treatment method for lowering anxiety and vertigo in COVID-19 patients. It's possible that the findings of this study cannot be applied to other populations, so more research with a wider range of samples is required.

While the study discovered that exercise had a favourable impact on the findings of anxiety and vertigo in COVID-19 individuals may not apply to other groups, hence further extensive research with a wider range of participants is required to confirm the findings. The study also emphasises how crucial it is to include balance training in post-COVID-19 rehabilitation programs and more investigation is required to ascertain the best kind and length of balance exercises for this particular population.

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Ethical approval

The research related to human use has complied with all the relevant national regulations and institutional policies, has followed the tenets of the Declaration of Helsinki, and has been approved by Merit University Hospital's ethical committee (approval No.: RE CMU 140), and received approval from clinical trial registration (NCT04996225). The date of the first trial registration was January 8, 2021.

Informed consent

Informed consent has been obtained from all individuals included in this study.

Disclosure statement

No author has any financial interest or received any financial benefit from this research.

Conflicts of interest

The authors state no conflicts of interest.

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