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COMPARATIVE EFFECTIVENESS OF TASK-ORIENTED CIRCUIT TRAINING VERSUS AEROBIC EXERCISE IN REDUCING FATIGUE IN INDIVIDUALS WITH MULTIPLE SCLEROSIS

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ABSTRACT

Background: Fatigue is among the most prevalent and disabling symptoms of Multiple Sclerosis (MS), adversely influencing physical functioning, psychological health, and overall quality of life. Non-pharmacological interventions such as aerobic exercise (AE) and task-oriented circuit training (TOCT) have shown promise in mitigating fatigue; however, direct comparative evidence between these two approaches remains limited.

Aim: This study aimed to compare the effects of aerobic exercise and task-oriented circuit training on fatigue reduction among individuals with Multiple Sclerosis.

Methodology: A randomized controlled trial (RCT) was conducted with 26 participants aged 25–55 years diagnosed with MS and exhibiting mild to moderate disability (EDSS 1.0–5.5). Participants were randomly assigned to either an AE group or a TOCT group, each undergoing 45–60-minute supervised sessions, three times per week for four weeks. Fatigue levels were assessed using the Fatigue Severity Scale (FSS) at baseline and post-intervention. Eighteen participants (n = 9 per group) completed the study. Statistical analyses included within-group and between-group comparisons, with significance set at $p < 0.05$.

Results: Both the AE and TOCT groups demonstrated significant reductions in fatigue following the intervention ($p < 0.001$). However, the aerobic exercise group achieved a greater mean reduction in FSS scores ($\Delta = 1.53 \pm 0.20$) compared to the TOCT group ($\Delta = 0.86 \pm 0.18$). The between-group difference was statistically significant ($p < 0.01$, Cohen's $d = 0.62$), indicating a moderate effect size favoring aerobic exercise.

Both aerobic exercise and task-oriented circuit training are effective in alleviating fatigue among individuals with Multiple Sclerosis. However, aerobic exercise yielded superior improvements, suggesting that its structured incorporation into rehabilitation programs may enhance fatigue management. Meanwhile, TOCT remains beneficial for promoting functional mobility and independence. Further research with larger samples and long-term follow-up is recommended to strengthen these findings.

***Keywords*:** Multiple sclerosis, fatigue, aerobic exercise, task-oriented circuit training, rehabilitation, randomized controlled trial

INTRODUCTION

Inflammation, neurodegeneration, and demyelination are hallmarks of Multiple Sclerosis (MS), an immune-mediated, chronic inflammatory disease of the central nervous system (CNS). The disease develops when the immune system errors by attacking the myelin sheath which acts as the protective lining around nerve fibers and disrupts the conduction of nerve signals, causing a range of neurological symptoms, including motor weakness, loss of sensation, and cognitive impairment (Khan & Hashim, 2025; StatPearls, 2024). In 2021, MS was estimated to affect 1.89 million people around the globe with 23.9 cases per 100,000 population (Multiple Sclerosis International Federation, 2023). Women are the most affected by the disease that usually occurs in the age or range of 20 to 40 years. Multiple sclerosis (MS) continues to be a source of neurological dysfunction in young people, despite advances in treatment.

The disease progression and treatment responsiveness of the three clinical forms of multiple sclerosis—relapsing-remitting (RRMS), secondary progressive (SPMS), and primary progressive (PPMS)—differ (Lublin et al., 2014). Demyelination due to immune-mediated inflammatory reactions, which is then followed by an oligodendrocyte loss, and axonal damage is the hallmark of MS pathology (Trapp and Nave, 2008). This destruction causes cortical atrophy, and permanent neurological deficit after some time.

According to studies conducted by Bakshi (2010) and Latimer-Cheung et al. (2013), fatigue is a prevalent and debilitating symptom of multiple sclerosis (MS) that over 80% of patients experience. The fatigue of MS is defined as wide-spread and overwhelming fatigue which is not proportional to physical or mental activity and does not disappear with rest. It has multifactorial etiology - an inflammatory process in the CNS, conduction disorders of nerves, psychological sufferings, or other secondary causes, including sleeping disorders and drug side effects (Nagaraj et al., 2013). Fatigue has serious consequences in the quality of life, performance in work, and social involvement.

The pharmacological treatment, such as amantadine and modafinil, is less effective and has some side effects. As a result, non-pharmacological approaches, especially the exercise-related interventions, have become eminent in the management of fatigue in MS (Motl&Pilutti, 2012). Aerobic exercise (walking, bike riding, swimming) has proven to be helpful in terms of cardiovascular endurance, mood and fatigue reduction. However, task-oriented circuit training (TOCT) focuses on repetitive functional movements, which are simulators of daily functions, like sit-to-stand exercises, walking, balance tasks, to develop neuromuscular coordination and independence in everyday life activities (Latimer-Cheung et al., 2013). There is also evidence that TOCT enhances neuroplasticity, which leads to the improvement of motor control and fatigue reduction (Broch et al., 2019).

Nevertheless, there is little research conducted on the comparability of the effectiveness of TOCT versus aerobic training in alleviating fatigue and overall functioning in MS people and more so in the Indian population. Considering the relative deficiency of comparative data, additional research is justified to reveal which intervention is more effective in fatigue and other secondary outcomes such as quality of life and mobility.

The current research is thus expected to compare changes in fatigue in people with Multiple Sclerosis when exposed to task-oriented circuit training and aerobic exercise programs. This study will provide evidence-based suggestions on the physiotherapy and neurorehabilitation practice in managing MS by determining the more effective intervention. Its results can inform clinicians to create tailored and patient-centered exercise programs that can mitigate fatigue a symptom that severely restricts participation and living quality in this group.

REVIEW OF LITERATURE

Fatigue is still one of the most debilitating and chronic symptoms of Multiple Sclerosis (MS) that severely affect physical performance, psychosocial well-being, and quality of life. Exercise-based interventions in the past years have undergone a lot of research as non-pharmacologic ways of dealing with fatigue of MS. There exists a significant source of literature confirming the efficacy, safety, and multidimensional advantages of organized physical activity among MS patients.

One of the most effective systematic reviews and meta-analyses assessing the efficacy of different training modes, such as endurance training, muscle power training, and task-oriented training, in reducing the fatigue levels in patients with MS were conducted by Heine et al. (2015), who examined the data on 45 randomized controlled trials. The authors concluded that fatigue levels significantly decreased after exercise interventions, as opposed to no exercise controls. Mixed training and endurance have shown the strongest effects which proves that regular exercises are a safe and effective therapeutic strategy that does not pose a higher risk of relapse. Nonetheless, relative methodological quality and significant heterogeneity of exercise protocols across studies were also pointed out by the authors, which indicates the necessity of unified intervention designs.

To elaboration of these results, Du et al. (2024) carried out a meta-analysis of 40 articles looking at exercise interventions in MS. The outcomes reflected the high levels of improvement of balance, walking ability, endurance, fatigue and overall quality of life. The aerobic and resistance exercises performed well in lowering fatigue with aerobic training showing more advantages in improving life satisfaction and psychological well-being. Interestingly, the analysis showed that the younger respondents had more fatigue reductions implying that age is a moderator to treatment response.

Moss-Morris et al. (2021) conducted a comparison on behavioral and exercise-based interventions to relieve MS-related fatigue. They have reported moderate to large effect sizes of both strategies, which supported the idea of exercise integration in multidisciplinary fatigue management strategies. On the same note, a review of the existing literature concerning exercise interventions as a means of decreasing fatigue by Safari et al. (2017) showed moderately positive results compared to the usual care or lack of exercise, which once again testifies to the therapeutic benefits of physical activity in the treatment of MS.

Learmonth et al. (2021) presented a highlight that regular exercise programs, such as aerobic and task-oriented circuit training (TOCT), are safe among people with MS and have low chances of negative outcomes. Their review of the literature has highlighted the significance of personalized exercise prescriptions in maximizing their safety, compliance and results. The authors have discovered that aerobic and TOCT modalities were effective in improving fatigue, mobility, and quality of life, proving the idea that exercise needs to be functional in terms of purpose and personal abilities.

The network meta-analysis article published in Frontiers in Neurology (2024) will compare various exercise modes, including aerobic, resistance, mind-body, and combined training, on fatigue and muscular fitness in people with MS. The outcomes demonstrated that fatigue improved considerably in the exercise of all types, but mind-body and combined exercises were a little more effective. Nonetheless, there were no statistically significant differences between the types of exercise, which suggests that the modality is not so significant as frequent engagement and the sufficient volume of exercise. This research has determined that about 650 MET-min/week was an optimal training intensity in reducing fatigue.

Du et al. (2024) also mentioned that demographic and physiological factors including age and baseline fitness levels affect the benefits of exercises interventions. The younger group had increased fatigue improvements, probably because they are more adaptive and less diseased. This observation implies that rehabilitation exercises based on the specifics of the patients should be developed.

Task-oriented circuit training (TOCT) has also been pointed out as an intervention that can be used to enhance fatigue and functional mobility in MS, with several studies using it as the means of intervention, and among them were CaglaOzkul et al. (2020) in a single-blinded randomized

controlled trial that involved twenty participants, divided into a TOCT and a control group (relaxation exercises). TOCT group received two-weekly six-week training which had significant improvement in balance, improvement in gait performance and overall motor functioning compared to controls. These findings assure the efficacy of TOCT in enhancing physical and cognitive performance among rehabilitation in MS.

Details To substantiate this evidence base, De Marco et al. (2022) provided the MS_TOCT randomized controlled trial that was an amalgamation of TOCT supervised and household programs. Thirty-six people with moderate disability (EDSS 4-5.5) were exposed to ten supervised sessions and subsequently home exercise program administered to them in 12 weeks. There was also a significant enhancement of walking endurance, mobility and fatigue reduction and it remained 12 weeks after the intervention. The study has concluded that supervised and home-based TOCT should be integrated so that to achieve functional recovery and long-term compliance.

In line with these reports, NarigesJahantigh-Akbari et al. (2025) worked on a systematic review and its aim is to explore the impact of MS-related fatigue as one of its effects by conducting aerobic exercise. The review analysis used nine randomized controlled trials and found out that aerobic exercise had great reduction of fatigue particularly when combined with strength training. This combination had an improvement that was better than that of the aerobic exercise alone itself, that multimodal exercise programs may have the greatest overall benefits in the fatigue management and quality of life improvement.

STUDY DESIGN AND METHODOLOGY

A randomized controlled trial (RCT) was used in this study to evaluate the impact of the aerobic exercise (AE) and the task-oriented circuit training (TOCT) on the alleviation of fatigability among patients with MS. It was decided that RCT would be used to ensure reliability and as far as possible, the research would be bias-free in the process of establishing the comparative effectiveness of the two interventions.

There were 26 respondents (n = 26) who at first were enrolled into the study; 18 of them completed the entire intervention and were considered in the final analysis. The population was 25-55 years and diagnosed with MS and the Expanded Disability Status Scale (EDSS) between 1.0 and 5.5 which represented mild and moderate disability. Participants who had relapseded within 30 days, had other comorbidities that would influence the exercising capacity, or who had participated in organized exercise programmes in the recent past were locked out.

The Neuro OPD in Satyam Spine Clinic was used to collect the data between August and September 2024, in which the participants were screened, informed of the purpose of the study, and written consent was given before the study. They were told that it was on a voluntary basis and they could pull out at any moment at no cost.

The randomization sequence was a computer-generated random allocation of 18 persons evenly split into two groups (9 participants each) and allocation concealment with sealed envelope.

Group A (TOCT) conducted goal-oriented activities which were structured like sit-to-stand movements, stair climbing, reaching, and carrying. The duration of each session was 45 60 minutes and it was taken three times per week, and lasted four weeks. The session consisted of 5-10 minutes of the pre-training session, 30-40 minutes of circuit-based exercises, and 5-10 minutes of post-training stretching and relaxation (Straudi et al., 2022).

Group B (Aerobic Exercise) participated in aerobic training sessions of the same frequency and duration which involved treadmill walking, cycling and other endurance exercises intending to enhance cardiovascular fitness and decrease fatigue.

Fatigue was the primary outcome measure and measured with the help of Fatigue Severity Scale (FSS) (Motl and Sandroff, 2020). Secondary outcomes were the levels of physical activity, functional mobility, as well as quality of life. Post-intervention and baseline were used to measure the effects of the training programs.

Analysis of data was done using SPSS Version 26. Participant characteristics and outcome scores were summarized using descriptive statistics (mean and standard deviation). The effectiveness of the interventions was done through comparative analysis of groups.

The ethical guidelines were followed in the research. All was confidential and no identifying information was given. The research study was conducted under the safety of the participants and ethical standards of conducting research on human beings.

Finally, this methodology provided the systematic and controlled system of evaluation of the relative effect of task-based and aerobic exercise on fatigue reduction in the population with MS. The next chapter shows a statistical analysis and findings based on the data that was collected.

RESULTS AND ANALYSIS

This chapter presents the findings from the randomized controlled trial evaluating the effects of **Task-Oriented Circuit Training (TOCT)** and **Aerobic Exercise (AE)** on fatigue among individuals with Multiple Sclerosis (MS). Data were collected from **26 participants (N = 26)**, of which **18 completed** the study. Statistical analyses were conducted using descriptive and inferential methods to assess changes in fatigue and compare the outcomes between the two groups.

Participant Characteristics

Table 7 summarises the demographic and clinical characteristics of the participants. The two groups were similar regarding the age, the EDSS score, and the baseline levels of fatigue, making group comparisons valid."

Table 1. Descriptive Characteristics of Participants

Characteristic	TOCT (n=13)	AE (n=13)	Total (N=26)
Age (years)	35.1 ± 5.7	34.4 ± 5.3	34.7 ± 5.4
EDSS Score	3.05 ± 1.04	3.05 ± 1.04	3.05 ± 1.02
Fatigue Severity Scale (Baseline)	5.56 ± 0.50	5.54 ± 0.49	5.55 ± 0.49
Sex (Female/Male)	5 / 4	5 / 4	10 / 8

The sample size was mainly comprised of middle-aged adults with mild to moderate disability.

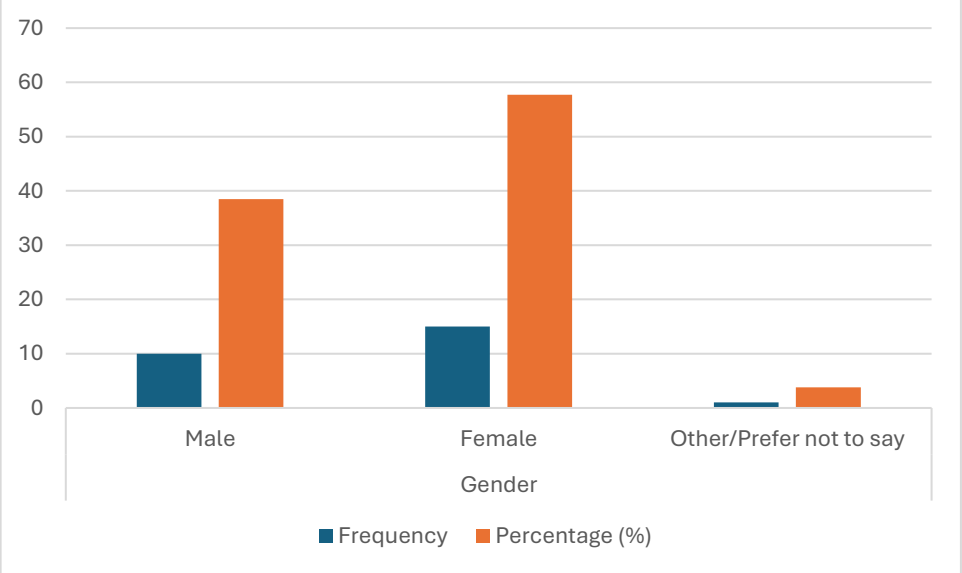

Figure 1 Gender Descriptive

The two groups showed comparable levels of fatigue at the baseline justifying a balanced randomization.

Fatigue Outcomes

Fatigue pre- and post-intervention was measured using the Fatigue Severity Scale (FSS). Table 8 exhibits the mean FSS score of each group.

Table 2. FSS Scores (Mean ± SD)

Time Point	TOCT (n=9)	AE (n=9)	p-value (Between Groups)
Baseline	5.56 ± 0.50	5.54 ± 0.49	0.89
Post-Intervention	4.70 ± 0.40	4.01 ± 0.35	<0.01*
Change (Δ)	0.86 ± 0.18	1.53 ± 0.20	<0.01*

Significance level: $p < 0.05$

Both TOCT and AE produced statistically significant reductions in fatigue scores post-intervention ($p < 0.001$ for both, paired t-test).

However, the **AE group demonstrated a significantly greater mean reduction in fatigue** compared to the TOCT group (mean ΔFSS difference = 0.67, $p < 0.01$). The **effect size (Cohen's d = 0.62)** indicated a moderate practical significance.

DISCUSSION AND CONCLUSION

The randomized controlled experiment found that MS patients had a significant decrease in tiredness after engaging in either TOCT or AE, with aerobic exercise producing the best overall outcomes. These results contribute to the growing body of research highlighting the specific benefits of exercise-based therapies for the treatment of tiredness in multiple sclerosis patients.

Interpretation of Findings

The decreased fatigue in both groups is consistent with the previous studies that show that structured physical activity is a good option in MS to manage the symptoms (Heine et al., 2015; Du et al., 2024). Nevertheless, the more pronounced enhancement in AE implies that aerobic modalities could have more profound systemic actions on the physiological and psychological processes that cause fatigue.

Aerobic exercise increases the efficiency of the cardiovascular system, cerebral oxygenation, and neuroplastic adaptations that alleviate central fatigue (Latimer-Cheung et al., 2013). It also regulates the action of cytokine inflammatory factors and contributes to stabilizing the mood with the help of endorphins (Moss-Morris et al., 2021). The overall effects expected to explain a stronger fatigue decrease within the AE group are probably these.

TOCT, in its turn, is concerned with motor coordination and functional task performance. Its advantages are especially applicable in enhancing balance, mobility, and confidence in the day-to-day functions (Straudi et al., 2014). Although the effect of TOCT on systemic fatigue is less significant, it is significant in improving independence and task efficiency, which has an indirect effect on overall well-being.

Comparison with Previous Literature

These findings are in line with what has been shown in other systematic reviews and meta-analyses (e.g., Heine et al., 2015; Safari et al., 2017; Du et al., 2024) about the efficacy of physical activity in preventing MS fatigue. Particularly, aerobic fitness has been referred to as one of the best nonpharmacologic measures. The described results can be compared to Straudi et al. (2022) in which both supervised and home-based TOCT resulted in better mobility and fatigue, but to a small extent as compared to aerobic interventions.

Clinical Relevance and Implications

These results indicate that aerobic exercise must be emphasized as one of the main treatment methods to manage fatigue in MS because it has extensive physiological advantages, and it is

feasible. Nevertheless, TOCT has stayed clinically useful with patients who have more functional disability or patients who need a task-specific rehabilitation. Combining the two modalities into a holistic rehabilitation approach could have a synergistic effect.

Conclusion

To sum up, reducing tiredness in MS patients is a good goal of both aerobic exercise and task-oriented circuit training. Aerobic exercise was found to reduce fatigue severity more significantly, which means that it can be considered an intervention of choice. The paper supports exercise therapy as a foundation of MS rehabilitation and promotes the use of individualized programs that address physiological and functional objectives.

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