

Case Study

The application of therapeutic exercise as a means of rehabilitation in a patient diagnosed with MS, case study

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Introduction

Multiple Sclerosis (MS) is a chronic and often progressive condition that affects the Central Nervous System (CNS) and as a result has negative consequences on a person's physical condition, functioning, mood, and Activities of Daily Living (ADL) [1]. The case study that will be analyzed in the paper was evaluated with the EDSS (Expanded Disability Status Scale), which is the official global rating scale for the disability that can be caused by MS for the purpose of monitoring the status of the person diagnosed (Appendix 1). The above rating scale was designed by the neurologist Kurtzke in 1983 and evaluates 8 functional systems of the human body related to the CNS. The systems investigated through the EDSS scale are:

- The pyramidal,
- Cerebellar functions,
- Brain functions,
- The aesthetic function,
- Bowel function,
- The visual functions,
- Mental functions and
- Neurological functions (Caspar et al., 2017)

The rating system scores the individual's condition taking into account the above functional systems, starting from 0 for no symptoms and no disability to 10 for death from MS. Scores from 0 – 10 increase by 0.5 points, which represent the progression of the disease. From 1.0 to 4.5 the rating refers to people diagnosed with MS who can walk without the use of any aid. The main criterion for increasing points on the scale is the person's ability to walk which is characterized by 5.0 to 9.5. Although the rating scale takes into account the person's MS-related disability, most people will never reach the high points of the scale. A fairly large survey showed that people

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with a diagnosis had an EDSS score of 5 or lower, with 88% having an EDSS score of 7 or lower [2].

The case study that we will examine in the paper concerns the application of Therapeutic Exercise (TA) as a means of rehabilitation in a patient diagnosed with MS and EDSS 5.5. In the specific scale of the evaluation table, the patient Ms. B experiences a severe enough disability to prevent her from performing all DKZ as well as the increased difficulty to walk more than 100m without rest. The main concerns of the patient, which led the health scientists of the rehabilitation center to recommend the KA as a means of rehabilitation, are the lack of balance, the fatigue during walking, and the signs of depression due to the disease in her behavior. In the Table below, the profile of the patient and the goals she set with the health scientists at the center are described in a nutshell, while the analytical form of the case study can be found in Appendix, Table 1.

Bibliographic review

As a first step for the bibliographic review process in this particular work, in order to provide data on the role of OA in the part of chronic rehabilitation in people with MS, it was the search for scientific articles in the following databases: PubMed, PEDro, and Elsevier. The search process took place between January 10, 2022, and April 25, 2022, in the following databases: PubMed, PEDro, and Scopus. The keywords used in the digital databases, depending on the requirements of each digital platform, in order to display the studies related to the topic are described in Table 2. In the second phase, the summaries and texts of basic scientific articles were read in

detail with a series of criteria in order to select those articles that will help to write the paper in a modern and scientific way.

The inclusion and exclusion criteria of the selected articles were guided by the case study studied by Ms. B, i.e. the disability scale on the EDSS 5.5 (Moderate to severe) and the parameters such as the motor and non-motor symptoms he exhibits due to MS. In addition, the bibliography review was limited to randomized controlled trials (RCTs), including pilot studies (PTS), which compared different forms of AE with each other or with a different mode of delivery. RCTs are considered to be among the most reliable forms of research study that researchers can perform, especially when they are properly designed by those involved (Langeskov, et al. 2020). Also, importance was given to the chronology of the research results with a range in the last decade 2012 – 2022, all other articles older than 2012 were excluded. Table 3 summarizes the inclusion and exclusion criteria of the scientific articles for the paper. The flow of the selection of studies that were included in the systematic review through the PRISMA assessment method is shown in Figures 1,2.

Critical Analysis of the Studies used in the paper

After completing the bibliographic review needed to write the paper, six (6) key articles were deemed reliable for the analysis of the appropriateness of therapeutic exercise

Table 1: Patient profile and method of restoration.

| Patient Profile | Problems due to MS | Method of Restoration | Goals |
|---|--|--|---|
| Gender: Female Age: 36 years old Diagnosis: SC MS stage: Mild to moderate disease stage (EDSS ≤ 5.5) Rehabilitation Intervention: Therapeutic exercise program | <ul style="list-style-type: none"> Lack of balance Problems walking Fatigue in short distances Signs of depression | <ul style="list-style-type: none"> Therapeutic Exercise | <ul style="list-style-type: none"> Improvement of balance and gait. Increase walking distance without breaks. Improving mental health. |

Table 2: The keywords used in the digital databases, depending on the requirements of each digital platform.

| Search platform | Keywords |
|-----------------|---|
| PubMed | "Multiple Sclerosis"[Mesh] AND "Health Promotion" AND ("rehabilitation"[Mesh] OR "rehabilitation care") AND ("therapeutic exercise "[Mesh] OR "therapeutic exercises") AND ("Balance"[Mesh] OR "Balance ability" OR "Balance lower extremity") AND ("Gait"[Mesh] OR "Gait lower extremity" OR "Gait motor function") AND "Depression" AND "Memtal Health" limit to: 2012–2022 |
| PEDro | "Multiple Sclerosis"[Mesh] AND "Health Promotion" AND ("rehabilitation"[Mesh] OR "rehabilitation care") AND ("therapeutic exercise "[Mesh] OR "therapeutic exercises") AND ("Balance"[Mesh] OR "Balance ability" OR "Balance lower extremity") AND ("Gait"[Mesh] OR "Gait lower extremity" OR "Gait motor function") AND "Depression" AND "Memtal Health" limit to: 2012–2022 |
| Scopus | "Multiple Sclerosis"[Mesh] AND "Health Promotion" AND ("rehabilitation"[Mesh] OR "rehabilitation care") AND ("therapeutic exercise "[Mesh] OR "therapeutic exercises") AND ("Balance"[Mesh] OR "Balance ability" OR "Balance lower extremity") AND ("Gait"[Mesh] OR "Gait lower extremity" OR "Gait motor function") AND "Depression" AND "Memtal Health" limit to: 2012–2022 AND (limit to (pubyear, 2012-2022)) AND (limit, (language "English"))). |

Table 3: Summarizes the inclusion and exclusion criteria of the scientific articles for the paper.

| Inclusion criteria | Exclusion criteria |
|---|--|
| <ul style="list-style-type: none"> RCTs (including pilot studies). Adults diagnosed with MS (EDSS ≤ 5.5). Publication of scientific articles in the last decade. Outcome in at least one of the parameters we are looking for the case study we are looking at. Web result with site links | <ul style="list-style-type: none"> Research without using WILL in the therapeutic intervention we are considering. No published data from the last decade. The language of the article should be other than English and Greek |



Figure 1: The Expanded Disability Status Scale (EDSS).

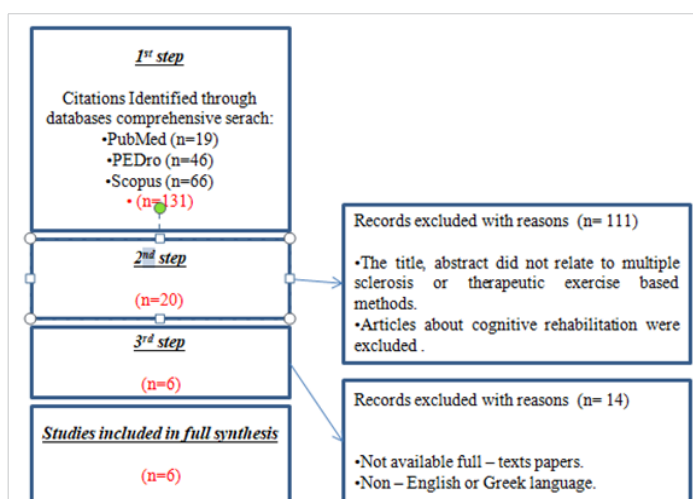


Figure 2: Records excluded with reasons.

programs in people diagnosed with MS and are found in Table 4. For the search of the articles for the purpose of information as far as MS is concerned, research studies of all kinds were used from data platforms which were PubMed and Elsevier.

The articles that were considered suitable for documenting the value of TA as a means of rehabilitating people with MS were searched exclusively from the PEDro research study search platform in order to use the platform’s evaluation scale. The reason it was necessary to search on this particular platform was that only studies using rigorous research methods are found on the PEDro search platform. Also, the studies are evaluated independently and separately for their quality with the PEDro scale.

The ratings help the user with the validity of the article they have chosen to read and the information they will use from the respective research study. The criteria used by PEDro to assess the reliability of a study are inclusion criteria, randomization of the sample, concealment of randomization, comparison at the beginning of the study, blinded participants,



Table 4: The analysis of the appropriateness of therapeutic exercise programs in people diagnosed with MS.

| Author / Year of publication | Article Title | Participants / EDSS Scale |
|------------------------------|--|---------------------------------------|
| [12] | Pragmatic exercise intervention in people with mild moderate multiple sclerosis : A randomized controlled feasibility study | Participants : 28 EDSS : 1.0 – 5.5 |
| [1] | Home based Pilates for symptoms of anxiety, depression and fatigue among persons with multiple sclerosis : An 8 week randomized controlled trial | Participants : 80 EDSS : 1.0 – 5.5 |
| [5] | Effects of aquatic exercises on postural control and hand function in multiple sclerosis :Hallwick versus aquatic plyometric exercises : A randomized controlled trial | Participants :30 EDSS : 1.0 – 6.5 |
| [11] | Effects of home based step training program on balance, stepping, cognition and functional performance in people with multiple sclerosis : A randomized controlled trial | Participants :50 EDSS :2.0 – 6.0 |
| [4] | Impact of Pilates exercise in multiple sclerosis: a randomized controlled trial | Participants : 30 EDSS : 1.0 – 5.0 |
| [9] | The effects of 10 week core stability training on balance in women with multiple sclerosis according to EDSS : A single blinded randomized controlled trial | Participants :69 EDSS :2.5 – 5.5 |

blinded therapists, blinded assessors, the adequate follow-up of the sample, the intention to treat, the comparison between the two groups (intervention/control) and the indicators of measurement and variability. The scale with the criteria and the total score for the main articles used in the paper can be found in Table 5.

The six (6) main articles that were studied to analyze TA as a way of rehabilitation for people with MS had as their main objective the improvement of factors related to the case study found in Appendix 1 and which aims to improve gait, balance and the early features of depression exhibited by the individual in the case study. The articles that will be analyzed below present various forms of TA for the case study agents.

Fleming and colleagues 2021 created an exercise book for home intervention [1]. The program concerned people with mild to moderate stages of the disease (1.0 EDSS – 5.5 EDSS), who performed an exercise program 2 times a week for 8 weeks, following a specialist trainer and having telephone psychological support whenever they wanted it. The main symptoms measured were anxiety, depression, and physical fatigue, which were assessed with validated tests every two weeks.

The MFSI (Modified Fatigue Impact Scale) is a 21-item questionnaire to measure physical and mental fatigue [3]. For anxiety and depression questionnaires (STAI-Y2) and (HADS-A) were used (Weiner et al., 2010). The results showed a significant reduction in the symptoms of anxiety, depression, and physical fatigue, recommending the Pilates method as a moderate-intensity exercise to improve mental health in people with MS, who find it difficult to perform any other type of sports activity.

In a similar study in 2018, Duff et al investigated a therapeutic intervention of the Pilates method in combination with a massage at home 2 times a week and 1 time respectively for people with MS who were on the EDSS scale 1.0 – 5.0, resulting in the improvement of gait and ability to walk at least 6 minutes without falling [4].

One year earlier in 2020, Gulpinal, et al. [5], compared and evaluated the effects of the Halliwick method and plyometric

Table 5: PEDro Evaluation Criteria Table.

| PEDro Rating Criteria Scale | PEDro Evaluation Criteria Table | | | | | |
|--|---------------------------------|------|------|------|------|------|
| | [1] | [5] | [9] | [11] | [4] | [12] |
| 1. Entry Criteria | Yes | No | No | Yes | Yes | Yes |
| 2. Sample Randomization | Yes | Yes | Yes | Yes | Yes | Yes |
| 3. Hide Randomization | No | No | No | Yes | No | Yes |
| 4. Baseline comparability | Yes | Yes | Yes | Yes | Yes | Yes |
| 5. Blind Participants | No | No | No | No | No | No |
| 6. Blind Healers | No | No | No | No | No | No |
| 7. Blind evaluators | Yes | Yes | No | Yes | Yes | Yes |
| 8. Adequate follow-up | Yes | Yes | Yes | Yes | Yes | Yes |
| 9. Intention-to-treat analysis | Yes | Yes | Yes | Yes | Yes | Yes |
| 10. Comparisons between the two groups | Yes | Yes | Yes | Yes | Yes | Yes |
| 11. Measurement and variability indicators | Yes | Yes | Yes | No | Yes | Yes |
| Total score | 7/10 | 6/10 | 5/10 | 7/10 | 7/10 | 8/10 |

pool exercise as PA methods for people with MS [5]. The Halliwick method is a neurokinetic therapeutic approach in a water environment such as a swimming pool and is based on static control, controlling body parts [6].

The approach involved 30 people with an EDSS index of 1.0 – 6.5, who were divided into 2 groups, each for the OA they represented. The program would take place 2 times a week for 8 weeks in small groups of 3 people for 45 minutes. The approach of the Halliwick method consisted of 4 types of rotations with the help of a specialist trained in the method, while the program of plyometric exercises in the pool consisted of a series of exercises based on jumps and stable positions.

The main purpose of the study was to find out which of the two methods would have better results in people with MS. Tests used measured improvement in posture and hand movement Los [7] and NHPT [8]. The research came to add to the literature that agrees on the positive effect of therapeutic approaches on people with MS, especially in the water environment (Cambell et al., 2015). Both approaches improved the factors sought by the researchers with a statistically minimal difference in favor of the Halliwick method.

To improve balance in women with MS with an EDSS index of 2.5 – 5.5, Amiri and colleagues used a 10-week exercise



program with trunk exercises, dividing the sample into two groups and then into subgroups according to the EDSS scale [9]. Before starting the program and after the 69 women were evaluated by the Biodex Stability Test (BST) and tests related to muscle their strength. The results of the method showed that the PA approach used significantly improved the balance ability of the women in the intervention group compared to the rest of the women. The exercises in this specific intervention were oriented to the muscles that help with balance, adding to the literature another research that proves that exercise programs consisting of strengthening exercises will positively help improve the balance of people with chronic diseases [10].

To improve gait and balance, Hoang, et al. 2015 [11] investigated a 12-week program [11]. They divided the sample of 50 people into two groups (intervention and control), with the second group simply continuing whatever sports activity they did in their daily life. The intervention group practiced for 12 weeks on a gait simulator with the help of music and specific game-type activities to assess gait and balance ability. The results were evaluated by the CRST and SST Tests showing that such activities have a therapeutic character, are fun, effective, and safe for improving gait and balance, without the fear of falls and injuries.

In 2013 the team of Carter and colleagues created a program aimed at a therapeutic approach for people with MS [12]. The evaluation of the sample from the EDSS scale was 1.0 – 5.0 giving them a choice of aerobic type of exercise such as walking, running, cycling, etc. with specific parameters of rest, repetitions, and heart rate, parameters evaluated with the TRIMP scale, which is a method of quantifying aerobic exercise load and how this translates into a training unit [13]. The intensity of the program was progressive according to the subject's abilities with the supervision of a specialist trainer (2 sessions/week) and once unsupervised individual training. The instruments used to assess outcomes were the Multiple Sclerosis Functional Composite (MSFC) (Mock et al., 2014) and Multiple Sclerosis Quality of Life – 54 (MSQOL54) [14-17]. The intervention program lasted 10 weeks with an assessment at the beginning of the program and 3 months afterward. The research and procedure were highly successful with a high

level of participation up to 3 months later (80%), proving it to be a feasible way to intervene in people with MS, improving all parameters measured.

Discussion

In order to decide whether the treatment is effective in addressing and rehabilitating the factors that need improvement in the case study of Mrs. B., we should, according to the critical analysis of the key articles analyzed above, conclude what type of treatment is ideal for this particular case, having as a guide its characteristics. According to the critical analysis, treatment is an ideal therapeutic approach for people diagnosed with MS, which depends on the particular characteristics of each person. Approaches should be done individually one to one (patient-therapist) or in small groups of people who are at the same stage of the disease according to the EDSS scale and in similar age groups [5]. Table 6 presents us with the key articles analyzed above and according to the factors we are looking for, the Pilates method appears to be the appropriate therapeutic exercise approach for Mrs. B. Fleming and Duff's groups having investigated the practical application of the Pilates method in people who: a) are in the age group of the case study we are studying (18 – 65 years), b) are at the same stage of the disease (1.0 – 5.5 EDSS) and c) is still functional in their daily life, they recommended the Pilates method according to their results as a moderate form of exercise with a therapeutic background in the factors of gait, balance and mild depression characteristics [1,4]. The rest of the studies deal entirely with the effectiveness of TA as a means of rehabilitating people with MS, with the difference that either the type of therapeutic approach involves intense physical exercise, which does not fit the case study we are examining, or they do not investigate all the factors that show Mrs. B. in her everyday life. According to Duff and colleagues, the result of the therapeutic approach through the Pilates method will be much better if it works cooperatively with massages even once a week. Tests performed by the group showed significantly improved walking (52m) compared to the control group (15m), balance management in test (TUG) with a time reduction of 1.3 vs. 0.9 of the control group, and a factor of PZ (such as mild depressive symptoms) improved for the intervention group +18.8 versus the control group +13.8 [4].

Table 6: It presents us with the key articles analyzed above and according to the factors.

| Author / Year of publication | Factor 1 (Walking) | Factor 2 (balance) | Factor 3 (Depression) |
|------------------------------|--|---|--|
| [12] | INTERVENTION GROUP – SIGNIFICANT DIFFERENCE | NOT COUNTED | INTERVENTION GROUP – SIGNIFICANT DIFFERENCE |
| [1] | INTERVENTION GROUP – SIGNIFICANT DIFFERENCE VERSUS CONTROL GROUP | INTERVENTION GROUP – SIGNIFICANT DIFFERENCE VERSUS CONTROL GROUP | INTERVENTION GROUP – SIGNIFICANT DIFFERENCE VERSUS CONTROL GROUP |
| [5] | NOT COUNTED | HALLIWIC METHOD SIGNIFICANT DIFFERENCE VERSUS PLEIOMETRICAL EXERCISES | NOT COUNTED |
| [11] | INTERVENTION GROUP – SIGNIFICANT DIFFERENCE | INTERVENTION GROUP – SIGNIFICANT DIFFERENCE | NOT COUNTED |
| [4] | INTERVENTION GROUP – SIGNIFICANT DIFFERENCE VERSUS CONTROL GROUP | INTERVENTION GROUP – SIGNIFICANT DIFFERENCE VERSUS CONTROL GROUP | INTERVENTION GROUP – SIGNIFICANT DIFFERENCE VERSUS CONTROL GROUP |
| [9] | INTERVENTION GROUP – SIGNIFICANT DIFFERENCE | INTERVENTION GROUP – SIGNIFICANT DIFFERENCE | NOT COUNTED |



Conclusion

The evidence found from the studies suggests the positive effect of TA as a means of rehabilitation for people with MS. However, this conclusion does not mean that every type will be suitable for all people diagnosed with MS. Rehabilitation programs for patients with MS should take into account the stage of the disease, degree of disability and neurological deficits. The appropriate time for the application of TA is during the period of remission of the respective symptoms, calculating the degree of the damage and the goals of the treatment. Therapeutic exercise programs are hindered by the patient's fatigue associated with the disease, which limits not only the patient's ability to move but also their mental health. In people who are on the EDSS scale from 1.0 to 5.5 with mild signs of the disease, the Pilates method is recommended as a safe form of exercise with positive results in improving gait, balance ability, and mild depressive symptoms. The special exercise program proposed by the researchers of the studied interventions concerns a circular program of basic exercises of the Pilates method, with intermediate breaks depending on the level of the patient, with the weight of the body, without the use of additional aids (pilates props). Also, programs at home involving the Pilates method, under the supervision of a qualified physical education teacher and physical therapist and also with the supervision of a specialist trainer at least once a week and simultaneous psychological support from a specialist, are recommended for the above category of people with MS. Finally, more randomized controlled studies are needed regarding the Pilates method and therapeutic rehabilitation for people with MS, so that we have a complete picture of the effectiveness in all stages of the disease and in both sexes.

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APPENDIX

| | |
|---|--|
| Name: B. Age: 36 | Diagnosis : Multiple sclerosis (MS) Rehabilitation intervention: therapeutic exercise program |
| <p>Personal factors</p> <ul style="list-style-type: none"> • Mrs. B. She is 36 years old and works in a private school. • She is married and has a small 2 year old son. • She lives with her husband, who is quite helpful around the house, especially after the birth of the child and the diagnosis of MS. • She was a former swimmer and remains in good physical condition. • After the diagnosis, she presents sporadic problems with her gait, her balance and some mild features of depression due to the onset of the disease. • She tries to accept her condition and meets once a week with a specialist psychologist. | |
| <p>Environment</p> <ul style="list-style-type: none"> • Lives in a 4th floor apartment, with elevator, no stairs inside the apartment. • He used to drive to work and activities, now he avoids it and uses MMM. • Her parents live in the lower apartment, who help her quite a bit with the house and raising the child when her husband is working. | |
| <p>Activities / Participation</p> <ul style="list-style-type: none"> • She can and does cope with ED, with some slight difficulty on days when she is tired and has difficulty walking or standing for long periods of time. • He has stopped running and swimming, but has expressed a desire to return to the sports part, even in the form of mild exercise. • At school her favorite activity was outdoor alternative education, which she avoids now because she doesn't feel confident and doesn't feel like doing it. | |