Sedentary behaviour and related factors in people with multiple sclerosis

Running head: Sedentary behaviour in MS

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Abstract

Background: Sedentary behaviour is a major problem in persons with multiple sclerosis (pwMS). However, little is known about the related factors of sedentary behaviour in MS. Our study aimed to examine the association between sedentary behaviour and physical activity level, fear of falling, and fatigue.

Method: Demographic and clinical data have been recorded. Sedentary behaviour was assessed with the Marshall Sitting Questionnaire, physical activity level was evaluated with the Godin Leisure Time Exercise Questionnaire, fear of falling was evaluated with the Fall Efficacy Scale International, and fatigue was evaluated with the Modified Fatigue Impact Scale (MFIS). The Timed 25-Foot Walk, 6-Minute Walk Test, Timed Up and Go Test, and 12-Item Multiple Sclerosis Walking Scale were also used to assess walking and perceived walking disability.

Results: We recruited 71 pwMS [49 were female (69%), mean age:38.08 years, median EDSS:1.5]. The mean daily sitting time was 593.54 minutes (~10 hours). No significant correlation was found between sitting times and demographics, leisure time physical activity, fear of falling, walking, perceived walking disability, and neurological disability level ($p>0.05$). Logistic regression analysis indicated that being male increased the risk of sedentary behaviour by 3.08 times, being employed increased the risk of sitting by 4.65 times, and each point increase in MFIS scores resulted in a 1.03-fold elevation in the odds of prolonged sitting.

Conclusion: The fact that pwMS, even with a mild disability spend almost 10 hours sitting highlights the significance of sedentary behaviour in this population. Developing strategies to address modifiable factors, such as fatigue, may be effective in reducing sedentary behaviour.

Keywords: Multiple sclerosis, physical activity, sedentary behaviour, fatigue, walk

Introduction

Sedentary behaviour is distinct from physical inactivity and is defined as “any waking behaviour characterized by an energy expenditure ≤1.5 Metabolic Equivalent Units (METs) while in a sitting, lying, or reclining posture” (Tremblay et al., 2017). It was determined that as the duration of the disease and the functional limitations caused by the disease increased in persons with multiple sclerosis (pwMS), the level of physical activity decreased, a sedentary lifestyle was established, and they were less active than healthy individuals in the same age group (Beckerman et al., 2010). Furthermore, it has been reported that low levels of physical activity and exercise and high levels of sedentary behaviour are common in pwMS, despite a consensus that physical activity is mandatory in pwMS (Hubbard et al., 2015).

Sedentary behaviour assessment is a relatively new and important field for preventive physiotherapy as well as physical activity assessment. As stated by the World Health Organization (WHO), sedentary behaviour assessments are gaining importance in order to prevent possible health consequences and to determine the measures and methods to be taken. Detailed analysis of sedentary behaviour assessments and identifying related factors will be guiding for these methods (Bull et al., 2020).

Despite the fact that pwMS have a sedentary lifestyle, relatively few studies have examined sedentary behaviour and related factors in this population. There are many possible factors that influence physical activity participation in pwMS. So far, studies have consistently reported that greater levels of sedentary behaviour are associated with more severe disability (Ezeugwu et al., 2015; Veldhuijzen Van Zanten et al., 2016). Additionally, pwMS describe a significant decrease in their physical activity levels compared to pre-disease levels, and in addition to this, they state that they develop a fear of physical activity (Ertekin et al., 2014; Kinnett-Hopkins et al., 2017). There is a need for studies examining the effects of demographic, clinical, physical, and psychosocial outcome measures that may affect sedentary behaviour in pwMS. Therefore, the aim of this study was to explore the relationship between self-reported sedentary behaviour and physical activity level, fear of falling, and fatigue. Evaluation of this relationship might be important as it will guide the rehabilitation team in overcoming the barriers to physical activity participation in pwMS.

Methods

Participants

This study obtained approval from the Noninvasive Research Ethics Board of Dokuz Eylül University with decision number 2020/04-07 on February 2, 2021. All participants provided written consent prior to data collection.

The sample size was determined based on the previous study investigated the relationship between sitting time and physical activity in MS ($r=0.34$, $p<0.001$) (Sasaki et al., 2019). Therefore, a sample size of at least 66 pwMS was calculated, with a 0.05 error probability and an effect size of 0.80.

PwMS were recruited from the MS Unit of the Neurology Department at Dokuz Eylül University Hospital between February 2021 and June 2021. Participants were scanned for eligibility based on the following inclusion criteria: a diagnosis of MS according to the McDonald 2017 criteria (Thompson et al., 2018), no relapse within the last 30 days, age above 18, and the ability to read and understand Turkish.

Outcome measures

Participants completed a questionnaire about demographic characteristics (i.e., age and sex). The clinical characteristics (i.e., the course of MS, EDSS, disease duration) were obtained from the patients' records.

Disability level

The perceived disease severity was assessed using the Patient Determined Disease Steps (PDDS). Participants rated the disability ranging from 0 (mild symptoms that do not restrict activity) to 8 (bedridden and unable to sit in a wheelchair for more than one hour) (Kahraman et al., 2021). Additionally, the Expanded Disability Status Scale (EDSS) was also determined by the senior neurologist to provide disease-specific neurological disability levels. The degree of disability ranges from 0 (normal) to 10 (death due to MS) in EDSS (Kurtzke, 1983).

Sedentary behaviour and physical activity

The Marshall Sitting Questionnaire (MSQ) includes questions about the duration of sitting in various areas both on weekdays and weekends. Participants are requested to provide information on the duration of sitting in hours and minutes in five specific categories: traveling, working, watching television, using a computer, and other leisure activities. The validity of MSQ has been investigated, and a moderate correlation has been found between MSQ and accelerometer-based data. Higher scores show increased sedentary behaviour (Marshall et al., 2010; Sasaki et al., 2019).

The measurement of physical activity was conducted using the Godin Leisure-Time Exercise Questionnaire (GLTEQ). It consists of three items that assess the frequency of strenuous, moderate, and mild exercise lasting over 15 minutes during leisure time in a typical week (Sari and Erdoğan, 2016). Higher scores show a greater level of leisure time physical activity.

Walking and perceived walking difficulties

The Timed-25 Foot Walk (T25FW) was performed to evaluate the fastest walking speed on a flat pathway, 7.62 m long. The average duration of the two trials was recorded (Fischer et al., 1999).

For evaluating walking endurance, the Six-Minute Walk Test (6MWT) was applied according to the protocol used by Goldman et al. Each participant was instructed to walk safely and as fast as possible for 6 min, and total distance was noted (Goldman et al., 2008).

The Timed Up and Go Test (TUG) was used to test functional mobility and dynamic balance. Participants were instructed to rise from a seated position, walk three meters, turn around, and then return to the seated position. The duration of this task was recorded (Sebastião et al., 2016).

The perceived walking difficulties were assessed by the MS Walking Scale (MSWS-12). Elevated scores show a greater degree of walking difficulties in daily life (Dib et al., 2017).

Fear of falling

The Fall Efficacy Scale International (FES-I) includes 16 items to assess the level of fear of falling during daily activities. Participants rate their concern about falling on a scale from 1 (not all concerned) to 4 (very concerned). Higher scores show an increased level of fear of falling. Higher scores show a higher fear of falling (Ulus et al., 2012; Van Vliet et al., 2013).

Fatigue

The Modified Fatigue Impact Scale (MFIS) is a self-reported questionnaire designed to assess the impact of fatigue on physical (9 items), psychosocial (2 items), and cognitive (10 items) dimensions. Higher scores on the MFIS indicate a greater perceived level of fatigue (Armutlu et al., 2007; Learmonth et al., 2013).

Statistical analysis

The IBM SPSS Statistics software (Version 28.0. Armonk, NY: IBM Corp.) was used for data analysis. The normal distribution of the data was checked by examining the Kolmogorov-Smirnov test and histograms. Descriptive statistics were presented as a median and interquartile range since the variables were non-normally distributed. Categorical variables were presented as number of participants and percentages. The overall sitting time in minutes/day was specified from the weighted average of the time spent seated on weekdays and weekends. Since there was no agreement on the optimal duration of sitting time, the participants were divided into two groups. The first group included values below the 75th percentile, while the second group included values equal to or above the 75th percentile. We chose to use the upper quartile (75th percentile) as the division point for categorizing the patients into two groups rather than the median (50th percentile) to better differentiate between individuals with more pronounced sitting time. This approach allows us to focus on a subset of patients who exhibit above average attributes. A comparison of continuous variables of the two groups was performed with the Mann-Whitney U test and Student t-test based on the data normality. Categorical outcomes were compared using the Chi-Squared test. The correlation between sitting time and other outcome measures was analyzed using Spearman correlation coefficients. Correlation coefficients between 0.1 and 0.29 were interpreted as weak, 0.3 and 0.49 as moderate, and between 0.5 and 1.0 as strong (Cohen, 1988). The logistic regression analysis was conducted to investigate the predictors of sitting time. Cox and Snell's R^2 and Nagelkerke's R^2 were used as measures of goodness-of-fit for binary logistic regression models.

Results

The descriptive statistics for demographics and all outcome measures are provided in Table 1. The majority of the sample of 71 pwMS was female (n = 49, 69%), with a mean age of 38.08 (SD=11.09) years of the total sample. The clinical course was relapsing-remitting MS (RRMS) in 63 pwMS (88.7%). The average disease duration was 7.92 (SD=6.52) years. The median EDSS score was 1.5 (IQR=0-3.0).

There were significant differences in sex, employment status, and subjective fatigue scores between high and low sitting time groups ($p<0.05$).

Bivariate correlations

The bivariate correlations between sedentary behaviour and other outcome measures are provided in Table 2. There was no significant correlation between sedentary behaviour assessed by MSQ and other measures ($p>0.05$).

Logistic regression analyses

Logistic regression analysis results are displayed in Table 3. Being female (OR: 3.08), being unemployed (OR: 4.65), and fatigue (OR: 1.03) were significant predictors of being sedentary in pwMS. The Cox and Snell's R^2 value was 0.287, and Nagelkerke's R value was 0.424, suggesting that these models provide an adequate fit for the data.

Table 1. Descriptive values of demographic and clinical characteristics

	Total (71)	Sitting time >75% (n=18)	Sitting time <75% (n=53)	p-value
Age (years), mean±SD	38.08±11.09	38.33±9.59	38±11.63	0.88
Gender, n (%)				
Female	49 (69%)	9 (50%)	40 (75.5%)	**0.043**
Male	22 (31%)	9 (50%)	13 (24.5%)	
EDSS (0-10), median (IQR)	1.5 (0-3.0)	1.75 (0-3.13)	1.5 (0-2.5)	0.74
PDDS (0-8), median (IQR)	1 (0-3.0)	2 (1-3)	1 (0-3.0)	0.14
MS course, n (%)				
Relapsing-Remitting	63 (88.7%)	15 (83.3%)	48 (90.6%)	0.216
Progressive	8 (11.3%)	3 (16.7%)	5 (9.4%)	
Disease duration (years), mean±SD	7.92±6.52	7.11±5.68	8.19±6.81	0.64
Employment, n (%)				
Employed	32 (45.1%)	13 (72.2%)	19 (35.8%)	**0.007**
Unemployed	39 (54.9)	5 (27.8%9	34 (64.2%)	
Marshall sitting questionnaire, mean±SD				
Weekdays	595.23±224.5	880±107.43	498.51±162.19	**<0.001**
Weekends	589.31±243.65	862.67±197.27	496.47±180.39	**<0.001**
Total	593.54±217.1	875.05±103.21	497.93±152.37	**<0.001**
GLTEQ, mean±SD	7.46±11.74	6.67±11.99	7.74±11.76	0.69
MFIS (0-84), mean±SD	28.63±21.83	37.61±20.94	25.58±21.46	**0.04**
FES-I (16-64), mean±SD	26.11±9.89	26.17±7.44	26.09±10.65	0.556
MSWS-12 (12-54), mean±SD	22.9±11.34	25.89±11.54	21.89±11.20	0.233

T25FW (sec), mean±SD	7.19±6.65	6.66±4.07	7.37±7.35	0.958
TUG (sec), mean±SD	10.59±10.18	9.83±6.49	10.85±11.20	0.890
6MWT (m), mean±SD	419.61±126.86	424.11±128.88	418.08±127.37	0.953

Bold values show significant differences (p<0.05).

p value of t test for continuous or chi-square for categorical variables.

Abbreviations: MSQ, Marshall Sitting Questionnaire; BMI, Body-mass index; EDSS, Expanded Disability Status Scale; PDDS, Patient-determined disability status scale; GLTEQ, Godin Leisure-Time Exercise Questionnaire; FES-I, Falls-Efficacy Scale-International; MFIS, Modified Fatigue Impact Scale; MSWS-12, MS Walking Scale; TUG, Timed Up and Go; 6MWT, Six Minute Walk Test; T25FW, Timed 25-Foot Walk

Table 2. Correlations among outcome measures

	MSQ sitting time	Age	BMI	Disease duration	EDSS	PDDS	GLTEQ	FES-I	MFIS	MSWS_12	6MWT	TUG	T25FW
MSQ sitting time	1.000	-0.113	-0.067	-0.107	-0.041	0.060	0.008	0.059	0.179	0.123	0.166	-0.156	-0.149
Age	-0.113	1.000	**0.451**	**0.457**	**0.370**	**0.436**	0.205	**0.395**	**0.364**	**0.438**	**-0.510**	**0.526**	**0.487**
BMI	-0.067	**0.451**	1.000	0.069	-0.008	0.192	0.041	0.122	0.199	0.086	-0.125	0.139	0.130
Disease duration	-0.107	**0.457**	0.069	1.000	**0.395**	**0.403**	-0.091	**0.332**	0.177	**0.355**	**-0.488**	**0.474**	**0.426**
EDSS	-0.041	**0.370**	-0.008	**0.395**	1.000	**0.656**	0.050	**0.665**	**0.448**	**0.675**	**-0.643**	**0.698**	**0.675**
PDDS	0.060	**0.436**	0.192	**0.403**	**0.656**	1.000	0.121	**0.820**	**0.652**	**0.852**	**-0.709**	**0.662**	**0.710**
GLTEQ	0.008	0.205	0.041	-0.091	0.050	0.121	1.000	0.012	-0.072	0.135	-0.105	0.059	0.037
FES-I	0.059	**0.395**	0.122	**0.332**	**0.665**	**0.820**	0.012	1.000	**0.672**	**0.864**	**-0.710**	**0.644**	**0.736**
MFIS	0.179	**0.364**	0.199	0.177	**0.448**	**0.652**	-0.072	**0.672**	1.000	**0.681**	**-0.475**	**0.432**	**0.489**
MSWS_12	0.123	**0.438**	0.086	**0.355**	**0.675**	**0.852**	0.135	**0.864**	**0.681**	1.000	**-0.696**	**0.674**	**0.683**
6MWT	0.166	**-0.510**	-0.125	**-0.488**	**-0.643**	**-0.709**	-0.105	**-0.710**	**-0.475**	**-0.696**	1.000	**-0.834**	**-0.899**
TUG	-0.156	**0.526**	0.139	**0.474**	**0.698**	**0.662**	0.059	**0.644**	**0.432**	**0.674**	**-0.834**	1.000	**0.862**
T25FW	-0.149	**0.487**	0.130	**0.426**	**0.675**	**0.710**	0.037	**0.736**	**0.489**	**0.683**	**-0.899**	**0.862**	1.000

1 | 0.5 | 0.3 | 0 | -0.3 | -0.5 | -1

Bold values show significant correlations ($p<0.05$)
Abbreviations: MSQ, Marshall Sitting Questionnaire; BMI, Body-mass index; EDSS, Expanded Disability Status Scale; PDDS, Patient-determined disability status scale; GLTEQ, Godin Leisure-Time Exercise Questionnaire; FES-I, Falls-Efficacy Scale-International; MFIS, Modified Fatigue Impact Scale; MSWS-12, MS Walking Scale; TUG, Timed Up and Go; 6MWT, Six Minute Walk Test; T25FW, Timed 25-Foot Walk

Tablo 3. Regression analysis findings to predict to sedentary behaviour			
	OR	95% CI (Lower and upper)	p value
Age	1.02	0.93 – 1.12	0.639
Gender	3.08	1.01 – 9.39	**0.048**
BMI	0.96	0.81-1.14	0.638
Education level			
Primary&secondary school	1.25	0.09-17.98	0.870
High school	1.68	0.27-10.33	0.583
University	2.08	0.36-11.27	0.394
Employment	4.65	1.44– 15.06	**0.01**
Disease duration	0.91	0.78 – 1.08	0.284
EDSS	1.03	0.57-1.86	0.933
PDDS	2.56	0.88-7.45	0.083
T25FW	0.98	0.89 – 1.08	0.699
GLTEQ	1.58	0.49 – 5.08	0.447
FES-I	0.84	0.71-1.003	0.054
MFIS	1.03	1 – 1.05	**0.048**
MSWS-12	1.05	0.91 – 1.22	0.490
TUG	0.90	0.59 – 1.38	0.623
6MWT	1.00	0.99 – 1.02	0.831

Bold values show significant predictive ability (p<0.05)
Abbreviations: CI, Confidence Interval; MSQ, Marshall Sitting Questionnaire; BMI, Body-mass index; EDSS, Expanded Disability Status Scale; PDDS, Patient-determined disability status scale; GLTEQ, Godin Leisure-Time Exercise Questionnaire; FES-I, Falls-Efficacy Scale-International; MFIS, Modified Fatigue Impact Scale; MSWS-12, MS Walking Scale; TUG, Timed Up and Go; 6MWT, Six Minute Walk Test; T25FW, Timed 25-Foot Walk

Discussion

In this study, we found that sitting time is associated with gender, employment status, and subjective fatigue in pwMS. Being male increased the risk of sitting 3.08 times, being employed increased the risk of sitting 4.65 times, and having each unit higher score on the fatigue scale increased the risk of sitting 1.03 times. There was no difference between weekday and weekend sitting times. Sitting time was not significantly associated with physical activity level, fear of falling, and gait parameters.

Sedentary behaviour is influenced by personal, social, and cultural factors. A study examining the descriptive epidemiology of sitting time in pwMS concluded that gender, age, race, education level, and income level did not statistically differ in the sitting time (Hubbard et al., 2015). The impact of gender on sedentary behaviour remains uncertain as studies have yet to reach a consensus on this matter. Meneguci et al. stated that older women sit for longer periods than men (Meneguci et al., 2015). In addition to personal and environmental factors, the fact that women are less involved in out-of-home activities in some cultures may also cause this situation (Meneguci et al., 2015). On the contrary, in another study evaluating pwMS in which, men reported a higher rate of sitting time. However, it was stated that this might be related to the time spent at work and preference for leisure time activities, in line with our findings (Jeffer E. Sasaki et al., 2018). Our study found that being in the male gender increased the risk of excessive sitting time by 3.08 times compared to being in the female gender.

A study examining the effect of demographic characteristics on sitting time emphasized that participants in the 18-39 age group reported higher sitting time than other age groups, and those with higher education reported higher sitting time than other education levels (Bauman et al., 2011). It has been reported that young adults reporting more sitting time may develop secondary to their use of more technology, sedentary occupational preferences, and preference for more passive transport methods (Bauman et al., 2011). In our study, in parallel with the literature, age and education level did not significantly associate with sitting time. When the data related to employment status are evaluated, employed individuals are expected to report more sitting time than unemployed individuals since most of today's working conditions are conducive to excessive time spent sitting. Studies examining the employment status of pwMS also reported more sitting time in employed participants (Jeffer E. Sasaki et al., 2018). These results related to employment status are consistent with our study in which the risk of reporting more sitting time in the employed group was 4.65 times higher than in the unemployed group.

In the literature, the disability level has been associated with sedentary behaviour in ambulatory pwMS. Although different cut-off values were used in the studies, it was generally determined that pwMS with more severe disability levels spent longer time in sedentary behaviour (Veldhuijzen Van Zanten et al., 2016). In our study, we used the EDSS and PDDS scales to examine the association between sedentary behaviour and disability levels, but we did not find a significant association between sitting time and disability. The higher sitting time in our study, despite the low level of disability among pwMS, suggests that pwMS may limit their physical movements even in the absence of symptoms following a diagnosis of MS. This finding can be considered evidence of self-imposed restrictions on activity in early phases of disease among pwMS. In addition, the fact that daytime sleep or lying down, which may be overlooked when reporting sedentary behaviour in self-report questionnaires, is higher at the level of severe disability may also hinder this difference.

In self-report questionnaires that determine sedentary behaviour levels by questioning sitting time, scales that evaluate weekdays and weekends separately have higher accuracy (Dall et al., n.d.)Furthermore, sitting time recorded in multiple questions may facilitate recall for pwMS. In addition, the fact that weekdays and weekends are recorded separately may be a determinant for behavioural changes to be planned to prevent sedentary behaviour. However, in line with our findings, previous studies generally showed non-significant differences in sitting time between weekdays and weekends (Van Uffelen et al., 2011). Hensman et al. found that, although the difference between weekdays and weekends was not statistically significant, pwMS reported sitting 72 (± 32) minutes more per day on weekdays than on weekends (Hensman et al., 2020). It has been argued that the reason for the differences in sitting time between weekdays and weekends among participants may be working status (Hensman et al., 2020). In parallel with these results, there was also a significant difference in sitting time between the employed and unemployed groups on weekdays; employment status was one of the most important determinants of sitting time in our study. Therefore, we think that rehabilitation targets that can change sedentary behaviour patterns in working life will contribute to health benefits. In addition, since studies evaluating sitting time on weekdays and weekends do not question the time spent awake, more time spent asleep at the end of the week may result in more sitting time on weekdays. Future studies should differentiate sleep time and sitting time.

In our study, participants were grouped according to their sitting time, and descriptive evaluations were made. In these evaluations, participants above the 75th percentile were considered as over-sitting (745.71 min/day) in accordance with the literature (Meneguci et al., 2015). This sitting time corresponds to almost three times the sitting time in the general population (J. E. Sasaki et al., 2018). Comparisons between these groups also revealed significant differences between gender, employment status, and fatigue level. Male pwMS tended to sit longer than female pwMS, as discussed earlier. In addition, employed pwMS reported more sitting time, which aligns with previous assessments.

One of the most widely used scales to measure physical activity in MS is the GLTEQ (Motl et al., 2018). A study investigating sitting time and physical activity level in pwMS concluded that pwMS performed 17.7 units less physical activity compared to healthy controls. Despite this result, the reported physical activity level has a weak association with the duration of sedentary behaviour. At this point, it was emphasized that sedentary behaviour and physical activity level are independent of each other, and sedentary behaviour should not be considered as the absence of moderate to vigorous physical activity (Hubbard et al., 2015). Another study found no association between mild and moderate physical activity levels and sedentary behaviour in pwMS (Motl et al., 2017). This result supports the conclusion that physical activity level and sedentary behaviour are independent.

There are few studies comparing physical activity level and sedentary behaviour with gait performance. A strong correlation was observed in the study between the scores obtained from two self-reported scales of physical activity, namely GLTEQ and IPAQ, and the gait-related assessments, MSWS-12 and PDDS (Weikert et al., 2010). Baird et al. concluded that the relationship between moderate physical activity level and walking performance, evaluated with T25FW and 6MWT, was significant in older adults with MS (60-79 years) according to the intensity of physical activity assessed by accelerometry (Baird et al., 2019). In another study, both moderate physical activity level and maximum oxygen consumption were found to be associated with walking tests according to 6MWT and T25FW and emphasized that increasing the intensity of physical activity level may be a target to improve walking performance (Hibner et al., 2020). In our study, no significant association was found between gait-related tests and sedentary behaviour and physical activity level. The reason for this may be the use of objective methods such as accelerometry in studies in the literature, unlike our study. Furthermore, it is worth noting that most pwMS in our study have a minimal disability, which may have influenced the observed outcome.

Fear of falling is a common problem affecting approximately 50-60% of pwMS. Individuals with a high fear of falling are less likely to participate in leisure-time physical activity. While 62% of pwMS in another study reported a fear of falling, 67% of this group stated that they restricted their movements for this reason (Matsuda et al., 2012). In our study, no significant association between fear of falling and sedentary behaviour and physical activity may result from having a minimal disability of pwMS.

Fatigue is one of the most common symptoms of MS, affecting almost 80% of pwMS (Khan et al., 2014). Blikman et al. found that ambulatory fatigued pwMS spent more time in sedentary behaviour and had lower rates of participation in moderate physical activity than healthy individuals (Blikman et al., 2015). Excessive fatigue and depressed mood were found to be associated with decreased physical activity (Kratz et al., 2019). In another study, fatigue was found to be an indicator of lower physical activity levels and higher sitting time (Marck et al., 2022). In our study, significant differences were found in the MFIS of the pwMS divided into two groups according to sitting time. In regression analysis, it was found that each unit increase in the MFIS increased the risk of excessive sitting time by 1.03 times. Based on these findings, it can be concluded that fatigue plays a significant role in sedentary behaviour. Intervention strategies to reduce fatigue might be recommended as a modifiable factor to reduce sedentary behaviour in pwMS.

There were several limitations of this study. The lack of an age- and sex-matched healthy control group would help to determine whether the observed effects were due to MS alone. The sample size is relatively small. In addition, our sample consists mainly of pwMS with mild disability and relapsing-remitting form. These characteristics may limit the generalizability of our findings to pwMS with moderate to severe disability or progressive forms of the disease.

Conclusion

This present study has investigated determinants of sedentary behaviour, which is considered a public health threat in pwMS. Total sitting time is associated with gender, employment status, and fatigue independent of physical activity level and fear of falling. Future studies may also incorporate accelerometry-based assessment of sedentary behaviour with clinical and demographic data. Especially in sedentary pwMS, where fatigue is at the forefront, the development and dissemination of effective behavioural approaches may play an important role in the person's social participation by removing the barrier to increasing physical activity.

Author contributions

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