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Effectiveness of Arm Cycling On Fatigue and Functional Outcomes in Patients with Multiple Sclerosis: A Review Article.

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Abstract:

Background: Multiple sclerosis disease (MS) is a persistent condition with ongoing inflammation, demyelination, and neurodegeneration of the central nervous system that impacts around 3 million people globally, experiencing worsening Physical difficulties and cognitive as well. Patients with multiple sclerosis (PwMS) participate in reduced physical activity, leading to de-conditioning and a decline in functional ability. Aerobic arm training is easily accessible, has advantages for PwMS especially in advanced stage and serving as an alternative option in various circumstances.

Objective: This study is intended to emphasize and summarize the main findings about the impact of arm cranking on fatigue and functional outcomes in patients suffering from multiple sclerosis disease.

Methods: We explored the scientific databases for arm cycling in multiple sclerosis disease. We decided that there will be no language restriction, no time limitation, only human studies, and only clinical trials studies will be included.

Conclusion: A review of the existing literature determined that employing arm cycling with PwMS acts as a possible intervention to improve Quality of their Life and the participation in everyday activities, especially when integrated with conventional rehabilitation methods. The available literature shows that a need for longer treatment time and high-quality studies to substantiate the evidence-based practice for PwMS.

Keywords: arm cranking, endurance, activities of daily living, disseminated sclerosis.

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Introduction:

Multiple sclerosis disease (MS) is the prevalent persistent Neuro-inflammatory, autoimmune and degenerative debilitating condition that affect the central nervous system (CNS). MS predominantly affects young and middle-aged individuals and results in considerable irreversible disability in two-thirds of patients[1-4].

Ongoing and unexpected episodes of demyelinating lesions may target different areas in the nervous system from the brain all the way to the spinal cord and may target optic nerves as well. the axonal injury sites are primarily responsible for the varied expression of symptoms[5]. The symptoms can encompass excessive muscle fatigue, muscle weakness, spasticity, and disrupted balance that may impact physical activity[3]. The lesions often lead to disruptions in motor function, including spasticity[6].

Patients with multiple sclerosis (PwMS) encounter escalating motor and cognitive deficits as the disease advances, leading to diminished cognitive processing speed, impaired walking capability, and decreased upper limb functionality[7]. Around 70% of individuals with MS display sensory-motor impairments such as diminished manual dexterity along with changes in the functions of upper extremities, sensitivity, muscle weakness, and tremors[1].

From the standpoint of patients, motor functions are regarded as essential bodily functions, significantly affecting their quality of life[7]. Among the three most pertinent bodily functions for PwMS, walking activity is one, and any treatment or method aimed at enhancing walking ability holds great importance for PwMS[2]; particularly if this treatment choice can be implemented even when the patient can no longer walk safely.

Multiple sclerosis disease is associated with diminished physical abilities and life's quality[8]. PwMS engage in less physical activity compared to the general people, and it is understood that physical exercise is linked to cardio-

respiratory fitness, muscle performance, and balance in PwMS[7]. Aerobic exercise might yield positive effects on health level and the ability to walk in PwMS[9]. Furthermore, it can be executed using different techniques like arm cycling.
Arm cycling (AC) training may display impact in activities with low intensity like walking among individuals with a low fitness level. Therefore, AC may enhance walking quality and serve as an alternative therapeutic choice for PwMS with moderate progressive severity[2] who is unable to participate in leg cycling physically and/or safely at this point and it might also serve as a substitute option in different situations.
Aerobic Arm training is possible and may offer advantages for individuals with progressive MS[9]. Research concerning arm cycling emphasizes the necessity for more extended and more robust studies[7].

The Impact of Aerobic Training on Fatigue in Patients with Multiple Sclerosis:

70–95% of patient with multiple sclerosis (PwMS) encounter fatigue[1, 10]. Excessive fatigue is among the most prevalent and debilitating signs of multiple sclerosis disease (MS), and it is the sole presenting symptom in one-third of individuals with MS[3, 10].
Fatigue in MS is described as an unusual feeling of weariness or insufficient energy, which is disproportionate to the amount of exertion or level of disability and greatly disrupts everyday physical or cognitive activities[3]. Fatigue serves as a significant, impairing sign in MS disease. The impact of fatigue and its frequency underscore the needs to set methods for the management[10].
Various physical signs frequently linked to MS condition include ataxia, muscle weakness, overall tiredness, increase muscle tone, disturbed sensation, and heat sensitivity externally and internally. Patients may experience the symptoms differently from a barely noticeable level to one that results in considerable physical disability[11]. Complexed nature of symptoms in MS disease hinders the management for fatigue and upper limb dysfunctions that affect daily life; therefore, define therapeutic options to alleviate the symptoms is essential for PwMS[1].
Exercise has been demonstrated to be safe in alleviating fatigue, with a supplementary positive impact on cardiorespiratory fitness, along with a decrease in fatigue and motor fatigability[1]. Exercise should focus on considering the neuro-psychiatric manifestations like cognitive difficulties, tiredness, mood change and depression in MS disease[9].
Depression serves as a significant predictor for the physical abilities and mental health of life's Quality, regardless of clinically assessed disability status and fatigue[3]. It has been documented that anxiety and depression are observed to be two times higher in PwMS compared to the general people[5]. Early exercise considered as an effective approach for anxiety relief and mood enhancement in PwMS especially for the relapsing-remitting PwMS who indicate a higher susceptibility to experiencing anxiety in various situations[5].
Fatigue self-Regulatory management techniques are effective in alleviating fatigue in PwMS, and one component of these comprehensive programs is aerobic exercise[5]. An early session of cycling exercise with moderate intensity was associated to reductions in fatigue also may serve as a suitable approach for the ongoing fatigue's management in PwMS[10]. Cycling training with progressive resistance may enhance the balance ability, alleviate tiredness and depressive mood and minimize falling's fear in PwMS, all while not exacerbating the signs and symptoms of multiple sclerosis[3].

The Impact of Aerobic Training on Functional Outcomes in Multiple Sclerosis Disease:

Patients with multiple sclerosis (PwMS) experience persistent inflammation that may affect their everyday functioning[12]. MS disease is the most common neurological disabled disorder, PwMS engage in less physical activity compared to the general population, resulting in de-conditioning and decreased capacity to carry out functional activities[13].
Muscle weakness, exhaustion, and balance issues lead to decreased daily activities in individuals with MS. Research has shown that MS patients experience a lower life's quality compared to the general people. This adversely impacts the physical abilities and psychological health[3].
Exercise can serve as a suitable intervention to enhance Life's Quality for PwMS and the daily living activities engagement[12]. Increasing physical activity in PwMS may be an effective approach to enhance the functional and clinical measures[7].
MRI revealed the possibility of training mitigates atrophy in brain and potentially enhance the thickness in the cortical area[2].
The training using arm ergometry has the potential to enhance walking capability in individuals with MS, possibly due to the positive impact on cardio-respiratory functions related to walking or improved stability in core muscles. Research indicates that standardized training has beneficial effects on fitness level, walking ability, cognitive function, and neuro-psychiatric symptoms in PwMS with moderate to advanced disabilities[9].

Discussion:

Continuous moderate-intensity training at least for 30 minutes at 40 % of maximal intensity for five to seven times a week or vigorous aerobic exercise 60% of maximal intensity three times a week; lowers the risk for metabolic and

cardiovascular disease in healthy adults, and achieving higher time and intensities results in a greater fitness improvement[14, 15].

It is understood that engaging in physical activity does not result in relapse or accelerate the advancement of the condition, but instead reduces tiredness and enhances aerobic capacity, quality of life, and specifically walking ability, including walking speed and stamina. Despite these realities, PwMS participate in less physical activity compared to the general people. The inactive style among PwMS is attributed to challenges in the neuromuscular system and psychosocial factors like the lack of pleasure, lack of confidence in the quality when exercising or a fear to deteriorate[8].

For long times, PwMS had advised and discouraged from exercising to prevent rise in the core temperature which will aggravate the symptoms. The inactive style along with the degree of disability resulted in limited physical activity among PwMS with subsequences of exacerbated symptoms[16].

Exercise is a crucial element of the treatment approach for PwMS; it is broadly acknowledged that after a few weeks of training, exercise offers numerous advantages for this population, including improved Aerobic fitness, muscular condition, mood, and the activities of daily living[12,13].

Exercise is an option for PwMS. Engaging in physical activity, particularly with relapsing-remitting MS, has been associated with a reduced disability, tiredness's feeling, high tone, and less sensory, manipulative, and urination dysfunction[12].

Aerobic exercise can be used as a warm-up exercise to prepare the brain before therapeutic exercise to level up the activation in the cortical areas and enhance the plasticity process[1].

Cycling is considered an aerobic exercise that is safe and feasible, with the ability to improve the aerobic capacity, musculoskeletal strength, tone, and functionality in individuals with neurological disorders. Cyclical activities involve reciprocal contraction and relaxation of specific muscles in the legs; that why cycling like walking and both share the sensory-motor control mechanism[13].

Exercising PwMS with severe disability is challenging and not easy to achieve[17].

Numerous populations recovering from injuries depend on arm exercises, such as arm cranking, to improve the fitness capacity and lose the extra weight[15]. For instance, the arm ergometry devices may be a preferable option for people with greater legs disabilities[12]. Arm training is well known in the rehabilitation of people with spinal cord incidents with obvious improvement in aerobic fitness and better independency while using the wheelchair[2].

Recent studies have also indicated that blood flow restriction in arms and legs cycling increases the volume of the blood, with a higher responsiveness in arms cycling than the legs cycling in repeated sprints a maximum level[15].

Responses to exercise vary physiologically between the arms and legs. Greater increases in the flow of blood flow in the arms relative to the legs to maintain the oxygen supply[15]. Because of the muscle mass is lesser in the arms than the legs; the high intensity training is hard to be achieved with arms training; but literature comparing hand and leg cycling in healthy females showed that at the end of 7 weeks of training, arm cycling can achieve 75% of VO2 peak which is achieved by leg cycling[2].

Heat sensitivity is a frequent symptom experienced by over half of the PwMS, leading to a temporary aggravation of MS symptoms during physical activities. Resistance training is more manageable for heat-sensitive PwMS since it causes a smaller rise in core temperature compared to endurance training. If resistance training cannot be conducted, 40 minutes of endurance training is adequate for PwMS to enhance aerobic capacity, and maximum strength of the limbs is achievable with various types of aerobic devices that focus on the arms or legs like rowing, cross trainer, arm ergometer[8].

The precise origin of MS remains unclear yet. it is now clearly recognized that inflammatory mechanisms are crucial in MS, and exercise training has anti-inflammatory benefits. The literature showed that; after 8 weeks of exercise training reduced the pro-inflammatory markers and elevated the anti-inflammatory cytokine[4].

Exercise training can lead to advantages for PwMS, including enhanced walking, reduced fatigue, better quality of life, increased mobility, isometric muscle strength, overall physical fitness, improved mood, and a more favorable chronic disease risk profile. On the other hand, research indicates that inactivity in individuals with MS correlates with a decline in independence and a decreased life's quality[18, 19].

Although exercise training offers advantages for PwMS there is a defect in literature on the ideal exercise dose and the training equipment that achieve the highest aerobic level and patients' preferences[19, 20]. Exercise studies involving patients with MS have typically not sufficiently regulated or tracked the frequency, duration, and intensity of the exercise[19].

Appropriate evaluation of physical fitness is essential for the development and assessment of exercise for PwMS; Peak physical capability for cardiorespiratory was higher with the recumbent stepping than arm ergometer, and Peak physical capability for muscular was higher with computerized dynamometry than hand-held dynamometry. The assessment and rehabilitation of exercise with PwMS should be designed to deliver the suitable stimulus[18].

The Significance of Arm Cycling for Patients with Multiple Sclerosis:

Multiple sclerosis disease (MS) is a persistent condition with ongoing inflammation, demyelination, and neurodegeneration of the central nervous system that impacts around 3 million people globally[21]. The therapies for PwMS should focus on alleviating the disease's symptoms, such as tiredness, muscular weakness, imbalance, and high tone[16].

The value of arm cycling training is that it can be utilized in specific circumstances where leg cycling is not feasible:
The progressive stage of the disease restricts the PwMS from performing leg-based endurance exercises once they have reached this phase, and limited literature investigated the impact of aerobic arm exercise in PwMS[2].
Patients with significant paraparesis, the arm ergometer may present an opportunity to enhance fitness and muscle function[2].
In Short-duration inpatient interventions utilizing high-intensity training have shown remarkable impacts on mobility and cognition's abilities in severe disabled PwMS[2].
Peripheral arterial disease, which can lead to intermittent claudication, typically affects older adults and considerably impairs their walking ability; those patients partly improved after involved in arm fitness exercise due to the increase in oxygen supply overall and to the legs as well[2].
Financial burdens for PwMS with the significant challenges faced by them when traveling, along with the total number of training sessions, while the arm ergometry seemed to enhance walking performance and can be implemented as a home-based program[2].
Managing spasticity in PwMS, The H-reflex and MAS exhibited a significant reduction following both arm and leg cycling exercises, particularly influenced by leg cycling. For individuals with MS experiencing lower limb spasticity accompanied by contracture and markedly restricted range of motion; an alternative method for addressing leg spasticity could entail arm cycling training. As the spinal pathways connect the cervicolumbosacral segments to coordinate interlimb movements, the neural coupling of arms and legs muscles in gait and cycling activities. The literature showed that with fixed lower limbs; rhythmic arms movements decrease soleus H-reflex of healthy people and stroke patients during the exercise[6].

Application of Arm Cycling for Patients with Multiple Sclerosis:

Arm cycling (AC) is achievable in patients with progressive disabled MS; with an adequate intensity it can stimulate the cardiovascular adaptations and can be coupled with the inpatient rehabilitation program with no negative events reported during the ET[17].
Moderate-severity PwMS engaged in moderate-intensity exercise necessitate lower aerobic demands when utilizing Arm ergometry and Functional Electrical Stimulation arm exercise (RT300) devices in contrast to the recumbent upper-lower limbs exercise (NuStep) and Functional Electrical Stimulation arm-leg exercise. Arm ergometer was considered safer than body-weight support treadmill training and potential risks increase when training involves transfer, upright postures, or external support[20].
Patients should be considered for arm fitness exercises when they believe they can undertake arm cycling training[2].
The arm ergometer device, such as the Motomed tool, captures the patient's data, ultimately demonstrating strong compliance with the program, and the primary objective is to enhance performance[7].
Home programs have been considered a viable and effective approach for PwMS to stay active or regain an active lifestyle[12]. PwMS could independently train using a detailed chip-card contain the training protocol, with a significant amount of telephone coaching is required to keep the patients compliant[2].
The training plan should be tailored to achieve the goal of training close to the fitness limit level to enhance fitness capacity. Every 4 weeks, the target should increase by 20 percent[2].

The Arm Cycling in our Future Research Studies and Rehabilitation Programs for Patients with Multiple Sclerosis:

Literature about Arm cycling is infrequent in Multiple Sclerosis disease[2].
Research investigates the impact of Arm ergometry on the connectivity of the brain in PwMS, showed that its potential benefit of a less reduction in functional connectivity with no significant effect on structural connectivity; maybe as the low intensity of the exercise is inadequate to trigger a significant structural change[7].
Fitness appears to play a crucial role as a moderator between the disruption of brain network and the physical and cognitive function, becoming increasingly significant as the disease advances. These results emphasize the necessity for and potential benefits of engaging in regular exercise in advanced MS[7].
Literature requires evidence of the positive impact of exercise on functional outcomes like aerobic fitness and walking capability, along with neuropsychiatric issues like cognitive decline, depressive symptoms, and fatigue in progressive MS[9], as the evidence supporting the benefits of training for PwMS with moderate to severe disability remains unclear and insufficient; well-designed future studies are essential[13, 17].

Conclusion:

The arm cycling has been reported as a safe method and might present further advantages for PwMS as it can potentially improve walking ability, boost physical engagement, enhance the aerobic fitness and reduce tiredness and physical fatigability.
Arm cycling might, therefore, represent a promising and effective strategy to enhance clinical outcomes. Integrating arm cycling training into the rehabilitation options for PwMS is viewed as an efficient approach in the rehabilitation.

Despite these positive findings, additional primary and secondary studies are necessary to verify sufficient evidence for implementing this type of stimulation in clinical environments.

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