

# Using mind-body exercise as a strategy for enhancing the health and well-being of people with multiple sclerosis

Project Reference: 101134389

# Deliverable D1.2

# OUTPUTS

(best practices, feasibility, target group reached, online exercise related resources)

December 2023 – May 2025











# Índice

1.Introduction	3
2.Objectives of the project	3
3.Functional groups	4
4. Synchronous part of the project	4
4.1. Recruitment process	4
4.2. Participants	5
4.3. Weekly schedule	5
4.4. The exercise program	6
4.5. Exercise Professionals	8
<b>4.6. Assessment</b> 4.6.1. Feasibility 4.6.2. Outcomes	<b>8</b> 8
5.RESULTS	<b>19</b> 19 27
6. Online exercise related resources	36
6.1. Components of the online exercise videos	<b>37</b> 37 38 38 39 39
6.2. Online Resources – A brief glance	40
7.Conclusion and Future Perspectives	43









# 1.Introduction

This report is produced within the scope of Work Package 1 (Deliverable 1.2) and covers the entire 18-month implementation period of the project. It includes both a descriptive and reflective component, providing an analysis of the results (feasibility, outputs, description of the exercise program, etc.) obtained throughout the project's implementation. This means that, as it was written in the description of the deliverable, it encompasses the middle-term and final outputs.

The project was highly successful, fully meeting the objectives and activities outlined in the original application. It enabled a significant number of people with Multiple Sclerosis (PwMS) to engage in regular, supervised exercise from the comfort of their homes and led to the creation of open-access online resources to support ongoing physical activity at home. High-quality videos were produced in the context of this project, to facilitate the engagement of PwMS in multicomponent mind-body exercise.

Participants were assessed at multiple time points (baseline, 5 months, and 9 months) throughout the implementation of the synchronous online program, using a variety of indicators: symptoms, functionality, physical fitness, mental health, body awareness, mindfulness, among others. As it is evidenced in the results section of this report, the participation in the online synchronous exercise program led to improvements in several assessed parameters, revealing a positive impact on participants' health, well-being, and functional capacity. Throughout this report, the scientific dimension of the project is implicit — from the design of the exercise program, grounded in current research on multicomponent interventions, to the careful evaluation of its effects on various aspects of participant functioning. This is a project that should be expanded in the future to new publics and partners.

# 2.Objectives of the project

PwMS have low levels of health-promoting physical activity. This is due to several barriers to physical activity, including a lack of information, few programs tailored to the specific symptoms (e.g., fatigue and pain) of MS, and the need for transportation to the exercise facilities.

In this line of thought, the main objective of the 'Active and Mindful' project was to promote the health, well-being, and quality of life of PwMS through their participation in mind-body exercises using digital resources.

The Active and Mindful had two specific and interconnected objectives:

(i) planning and implementing a mind-body exercise program tailored to the participants' characteristics that target physical and psychological functioning; the program will be developed exclusively online (synchronous sessions).









(ii) using digital tools to produce and provide open-exercise related resources that can used by PwMS in their homes (asynchronous) according to their level of functionality.

# 3. Functional groups

The project team decided to divide the participants according to their functionality.

- Profile A "My symptoms do not significantly affect my mobility"
- Profile B "I walk with some difficulty";
- **Profile C** "I usually use a manual or electric wheelchair to get around";



This functional stratification allowed the program to be tailored to the specific needs, capacities, and limitations of each group, ensuring appropriate intensity, movement adaptations, and support. By creating three distinct profiles — the intervention could respect individual differences and avoid a one-size-fits-all approach. This ensured greater engagement, accessibility, and safety during the sessions, and made it possible for participants to benefit from a program that was aligned with their functional level and daily living realities.

# 4. Synchronous part of the project

4.1. Recruitment process









Both the Asociación de Familiares y Afectados de Esclerosis Múltiple de Burgos (AFAEM) and the Sociedade Portuguesa de Esclerose Múltipla (SPEM) had a major role in the recruitment of the PwMS for participating in the project activities. Due to their nature and mission, AFAEM and SPEM were able to reach PwMS using different means, including personal contact (phone, e-mail, in-person) and virtual communication channels (e.g., webpage, Facebook, Instagram, etc). Moreover, as this project was digitally based, PwMS participation in the project come from different parts of the country, especially in Portugal (we have people from the south, centre, north and islands)

# 4.2. Participants

Considering the functional status of the participants, and the goal of quality exercise sessions, the maximum number of people per group was 8 for profile A, 6 for profile B, and 5 for profile C.

Several groups were formed for each functional profile: Profile A – Group A1 (PT), Group A2 (PT), Group A3 (ES) Profile B – Group B1 (PT), Group B2 (PT), Group B3 (ES) Profile A – Group C1 (PT), Group C2 (PT), Group C3 (ES)

The number of participants that entered the online exercise sessions are presented in the next table.

Profile	Portugal	Burgos (Spain)	Total
А	14 (8 + 6)	5	19
В	14 (8 + 6)	5	19
С	6 (3 + 3)	5	11
Total	34	15	49

# 4.3. Weekly schedule

A previous zoom meeting was arranged with the participants for organizing the schedule for each group.









Mon 12	Tue 13	Wed 14	Thu 15	Fri 16
		Session Group C (ES) 10:45-11:45 AM		
		Session Group B (ES) 12-1PM		Session Group B (ES) 12-1PM
		Session Group A (ES) 1-2 PM		Session Group A (ES) 1-2 PM
Session Group C1 (PT) 2:30-3:30 PM		Session Group C1 (PT) 2:30-3:30 PM		
	Session Group A2 (PT) 3-4 PM		Session Group A2 (PT) 3-4 PM	
Session Group C2 (PT) 4:30-5:30 PM	Session Group B1 (PT) 4:30-5:30 PM	Session Group C2 (PT) 4:30-5:30 PM	Session Group B1 (PT) 4:30-5:30 PM	
Session Group B2 (PT) 6-7PM		Session Group B2 (PT) 6-7PM		
	Session Group A1 (PT) 6:45-7:45 PM		Session Group A1 (PT) 6:45-7:45 PM	

For each session, the participants were asked to have:

>A computer or tablet, with good internet access on-site and the ZOOM platform installed, camera turned on.

>Materials for the sessions: chair, exercise mat.

>Space: 1.5 meters or 3 normal walking steps.

# 4.4. The exercise program

During nine months, online exercise sessions (2 x per week for each group) were delivered live and supervised by qualified health professionals.

These synchronous online sessions (zoom) took place between April 2024 and January 2025 in Portugal and Spain (Burgos). The main components of the exercise program were:

>Warm-up

- >Cardiorespiratory and Mobility Training
- >Balance
- >Strength
- >Mindfulness, Breathing and Body Awareness

For group C, we added an extra exercise component, neuromotor exercises, that focused coordinative movements of the upper limbs.

The exercises were designed based on international recommendations for individuals with Multiple Sclerosis.









The exercise program was structured across three different levels of functionality, with several small groups (3 to 8 participants) within each level. All groups completed two exercise sessions per week.



The development of the "Active and Mindful" program was rooted in evidence-based practice and shaped through a collaborative and interdisciplinary process. The program was designed by a team composed of academic researchers, healthcare professionals, and institutional practitioners working closely with individuals affected by multiple sclerosis. This team included experts in exercise science, physiotherapy, occupational therapy, and psychology, and was supported by professionals from SPEM and AFAEM.

Drawing on international guidelines and current literature on exercise and mindbody interventions for neurological conditions, the team carefully structured a program that is both grounded in scientific evidence and responsive to the needs and abilities of people with MS. Emerging studies integrating physical exercise and mindfulness suggest that the combined approach yields better outcomes than either component alone; thus, adding mindfulness training to an exercise program could result in greater reductions in fatigue and MS-related impact. The program's design also prioritized safety, feasibility, and individualization, aiming to promote physical, emotional, and cognitive well-being.









Building on this rich experience, the team proceeded to design a series of asynchronous video resources, following the same rigorous logic: functional stratification, clear structure, precise instructions, and technical quality. These videos are now freely accessible on the project website, enabling users to continue exercising autonomously. These resources will be presented later in this report.

## 4.5. Exercise Professionals

The synchronous sessions were conducted by a team of exercise physiologists and physiotherapists, whose expertise ensured the safety, progression, and individualisation of the programme. Professionals from both Portugal and Spain met regularly to coordinate and plan the sessions in detail, discussing participant feedback, refining the content, and making all necessary adjustments to adapt the intervention to the evolving needs and capacities of each group. This ongoing collaboration was key to maintaining the coherence and quality of the programme across institutions and countries.

Cailer (Cor. $v = 11 \rightarrow A^{*} A^{*} A a v$ N $I \leq v \Rightarrow x, x^{*} \Rightarrow a v \neq v \Rightarrow A$ Promover a mobilidade. Consolidação	A₀         E + [E + K + K]         If         If	0	
GRUPO A			
OBJETIVOS OPERACIONAIS	ATIVIDADE	MATERIAL	DURAÇÃO/REPETIÇÕES
<ol> <li>Posicionar corretamente os 6 pontos do alinhamento minuto,</li> <li>Marchar durante urrepitições</li> <li>Girar externamente as articulações do ombro para separa os antebraços. Manter a estabilização dos omoplatas, pelo menos 12 a 15 repetições.</li> <li>Subri a pontas dos pés, sem afastamento dos calcanhares, 6 das 15 repetições.</li> <li>Elevar a bacia em direção ao teto, pelo menos 12 a 15 repetições.</li> <li>Manter o controlo da respiração 6 - Elevar os braços, à frente, 15</li> <li>Tobalizar o pé em cinna de uma tobalha, 21 das 15 repetições.</li> <li>Bostizar o pé em cinna de uma tobalha, 20 das 15 repetições.</li> <li>Destizar o pé em cinna de uma tobalha, 21 das 15 repetições.</li> <li>Destizar o pé em cinna de uma tobalha, 21 das 15 repetições.</li> <li>Destizar o pé em cinna de uma tobalha, com texensão simultánea dos braços 12 das 15 repetições.</li> </ol>	<ol> <li>Alinhamento/vertical com mobilidade</li> <li>Marcha/dissiccamento multificrecional, em pé, cognitiva</li> <li>Durby Natter com peo</li> <li>Saine Carl (DD) com peo</li> <li>Saine Carl (DD) com peo</li> <li>Leg slides (DD)</li> <li>Floating arms (DD) <u>om simultâneo</u> com leg slides com peo</li> </ol>	Cadeira	<ol> <li>2 series, 1' de trabalh com 1' de descanso (5')</li> <li>2 carries de 31'-1'(5')</li> <li>3 descanso (5')</li> <li>2 series, 1' de trabalh com 30'-1' de descanso (5')</li> <li>2 series, 1' de trabalh com 1' de descanso (5')</li> <li>2 series, 1' de trabalh com 1' de descanso (5')</li> <li>2 series, 1' de trabalh com 1' de descanso (5')</li> <li>2 series, 1' de trabalh com 1' de descanso (5')</li> </ol>

(A screenshot from an online meeting between the portuguese and spanish professionals who conducted the sessions; these meetings took place regularly throughout the project)

#### 4.6. Assessment

#### 4.6.1. Feasibility

#### Recruitment and attendance

To evaluate the feasibility of the Active and Mindful online exercise program for people with multiple sclerosis (MS), several dimensions were assessed throughout the 9-month intervention (twice-weekly sessions). The combination of quantitative







and qualitative indicators provided a comprehensive understanding of the program's feasibility, informing future implementation and scalability efforts.

*Recruitment Capacity.* The ability to successfully recruit participants was monitored, indicating the accessibility and appeal of the program.

*Attendance*. Session attendance was tracked systematically to gauge engagement and regular participation.

*Retention*. Participant retention over the course of the program was used as a key indicator of long-term feasibility and acceptability.

*Qualitative Feedback*. Participants were asked to share their perceptions regarding positive aspects, potential challenges, and suggestions for improvement. This feedback helped to refine the intervention and understand user experience more deeply.

#### Satisfaction-related Measures

At the end of each online session, participants completed three brief Visual Analogue Scales (VAS) using coloured facial icons and Likert-style response options. These aimed to capture immediate feedback on

- 1. Satisfaction with the session
  - Scale from "Very dissatisfied" (red, sad face) to "Very satisfied" (green, smiling face).
  - Question: "I was satisfied with the session I completed."



(Portuguese version)

- 2. Willingness to participate again
  - Scale from "Strongly disagree" to "Strongly agree", using emotional faces.
  - Question: "I would like to participate in this session again."







(Portuguese version)

- 3. Perceived ease of following the session online
  - Scale from *"Strongly disagree"* to *"Strongly agree"*, assessing the participant's ability to follow instructions remotely.
  - Question: "It was easy to follow the exercises online."

These VAS were designed to be simple, accessible, and intuitive, accommodating potential cognitive and visual processing limitations common in people with multiple sclerosis.



(Portuguese version)

#### Borg scale of perceived exertion

The Borg CR10 Scale was applied after each session to assess perceived intensity of effort, ensuring appropriateness of exercise load. The Borg Scale provides a practical and safe method to gauge exercise effort in people with MS, enabling adaptive intensity control during sessions — particularly valuable in online programs where direct physiological monitoring is limited.

In this Project we use the 0 to 10 (modified CR10 version) – where 0 = "nothing at all", and 10 = "very, very hard".







Rating	Descriptor
0	Rest
1	Very, Very Easy
2	Easy
3	Moderate
4	Somewhat Hard
5	Hard
6	-
7	Very Hard
8	-
9	-
10	Maximal

#### Participants' perceptions and suggestions regarding the program

During the exercise program, participants were invited to evaluate the online sessions. They were asked to comment on both the positive and negative aspects and to suggest changes to the activities. A thematic analysis was conducted on the collected feedback.

#### 4.6.2. Outcomes

The participants were assessed in three different moments (pretest, middle-test and posttest) to examine their progression over the 9 months of the program. The questionnaires and scales are provided in the appendices of this report.

Quality of life Mental Health Functional status Symptoms Body awareness Physical Fitness

We use the notion platform for organizing the instruments and facilitate the response by the participants

PT https://activeandmindful.notion.site/Avalia-esbb53850195554b6abd5410d762b8da40

ES https://activeandmindful.notion.site/Evaluaci-nc463ccdd08e944b08edc54a79a633b59









ACTIVE AND MINDFUL	AND MINDFUL
<b>Avaliações</b> Para preencher os questionários clique na palavra ( <u>I<sup>h</sup>Registo</u> ) que está sublinhada em cada componente	Evaluación Para completar los cuestionarios, haga clic en la palabra ( <u>Registro</u> ) que está subrayada en cada componente
Consentimento Informado	Consentimiento Informado
Qualidade de Vida	Calidad de Vida
Saúde Mental	Salud Mental
Funcionals	Funcionales
Sintomas Ib Registe-Cor Ib Registe-Fadga	Síntomas
Consciència Corporal Peginto-MAA Peginto-Atencio	Consciencia Corporal
Satisfação	Satifacción
Comentários	Comentarios

#### Modified Fatigue Impact Scale (MFIS)

The Modified Fatigue Impact Scale (MFIS) is a widely used self-report questionnaire designed to assess the impact of fatigue on individuals with multiple sclerosis (MS). It evaluates how fatigue affects a person's physical, cognitive, and psychosocial functioning over the previous four weeks.

The MFIS consists of 21 items divided into three subscales:

- Physical (9 items)
- Cognitive (10 items)
- Psychosocial (2 items)

Participants rate each item on a 5-point Likert scale ranging from 0 (*Never*) to 4 (*Almost Always*), indicating how often fatigue has affected various aspects of their daily life. The total score ranges from 0 to 84, with higher scores reflecting a greater perceived impact of fatigue.

The MFIS is a validated instrument for use in MS populations and is recommended for both clinical and research settings to monitor fatigue-related outcomes.

Brief Pain Inventory (BPI)







The Brief Pain Inventory (BPI) is a widely used self-report instrument developed to assess both the intensity of pain and the impact of pain on daily functioning. It was originally developed for cancer pain but has been validated and adapted for use across a wide range of chronic pain conditions, including neurological disorders such as multiple sclerosis.

The BPI includes two main dimensions:

#### >Pain Severity

Participants rate their pain on a 0–10 numeric scale, with 0 meaning "no pain" and 10 meaning "pain as bad as you can imagine." Pain is rated at its: Worst, Least, Average, Current (at the time of responding)

#### >Pain Interference

Respondents indicate how much pain has interfered with seven domains of daily life: General activity, mood, walking ability, normal work (both outside and inside the home), relations with other people, sleep, enjoyment of life

Each item is scored from 0 (does not interfere) to 10 (completely interferes).

#### Hospital Anxiety and Depression Scale (HADS)

The HADS is a widely applied self-report instrument specifically designed to assess emotional distress in non-psychiatric populations, such as individuals with physical health conditions or those participating in lifestyle interventions.

The scale consists of 14 items, divided into two subscales: 7 items assess anxiety (HADS-A) and 7 items assess depression (HADS-D). Each item is rated on a 4-point Likert scale ranging from 0 to 3, with subscale scores ranging from 0 to 21. Higher scores indicate greater symptom severity. A score of 8 or above on either subscale is generally considered to reflect clinically relevant symptoms.

The HADS has demonstrated robust psychometric properties, including good internal consistency and construct validity across diverse populations. It has been validated for use in the Portuguese and Spanish population.

#### Activities-specific Balance Confidence Scale (ABC)

The ABC is a self-report measure designed to assess an individual's confidence in maintaining balance while performing various everyday activities. It was developed by Powell and Myers (1995) to evaluate balance-related self-efficacy. The ABC Scale has been widely validated and is considered reliable for older adults and individuals with neurological conditions (e.g., stroke, Parkinson's disease, multiple sclerosis),









The ABC Scale consists of 16 items, each describing a specific activity (e.g., walking around the house, reaching at eye level, walking on icy sidewalks). For each item, respondents rate their confidence in performing the activity without losing balance or becoming unsteady, using a scale from 0% (no confidence at all) to 100% (completely confident).

The overall score is calculated as the average of the 16 item scores, expressed as a percentage. Higher scores indicate greater confidence in balance during daily activities, while lower scores suggest fear of falling or reduced balance self-efficacy. It is often used in research and rehabilitation programs to monitor changes in balance confidence over time or following an intervention.

#### **Physical fitness**

A protocol was prepared for assessing the physical abilities of the participants, namely balance, strength and cardiorespiratory fitness.

All assessments were careful prepared with the participants. Instructions were previously sent to the participants to prepare the space and positioning the camera (computer, smarthphone ou tablet)

We reproduce here the document (portuguese version) produced to support the physical assessment.

\_\_\_\_\_

PHYSICAL ASSESSMENT PROCEDURE GUIDE

Important

All tasks are demonstrated in advance by the evaluator. Tasks are carried out in the order presented in this document.

1. Semi-Tandem Balance

Equipment:

- 1 table
- 1 chair (for the computer)

Practice: one trial Assessment: two trials

Procedures:

- 1. Arm position:
- (Group A) arms crossed over the chest (Group B) arms free
- 2. Place one foot behind and slightly to the side of the other (big toe touches the lateral heel area)
- 3. Timing starts once the participant holds the correct position
- 4. Stopwatch is stopped once the participant moves out of position or uses support
- 5. Stop the test if the participant reaches 30 seconds











Feet in semi-tandem position



Lateral camera position

#### 2. Tandem Balance

Equipment:

- 1 table
- 1 chair (for the computer)

Practice: one trial Assessment: two trials

Procedures:

- 1. Arm position:
- (Group A) arms crossed over the chest (Group B) arms free
- 2. Place one foot directly behind the other (heel-to-toe contact)
- 3. Timing starts once the participant holds the correct position
- 4. Stopwatch is stopped once the participant moves or uses support
- 5. Stop the test if the participant reaches 30 seconds





Feet in tandem position

Lateral camera position

3. Unipedal Balance









Practice: one trial for each foot Assessment: two trials for each foot

Procedures:

- 1. Arm position:
- (Group A) arms crossed over the chest (Group B) arms free
- 2. Raise one foot off the ground and maintain balance
- 3. Timing starts when the foot leaves the ground
- 4. Stopwatch is stopped when the foot touches the floor or the participant uses support
- 5. Stop the test if the participant reaches 30 seconds



Raise one foot and maintain balance



Lateral camera position

#### 4.Sit-to-Stand test

Equipment: - 2 chairs (at least one without armrests)

Practice: 1 repetition Assessment: 5 repetitions

1. The chair (without armrests) should be against a wall. For safety, place another chair in front.

2. The participant should sit upright, feet shoulder-width apart and fully supported on the floor.

3.One foot may be slightly in front of the other for balance.

4.Arm position:

(Group A) arms crossed over the chest (Figure 1)

(Group B) arms free without touching the chair (Figure 2)

5.At the command 'start', the participant stands up to full extension and returns to a full seated position.

6.Complete five repetitions as quickly as possible.



Figure 1













#### 5. Two-Minute Step-in-Place

#### Equipment:

- 1 table
- 1 chair (for the computer)

Practice: 15 seconds Assessment: 2 minutes

#### Procedures:

1. The participant should select a table with a height around mid-thigh level.

2.Stand sideways next to the table.

3.At the command 'start', alternate knee lifts for the duration of the test.

4.Knees should reach at least the height of the table.

5.If that is difficult, lift knees to a comfortable height.

6.If fatigued, slow down, pause or rest as needed.

7.One hand may be used for support on the table if necessary.



Knees should lift to the height of the table



Lateral camera position

#### Mindful Attention Awareness Scale (MAAS)

The Mindful Attention Awareness Scale (MAAS) is a validated self-report questionnaire designed to assess a core aspect of mindfulness: the individual's ability to maintain attention and awareness of the present moment. It reflects how frequently people experience states of mind that are characterized by absentmindedness, automatic pilot, and lack of present awareness.





-------





The standard version of the MAAS consists of **15 items**, each rated on a **6-point Likert scale** ranging from 1 (*Almost Always*) to 6 (*Almost Never*). Higher scores indicate greater levels of dispositional mindfulness — that is, a stronger tendency to be attentive and aware in daily life.

Rather than asking about formal mindfulness practices, the MAAS focuses on everyday experiences such as noticing sensations, being aware of actions, and paying attention to thoughts and emotions. It is commonly used in clinical, educational, and research settings to assess the effects of interventions aimed at increasing mindfulness.

The MAAS has been translated and validated in several languages, including European Portuguese and Spanish, and is considered a reliable measure of trait mindfulness in both general and clinical populations.

#### Multidimensional Assessment of Interoceptive Awareness (MAIA)

The Multidimensional Assessment of Interoceptive Awareness (MAIA) is a selfreport instrument designed to evaluate multiple dimensions of interoceptive awareness — the conscious perception of internal bodily sensations and their emotional and regulatory significance.

The Portuguese version of the MAIA was culturally adapted and validated by Machorrinho, Marmeleira et al., maintaining the conceptual structure of the original scale, while ensuring linguistic and cultural appropriateness for the Portuguese population. The Spanish version of the MAIA was adapted into Spanish by Valenzuela-Moguillansky & Reyes-Reyes, and also retains the original structure of 32 items:

- 1. Noticing awareness of body sensations such as heartbeat, breathing, or tension.
- 2. Not-Distracting tendency not to ignore or distract oneself from uncomfortable sensations.
- 3. Not-Worrying low tendency to experience anxiety in response to bodily discomfort.
- 4. Attention Regulation ability to focus and sustain attention on body sensations.
- 5. Emotional Awareness awareness of the connection between body sensations and emotional states.
- 6. Self-Regulation ability to regulate distress through attention to body sensations.
- 7. Body Listening active listening to the body for insight.
- 8. Trusting experiencing the body as safe and trustworthy.

Items are rated on a 6-point Likert scale, from 0 (*never*) to 5 (*always*), and higher scores reflect greater interoceptive awareness within each domain. This multidimensional approach allows for a comprehensive assessment of how









individuals relate to their bodily sensations in terms of perception, emotional meaning, and self-regulation. The Portuguese version demonstrated strong psychometric properties and is suitable for use in clinical and research contexts, particularly in studies involving mindfulness, body awareness, and psychosomatic health.

# **5.RESULTS**

#### 5.1. Feasibility

#### Recruitment

At the outset, the project's technical team determined the ideal number of participants for each group based on functional status. Three functional groups were established – A, B, and C – comprising a total of 57 individuals. Of these, 49 participants initiated the program, as some who had initially registered did not proceed to enrolment.

#### Retention

During the nine months of the program, 7 participants (14.3%) discontinued their participation, which means that 42 participants (85.7%) finished the online exercise program. These are very good numbers.

#### Attendance

Next, we present the % of attendance according to the participants' profile over the 9-months of the synchronous exercise program.





















Overall, the attendance was positive (~62%). Over the course of the 9-month period, there was a slight but consistent decline in attendance across both countries: In Portugal, attendance started high in May (with averages near 85%) and decreased progressively, reaching lower values between December and January (33–65%); In Spain (Burgos), attendance began exceptionally high in May and June (up to 95% in Profile A), but dropped more sharply after the summer, with average rates falling to around 40–60% in the final months.

Although attendance showed a gradual decline over the course of the program, several factors help explain this trend. Firstly, the participants included individuals with functional limitations, for whom sustained engagement — even in an online format — can be challenging. Issues such as health fluctuations, fatigue, or difficulty using digital platforms may have contributed to reduced participation over time. Seasonal effects may have played a role as well. The drop in attendance during the autumn and winter months could be linked to health issues and holiday periods. Despite the decrease, it is important to highlight that a large proportion of participants remained active over several months. This suggests that, even with the challenges inherent to remote delivery and participant characteristics, the program had meaningful impact and relevance for many.

One should note that given the multiple barriers to physical activity in people with multiple sclerosis, it is likely that many participants would not have engaged in regular exercise if it weren't for the structure of the program and the fact that it was delivered online.

Satisfation













Across the different months and contexts, the satisfaction data consistently reflect a highly positive perception of the *Active and Mindful* online exercise program. The three assessed items – satisfaction with the session, willingness to return, and ease of following exercises online – all showed stable and elevated scores, generally









ranging between 4.6 and 4.9 (on a 5-point scale), with only minor variations over time.

These results suggest that the program was well aligned with participants' expectations, needs, and abilities. The consistently high ratings for "I would like to participate again" highlight the motivational potential of the sessions and indicate sustained engagement. Similarly, the high scores for "It was easy to follow the exercises online" demonstrate that the digital format did not constitute a significant barrier – on the contrary, it likely facilitated participation by removing logistical and physical obstacles often experienced by people with multiple sclerosis.

The ability to maintain such high satisfaction over nine months suggests that online exercise programs, when carefully tailored, can offer a viable, motivating, and accessible solution for promoting regular physical activity in this population. Given the known benefits of exercise for individuals with MS – including improvements in fatigue, mobility, mood, and quality of life – the data support the relevance and feasibility of continuing and scaling such interventions.



#### Borg scale of perceived exertion



























Across all groups in both Portugal and Spain, the reported perceived exertion values using the Borg CR10 Scale (0-10) were generally in line with international recommendations for moderate-intensity exercise in people with multiple sclerosis, which typically advise staying within the 3 to 5 range (moderate to somewhat hard / hard exertion).

#### Participants' perceptions and suggestions regarding the program

During the exercise program, participants were invited to evaluate the online sessions. They were asked to comment on both the positive and negative aspects and to suggest changes to the activities. A simple thematic analysis was conducted on the collected feedback. Below are the key findings, both in terms of strengths and areas for improvement.

Positive aspects

Physical and Well-being Benefits







Participants reported feeling more agile, energetic, and calm after the sessions. They mentioned improvements in mobility, strength, and reductions in spasticity and fatigue.

#### Convenience

Being able to exercise and follow a rehabilitation program from home was highly valued, particularly by those living far from urban centres or with limited mobility.

#### Social Interaction

Participants appreciated the opportunity for social interaction, stating they felt part of a group and were able to share experiences with others in similar situations.

#### Professionalism and Empathy

Instructors were praised for their professionalism, friendliness, and empathetic attitude. Participants highlighted the way exercises were adapted to individual capacities.

#### Technology and Accessibility

The use of online platforms like Zoom was viewed positively, as it enabled regular participation and improved accessibility.

#### Adapted Exercises

The exercises were considered well adapted to the participants' conditions and abilities, making the sessions more inclusive and safer.

#### Aspects to Improve

#### Group Composition

Participants suggested that groups could be better organised according to different ability levels and fatigue thresholds to ensure a more balanced and effective experience.

#### Instructions and Tailored Exercises

There was a request for a more detailed exercise guide specifically designed for people with multiple sclerosis, to ensure inclusivity and clarity in all movements.

#### Session Structure and Timing

The relaxation period was considered too short, and more emphasis could be placed on breathing during the exercises.

#### Feedback and Evaluation Opportunities

Participants wanted more opportunities to share detailed feedback, especially regarding individual difficulties and needs.

#### Program Frequency and Duration

Several participants recommended increasing the number of weekly sessions to at least three and extending the overall program duration to enhance its benefits.









The analysis highlights strong satisfaction with the Active and Mindful program, particularly regarding its accessibility, personalisation, and positive impact on physical and emotional well-being. The online format and empathetic delivery were seen as key strengths. However, suggestions for greater individualisation, expanded content, and more frequent sessions indicate that participants are motivated to deepen their involvement — a sign of engagement and perceived usefulness. Addressing these areas could further enhance the program's effectiveness and inclusivity.

## 5.2. Outcomes



#### Modified Fatigue Impact Scale (MFIS)

The evolution of fatigue over the course of the program showed a clear reduction across all MFIS subscales. From the initial assessment to the 9-month follow-up:

Cognitive fatigue decreased by 3.2 points, representing a reduction of approximately 19%.

Physical fatigue showed a reduction of 3.9 points, equivalent to a 19% decrease. Psychosocial fatigue exhibited the most significant relative change, decreasing by 0.88 points, which corresponds to a 23% reduction.

Most of the improvement occurred between the initial and middle evaluations, with cognitive fatigue stabilizing afterwards, while physical and psychosocial fatigue continued to decline slightly through to the 9-month mark. These results suggest a sustained benefit of the program, particularly in reducing the perceived impact of fatigue on daily functioning.









#### Brief Pain Inventory (BPI)



Within the Active & Mindful program, participants reported progressive improvements in both pain severity and pain interference over the 9-month intervention period.

For Pain Severity there was a moderate reduction in reported pain severity, decreasing from 2.9 at baseline to 2.5 at 9 months. This 0.4-point reduction, while subtle, suggests a stabilisation or mild relief of pain perception throughout the program.

For pain interference a more notable reduction was observed in pain interference, with scores dropping from 2.8 to 1.8. This 1-point reduction reflects a 36% decrease in the extent to which pain affected participants' daily activities and quality of life.

These findings suggest that, beyond its impact on fatigue and mindfulness, the Active & Mindful intervention may have contributed meaningfully to participants' functional well-being, particularly by reducing the disruptive impact of pain in everyday life. The combination of physical activity, body awareness and mindfulness practices may have enhanced pain management and coping strategies.







#### Hospital Anxiety and Depression Scale (HADS)



The results show a positive evolution in emotional well-being among participants of the *Active and Mindful* program. From the initial assessment to the end of the program (9 months), anxiety scores decreased by approximately 8.3%, while depression scores showed a more substantial reduction of 18.75%. Notably, the most pronounced reduction in depressive symptoms occurred in the first five months (6.25%), followed by a further decline, suggesting a cumulative effect. Anxiety scores remained stable in the first half and decreased in the second half of the program.

Regarding clinical significance, at baseline, anxiety levels were within the normal range (score = 6), while depression scores were borderline (score = 8), suggesting a mild risk for emotional distress. However, by the 5-month mark, depression scores had decreased to 7.5 — entering the normal range — and continued to decline to 6.5 by the end of the program. These findings point to a gradual and clinically relevant improvement, particularly in depressive symptomatology.







#### Activities-specific Balance Confidence Scale (ABC)



The Active and Mindful program led to a substantial and sustained improvement in balance confidence, with the most notable gain occurring in the first 5 months (+9.5%), and a slight retention at 9 months (+8.1%). These findings suggest the program had a positive and clinically relevant impact on participants' perceived balance abilities — particularly important for individuals with MS, where balance confidence is closely linked to fall risk, mobility, and quality of life.

The ABC Scale evaluates individuals' confidence in maintaining balance during various daily activities — a crucial factor for people with MS, who often experience balance impairments, proprioceptive difficulties, and fatigue.

A change of 8–10% in ABC scores is generally considered clinically meaningful in populations with neurological conditions. In people with MS, improvements of this magnitude are associated with reduced fear of falling, which is a major contributor to physical inactivity, increased functional independence and willingness to engage in physical and social activities, and to greater autonomy and self-efficacy in daily life.









# **Physical Fitness**





























Over the course of the 9-month *Active and Mindful* online intervention, participants in both Group A and Group B demonstrated meaningful gains in balance, aerobic endurance, and lower-limb functional strength, with adaptations reflecting improved physical function and mobility.

#### Balance

Group A maintained maximum values (30s) in semi-tandem and tandem positions across all timepoints, suggesting preserved high-level static balance. Performance in single-leg balance remained high, with only minor fluctuations (e.g., left leg: 27.5s  $\Rightarrow$  26.67s).

Group B, starting from lower baseline values, showed substantial improvements: Semi-tandem: from 20.6s to 29s Tandem: from 15.4s to 16.22s Single-leg (right): from 6.8s to 13s.

These results indicate enhanced postural control and neuromuscular stability in progressively challenging balance tasks

Aerobic Capacity, 2-Minute Step Test

Group A improved from 128 to 158 steps at 5 months, maintaining high performance at 9 months (154), reflecting enhanced cardiovascular endurance and motor coordination.

Group B showed a positive trajectory as well, from 79 to 88 steps, despite more limited baseline capacity.

Lower Limb Strength – Sit-to-Stand Test







Group A improved performance over time, reducing the time taken from 13.8s to 10.28s, suggesting improved lower-limb strength and movement efficiency.

Group B also showed significant progress, from 20.2s to 16.76s, reinforcing the benefits even in individuals with lower starting capacity.



## Mindful Attention Awareness Scale (MAAS)

From baseline to 5 months, the MAAS score increased by 3.9 points, which represents a 6.3% improvement in dispositional mindfulness. This gain was maintained at the 9-month assessment, with no further increase or decrease observed between 5 and 9 months.

This suggests that the participants experienced a meaningful enhancement in their ability to remain present and aware during the first half of the program, with those gains remaining stable over time — indicating potential consolidation of mindfulness-related skills.









#### Multidimensional Assessment of Interoceptive Awareness (MAIA)

The bar chart presents the evolution of the subscales of the Multidimensional Assessment of Interoceptive Awareness (MAIA) at three time points: initially (baseline), mid-program (~5 months), and at the end of the *Active and Mindful* program (9 months).

Overall, the data suggest a positive trend in interoceptive awareness across all subscales. The Noticing subscale shows a clear increase from baseline to midprogram, which is maintained through to the end, indicating that participants became more aware of bodily sensations early on and sustained this awareness throughout the program. Not-distracting, which had the lowest baseline scores, improved gradually, suggesting that participants became progressively more capable of staying present with uncomfortable or unpleasant sensations rather than avoiding them.

In the case of Not-worrying, the scores remained stable during the first half of the program but showed a meaningful increase by the end. This delayed improvement may reflect a longer process of developing emotional resilience in response to internal experiences. Attention regulation exhibited a steady rise from baseline to the final assessment, pointing to a growing ability to direct and maintain attention toward bodily signals.

Emotional awareness, already relatively high at the start, increased slightly but consistently, reflecting a subtle yet continued integration of bodily sensations and









emotional understanding. Self-regulation displayed one of the most significant improvements, particularly in the second half of the program, suggesting that participants increasingly used body awareness to regulate distress and maintain emotional balance. Finally, Trusting, which reflects confidence in bodily signals, also improved steadily across time points, indicating a growing sense of safety and reliability in interpreting bodily cues.

Taken together, the results demonstrate that the *Active and Mindful* program effectively enhanced interoceptive awareness, with the most substantial gains emerging in self-regulatory and attentional capacities, as well as in participants' ability to trust their bodies. These findings highlight the program's potential to support

## 6. Online exercise related resources

The "Active and Mindful" project was conceived to include asynchronous online resources, making use of pre-recorded videos and digital resources to support autonomous participation. For each component—warm-up, cardiorespiratory and mobility training, balance, strength, and mind-body practices—dedicated video sessions were developed and made available on a digital platform.

This online structure allowed for flexibility and accessibility, enabling participants to engage with the content at their own pace and according to their individual daily rhythms. The videos were designed to be clear, progressive, and adaptable, considering various levels of physical capacity. This digital strategy also enabled broader outreach and continuity of care, especially for individuals facing mobility or transportation challenges.

Like the 9-month synchronous online exercise program, the asynchronous videos were accessible to a wide range of functional abilities, each exercise component was designed with three functional levels in mind: Level A, Level B, and Level C. These levels were introduced earlier in the report and reflect a graded approach to mobility and independence:

- Profile A: "My symptoms do not significantly affect my mobility"
- Profile B: "I walk with some difficulty"
- Profile C: "I usually use a manual or electric wheelchair to get around"









Video resources were thus adapted and recorded specifically for each level, ensuring that all participants, regardless of functional capacity, could engage safely and meaningfully with the content. This stratification allowed participants to follow a progression aligned with their individual abilities and needs, while promoting autonomy and a sense of inclusion across all levels of mobility.

# 6.1. Components of the online exercise videos

#### Warm-up

The warm-up phase prepares the body and mind for the upcoming physical activity. Online exercise videos include light aerobic exercises, dynamic stretching, and joint mobility activities designed to increase body temperature, improve blood flow to muscles, and enhance neuromuscular readiness. In individuals with MS, warm-up can help reduce stiffness and spasticity, improve proprioception, and prevent injury. It also serves to mentally engage the participant and build motivation for the session.



An example (video) from the webpage









#### Cardiorespiratory Training (and Mobility)

Aerobic training is essential to improve cardiovascular endurance and respiratory function. The video includes low- to moderate-intensity activities such as walking, stepping, or rhythmic movements were often used. These exercises enhance oxygen delivery, promote vascular health, and improve fatigue resistance. When integrated with mobility drills, such as dynamic range-of-motion movements, step transitions, or direction changes, this component helps maintain or improve movement fluidity and joint function. For individuals with MS, this combination improves stamina, walking efficiency, and mobility confidence.



An example (video) from the webpage

#### Balance

Balance training aimed to improve postural control and prevent falls—a common concern in MS. Exercises in the videos include standing on one leg, weight shifts, tandem walking, and dynamic balance tasks, etc. Balance drills challenge the vestibular, visual, and proprioceptive systems, enhancing neuromuscular coordination. Consistent balance training contributes to safer movement, better reaction times, and increased confidence in daily activities.









An example (video) from the webpage

# Strength Training

Resistance exercises focus on maintaining and improving muscle strength, particularly in the lower limbs, core, and postural muscles. Common modalities include bodyweight exercises, resistance bands, and light weights. Progressive overload principles are applied gradually, respecting individual fatigue thresholds. In MS, where muscle weakness and deconditioning are common, strength training supports functional independence, improves gait, and reduces the risk of falls and secondary complications.



An example (video) from the webpage

# Body Awareness – Including Mindful, Breathing, and Relaxation

This component integrated practices aimed at cultivating present-moment awareness and promoting autonomic balance. Breathing exercises (e.g.,









diaphragmatic breathing, paced breathing) stimulate the parasympathetic nervous system and help manage stress, anxiety, and emotional fluctuations. Mindfulness practices, such as body scans or guided meditation, foster self-awareness, emotional regulation, and acceptance. This inward focus can reduce perceived stress and improve cognitive and emotional functioning. Additionally, mindful movement and conscious body awareness enhance motor control, reduce muscle tension, and improve self-efficacy.



#### An example (video) from the webpage

# 6.2. Online Resources – A brief glance

Here we provide more information regarding the exercise-related online resources, which can be visioned here:

https://activeandmindful.uevora.pt/programa-de-exercicio/ (Portuguese version)

https://activeandmindful.uevora.pt/es/programa-de-ejercicio/ (Spanish version)

The project team prepared and recorded dozens of videos for the various exercise components. The videos are accompanied by clear and objective instructions (in both Portuguese and Spanish) that help participants perform the movements or the body awareness and mindfulness activities correctly.

Each video contains several exercises, making it easy to carry them out at home. At home, participants can select videos according to their functionality and physical fitness level. To facilitate progression, the videos are organized into three levels of difficulty: Beginner, Intermediate, and Advanced.









Below we present some images from the project's webpage referring to the exercise resources. All resources on the webpage are available in both Spanish and Portuguese.

ACTIV AND MINDFUL	o Y O Projeto Y Exerc	icio Online 🎽 Eve	entos Notícias 💶 Portugi	Jês Y
Programa de Exercíc	0			
Durante a primeira fase do projeto "Active and (Burgos), devidamente supervisionadas por pr são disponibilizados neste site e que incluem	Mindful" foram dinamizadas s ofissionais de saúde. Com bas diversas componentes de exer	essões de exercício e nessa experiência, cício.	online em Portugal e em Espa foram criados recursos vídeo	nha que
Exercício Online 1º Escolha o seu Perfil Funcional (A, B ou C)				
2º Escolha a(s) componente(s) que pretende	treinar			
3º Escolha o nível de dificuldade (inicial, intern	nédio e avançado) em cada co	mponente		
Os exercícios foram elaborados tendo como n incluem as componentes:	eferência as recomendações ir	nternacionais para p	essoas com Esclerose Múltipla	a e
>Aquecimento				
>Equilíbrio				
>Exercício Cardiorrespiratório				
>Força				
>Consciência Corporal				
ACTIVE AND MINDFUL	Início 🖌 O Projeto 🖌	Exercício Online	<ul> <li>Eventos Notícias</li> </ul>	Português
		Escolha o seu perfil		
		Perfil A	>	
			>	
Escolha o seu perfil		Porfil C		
Perfil C >				
Antes de iniciar as sessões de exercício,	escolha o seu perfil funcior	nal.		
			_	
Os meus	Caminho co	om	Eu utilizo	
sintomas não	alguma		normalmente	•
afetam a minha	dificuldad	е	uma cadeira d	е
mobilidade de			rodas	
forma			(manual/elétric	a)
significativa			para me desloc	ar
Significativa				









# Não esquecer



Conselhos importantes para se manter em segurança e tirar o maior proveito do exercício:

✓ Consultar um profissional de saúde antes de iniciar uma nova rotina de exercício.

✓ Exercitar-se numa sala fresca e, se estiver no exterior, optar pelas horas mais frescas do dia.

✓ Começar devagar e aumentar progressivamente a dificuldade/intensidade.

 ${\boldsymbol {\sf V}}$  Dar prioridade à segurança para reduzir o risco de lesões.

✔ Manter-se hidratado.

 $\checkmark$  Fazer exercício várias vezes por semana.

# PERFIL A – AQUECIMENTO

1

8:55 / 1

----

# InicialImage: PT Perfil A/B aqueciment: Image: Image:

High quality videos were added for each exercise component and for each functional profile. Above, an example for Warm-up – Functional profile A.



YouTube





ACTIVE AND MINDFUL	ICIO V O Projeto V Exercicio Online V	Eventos Noticias 🖬 Portugues Y	
PERFIL B - CARDIOR	RESPIRATÓRIO		
	Inicial		
Perfil A/B - Cardiorrepirató (9)	PT. Perfil A/B. Cardiorrespir.	PT. Perfil A/B, Cardforrespir?	
Intermédio			
PT Perfil A/B. Cardiorrespir.	PT Perfil A/B, Cardiorrespin 22	PT Perfil A/B Cardiorrespir : 	
	Avançado		
PT Perfil A/B. Cardiorrespir.	PT Rerfil A/B- Cardiorrespi :	PT Perfi A/B - Cardiorrespi.	

High quality videos were added for each exercise component and for each functional profile. Above, an example for Cardiorespiratory exercise – Functional profile B.

# **7.**Conclusion and Future Perspectives

The Active and Mindful project clearly demonstrated how well-designed, inclusive mind-body exercise programs—delivered via digital platforms—can contribute significantly to the health, well-being, and functional capacity of people living with multiple sclerosis (PwMS). Developed through a strong partnership between institutions in Portugal and Spain, the project spanned 18 months, with a central phase consisting of nine months of synchronous, live online exercise sessions, tailored to different levels of functionality and supervised by experienced professionals.

The synchronous phase was not only successful in terms of participation and adherence, but also in the quality of the interaction established with the participants. Throughout this phase, valuable data were collected: feedback from participants, systematic assessments, and reflections from the professionals and wider project team. This close proximity to participants allowed for ongoing









adjustments and refinements, ensuring that the exercise program remained relevant, engaging, and effective.

Building on this solid foundation, the team used the insights gained during the first nine months—particularly regarding the feasibility, effectiveness, and participant experience—to develop a series of high-quality asynchronous video resources. These materials were carefully structured, functionally stratified, and uploaded to the project's website. They now serve as open-access tools, enabling individuals to organise their physical activity routines independently, while drawing upon the knowledge, skills, and habits acquired during the live sessions. This continuity reflects one of the project's core values: empowering participants to actively manage their own health through accessible, evidence-based guidance.

The partnership between the three institutions—each with a different background (scientific, associative, and patient care)—proved essential to the project's success, establishing a foundation of trust and cooperation that can be further strengthened in future initiatives.

Looking ahead, the *Active and Mindful* project opens the door to a broader, transnational effort, one that might include new partner countries, while continuing to promote quality exercise interventions supported by digital innovation. With continued support—such as from future Erasmus+ funding—this type of initiative has the potential to reach even more PwMS, offering inclusive, scalable solutions for active, healthy living across Europe.



