Faculteit Revalidatiewetenschappen

master in de revalidatiewetenschappen en de kinesitherapie

Masterthesis

The effect of a 10 months home-based supervised running program on Participation in persons with Multiple Sclerosis

Mathias Duckaert
Jonas Wellens

Scriptie ingediend tot het behalen van de graad van master in de revalidatiewetenschappen en de kinesitherapie, afstudeerrichting revalidatiewetenschappen en kinesitherapie bij musculoskeletale aandoeningen

PROMOTOR :
Prof. dr. Peter FEYS

BEGELEIDER :
Mevrouw Joke RAATS

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Research context

Participation gains increasing interest as a rehabilitation outcome within clinical practice and scientific research fields related to neurological populations (Erler, Kew, & Juengst, 2020; Goverover, Genova, Smith, Lengenfelder, & Chiaravalloti, 2020; Lund, Nordlund, Bernspang, & Lexell, 2007). Since it provides clinicians and researchers not only an overview of activities of daily life but also highlights the social functioning of an individual. Furthermore, participation is associated with important health outcomes like life satisfaction, well-being and quality of life (Ben Ari Shevil, Johansson, Ytterberg, Bergstrom, & von Koch, 2014; Cardol et al., 2002). So the optimization of participation in daily life regarding persons with disabilities is considered as a key goal for rehabilitation such as indicated by the World Health Organization (WHO) and the Convention of the Rights of Persons with Disabilities (United Nations, 2007; World Health Organization [WHO], 2001). Even though these recommendations in terms of improving participation are strongly recognized, the evidence concerning effective interventions is limited. Explanations for this shortage could suggest a lack of conceptual clarity causing hampered implementation of appropriate questionnaires and comprehensive interventions. However, according to the International Classification of Functioning, Disability and Health (ICF) it is clear that participation requires a biopsychosocial perspective thereby pointing out the dynamic interplay between the health condition and contextual factors (Ben Ari Shevil et al., 2014; WHO, 2001).

Therefore, this non-randomized controlled trial investigated the effect of an aerobic training intervention on the ICF-component participation within the research domain of neurological rehabilitation in particular within the study population of multiple sclerosis. Additionally, a multidimensional questionnaire was implemented regarding the evaluation of our main outcome measure self-perceived participation. The purpose of the application of a multidimensional questionnaire was to ascertain more detailed information about this comprehensive topic. The content of this intervention corresponded with a previously published intervention within this research group (Feys et al., 2019). However, one should take into account the circumstances in which the intervention was performed namely during the Covid-19 pandemic. So one should consider the fact that liberties of participants were strongly restricted by regulations of the Belgian government.

Furthermore, this study needs to be framed within the research project of PhD-student I. Nieste entitled: ‘The impact of structured exercise on physical fitness, sedentary time, brain volume, cognitive, health-related and immunological parameters in Multiple Sclerosis’ (Nieste & Op ’t Eijnde, 2019). The study design was conducted without the cooperation of second master students in physiotherapy and rehabilitation sciences M. Duckaert and J. Wellens. Moreover, the research itself took place at REVAL rehabilitation research institute (UHasselt) from January, 2020 (pre-testing) to November, 2020 (post-testing) for the experimental group and July, 2020 (pre-testing) to June, 2021 (post-testing) for the control group. Both second master students were involved in terms of the data acquisition of questionnaires (GPS, MSWS-12, MFIS) and cognitive tests (SDMT and SPART). M. Duckaert and J. Wellens attended both measurement periods for the experimental group but only pre-testing for the sedentary control group. Further, the research project of PhD-student I. Nieste focused predominantly on the impact of an exercise program on cardiovascular parameters (body composition, blood pressure, resting heart rate and cardiovascular fitness). Our research group analyzed and reported on data related to the following outcome measures: participation, cognitive function, walking ability and fatigue. All data-analyses just as the writing process were executed with an equal contribution by both second master students (M. Duckaert and J. Wellens).

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Abstract

Background: Intervention studies by persons with MS (PwMS) are primarily interested concerning outcomes on body functioning and activity level whereas the effect on participation remains under-investigated.

Objectives: This non-randomized controlled trial examined the effects of a home-based supervised running intervention on the ICF-component participation measured by the Ghent Participation Scale (GPS) in pwMS.

Participants: 60 mildly disabled pwMS (EDSS< 4) and 96 healthy controls (HC) were allocated to either the experimental group (EXP) or the sedentary control group (SDC). The EXP (n=117) consisted of 42 pwMS and 75 HC, the SDC (n=39) included 18 pwMS and 21 HC. The EXP received 3-weekly individualized training instructions during ten months aiming to participate in a running event. The SDC was instructed to continue their habitual activities of daily life.

Measurements: Primary outcome was the GPS. Secondary outcome measures were Multiple Sclerosis Walking Scale-12(MSWS-12), Symbol Digit Modalities Test (SDMT), Spatial Recall Test (SPART) and Modified Fatigue Impact Scale (MFIS).

Results: Repeated measures ANOVA did not indicate a significant difference regarding the total participation score or one of the subscales between baseline and post-measurement of pwMS in the EXP (EXP-pwMS). Also no significant difference was reported between the EXP-pwMS, EXP-HC, SDC-pwMS and SDC-HC regarding total participation score on all time points. Results on the MFIS and MSWS-12 showed significant improvements in both experimental groups with a significant difference of the EXP-PwMS over the EXP-HC concerning the MFIS. Multiple linear regression did not identify significant correlations related to participation.

Conclusion: This running intervention could not establish significant differences regarding self-perceived participation in pwMS. Though, one should consider the impact of the COVID-19 pandemic on important health outcomes like psychological functioning. Therefore, further research should take into account a broader biopsychosocial perspective regarding self-perceived participation.

Keywords: Participation, ICF, Multiple Sclerosis, rehabilitation, exercise, endurance training

Introduction

Multiple Sclerosis (MS) is primarily an inflammatory disease affecting the central nervous system (CNS) through demyelination plaques, axonal damage and white matter lesions (Compston & Coles, 2008; Karussis, 2014). MS is characterized by chronic neurodegeneration of the CNS leading to the progressive accumulation of disability. Moreover, this autoimmune and neurodegenerative disease damages the motor, sensory, visual and autonomic systems resulting in a heterogeneous array of symptoms and signs (Doshi & Chataway, 2016). Clinical manifestations predominantly include muscle weakness, fatigue, pain, mobility and cognitive impairments (Dalgas, Stenager, & Ingemann-Hansen, 2008; Kister et al., 2013). Therefore, persons with MS (pwMS) are often exposed to adjustments in their daily life activities and even more participation in leisure and recreational activities (Goverover, Genova, Smith, Lengenfelder, & Chiaravalloti, 2020). Accordingly, pwMS are likely to experience lower levels of self-efficacy (Motl & Snook, 2008) and self-esteem (Ifantopoulou et al., 2015) so that feelings of anxiety increase (Wood et al., 2013) and sedentary behavior amplifies (Veldhuijzen van Zanten, Pilutti, Duda, & Motl, 2016). As a result of the dynamic interplay between all these impairments, pwMS appear less satisfied with their degree of self-perceived participation in meaningful life events (Karhula, Kanelisto, Ruutiainen, Hamalainen, & Salminen, 2013) so that eventually quality of life diminishes overtime (Benedict et al., 2005).

Participation is considered as a key rehabilitation outcome for persons living with chronic disabling conditions due to associations with well-beiing, life satisfaction and health-related quality of life (Ben Ari Shevil, Johansson, Ytterberg, Bergstrom, & von Koch, 2014; Cardol, de Jong, van den Bos, et al., 2002). The Convention of the Rights of Persons with Disabilities emphasizes its importance through recommendations regarding the attainment and maintenance of full participation in all life aspects (United Nations [UN], 2007). Although, a conclusive description of participation is still missing so that the definition of the International Classification of Functioning, Disability and Health (ICF) is still predominantly adopted, namely ‘the involvement in a life situation’. Besides providing a definition, the ICF acknowledges participation as a component of the Model of Functioning and Disability (World Health Organisation [WHO], 2001; Latimer-Cheung et al., 2013). This biopsychosocial model outlines that several factors (e.g. impairments, activity limitations and contextual factors) impact participation hence it is important to detect the relative contribution of these factors and their mutual relationships to guide rehabilitation interventions (Ben Ari Shevil et al., 2014). However, the implementation of effective interventions regarding participation in clinical practice and research is hampered (Heine et al., 2017; Van de Velde et al., 2018). On this issue Van de Velde et al. (2018, p. 3) described four recurring limitations: “(i) there is ambiguity and vagueness about the term participation itself; (ii) differentiating between activity and participation remains unclear; (iii) the subjective aspects of participation are missing; and (iv) there is no consensus about how to measure participation”. Consequently, the lack of overall consensus entails diverging interpretations among researchers and clinicians resulting in difficulties to direct evidence-based decisions towards enhancing participation (Stallinga, Dijkstra, Bos, Heerkens, & Roodbol, 2014).

Notwithstanding, there is already a huge body of knowledge regarding the operationalization of questionnaires, the endorsement of participation within several instruments is still debatable (Van de Velde et al., 2018). For instance, some instruments encompass adjacent constructs like community integration, psychosocial functioning, quality of life or sometimes even aspects on the body-functioning level so that questions raise towards expedience. Another frequent shortcoming outlines the unidimensional perspective of authors on participation, often limited to only objective standards or subjective appreciation. Conversely, multidimensional questionnaires like the Ghent Participation Scale (Van de Velde et al., 2017), Utrecht Scale for Evaluation of Rehabilitation (Post et al., 2012) and Participation Survey/ Mobility (Gray, Hollingsworth, Stark, & Morgan, 2006) include both objective and subjective aspects of participation (Cardol, De Jong, & Ward, 2002). Although, these questionnaires differ from each other based on the degree of inclusion of the nine domains of activities and participation within the ICF and by providing a separated or combined score(s) of the variables. The Ghent Participation Scale (GPS) covers all nine domains of activities and participation, combines the subjective and objective variables in an overall score and is considered a valid method concerning the assessment of self-perceived participation in chronically disabled populations (Van de Velde et al., 2017).

Rehabilitation interventions aiming at improvements in functional independence and enhancements towards participation are considered as a key supportive treatment within a multidisciplinary disease management approach for pwMS (Amatya, Khan, & Galea, 2019; Beer, Khan, & Kesselring, 2012). Especially, physical therapeutic modalities such as exercise and physical therapy prove their effectiveness on various clinical meaningful outcomes like fatigue, walking mobility, depressive symptoms and quality of life (Latimer-Cheung et al., 2013; Motl et al., 2017). Aerobic training is like other rehabilitation interventions a generally safe and effective treatment strategy for pwMS and can be implemented as high-intensity interval training (HIIT) or low-to-moderate interval training (MCIT) (Campbell, Coulter, & Paul, 2018; Dalgas et al., 2008). Both methods of interval training induce not only favorable gains regarding aerobic capacity but also cardiovascular risk factors such as body composition and blood pressure (Briken et al., 2014; Keytsman, Hansen, Wens, & Op ’t Eijnde, 2019). Studies implementing HIIT within a periodized home-based training program for pwMS indicate improvements in exercise capacity, cognitive performance (Zimmer et al., 2018) and more importantly quality of life (Keytsman, Van Noten, et al., 2019). Although, the effectiveness of aerobic training concerning the ICF -component participation is limited for pwMS (Feys et al., 2020). Heine et al. (2017) investigated the impact of MCIT on societal participation by applying a combination of supervised and home-based aerobic interval training whereby social contact with the community was minimized. Nevertheless, the Impact on Participation and Autonomy (IPA) did not demonstrate significant improvements (Heine et al., 2017). Therefore, enhancing participation requires more than only aerobic training (Feys et al., 2020).

The primary objective of this study was to investigate multidimensional effects regarding self-perceived participation of mildly disabled pwMS following a home-based supervised running program. Initially, the participants should have accomplished the intervention within a community setting thereby offering the opportunity to ensure regular contact with each other and build a sense of community. Therefore, the motivation of the participants would be more stimulated and training adherence would be better maintained so that after a training period of ten months they could participate together in a public running event. We hypothesized that regular physical activity, social contact and appreciation will decrease the feeling of fatigue, improve cognitive function and mobility facilitating the enhancement of self-perceived participation of the participants. Accordingly, the main outcome measure was self-perceived participation and secondary outcome measures were fatigue, cognitive function and walking ability.

Methods

Participants

PwMS (MS - relapse remitting), diagnosed according to the McDonald criteria, and healthy controls (HC) participated in this study. Persons were included if age > 18 years, following written informed consent and approval after medical safety screening. Exclusion criteria were contra-indications concerning participation in moderate to high-intensity exercise, contra-indications to undergo magnetic resonance imaging (pacemaker/defibrillator or wires other than sternal wires, insulin pumps, metal foreign bodies, deep brain stimulator, cerebral aneurysm clips, cochlear implant, magnetic dental implant, drug infusion device), medication changes in the last month before the start of the intervention, following a weight reduction program, pregnancy, already participating in another study, an acute MS exacerbation <3 months prior to the start of the study, EDSS score >4, consumption of more than 20 alcohol units/week or no daily internet access.

PwMS were recruited through announcements at the MS Center Overpelt (Belgium), MS Society, 'Move-to-Sport' organization and by mail if they participated in prior studies linked to UHasselt. Healthy controls were recruited using announcements on social media. Participants attended an information session and brochure about the study 'Run for your Brain' in November 2019, additional information was offered by mail. The Medical Ethical Committee of Hasselt University provided ethical approval on 16/10/2019 and assigned the following code B911520194L7L5. This study was performed in accordance with the Declaration of Helsinki and was registered at ClinicalTrials.gov with the number NCT04191772.

Experimental Design

Figure 1 illustrates the design of this non-randomized controlled trial. Following inclusion, participants were assigned to the experimental group (EXP) or sedentary control group (SDC). Assignment to the experimental group was supported by motivation and willingness to participate in a running program with the goal to complete a public running event on October 11, 2020 (Dwars door Hasselt). The sample size was initially calculated at 140 participants that were equally distributed between the SDC (n=70) and EXP (n=70).

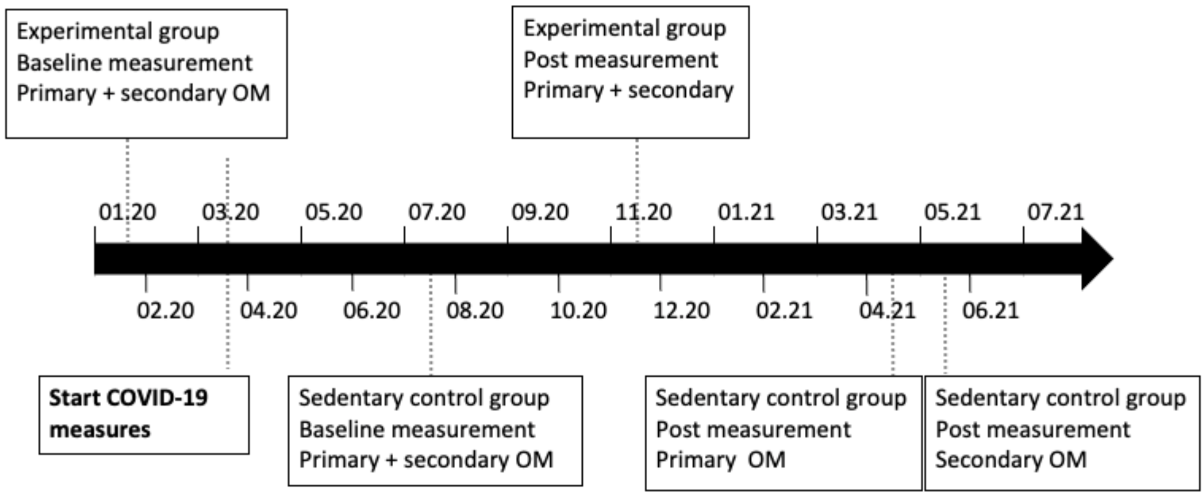

Figure 1: Study design

Intervention

The experimental group executed a home-based supervised exercise training program for a period of ten months from January, 2020 until October, 2020. Participants were dedicated to training three times weekly in accordance with personalized training instructions in terms of intensity and duration. Instructions were offered by means of a smartphone-based heart rate monitor application (Polar®app) whereby training data was supervised using two smartphone-based applications (Polar®app and ©2020 Strava). If compliance with three consecutive training sessions wasn't fulfilled, the research assistant contacted the participant concerning enquiry. Before the start of the intervention, participants of the experimental group were subdivided into three training groups based on VO2max values and running experience which both were established during pre-measurements. VO2max values were classified, according to reference values, in five different groups ranging from poor to superior VO2max (Gibson, Wagner, & Heyward, 2018). Running experience was categorized as 'no running experience' or 'running experience'. How participants were assigned to training goal one or two is demonstrated within supplemental material S1. So participants allocated to training goal one aimed to run 45 minutes continuously, allocation to training goal two corresponded with the goal to run continuously for 75 minutes both at the end of the program.

The intervention was based on linear periodization so that first aerobic capacity was built through a period of high-volume/low-intensity training before the proportion of high-intensity training was increased (Bradbury, Landers, Benjanuvatra, & Goods, 2020). At the beginning of the intervention, both training groups performed a start-to-run training program until they were able to run 45min or 75min continuously at low intensity (50- 70%HRmax*) (Nieste & Op 't Eijnde, 2019). This program corresponded with the previously published work of the research group 'Reval' at Uhasselt (Feys et al., 2019).

Hereafter, training intensity was increased (50-90%HRmax*) and recuperation weeks were added every two weeks (only one or two training sessions). The first two training sessions of every week were shorter in duration and higher in intensity (60-90%HRmax*), the third training session had a longer duration but lower intensity (50-70%HRmax*). In the recuperation week with only one training, a HIIT session with a

> maximal intensity of 90-100%HRmax* was performed. For HIIT sessions, a five-minute standardized warming up and five-minute cooling down was performed. (Nieste & Op ‘t Eijnde, 2019, p. 4)

Participants of the SDC group were instructed to continue their activities of daily life following ten months but they were not allowed to participate in any specific kind of training intervention. The execution of sports activities was permitted if it was a part of their activities of daily life.

Outcome measures and test procedures

Pre- and post-measurements were carried out on two test days per participant. Test day one (3h) took place at the REVAL rehabilitation research institute (UHasselt). First, blood pressure and resting heart rate were measured as health-related variables. Secondly, blood samples were taken to measure immunological parameters such as the concentration of cytokines and the number and composition of the peripheral blood immune cell population. Next, the whole-body composition was measured with a Dual-Energy Xray Absorptiometry (DEXA) scan. Subsequently, questionnaires concerning fatigue, participation and mobility were administered then followed by the two cognitive tests (Spatial Recognition Test and Symbol Digit Modalities Test). Finally, coordination and cardiorespiratory fitness were evaluated using a timed tandem walk (TTW) and a cardiopulmonary exercise test (CPET). On the second test day (1h), which was conducted within one week after test day one, a brain MRI scan was performed in the Jessa Hospital of Hasselt. Before the start of the intervention, during (five months) and after the intervention, physical activity and sedentary behavior were measured. Only physical activity and sedentary behavior are registered at three different time points with the ActivPAL3TM activity monitor (PAL Technologies Ltd, Glasgow, UK). Participants also had to complete a fatigue-related questionnaire and keep track of dietary habits for seven consecutive days utilizing a diary. Results on brain imaging and cardiovascular parameters will be described in another future study. This study reports on secondary factor analysis focussing on participation, mobility, fatigue and cognition parameters.

Primary Outcome

The Ghent Participation Scale (GPS) is a digital, self-administered instrument used for the assessment of participation (Van de Velde et al., 2016; Van de Velde et al., 2017). This multidimensional questionnaire operationalizes participation through two objective and 15 subjective variables. In the first phase, respondents point out the five most important self-performed activities (SelfPA) and the five most important delegated activities (DelA) in the last week. Secondly, they indicated the location where the activity was performed. Subsequently, respondents assigned these activities within proposed categories and afterward within the analyses, these activities were categorized following the ICF-list of activities and participation. Then, the participants prioritize the five most important SelfPA and the five most important DelA. In the next step, participants assess nine different subjective statements concerning the prioritized SelfPA and six different subjective statements concerning the prioritized DelA on a Likert Scale ranging from totally disagree (1) to totally agree (5).

This scale calculates an overall participation score (%) based on the mean scores of two main subscales in particular SelfPA and DelA. The SelfPA- subscale is further divided into two smaller subscales. The first smaller subscale includes SelfPA in accordance with personal choices and wishes. The second one reports SelfPA leading to appreciation and social acceptance. The third subscale compromises DelA. Calculations of these subscales are weighted differently regarding the overall participation score. So the subscales related to SelfPA are weighted according to the time spent on it and the subscale related to DelA is weighted according to the number of delegated activities that the respondent wanted to perform themselves. The final participation score is indicated by a percentage whereby higher values represent higher self-perceived participation. Finally, the GPS has proven to contain excellent internal consistency, excellent test-retest reliability and good responsiveness irrespective of the pathology of the respondent (Van de Velde et al., 2017).

Secondary Outcomes

The Multiple Sclerosis Walking Scale-12 (MSWS-12) is a self-assessment scale measuring perceived limitations regarding walking ability due to the impact of MS. The MSWS-12 consists of 12-items and utilizes a five-point ordinal scoring system whereby a lower score indicates better walking ability. Also, this outcome measure is considered valid to measure the impact of MS on walking (Hobart, Riazi, Lamping, Fitzpatrick, & Thompson, 2003). All statistical parameters show high and excellent numbers following 'Shirley Ryan Abilitylab' (https://www.sralab.org).

To evaluate the impact of structured training on fatigue the Modified Fatigue Impact Scale (MFIS) was used. The MFIS is the recommended questionnaire for research related to fatigue by the Multiple Sclerosis Council for Clinical guidelines (Rietberg, Van Wegen, & Kwakkel, 2010). "In the MFIS, the perceived impact of fatigue on physical, cognitive and psychosocial functioning of the past four weeks is assessed" (Nieste & Op 't Eijnde, 2019, p. 5). The total score ranges from 0 to 84 with a cut-off score of 38 pointing out significant MS-related fatigue (Flachenecker et al., 2002). "Higher scores reveal higher levels of fatigue. Good test-retest reliability, validity and responsiveness have already been shown (Kos et al., 2003; Rietberg et al., 2010)" (Nieste & Op 't Eijnde, 2019, p. 5). Participants had to fill in only this questionnaire at three different time points, as previous research recommended repeated measurements rather than pre-post assessments alone (Rietberg et al., 2010).

The Spatial Recall Test (SPART) was applied to assess visuospatial memory. The test procedure implies the following steps: participants were given ten seconds to memorize the location of seven checkers on a 6x4 grid, after these ten seconds participants immediately filled out a provided empty grid recalling the location of the seven checkers. Subsequently, participants had a 30-minute break after which they again needed to recall the location of the checkers. The total score is the sum of all the correct checkers and higher scores indicate higher levels of visuospatial memory. "This has been shown to be one of the most sensitive measures for detecting memory impairments in PwMS and showed improved performance after a running program in a previous pilot RCT of our research group (Feys et al., 2019; Gerstenecker, Martin, Marson, Bashir, & Triebel, 2016)" (Nieste & Op 't Eijnde, 2019, p. 5).

The Symbol Digit Modalities Test (SDMT) was used for testing cognitive processing speed whereby higher scores indicate higher levels of cognitive processing speed. Processing speed is known as one of the greatest cognitive impairments in pwMS and it can also lead to higher cognitive impairments. "The SDMT has been found to be a reliable and valid test in MS and a responder definition of approximating four points or 10% in magnitude SDMT change was recommended (Benedict et al., 2017; Patel, Walker, & Feinstein, 2017)" (Nieste & Op 't Eijnde, 2019, p. 5).

Statistical-analysis

IBM SPSS® version 25.0 was used for statistical analyses. The normality of data was controlled by the Shapiro-Wilk test and homogeneity of variances was evaluated with the Brown-Forsythe test. Baseline characteristics were compared using analysis of variance one-way ANOVA. Bonferroni post hoc test was applied to correct for multiple comparisons. Between-group differences concerning primary and secondary outcome measure(s) were analyzed using two-way repeated measures ANOVA (within-subject variable: time, between-subject variable: group). Multiple linear regression was used to investigate significant correlations between explanatory variables (fatigue, cognitive processing speed, visuospatial memory, walking mobility, EDSS, disease duration, gender, age) on the GPS at baseline. The threshold for statistical significance was set at $p<0.05$.

Results

Participants

A total of 160 subjects were assessed eligible for inclusion whose 156 were assigned to the four groups (EXP-pwMS, EXP-HC, SDC-pwMS, SDC-HC) because four subjects declined participation (Figure 2). Of the 156 participants, 106 received their allocated intervention in the EXP and 39 received predefined instructions related to allocation to the SDC. During the ten months intervention, 24 participants discontinued the training program but there was still data available of ten participants at post measurement. Due to missing data concerning the GPS at pre-measurement (SDC: n= 14) and post-measurement (EXP: n=14 - SDC: n=3), statistical analyses were eventually applied to 78 participants in the EXP and 22 participants in the SDC. Reasons for not receiving the intervention and discontinued intervention are specified in Figure 2.

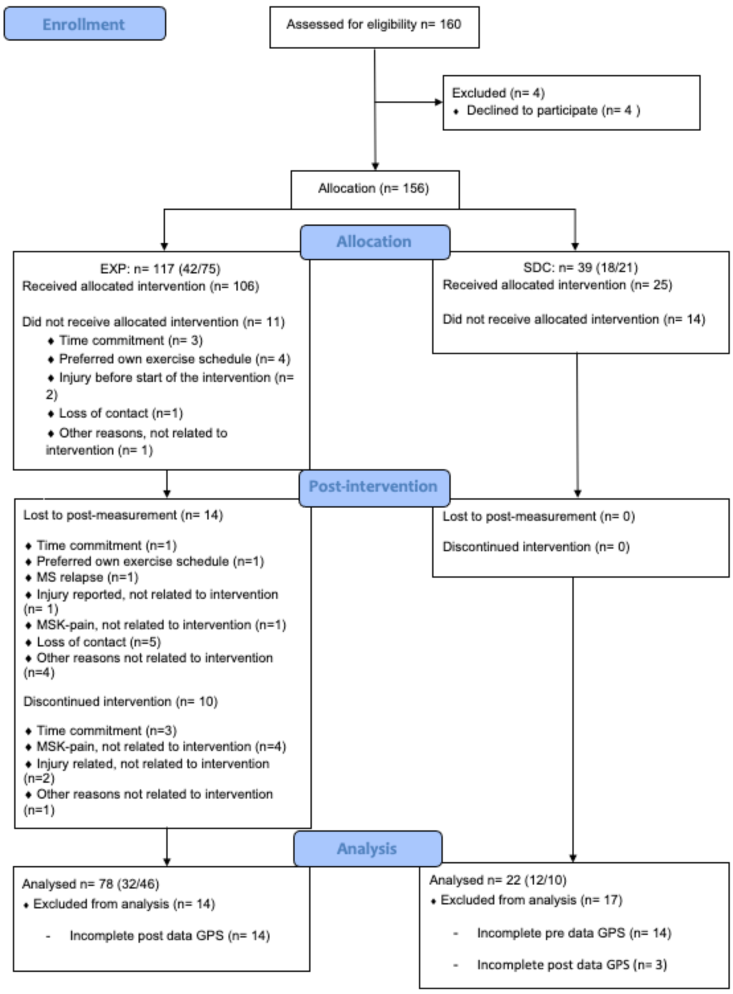

Figure 2: Flowchart participants according to CONSORT

Baseline characteristics are presented in Table 1. All characteristics at baseline between the EXP-pwMS and SDC-pwMS showed a significant difference in particular for EDSS, disease duration and MSWS-12. An overall significant difference between the mean age of the SDC-pwMS and all other groups was noted. Also, baseline data on the MFIS, SDMT and SPART revealed a significant difference between the EXP- HC and the SDC- pwMS. Table 2 illustrates baseline data of the four groups in terms of total participation score and the scores related to the subscales of the GPS. No significant differences were found between the four groups with regard to the total participation score. The subscale of DelA stated a significantly higher score ($p<0.05$) of the EXP-pwMS compared to the SDC-pwMS. All other subscales demonstrated no significant differences between the four groups.

Effects of the training program

Table 3 indicates data at post-measurement of the four groups in terms of total participation score and the scores related to the subscales of the GPS. This data represents no significant difference neither on total participation score nor one of the subscales between all groups. The results related to the intervention over time on participation are outlined in Table 4 and Table 5, respectively between pwMS and HC in the experimental group (Table 4) and between pwMS in the experimental and sedentary control group (Table 5). There were no significant differences of the intervention reported for the within-subjects analysis of the EXP-pwMS regarding all participation subscales and total participation score. The effect of the intervention for the EXP-HC revealed a significant reduction ($p<0.05$) of two subscales related to SelfPA namely 'appreciation and social acceptance' and 'choices and wishes'. No significant differences were found between the EXP-pwMS and EXP-HC for the effect of the intervention over time. There were also no significant differences demonstrated in terms of within-group analysis in the SDC-pwMS group. Between-group analysis of the EXP-pwMS and SDC-pwMS established a significant difference ($p<0.05$) for the subscale delegated activities over the intervention.

Findings related to the EXP-pwMS and EXP-HC on secondary outcome measures are specified in Table 6. The analysis relating to the MFIS established both a significant within-group ($p<0.001$) and between-group difference ($p<0.05$) in both these groups. Similar significant within-group results were found concerning the SDMT for both EXP-pwMS and EXP-HC but without a significant between-group difference. Analysis of the SPART and MSWS-12 didn't detect significant within- and between-group differences regarding EXP-pwMS and EXP-HC.

No significant correlations between the primary outcome participation and one of the explanatory variables or an interaction of the explanatory variables were indicated (adjusted R square = 0.030) within all. This finding accounted for both the total participation score as one of the subscales. The explanatory variables added in the multiple linear regression were cognition, fatigue, mobility, EDSS value, disease duration, sex and age.

Table 1: Baseline characteristics for experimental groups (EXP) and sedentary control groups (SDC)

	EXP		*SDC*		*p-value*
	pwMS [1]	HC [2]	pwMS [3]	HC [4]	
n (%)	42 (26.9)	75 (48.1)	18 (11.5)	21 (13.5)	/
Age (years)	41.81 ± 7.39	38.03 ± 8.96	50.33 ± 11.55	39.89 ± 11.58	1-3 * 2-3 ** 3-4 *
Gender (M/F)	8/34	35/39 ^	4/14	9/11 ^	/
EDSS	1.58 ± 1.20	/	2.56 ± 1.69	/	1-3 *
Disease duration (years)	9.63 ± 5.88	/	17.33 ± 12.86	/	1-3 *
MSWS-12 (0-60)	16.40 ± 5.90	/	28.00 ± 12.64	/	1-3 *
MFIS total (0-84)	31.43 ± 16.19	24.49 ± 12.03	35.28 ± 14.74	23.95 ± 12.06	2-3 *
SDMT (0-110)	64.86 ± 10.28	69.20 ± 10.66	58.11 ± 14.71	65.19 ± 13.12	2-3 *
SPART (0-35)	32.52 ± 2.81	32.80 ± 2.41	30.17 ± 5.62	31.62 ± 3.20	2-3 *

*Data are expressed by mean ± standard deviation; pwMS: persons with Multiple Sclerosis; HC: healthy controls; M: Male; F: Female; EDSS: Expanded Disability Status Scale; MSWS: Multiple Sclerosis Walking Scale (lower score is better walking ability); MFIS: Modified Fatigue Impact Scale (higher score express more fatigue); SDMT: Symbol Digit Modalities Test (higher score express better cognitive processing speed); SPART: Spatial Recognition Test (higher score express better visuospatial memory); ^: missing data; *: p<0.05; **: p<0.001*
1: pwMS experimental group; 2: HC experimental group; 3: pwMS sedentary control group; 4: HC sedentary control group

Table 2: Participation scores at baseline for both experimental groups (EXP) and sedentary control groups (SDC)

	EXP		*SDC*		*p-value*
	pwMS (n=42) [1]	HC (n=75) [2]	pwMS (n=13) [3]	HC (n=12) [4]	
GPS total (%)	67.08 ± 13.29	64.91 ± 10.87	58.17 ± 11.08	61.84 ± 13.63	ns
GPS selfPA-overall score (%)	67.68 ± 15.00	65.61 ± 13.74	66.50 ± 10.29	65.45 ± 10.98	ns
GPS selfPA-appreciation and social acceptance (%)	64.47 ± 16.48	62.98 ± 14.04	65.11 ± 11.51	59.72 ± 14.00	ns
GPS SelfPA-choices and wishes (%)	70.26 ± 14.63	67.72 ± 14.17	67.62 ± 9.78	70.04 ± 9.96	ns
GPS DelA (%)	66.20 ± 22.16	63.87 ± 19.28	45.67 ± 18.01	56.42 ± 26.13	1-3 *

*Data are expressed by mean ± standard deviation; pwMS: persons with Multiple Sclerosis; HC: healthy controls; GPS: Ghent Participation Scale; ns: not significant; *: p<0.05*
1: pwMS experimental group; 2: HC experimental group; 3: pwMS sedentary control group; 4: HC sedentary control group

Table 3: Participation scores post measurement for both experimental groups (EXP) and sedentary control groups (SDC)

	EXP		*SDC*		*p-value*
	pwMS (n=32) [1]	HC (n=46) [2]	pwMS (n=12) [3]	HC (n=10) [4]	
GPS total (%)	64.15 ± 12.84	61.42 ± 13.02	64.97 ± 13.29	60.97 ± 13.74	ns
GPS selfPA-overall score (%)	65.43 ± 15.66	59.93 ± 15.00	69.91 ± 11.73	62.62 ± 9.91	ns
GPS selfPA-appreciation and social acceptance (%)	62.54 ± 17.58	56.47 ± 15.54	67.43 ± 13.85	56.94 ± 14.64	ns
GPS SelfPA-choices and wishes (%)	67.74 ± 14.88	62.71 ± 15.34	71.69 ± 10.99	67.17 ± 8.38	ns
GPS DelA (%)	62.23 ± 23.54	63.66 ± 19.77	57.58 ± 27.74	58.50 ± 29.03	ns

Data are expressed by mean ± standard deviation; pwMS: persons with Multiple Sclerosis; HC: Healthy Controls; GPS: Ghent Participation scale; ns: not significant

Table 4: Intervention effect on participation scores in experimental groups between pwMS and HC

	pwMS (n=32)		*p-value within*	*HC (n=46)*		*p-value within*	*p-value between*
Time	Baseline	Post		Baseline	Post		
GPS total (%)	66.62 ± 12.01	64.15 ± 12.84	ns	65.37 ± 11.02	61.42 ± 13.02	ns	ns
GPS selfPA-overall score (%)	67.18 ± 15.32	65.43 ± 15.66	ns	65.33 ± 13.45	59.93 ± 15.00	p<0.05	ns
GPS selfPA-appreciation and social acceptance (%)	64.30 ± 15.82	62.54 ± 17.58	ns	62.04 ± 14.02	56.47 ± 15.54	p<0.05	ns
GPS SelfPA-choices and wishes (%)	69.48 ± 15.40	67.74 ± 14.88	ns	67.95 ± 13.55	62.71 ± 15.34	p<0.05	ns
GPS DelA (%)	65.81 ± 20.90	62.23 ± 23.54	ns	65.43 ± 19.11	63.66 ± 19.77	ns	ns

Data are expressed by mean ± standard deviation; pwMS: persons with Multiple Sclerosis; HC: healthy controls; GPS: Ghent Participation scale; ns: not significant

Table 5: Intervention effect on participation scores in pwMS between experimental (EXP) and sedentary control group (SDC)

	pwMS-EXP (n=32)		*p-value within*	*pwMS-SDC(n=12)*		*p-value within*	*p-value between*
Time	Baseline	Post		Baseline	Post		
GPS total (%)	66.62 ± 12.01	64.15 ± 12.84	ns	56.54 ± 9.81	64.97 ± 13.29	ns	ns
GPS selfPA-overall score (%)	67.18 ± 15.32	65.43 ± 15.66	ns	65.88 ± 10.49	69.91 ± 11.73	ns	ns
GPS selfPA-appreciation and social acceptance (%)	64.30 ± 15.82	62.54 ± 17.58	ns	64.41 ± 11.73	67.43 ± 13.85	ns	ns
GPS SelfPA-choices and wishes (%)	69.48 ± 15.40	67.74 ± 14.88	ns	67.05 ± 9.99	71.69 ± 10.99	ns	ns
GPS DelA (%)	65.81 ± 20.90	62.23 ± 23.54	ns	42.53 ± 14.63	57.58 ± 27.74	ns	p<0.05

Data are expressed by mean ± standard deviation; pwMS: persons with Multiple Sclerosis; HC: healthy controls; GPS: Ghent Participation scale; ns: not significant

Table 6: Intervention effect on secondary outcome measures in experimental groups (EXP) between pwMS and HC

	pwMS-EXP (n=36)		*p-value within*	*HC-EXP (n=54)*		*p-value within*	*p-value between*
Time	Baseline	Post		Baseline	Post		
MFIS total (0-84)	31.53 ± 16.81	26.00 ± 14.83	p <0.001	25.28 ± 12.45	20.07 ± 13.40	p <0.001	p <0.05
SPART (0-35)	32.36 ± 3.00	32.97 ± 2.59	ns	33.04 ± 2.12	33.15 ± 3.22	ns	ns
SDMT (0-110)	65.33 ± 10.24	68.03 ± 10.27	p <0.05	69.31 ± 10.22	72.85 ± 12.60	p <0.001	ns
MSWS-12 (0-60)	16.11 ± 6.06	14.42 ± 7.72	ns	/	/	/	/

Data are expressed by mean ± standard deviation; pwMS: persons with Multiple Sclerosis; HC: healthy controls; MSWS: Multiple Sclerosis Walking Scale (lower score is better walking ability); MFIS: Modified Fatigue Impact Scale (higher score express more fatigue); SDMT: Symbol Digit Modalities Test (higher score express better cognitive processing speed); SPART: Spatial Recognition Test (higher score express better visuospatial memory)

Discussion

This non-randomized controlled trial evaluated the effect of a ten months home-based supervised running program within a community setting on self-perceived participation in healthy controls (HC) and mildly disabled pwMS. To the best of our knowledge, this is the first controlled clinical trial that investigated the underlying multidimensional aspects attached to participation in pwMS and HC using the Ghent Participation Scale (GPS). However, our analyses did not demonstrate any significant differences regarding overall self-perceived participation in pwMS of the experimental group after the intervention. There was also no significant difference reported in terms of overall self-perceived participation between pwMS in the experimental group and pwMS in the sedentary control group.

The effectiveness of an aerobic training program on societal participation was investigated earlier but predominantly differed from this study according to intervention duration and multidimensionality of the applied participation questionnaire. Notwithstanding these methodological adjustments, our findings were similar to this study of the TREFAMS-ACE multi-trial program (Heine et al., 2017). Although, one should be cautious by interpreting these findings since the intervention was executed during the COVID-19 pandemic. This means that participants repeatedly were subjected to various public health measures, ranging from physical distancing recommendations to stay-at-home instructions imposed by the Belgian government, during the intervention period of ten months. These regulations aimed at protecting the physical health of citizens but conversely induced different negative social and economical consequences on individuals' daily life thereby resulting in several mental health issues. Moreover, recent studies indicate increased feelings of loneliness, depression, anxiety, stress and financial worry in combination with reduced social support as a result of COVID-19 related issues (Asmundson & Taylor, 2020; Reger, Stanley, & Joiner, 2020; Wang et al., 2020). Hence, a major concern during this ten months running program was the occurrence of various psychosocial difficulties impacting self-perceived participation given that participation represents the societal perspective on functioning according to the ICF. Therefore, we assumed that self-perceived participation regarding meaningful activities of daily life was strongly modified or even reduced causing lower levels of life satisfaction, well-being and eventually the quality of life. This assumption could declare results related to the

EXP-HC concerning the subscales of SelfPA and the combined SelfPA-score at post-measurement but it is not in line with the findings related to the EXP-pwMS and the SDC-pwMS. So it could be hypothesized that pwMS in both groups are better adaptable to environmental changes or prioritize activities involving less social importance.

Furthermore, it is remarkable that pwMS in the sedentary control group only demonstrated a significant difference regarding DelA on baseline and post-measurement compared to EXP-pwMS. This finding could be explained by the fact that SDC-pwMS were instructed to continue their activities of daily life, allowing participants to modify their lifestyle more actively and energetically in terms of coping with the consequences of the COVID-19 pandemic. Another explanation points to the baseline characteristics of the SDC-pwMS illustrating significantly higher age, EDSS-value, disease duration and MSWS-12 than the EXP-pwMS. Consequently, one could hypothesize that participants of the SDC-pwMS experienced more difficulties related to e.g. muscle weakness, balance disorders, sensory deficits and problems with vision (Halabchi, Alizadeh, Sahraian, & Abolhasani, 2017) so that these participants were more likely to delegate certain activities. Therefore, a potential intervention effect could be masked about self-perceived participation of pwMS in the experimental group. Also, these findings suggest that whether or not participants of the SDC-pwMS wanted to perform their delegated activities by themselves, did not result in significant differences in terms of total participation score between EXP-pwMS and SDC-pwMS.

Nevertheless, an intervention effect is noticed in favor of the experimental groups since both EXP-pwMS and EXP-HC experienced less impact of fatigue on daily life and had higher cognitive processing speed after the intervention. This finding corresponds with the results of previous studies reporting the effectiveness of aerobic exercise on fatigue and cognitive function (Briken et al., 2014; Grazioli et al., 2019; Sabapathy, Minahan, Turner, & Broadley, 2011). Admittedly, pwMS in the experimental group experienced even less impact of fatigue on daily life than the HC in the experimental group. Though, the interpretation concerning the between-group difference on the MFIS of EXP-pwMS and EXP-HC should take into consideration the distribution of drop-outs. The percentage of drop-outs in the EXP-HC was two times higher compared to the EXP-pwMS, respectively 28% and 14%, so one could presume that more participants of the EXP-HC with higher feelings of fatigue could have discontinued the intervention and lost to follow-up. Nonetheless, the clinical relevance of this significant improvement related to the pwMS in the experimental group is questionable because baseline data about the MFIS demonstrated no significant MS-related fatigue.

Besides, it is notable that there was no significant correlation between one of the explanatory variables and the dependent variable participation despite associations of participation with cognitive function and fatigue indicated by the literature (Chiaravalloti & DeLuca, 2008; de Groot et al., 2008). However, it is unclear to which degree these impairments need to be present in order to detect significant correlations or whether other body functions and structures are more likely to influence self-perceived participation in this MS population. On the other hand, we suppose that there are other factors of more importance regarding correlations with self-perceived participation like self-efficacy, social support, community integration and feelings of anxiety.

Strengths and limitations

A major strength of this study is the application of the GPS as the evaluation tool for self-perceived participation. The GPS provided us with multidimensional insights regarding participants' perceived participation by combining subjective and objective dimensions related to participation. Furthermore, this home-based supervised running program has proven to be applicable in a mildly disabled MS population because of limited pwMS who discontinued the intervention. Accordingly, the training adherence rate (80%) shows similarity with the training adherence rates of previous studies applying aerobic training (75%-86%) by pwMS with an EDSS ≤ 4 (Heine et al., 2017; Rampello et al., 2007) but one should notice that this training program extended for ten months while others predominantly used eight to twelve weeks. A possible explanation for this percentage of training adherence points to the strongly individualized running program that was based on personal VO2 max values. Participants were also closely supervised by a therapist and the ground for group allocation, including only motivated subjects to the experimental group, will of course have contributed to the demonstrated training adherence rate. Consequently, the allocation of subjects was not concealed and there was no blinding of therapists, subjects and assessors. Further, we confirmed that aerobic training is a safe treatment strategy for mildly disabled pwMS since there was merely one MS-relapse reported. An important limitation of this study is the restricted social component of the intervention due to the COVID-19 related regulations so that participants were impeded to build social relationships and a sense of community. As well, we hypothesized that regular social contact would not only support motivation and therapy adherence but also enhance self-esteem, social support and self-efficacy.

Indeed, there is a total of 33 percent missing data related to the GPS at post-measurement thus the interpretation of results requires caution. A possible explanation for this missing data is that at post-measurement the GPS was not completed during the second test day at REVAL but was transmitted by mail and supposed to be fulfilled at home by the participants therefore the assessors could not supervise accomplishment. Also, at pre-measurements of the sedentary control groups, the GPS was assumed to be completed at home by the participants. Unfortunately, participants were probably not sufficiently motivated or had time commitment, prohibited accomplishment, or even started this comprehensive questionnaire. Besides, the follow-up of incoming GPS data was monitored by a staff member related to Ghent University resulting in a delay or even a lack of intervention if participants did not complete the GPS. Adequate statistical corrections for this shortcoming utilizing e.g. Multiple Imputation and Maximum Likelihood were not applied due to the extent of missing data. The predefined distribution of the sample over the experimental and sedentary group was not followed because of the interest of subjects about the running program but also therapists wanted to maintain participants' motivation to complete the study. Even though this study probably appealed to predominantly pwMS with relatively low levels of fatigue, walking and cognitive difficulties in the experimental group so a selection bias is warranted. It is also possible that pwMS and HC in the experimental groups are already satisfied with their level of participation they experience so that they are less susceptible to changes of participation or that the GPS is insufficiently sensitive to detect these changes. Lastly, data in terms of secondary outcomes related to the SDC-pwMS and SDC-HC were not yet available during the writing process so considerations concerning these results are hampered.

Recommendations

Self-efficacy is considered a key modifier regarding physical activity and quality of life in pwMS (Guicciardi, Carta, Pau, & Cocco, 2019; Motl & Snook, 2008). More importantly, a systematic review investigated the effectiveness of various rehabilitation interventions targeting participation and only two interventions indicated a post-intervention effect. Moreover, Lewthwaite et al. applied an exercise intervention in a stroke population but focussed also on the enhancement of self-efficacy (Lewthwaite et al., 2018). Therefore, we recommend that further research should investigate associations between self-efficacy and participation in pwMS. Besides, future research should be aware that participation requires a biopsychosocial perspective due to the dynamic interplay between various factors indicated by the Model of Functioning and Disability within the ICF (WHO, 2001). Therefore, it is recommended not to limit the development of interventions and the investigation of correlations concerning participation regression analyses to a body-functioning level but rather to broaden them by considering psychosocial functioning and contextual factors. We also strongly advise the implementation of multidimensional questionnaires regarding the assessment of self-perceived participation because it could enrich the clinical reasoning of clinicians and researchers (Van de Velde et al., 2017). Finally, future research should investigate self-perceived participation by pwMS with more advanced disabilities since it is likely that they should experience lower levels of self-perceived participation and would benefit more from a comprehensive rehabilitation intervention.

Conclusion

This home-based supervised running program did not induce a significant difference in self-perceived participation by pwMS within the experimental group. There was also no significant difference between pwMS in the experimental group and the sedentary control group. Though, the COVID-19 pandemic strongly affected the course of the predefined intervention and accordingly the interpretation of the results. Conversely, our findings indicate various opportunities for future research including a broader biopsychosocial perspective on participation regarding the development of interventions and the application of multidimensional questionnaires as a primary assessment tool.

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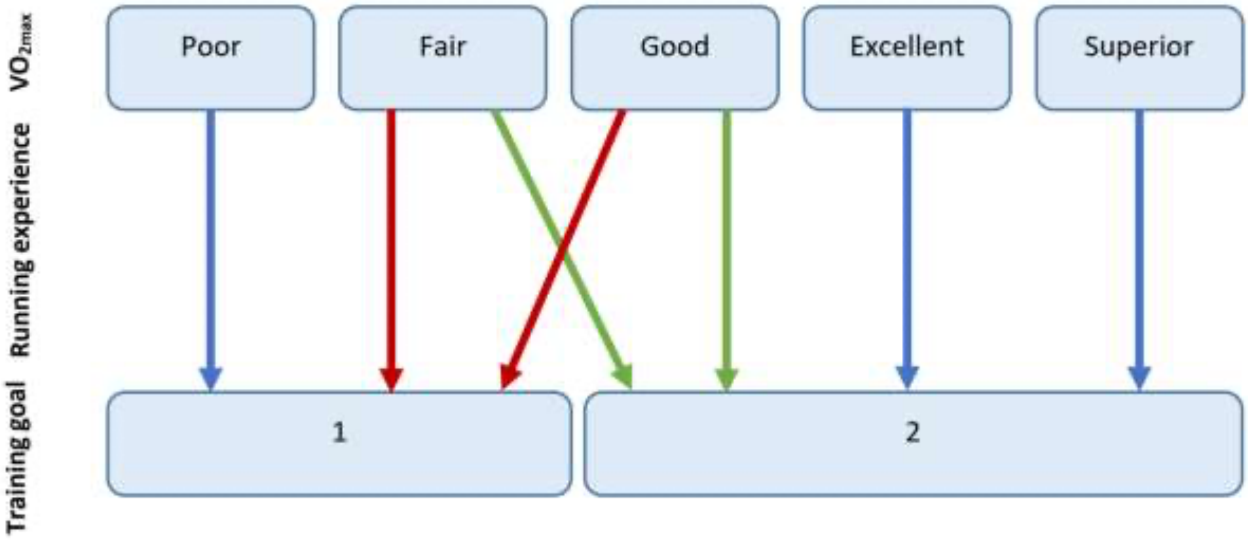
Attachments

Supplement material S1



Registration form jury Master's thesis

Inschrijvingsformulier verdediging masterproef academiejaar 2020-2021,
Registration form jury Master's thesis academic year 2020-2021,

GEGEVENS STUDENT - *INFORMATION STUDENT*

Faculteit/School: **Faculteit Revalidatiewetenschappen**
Faculty/School: ***Rehabilitation Sciences***

Stamnummer + naam: **1644088 Duckaert Mathias**
Student number + name

Opleiding/*Programme*: **2 ma revalid. & kine musc.**

INSTRUCTIES - *INSTRUCTIONS*

Neem onderstaande informatie grondig door.

Print dit document en vul het aan met DRUKLETTERS.

In tijden van van online onderwijs door COVID-19 verstuur je het document (scan of leesbare foto) ingevuld via mail naar je promotor. Je promotor bezorgt het aan de juiste dienst voor verdere afhandeling.

Vul luik A aan. Bezorg het formulier aan je promotoren voor de aanvullingen in luik B. Zorg dat het formulier ondertekend en gedateerd wordt door jezelf en je promotoren in luik D en dien het in bij de juiste dienst volgens de afspraken in jouw opleiding.
Zonder dit inschrijvingsformulier krijg je geen toegang tot upload/verdediging van je masterproef.

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Without this registration form, you will not have access to the upload/defense of your master's thesis.

LUIK A - VERPLICHT - IN TE VULLEN DOOR DE STUDENT
PART A - MANDATORY - TO BE FILLED OUT BY THE STUDENT

Titel van Masterproef/*Title of Master's thesis:* The effect of a 10 months home-based supervised running program on participation in persons with Multiple Sclerosis

☒ behouden - *keep*

O wijzigen - *change to:*

/:

O behouden - *keep*

O wijzigen - *change to:*

In geval van samenwerking tussen studenten, naam van de medestudent(en)/*In case of group work, name of fellow student(s)*: WELLENS JONAS

X behouden - *keep*

O wijzigen - *change to:*

LUIK B - VERPLICHT - IN TE VULLEN DOOR DE PROMOTOR(EN)
PART B - MANDATORY - TO BE FILLED OUT BY THE SUPERVISOR(S)

Wijziging gegevens masterproef in luik A/*Change information Master's thesis in part A:*

O goedgekeurd - *approved*

O goedgekeurd mits wijziging van - *approved if modification of:*

Scriptie/*Thesis:*

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Juryverdediging/*Jury Defense:*

De promotor(en) geeft (geven) de student(en) het niet-bindend advies om de bovenvermelde masterproef in de bovenvermelde periode/*The supervisor(s) give(s) the student(s) the non-binding advice:*

te verdedigen/*to defend the aforementioned Master's thesis within the aforementioned period of time*

de verdediging is openbaar/*in public*

O de verdediging is niet openbaar/*not in public*

O niet te verdedigen/*not to defend the aforementioned Master's thesis within the aforementioned period of time*

LUIK C - OPTIONEEL - IN TE VULLEN DOOR STUDENT, alleen als hij luik B wil overrulen
PART C - OPTIONAL - TO BE FILLED OUT BY THE STUDENT, only if he wants to overrule part B

In tegenstelling tot het niet-bindend advies van de promotor(en) wenst de student de bovenvermelde masterproef in de bovenvermelde periode/*In contrast to the non-binding advice put forward by the supervisor(s), the student wishes:*

O niet te verdedigen/*not to defend the aforementioned Master's thesis within the aforementioned period of time*

O te verdedigen/*to defend the aforementioned Master's thesis within the aforementioned period of time*

LUIK D - VERPLICHT - IN TE VULLEN DOOR DE STUDENT EN DE PROMOTOR(EN)
PART D - MANDATORY - TO BE FILLED OUT BY THE STUDENT AND THE SUPERVISOR(S)

Datum en handtekening student(en)
Date and signature student(s)

26/05/2021
Mathias

Datum en handtekening promotor(en)
Date and signature supervisor(s)

Peter Feys

28/05/2021

Inventory form

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KNOWLEDGE IN ACTION

INVENTARISATIEFORMULIER WETENSCHAPPELIJKE STAGE DEEL 2

DATUM	INHOUD OVERLEG	HANDTEKENINGEN
30/09/2020	Opstart MP2 Prof. Dr. Peter Feys & Joke Raats (Google meet)	Promotor: Peter Feys Copromotor/Begeleider: Joke Raats Student(e): Mathias Duckaert Student(e): Jonas Wellens
21/10/2020	Bepaling uitkomstmaten MP2 Prof. Dr. Peter Feys & Joke Raats (Google meet)	Promotor: Peter Feys Copromotor/Begeleider: Joke Raats Student(e): Mathias Duckaert Student(e): Jonas Wellens
08/11/2020	Eerste versie inleiding, feedback Prof. Dr. Peter Feys & Joke Raats (mail)	Promotor: Peter Feys Copromotor/Begeleider: Joke Raats Student(e): Mathias Duckaert Student(e): Jonas Wellens
16/03/2021	Update MP2, herschreven inleiding + eerste versie methode. Feedback Prof. Dr. Peter Feys & Joke Raats (Google-meet)	Promotor: Peter Feys Copromotor/Begeleider: Joke Raats Student(e): Mathias Duckaert Student(e): Jonas Wellens
30/03/2021	Update MP2, herschreven methode + overzicht missing data. Definitieve beslissing post-metingen. Feedback + overleg Prof. Dr. Peter Feys & Joke Raats (Google-meet)	Promotor: Peter Feys Copromotor/Begeleider: Joke Raats Student(e): Mathias Duckaert Student(e): Jonas Wellens
14/04/2021	Statistiek, overleg Joke Raats (Google-meet)	Copromotor/Begeleider: Joke Raats Student(e): Mathias Duckaert Student(e): Jonas Wellens
10/05/2021	Eerste Versie tot en met resultaten, Feedback Joke Raats (mail)	Copromotor/Begeleider: Joke Raats Student(e): Mathias Duckaert Student(e): Jonas Wellens
24/05/2021	Eerste versie discussie, feedback Joke Raats (mail)	Copromotor/Begeleider: Joke Raats Student(e): Mathias Duckaert Student(e): Jonas Wellens
27/05/2021	Volledige versie, feedback Prof. Dr. Peter Feys (mail) Niet-bindend advies: verdedigen MP2 in eerste zittijd.	Promotor: Peter Feys Copromotor/Begeleider: Joke Raats Student(e): Mathias Duckaert Student(e): Jonas Wellens

In te vullen door de promotor(en) en eventuele copromotor aan het einde van MP2:

Naam Student(e): Mathias Duckaert, Jonas Wellens

Datum: 03/06/2021

Titel Masterproef: The effect of a 10 months home-based supervised running program on Participation in persons with Multiple Sclerosis.

1) Geef aan in hoeverre de student(e) onderstaande competenties zelfstandig uitvoerde:
   - NVT: De student(e) leverde hierin geen bijdrage, aangezien hij/zij in een reeds lopende studie meewerkte.
   - 1: De student(e) was niet zelfstandig en sterk afhankelijk van medestudent(e) of promotor en teamleden bij de uitwerking en uitvoering.
   - 2: De student(e) had veel hulp en ondersteuning nodig bij de uitwerking en uitvoering.
   - 3: De student(e) was redelijk zelfstandig bij de uitwerking en uitvoering
   - 4: De student(e) had weinig tot geringe hulp nodig bij de uitwerking en uitvoering.
   - 5: De student(e) werkte zeer zelfstandig en had slechts zeer sporadisch hulp en bijsturing nodig van de promotor of zijn team bij de uitwerking en uitvoering.

Competenties	**NVT**	**1**	**2**	**3**	**4**	**5**
Opstelling onderzoeksvraag	⊗	O	O	O	O	O
Methodologische uitwerking	⊗	O	O	O	O	O
Data acquisitie	O	O	O	O	O	⊗
Data management	O	O	O	O	⊗	O
Dataverwerking/Statistiek	O	O	O	O	⊗	O
Rapportage	O	O	O	O	⊗	O

2) Niet-bindend advies: Student(e) krijgt toelating/geen toelating (schrappen wat niet past) om bovenvermelde Wetenschappelijke stage/masterproef deel 2 te verdedigen in bovenvermelde periode. Deze eventuele toelating houdt geen garantie in dat de student geslaagd is voor dit opleidingsonderdeel.

3) Deze wetenschappelijke stage/masterproef deel 2 mag wel/niet (schrappen wat niet past) openbaar verdedigd worden.

4) Deze wetenschappelijke stage/masterproef deel 2 mag wel/niet (schrappen wat niet past) opgenomen worden in de bibliotheek en docserver van de UHasselt.

Datum en handtekening Student(e)	Datum en handtekening promotor(en)	Datum en handtekening Co-promotor(en)
03/06/2021 3/06/2021	Peter Feys 06/06/2021	Joke Raats