Physiotherapy & Sports Injury
E-Science Information
Physiotherapy & Sports Injury
Volume 1,Issue 2
Case Report

A 9-Month of Adapted and Combined Exercise Program in Multiple Sclerosis: A Case Study

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Received: May 21, 2023; **Accepted:** July 18, 2023; **Published:** August 07, 2023

Abstract

Multiple sclerosis (MS) is a neurodegenerative disease which affects the central nervous system. The MS symptoms are fatigue, muscle spasticity and weakness and gait disturbances with a consequent decrease in the quality of life. Several studies support a combination of both endurance and resistance training to increase functional and psychological outcomes in people with MS. The aim of our study is to report the modifications and the progression during 9 months of supervised and combined training. A 42-years old woman with mild multiple sclerosis followed a 9-month combined training program during which the trend of walking/running velocity, the distance, the intensity and the duration of the resistance training were monitored and reported considering 3-month time windows. The distance covered during the sessions improved by 4.36%, 39.7%, and 143.74% after 3, 6, and 9 months respectively when compared to the initial performance and, the average walking/running speed increased by 22.87%, 79.18%, and 87.71% after 3, 6, and 9 months respectively when compared to the initial performance. The resistance training loads progressively raised increasing in terms of weight lifted, repetitions and exercise difficulty, while the total duration (20 minutes) of the session remained constant throughout the 9 months. The current case report displays the benefits induced by an individualized training program adapted to MS disease, highlighting the importance of including a sport specialist figure in a multidisciplinary team.

Keywords

Exercise Program; Sclerosis; Neurodegenerative disease

Introduction

Multiple sclerosis (MS) is a neurodegenerative, inflammatory, and demyelinating disease which affects the central nervous system (CNS) with an autoimmune pathogenesis, and it is characterised by the destruction of neurons' myelin sheath, leading to an alteration of body homeostatic balance causing an impairment of the electrical conduction. The most common SM symptoms are fatigue (described as an overwhelming feeling of exhaustion), muscle spasticity and weakness, gait disturbances, chronic pain, and sleep disturbances with a consequent decrease in the quality of life [1]. Due to their condition, people with MS often enter a vicious circle in which the SM symptoms intensify as sedentary behaviour increases, further reducing the level of active lifestyle and the health-related quality of life. Several studies outline the benefits of exercise practice for improving both cardiovascular and muscular fitness as part of the MS symptoms management strategy. In particular, endurance training induces improvements in both aerobic fitness and measures of health-related quality of life, with positive effects on functional capacities. On the another hand, resistance training seems to be more effective in reducing muscle weakness, improving balance, and decreasing the perceived fatigue feeling, with a positive impact on activities of the daily living such as walking and chair rise, having a beneficial impact on the quality of life and the well-being of people with MS [2,3].

Nowadays, several studies confirm and support that a combination of both endurance and resistance training increases functional and psychological therapeutic outcomes in people with MS [4,5]. For these reasons, an attentive choice of type, intensity and amount of exercise should always aim at the achievement of the exercise-induced benefits for the management of MS disease and its symptoms. Sport specialists, as part of a team made of medical doctors and physiotherapists, play a key role in designing the adapted training and tailoring the exercise program on individual needs and abilities. To the best of our knowledge, no other study monitored the training variables trend of an adapted and tailored exercise program on people with MS for a 9-month supervised and combined training. For these reasons, the aim of our study is to report the modifications and the progressions during 9 months of supervised training which included both endurance and resistance training sessions.

Methods

A 42-years old woman with mild multiple sclerosis, and with an Expanded Disability Status Scale score of 2, joined the training program managed by the Laboratory of Adapted Motor Activity (LAMA) of University of Pavia. The patient was able to walk independently without the need of any external assistance, and she did not suffer from other medical conditions such as hypertension or diabetes. After the MS diagnosis, she tried to maintain an active lifestyle performing daily walks and, in accordance with her doctor, she started a supervised adapted training program twice a week.

Before the beginning of the training protocol, a sport specialist performed specific functional evaluations to test her cardiorespiratory fitness and muscular strength, in order to consequently tailor the exercise types and intensities. A resting heart rate was measured with a heart rate monitor while the person was in a lying position for a total time of ten minutes. Then, the heart rate reserve (HRR) was calculated through the Karvonen formula to choose the most suitable training intensity and monitor its trend across time. The resistance load was calculated based on a sub-maximal test (8 repetition maximum) of four main body-weight exercises: squat, push up, pull up and crunch. The exercise program was developed based on both clinical condition, and initial physical fitness level of the patient.

The training protocol consisted of two 55-minute sessions per week of combined training, including both endurance and resistance exercises, for total training protocol duration of 9 months. Exercise intervention duration greater than 32 weeks has shown a higher level of commitment to the activity since it encourages the acquisition of a new habit. Therefore, a period of 9 months should motivate the patient engaging in physical activity practice as part of her lifestyle [6]. The training session consisted of three different phases: a 10-minute warm-up phase consisting of mobility and balance exercises, then 40 minutes of combined training and a final 5-minute phase of cool-down and stretching.

The endurance training consisted of 20 minutes of aerobic training at a moderate-to-vigorous exercise intensity (50–70% HRR), with the heart rate being monitored continuously in each session. The exercise intensity was progressively increased or decreased every 2 weeks based on patient’s heart rate responses. The endurance training was followed by 20 minutes of resistance training, consisting of body weight, calisthenics, dumbbells, and elastic band exercises for the major muscle groups (lower and upper limbs, trunk and core body parts). The participant was instructed to complete 3 sets of 8–12 repetitions for each exercise, with a resting period ranging from 60-to-90 s between sets and exercise type. The load was increased when 3 sets of 12 repetitions for a certain exercise could be easily completed. Moreover, the resting periods during each training session were further adjusted according to the patients need to avoid excessive increase in the body temperature and a consequent exacerbation of the MS symptoms. For the same reason, both during and after the sessions the patient was encouraged to maintain an adequate hydration level.

The trend of progression for both aerobic and resistance training was monitored from the start of the program and throughout the 9 months evaluating the difference in percentage of HRR, walking/running velocity and loads every 3 months (month 0, month 3, month 6 and month 9).

Results

Table 1 shows the increments of the aerobic performance described by total duration, distance covered, and average walking/running speed used during the aerobic sessions. The distance covered during the sessions improved by 4.36%, 39.7%, and 143.74% after 3, 6, and 9 months respectively when compared to the initial performance and, the average walking/running speed improved by 22.87%, 79.18%, and 87.71% after 3, 6, and 9 months respectively when compared to the initial performance.

Table 1: Progression of the aerobic performance throughout the total training period of 9 months described by means of 3-month intervals.

Time	Duration (min)	Distance (m)	Average speed (km/h)
Month 0	14	687.2	2.93
Month 3	11.5	717.19	3.6
Month 6	11	960	5.25
Month 9	18	1675	5.5

Legend: min=minutes; m=meters; Km=kilometres; h=hour.

Discussion

Several studies demonstrated that regular exercise practice produces several positive effects for psychophysical wellbeing in both general population and MS patients. In addition, physical activity practice helps in the management of MS symptoms, positively affecting the fatigue level with the amelioration of health-related outcomes and an improved quality of life [7]. In the present case report, the exercise intensity was adjusted weekly, individualising the adaptations to the patient’s needs with the aim of achieving improved performance outcomes for both aerobic capacity and general strength. The trend during 9 months of training showed a progressive increment of load for both aerobic and resistance trainings. In particular, the aerobic training performed on the treadmill had a total duration ranging between 10 to 20 minutes for each session. In the case of steady-state aerobic trainings, the HRR was increased from 50% to 65% after 3 months, then up to 75% at 6 months and finally up to 80% at 9 months for steady state. After 3 months, high-interval training sessions were introduced, with intensities ranging from 50%-60% HRR for long intervals (3-to-5-minute intervals), and up to 80-85% HRR for short intervals (1-to-2-minute intervals). The walking distance improved from 687.2 m at an average speed of 2.93 km/h to 1675m at an average speed of 5.5 km/h. Furthermore, the maximal speed used during the aerobic sessions increased from a walking speed of 3.5 km/h to a running speed equal to 7 km/h when comparing the performances during the first to the last training session. These achievements underline a greater walking autonomy of the patient, which contributes to a higher level of independency which positively affects her quality of life [4].

The loads of the resistance training were raised progressively, while its total duration (20 minutes) remained constant throughout the 9 months. The resistance training sessions during the first three months included mainly body-weight exercises (such as squats, lunges, push-ups, and sit-ups) for the major muscle-groups, while light-to-moderate intensity elastic bands were used for some upper-limb exercises (such as biceps and triceps curls). For each exercise type, the patient performed 10-12 repetitions for a total of 3 series. After the 3 months, kettlebells of 2 to 4 kilograms were introduced for lower limb exercises such as squat and lunges, while high intensity elastic bands were used for upper limb exercises. In this case the number of repetitions decreased to 8 for a total of 3 series for each exercise. Abdominal training included intervals ranging from 30 seconds up to 1 minute during which the patient held a plank position. Moreover, the intensity of exercise was further increased from month 6 to month 9.

The amount of exercise, type and intensity had to be carefully chosen and monitored by the sport specialists to ensure safe and effective training. In fact, excessive training loads and efforts could lead to a worsened fatigue symptom, which could lead to the onset of negative training-related feelings that could create a barrier to exercise practice [8]. The results achieved in 9 months of training helped the patient improve her walking abilities, as well as her overall strength. These achievements are associated, not only to a higher physical fitness level, but to a reduced sedentariness in the patient’s lifestyle. As mentioned above, a reduction in sedentary behaviour and engaging in physical activity practice helps MS patients improve and maintain functional abilities and managing the symptoms caused by the pathology [4,5].

Conclusion

The training protocol described above outlines the benefits of an individualised training program adapted to MS disease. The improvements described in this case report show the importance of including a sport specialist figure in a multidisciplinary team. In fact, the training protocol should be adapted to the specific health condition and tailored to individual needs and abilities allowing stepwise adjustments.

Limitations of the Case Report

Our case report has several weaknesses. Firstly, direct quality of life outcomes (e.g., questionnaires) are missing. Additionally, measures related to her fatigue level before and after each training session are missing. However, the adaptations made throughout the training program were tailored to the patient’s needs, feelings, and clinical symptoms even if we did not report them.

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