



COMPARING THE EFFECTS OF AEROBIC TRAINING AND CIRCUIT TRAINING ON DISEASE SEVERITY IN ATAXIC PATIENTS

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ABSTRACT

The word ataxia is used to describe more specifically the incoordination of movement disorder. It basically occurs after damage to our sensory system, cerebellum or it's connections. There are many conditions that can cause ataxia like stroke, cerebral palsy, multiple sclerosis, brain tumor, certain medications or genetic diseases. Conventional training does help but scarce in reducing disease severity while aerobic training helps in reducing overall disease severity of ataxic patients and finally, circuit training helps in improving symptoms as well. The main purpose of this study was to determine which treatment plan is more beneficial for ataxic patients; weather aerobic or circuit training. For this purpose, a randomized clinical trial was carried out with 18 patients (9 patients in each group). Time duration for this study was approximately four months where data collection took almost one month. Data was calculated from Allied hospital. Assessment and examination were carried out using Scale for Assessment and Rating of Ataxia (SARA) and Functional staging for ataxia giving pre and post values. Data was analyzed statistically through SPSS 20. The study showed that significant improvement was found in both groups in both variables while aerobic training group was slightly superior to circuit training group in terms of efficacy.

Keywords: Ataxia, stroke, spinocerebellar ataxia, circuit training, aerobic exercises, Scale for Assessment and Rating of Ataxia (SARA), Functional Staging for Ataxia.

INTRODUCTION

The word ataxia basically is derived from a Greek word meaning disorderly. Primarily, the word ataxia applied as a general term initially to describe different types of medical disorders related to movement, gate and heartbeat (1). Now a days the word ataxia is more specifically used to indicate the incoordination of movements following damage to the cerebellar or sensory system (2). Hence, ataxia describes as having problems in coordinating muscles or simply poor control on muscular system that leads to clumsy and awkward movements (3). The common difficulties seen in ataxic patients are the problems in swallowing, vision, task requiring fine motor movements or high level of control such as writing, balancing, walking and speaking (4). It basically occurs after damage to the sensory system, cerebellum or it's connections. There are many conditions that can cause ataxia

like stroke, CP, multiple sclerosis, brain tumor, certain medications or genetic diseases. As said above, ataxia can be a manifestation of different types of diseases. That's why an underlying cause or etiology always needs an investigation (5).

Due to modern technology, many new techniques have been introduced in the recent years such as biofeedback, treadmill training mostly with supposed bodyweight, virtual reality, that has further increased the efficacy of rehabilitation in ataxic patients (6). The primary goal for an ataxic patient is to improve their quality of life. For this purpose, an individualized approach is needed for every single patient. Different kind of treatment options are available to treat different symptoms, for example physical therapy, occupational therapy, language and speech therapy they can be used individually or sometimes in conjunction to manage varying symptoms (7).

There are two more exercise plans out there that are gaining a lot of popularity in terms of treating ataxic patients i.e. their progressing symptoms. One of them is the use of aerobic training program to reduce the overall severity of the ataxic symptoms. An aerobic exercise which is also known as cardiovascular conditioning simply means working of the heart muscle as in pumping blood (8). There are quite examples of aerobic exercise, such a walking, running, jogging, cycling etc. but in researches the common use of aerobic training is done through the use of stationary cycling (9). The optimal time and sessions were found of almost 30 minutes with five sessions a week in almost all the recent found literature (10). Few researches conducted by i.e. Scott Barbuto in 2020 undertook a phase I case-control study involving 20 participants to assess the advantages of aerobic training and subsequently (11), in 2021, a second-phase trial with 36 participants was carried out to contrast the impacts of aerobic training with balance training (12). The findings in both studies highlighted that aerobic exercise was found more efficient in reducing disease severity compared to balance training. Researchers Elisa Grazioli and Eliana Tranchita investigated the consequences of aerobic training on the functional status level in the patients suffering with the multiple sclerosis in 2019 (13).

Other interesting intervention that is well received in terms of treatment of ataxic patients is basically a formation of different exercises in a complete regimen. Commonly known as circuit training (14). Dogan and Ayvat studied the effects of circuit training, which included task-oriented training and virtual reality support, versus the mobile-based rehabilitation process known as telerehabilitation in 2023 to see which was more effective in improving upper limb functioning and normal functional activities in the patients suffering from multiple sclerosis ataxia with the end result of circuit training proved more effective (15).

The main objectives of this study were to determine the individual effects of aerobic training and circuit training on disease severity in ataxic patient along with comparison between the two groups.

METHODS

The research type for this study was the randomized clinical study. It was a single blinded study, where the participants were blinded. The participants were blinded in this study as they were allocated into groups through the use of lottery method. Simple random sampling was used to allocate the patients. The purpose or objective explained was like to figure out this that the comparative effects between aerobic training and circuit training on disease severity in ataxic patients. Basically, diagnosed patients or participants were added in the current study after meeting the set inclusion set or criteria which was that participants age should be ranging from 30-65 years (mid adulthood), Scale for Assessment and Rating of Ataxia (SARA) sitting sub-score should less than or equal to 1 (patients are able to sit and use a stationary exercise bike), hemodynamically stable patients, patient falling on the stage "3 and 4" of Ataxia staging scale and patients should be able to walk independently with or without assistive device for at least 5 minutes (as a minimum criteria). Exclusion criteria included patients suffering from recent surgery of low back or lower limb or encountered any recent musculoskeletal injury (fracture, dislocation, soft tissue injury), patients suffering from heart problems/diseases. Patients who were unable to exercise along with medically unstable patients and uncooperative patients.

Finally, the participants were allocated in two different groups where group A was set for the aerobic training group and group B suppositively for the circuit training group. Scale for Assessment and

Rating of Ataxia (SARA) scale helped when determining disease severity among the ataxic patients. Both of the groups received intervention almost 5 times each week for about 4 weeks or 1 month. Pre readings/values were assessed before the initiation of the interventions, and post final reading were figure out after 4th week.

Group A

Group A was set as the aerobic training session/group. Patient in this set group received 30 minute aerobic training session on a stationary cycling (11).



Figure 1 Patient on a stationary cycle

Group B

Group B was the circuit training group and patient in this group received 30 minute session of training including combination of exercises (16).

The exercises performed by the participants in this group were the; stretching of biceps, calf and hams (30 sec hold/5 rep), bridging (1 set/5 rep), sit to stand (1 set/5 rep) (weight bearing for 30 sec in each rep), stationary cycling (5 minute), walk on parallel bars (5 minute)



Figure 2 Bridging from circuit training



Figure 3 Stretching of calf muscles from circuit training

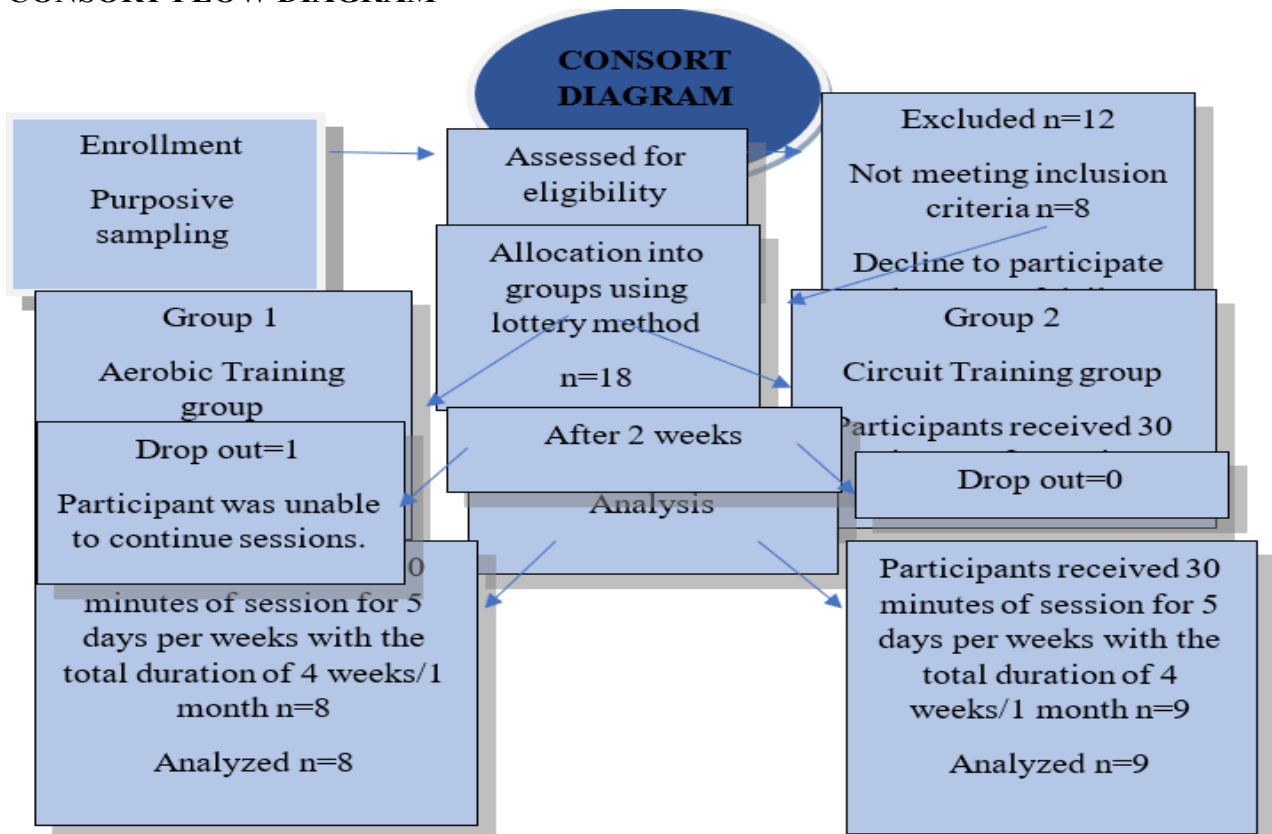
Follow Up

Both groups received intervention 5 times per week for 4 weeks/1 month. Pre readings or the values were practically calculated before any initiation of the interventions, and the post reading were taken or measured at the final stage i.e. after 4th week. There was no follow up in between the pre and post treatment readings.

Outcome Measures

Disease severity of ataxic patients using SARA scale.
 Functional staging of ataxia for ataxia staging.

CONSORT FLOW DIAGRAM



STATISTICAL ANALYSIS (RESULTS)

The analysis of the results was done using the statistical software i.e. SPSS 20.0. Primarily, variables were written in the variable view of the SPSS sheet that were age, gender and pre and post values of SARA scale (Scale for Assessment and Rating of Ataxia) for ataxic severity and lastly functional staging of ataxia for to determine the level of improvement among the ataxic patients at the final stage of their treatment. The following information was displayed in the form of descriptive statistics for both variables to properly determine the normal distribution of these variables.

Frequency Charts of Age

Five patients were found in 2nd age range group where 2 of those found patients were presented in the set of group 1. More number of patients were found in 1st age range group that were 7 patients, 5 in group1 and 2 in group 2. Total of 6 patients were found in 3rd age range group, here 2 patients fall under the category of 55-65 in the group 1; on the other hand, 4 patients in group 2.

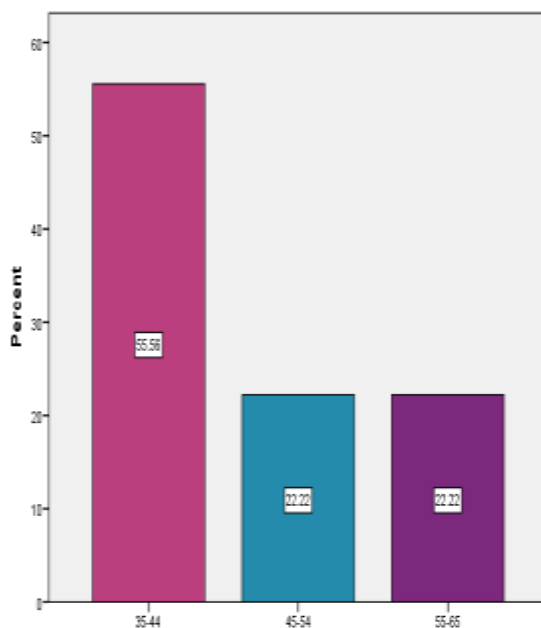


Figure 4 Graphically presented reorientation of all given respondents regarding to age group they belong in the Group 1.

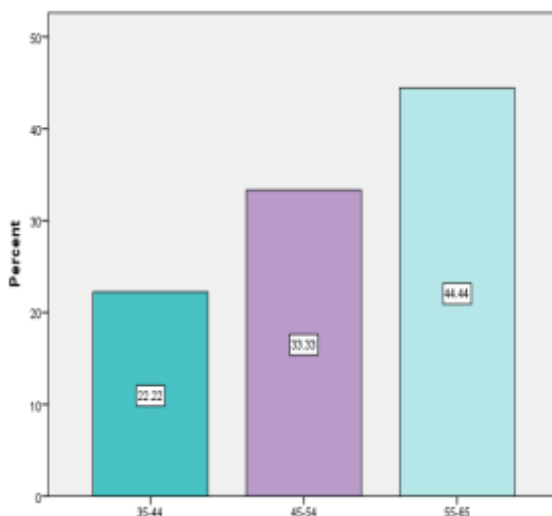


Figure 5 Graphical reorientation for the participants of group 2 according to the age group belonging in Group 2.

Descriptive Charts of the Gender

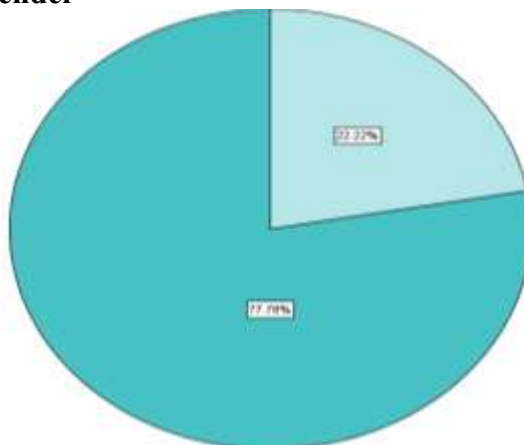


Figure 6 Graphical reorientation of the respondents according to their gender in Group 1.

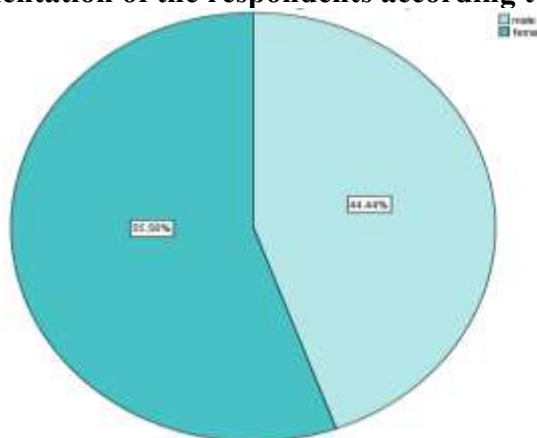


Figure 7 Graphical reorientation of the respondents according to their gender in Group 2.

The above presented charts showed the number of patients (frequency) found in which gender with given percentages. From the total of 18 patients, six male patients were found with the percentages of 22.22% in the group 1 on the other hand 44.44% in the group 2 while 11 female patients were found with the majority percentage of 77.78% in group 1 and 55.56% in 2.

Comparative effects within group and between groups

Table 1: The Shapiro-Wilk value for significance is taken into account to determine the data.

Test of normality		
Groups	SARA scale	Functional staging of ataxia
Group 1	.820	.001
Group 2	.712	.0004

The value of p was found greater in the first variable of both groups than 0.05; therefor parametric test was applied in between groups and within groups while p value was found less than 0.05 in the second variable of ataxia staging, so non-parametric tests was applied in this case.

Scale for assessment and rating of ataxia within group and between group;

Table 2: Paired t-test on aerobic group (group 1) and circuit training group (group 2) to determine ataxic severity

Difference between pre and post value	Mean	Std. Deviation	Std. Error Mean	Sig. (2-tailed) P value
GROUP 1	7.688	1.889	.668	.000008 (<.001)
GROUP 2	5.778	2.360	.787	.00008 (<.001)

Table 3: Independent Sample t-test on comparison between two groups in determining ataxic severity

Comparison between groups	Mean Difference	Std. Error Difference	P value
Pre value	-1.056	-1.056	.690
Post value	2.598	2.614	.262

The difference found between the pre and the post value in mean and standard deviation in group 1 (aerobic training group) was 7.68 ± 1.88 with the significance value of $p=0.000008$. The difference between pre and post value in mean and standard deviation in group 2 (circuit training group) was 5.77 ± 2.36 with the significance value of $p=0.00008$. At the end, while comparing both groups, the p value was .26 which was more than 0.05. The mean difference or the paired difference is greater in group 1 than in group 2 indicating the greater improvement found in group 1 than in group 2 when it comes to treating ataxia severity.

Functional Staging for Ataxia within group and between group;

Table 4: Wilcoxon test on group 1 and 2 to determine ataxia staging

Comparison in pre and post values		N	Mean Ranks	Sum of Ranks	P value
Group 1	Negative Ranks	8	4.50	36.00	.009
	Positive Ranks	0	.00	.00	
	Ties	0			
	Total	8			
Group 2	Negative Ranks	5	3.00	15.00	.034
	Positive Ranks	0	.00	.00	
	Ties	4			
	Total	9			

Mann Whitney U test on comparison between two groups in determining ataxia staging.

	Median	Value of P
Pre-Value	4	1.000
Post-Value	3	.167

The first treatment group, which consisted of aerobic exercise, had a mean rank of 9.50 prior to treatment and 7.50 following treatment. Conversely, the mean rank of the second treatment group, which consisted of circuit training, was 10.33 at the post-treatment level and 9.50 at the pre-treatment level. According to the Mann-Whitney statistic U test, that the post-treatment value of p was .16 and the given pretreatment level p value was 1.000. The fact that both scores were higher than the given p-value of 0.05, which indicated significance, particularly meant that there was found no discernible difference in the way participants were treated between the two groups. While the mean ranks indicated that even though both treatments equally made improvements in the participant's still, aerobic training group was slightly significant than the circuit training group.

DISCUSSION

Scott Barbuto conducted several studies to figure out how aerobic exercise can affect patients with cerebellar degeneration. His initial study was about the impact of aerobic exercise in patients with cerebellar degeneration that was conducted in 2020. The study's conclusion indicated that the aerobic training group showed a greater improvement in the ataxic severity (12). Afterwards, another research was done to examine the impact of aerobic exercise against traditional balance training in patients with cerebellar degeneration. The study's conclusion indicated that while the aerobic interventional

training group presented the remarkable improvement in the ataxia severity rather than the balance interventional group (11). The recent study conducted by Scott barbuto in 2023 about the potential effects of aerobic training when compared to circuit training in ataxic patient was of total six months' time duration. When the trial came to an end, the home aerobic intervention group's ataxic symptoms had considerably improved, but the aerobic training group's balance had not improved at all when compared to the traditional balance training group. The current study's results, which likewise showed that an aerobic training group was helpful in reducing ataxia severity and improving balance and ataxia staging, are rather similar to the findings of these investigations. Both groups of the current study helped the patients effectively in improvement (17).

In 2023, Dogan and Ayvat conducted a study to compare the effectiveness of telerehabilitation, with circuit training, which included task-oriented training and virtual reality support, in improving upper limb functioning and normal functional activity among the patients suffering from multiple sclerosis ataxic patients. At the termination for the study, it concluded that the circuit training and telerehabilitation both improved the functioning of upper limb and simple functional activities but still circuit training was proved more effective in terms of normal functioning and kinetic functioning when compared with telerehabilitation. In the current study, even the circuit training proved quite beneficial in improving balance and reducing ataxia severity while leading to the improvement in overall functionality but aerobic training group was a bit superior to it. Yet, it won't be wrong to say that both interventions are effective for ataxic patients and can be employed in them according to the capability of the patients (15).

Overall, everything comes down to one thing that these two interventions did outperform many times when compared with other treatment interventions. Even though, not enough literature can be found on the comparison between these two interventions; their individuals' effects are enough to be the evidence of their effectiveness.

CONCLUSION

At the end of the study, significant difference was found in the pre-treatment and post treatment values. Concluding remarks of current study were that both interventions proved beneficial in the treatment of ataxic patients, still aerobic training group was a bit superior in terms of circuit training group.

STRENGTHS

- Using valid scales for the assessment of the patients.
- Complete preventive measures were taken during this study as to prevent any mishap or injury that might had occurred during sessions.
- Ethical considerations were taken into account during this study.

LIMITATIONS

- SARA scale is not that reliable to perform an assessment on children especially on the children under the age of 8 (84). Early onset ataxia (EOA) in young infants is influenced longitudinally by the physiological age effect on motor coordination. Even in toddlers SARA score can be accurately determined by employing two age modifications (18). The main reason why cerebellar CP children were not included in this study.
- This study involved the ataxic patients generally not specially. It excluded the fact that the results might not completely but may differ slightly in patient cerebellar ataxic patients, multiple sclerosis and cerebellar stroke patients.
- A long term treatment plan was not the part of current study which limited the effects of both treatment groups.

RECOMMENDATIONS

- Making certain modification for the assessment of ataxia by using SARA scale, this research can be conducted on school going kids suffering from (for example, after 7-8 years to 16-17 years of age).
- A six month duration intervention plan can be made for ataxic patients to figure out whether the results will sustain in the next few months or not.
- A more specific study about ataxic patients can be done, where only single kind of ataxic population will be studied; be it cerebellar ataxic patients or multiple sclerosis patients.
- This scale specified the patients to only 3rd and 4th ataxia staging on Functional staging of ataxia. While patients on 5th stage can also be used for study to figure out given the seriousness of the disease whether it will provide any difference or not.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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COMPLIANCE WITH ETHICAL STANDARDS

Ethical approval was obtained from The University of Faisalabad under Ref. no. Tuf/IRB/359/24.

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