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ORIGINAL ARTICLE

A Dutch validation study of the Multiple Sclerosis Work Difficulties Questionnaire in relapsing remitting multiple sclerosis

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ABSTRACT

Purpose: The current study aimed to evaluate the psychometric properties of the Dutch version of the Multiple Sclerosis Work Difficulties Questionnaire-23 (MSWDQ-23).

Methods: Two hundred and thirty-nine employed persons with multiple sclerosis (MS) and 59 healthy controls completed the MSWDQ-23. To verify the factor structure, a confirmatory factor analysis was conducted. To assess construct validity, the MSWDQ-23 scores were correlated to measures of physical disability, fatigue, cognitive and neuropsychiatric problems, depression, health-related quality of life, and work-related variables. MSWDQ-23 scores were compared within different age groups, gender, education levels, and job types. Predictive validity was assessed using a logistic regression analysis to predict a deterioration in employment status after one year based on MSWDQ-23 scores.

Results: The internal consistency of the MSWDQ-23 was acceptable ($\alpha = 0.913$, 95% CI = 0.897–0.928) and the results indicated a fair fit. The MSWDQ-23 showed acceptable construct validity, confirming 94% of the hypotheses. The total scale and the psychological/cognitive subscale were able to predict a deterioration in employment status after one year ($\chi^2(1) = 18.164$, $p < 0.001$).

Conclusions: The Dutch version of the MSWDQ-23 is a valid and internally consistent instrument to measure self-reported work difficulties in persons with MS.

➤ IMPLICATIONS FOR REHABILITATION

- The Dutch version of the 23-item Multiple Sclerosis Work Difficulties Questionnaire (MSWDQ-23) is a reliable and valid tool to measure self-reported work difficulties in people with multiple sclerosis (MS).
- More psychological and cognitive work difficulties are predictive of a deteriorated employment status after one year.
- The MSWDQ-23 is a helpful tool for researchers and (occupational) health professionals to identify current work difficulties in persons with MS and identify persons at risk for a deterioration in employment one year later.

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Introduction

Multiple sclerosis (MS) is a chronic, demyelinating, and degenerative disease of the central nervous system. The disease is often diagnosed between the age of 20 and 40 years, while people are in the midst of their working career, significantly interfering with their working ability [1]. In a recent Dutch study amongst 382 persons with MS, 82% reported a decrease in productivity at work as a consequence of MS [2]. An unemployment rate as high as 69% was reported amongst this sample of persons with MS that reflected a wide range of severity of disability (Expanded Disability Status Scale (EDSS) scores ranging from 0 to 9) [2].

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Supplemental data for this article can be accessed here.

It has been known that MS poses an economic burden on the individual, their family and society in general [3]. Production loss (especially early retirement costs due to MS) covers almost half of the total annual MS-related costs in the Netherlands (45.8%) [4]. Research in a Dutch population suggests that unemployment in persons with MS is related to a lower quality of life and worse mental health [5].

As a result of the substantial societal and personal costs associated with impaired work participation in MS, there is an increased interest in research into disease and patient characteristics that are related to employment. Several studies suggest that physical disability, self-reported fatigue, and both subjective and objective cognitive impairment, influence the probability of working, totally or partially in the form of reduction of working hours [6–9]. Additionally, evidence has been found for the impact of psychological factors, such as anxiety, depression, and coping on work participation [10]. The type of work undertaken also influences the impact of MS on work functioning (e.g., sedentary work versus jobs requiring frequent moving) [11], as well as the context in which the work is carried out (e.g., the balance between working and private life) [12].

Given the major impact of employment on mental wellbeing and economic status, it is essential to further assess individual factors that interfere with the working ability of persons with MS. Honan et al. [13] developed the 50-item Multiple Sclerosis Work Difficulties Questionnaire (MSWDQ), which aims to measure self-reported workplace difficulties in persons with MS. However, the original MSWDQ might not be suitable for a clinical setting due to its length [14]. Therefore, a shorter version was developed based on the second-order structure of the MSWDQ, including 23 items [14]. The Multiple Sclerosis Work Difficulties Questionnaire-23 (MSWDQ-23) is an internally consistent measure of subjective difficulties experienced in a work setting by persons with MS. The scale consists of three subscales: psychological/cognitive, physical, and external barriers [14]. Recently, several validation studies have been carried out for non-English languages including German, Spanish, and Turkish [15–17]. However, the questionnaire has yet to be validated for the Dutch population. The results of the previous validation studies demonstrated that the translated tools have adequate validity and reliability. Thus, the Dutch version of the MSWDQ-23 may be a promising tool to detect work difficulties in persons with MS. The current validation study is based on the elements of the COnsensus-based Standards for the selection of health Measurement INstruments (COSMIN) checklist for cross-cultural validation [18,19].

The goal of the current study was to verify the three-factor structure and evaluate the psychometric properties of the Dutch version of the MSWDQ-23. We hypothesised that the MSWDQ-23 would show an acceptable internal consistency and an acceptable model of fit based on confirmatory factor analysis, in line with previous validation studies [14,17]. We also expected an acceptable construct validity with conceptually related measures of physical disability, fatigue, cognitive and neuropsychiatric problems, depression and health-related quality of life, using defined hypothesis. Finally, we expected acceptable predictive validity in employment status after one year.

Methods

Participants

The current study included 297 persons with MS. They were recruited in the context of the MS@Work study, an ongoing three-year follow-up study carried out across 16 MS outpatient clinics in the Netherlands [20]. The inclusion criteria for the MS@Work study in general were (a) a minimum age of 18 years, (b) a diagnosis of relapsing remitting MS according to the Polman-McDonald criteria [21], (c) currently being employed or within three years since their last employment, and (d) being proficient in the Dutch language. Exclusion criteria included comorbid psychiatric or neurological disorders, substance abuse or neurological impairment that might affect neuropsychological assessment. We included only the persons with MS who were employed and completed the MSWDQ-23 at baseline ($N = 239$). Moreover, we recruited a matched healthy control group ($N = 59$), through advertisement in newspapers and social media, to examine whether the perceived work difficulties are MS-specific. The healthy controls were matched on age, gender, and education. They had a minimum age of 18 years and were proficient in Dutch. Exclusion criteria included psychiatric or neurological disorders or chronic disorders of another kind, as well as substance abuse.

The study was approved by the Medical Ethical Committee Brabant (NL43098.008.12 1307). Written informed consent was provided by all participants.

Study procedure

Participants that met the inclusion criteria and signed an informed consent form, were asked to fill in online questionnaires yearly for a period of three years. The questionnaires inquired about employment and work functioning, fatigue, self-reported cognitive and neuropsychiatric functioning, depression, anxiety, health-related quality of life, and demographic characteristics. Moreover, the persons with MS visited the outpatient MS clinics yearly and underwent neurological and neuropsychological assessments. The EDSS scores were obtained by the neurologists of the participating MS outpatient clinics during the neurological examination. For the current study, we used the data of the baseline and one-year measurements. For an extensive description of the study protocol, see van der Hiele et al. [20].

After approval from the developer of the MSWDQ-23 [13], we translated the MSWDQ-23 into Dutch using a forward and back-translation method. The forward translator was a health care professional and researcher, familiar with the MSWDQ-23.The questionnaire was translated back into English by an independent translator, who is a native English speaker, fluent in Dutch and without any knowledge concerning the MSWDQ-23. Conceptual and cultural equivalence was prioritised over linguistic equivalence. The Dutch version of the MSWDQ-23 can be found in the online Supplementary Material.

Measures

The Multiple Sclerosis Work Difficulties Questionnaire-23

To assess perceived work difficulties, the MSWDQ-23 [14] was administered. The MSWDQ-23 is a 23-item self-report scale that consists of three subscales: psychological/cognitive barriers, physical barriers, and external barriers. Participants rate their perceived difficulties over the last four weeks on a five-point Likert scale (answer options ranging from 0 *Never* to 4 *Always*). The MSWDQ-23 is an internally consistent questionnaire in English and non-English languages that is able to predict both work outcomes and expectations [14]. Subscale scores can be computed by summing the observed item scores, divided by the total possible item scores in each subscale, and then multiplying the value by 100. The maximum score of each subscale is 100, with higher scores

indicating higher perceived difficulties [14]. The total MSWDQ-23 score consists of an average of the three subscale scores.

Expanded Disability Status Scale

The EDSS [22] was used to quantify physical disability. The scale ranges from 0 to 10, with higher scores indicating more disability. Although problems with the inter-rater reliability have been reported, the EDSS is an acceptable outcome criterion to monitor disease progression [23].

Modified Fatigue Impact Scale-21

To measure the impact of fatigue on cognitive, physical and psychosocial functioning, the Modified Fatigue Impact Scale-21 [24] was administered. The Modified Fatigue Impact Scale-21 is a 21-item scale, with answers ranging from 0 to 4. Higher scores are indicative of a greater impact of fatigue. The Dutch version of the Modified Fatigue Impact Scale-21 is a valid and reliable tool to assess the impact of fatigue on a variety of daily activities in persons with MS [25].

Multiple Sclerosis Neuropsychological Screening Questionnaire

The Multiple Sclerosis Neuropsychological Screening Questionnaire was administered to measure patient-reported cognitive and neuropsychiatric functioning [26,27]. The Multiple Sclerosis Neuropsychological Screening Questionnaire is comprised of 15 items, with responses ranging from 0 to 4. A higher score implies more perceived cognitive and neuropsychiatric problems. The Multiple Sclerosis Neuropsychological Screening Questionnaire showed a good internal consistency in a Dutch study [27].

Hospital Anxiety Depression Scale

The Hospital Anxiety Depression Scale depression subscale [28] was used to measure depressive symptoms. The depression subscale consists of seven items with answer options ranging from 0 to 3. A higher score demonstrates more self-reported depressive symptoms. The scale demonstrated high sensitivity and specificity for the detection of depressive symptoms in persons with MS [29].

Multiple Sclerosis Quality of Life-54

The Multiple Sclerosis Quality of Life-54 [30,31] was administered to measure health-related quality of life (physical, mental, and social health). The scale consists of 54 items and shows good internal consistency and structural validity [32]. The Multiple Sclerosis Quality of Life-54 consists of two composite scores: mental health and physical health. Moreover, there are 12 subscales: physical function, role limitations-physical, role limitations-emotional, pain, emotional well-being, energy, health perceptions, social function, cognitive function, health distress, overall quality of life, and sexual function. The composite scores range from 0 to 100, with a higher score indicating a better perceived health. For the current study, we used the two composite scores.

Employment measures

Information about employment status and number of working hours was obtained using a general questionnaire. We added questions concerning work ability as compared to lifetime best [33] and presenteeism (the interference of MS on the productivity at work: Work Productivity and Activity Impairment Questionnaire) [34]. After one year, we obtained information on whether the employment status remained stable or had deteriorated over the past year due to MS. A liberal definition of deterioration was used [35]. This definition contains any reduction in work responsibilities, for instance, demotion or reduction in working hours. We considered employment status as deteriorated if either someone lost his/her job, reduced their working hours due to MS or reduced their responsibilities one year after baseline measurements. Persons with MS with a stable or an improved employment status, e.g., an increase in work hours, were included in the stable employment status group.

Demographics

The demographic characteristics included questions concerning age, gender, education, and job type. The persons with MS were divided into five age groups by decade, ranging from 1 (20–29 years) to 5 (60–69 years). The education levels varied from 1 to 8 (1 = primary education, 8 = doctoral (PhD)), and were divided into three groups: lower education, middle education, and higher education. We included people who finished low level secondary school in the lower education group. People were considered to have a middle education level when they finished secondary school at a medium level. The high education group consisted of people who finished secondary school at the highest level or acquired a college/university degree. We distinguished three job types: a mentally challenging job, a physically challenging job or a combination of both.

Statistical analysis

Mann–Whitney's *U*-tests and Chi-square tests were used to examine differences in demographics and work characteristics between persons with MS and healthy controls.

Reliability

Internal consistency. The reliability was assessed by examining the internal consistency of each subscale and the total MSWDQ-23 with Cronbach's alpha in the persons with MS. A value of $\geq$0.70 was considered acceptable [36]. For the item-total correlations, a value of 0.30 or higher was considered adequate [37].

Floor and ceiling effects. Floor and ceiling effects were calculated for the persons with MS. These effects were considered present if 15% of the participants achieved the highest or lowest score possible on the total MSWDQ-23 scale [38].

Validity

Confirmatory factor analysis. A confirmatory factor analysis was applied in a sample of persons with MS to verify the three-factor structure as found by Honan et al. [14] using AMOS (version 25) [39]. Since the confirmatory factor analysis assumes normality, the Bollen–Stine bootstrap method was applied. The recommendations of Hu and Bentler [40], as well as the recommendations of Kline [41], were used to evaluate the goodness of fit.

In the recommendations of Hu and Bentler [40], the χ^2/df is proposed as a replacement of the regular χ^2 because the latter is affected by sample size. A value lower than 2.0 is regarded as a reflection of good model fit. Second, the Comparative Fit Index is qualified as a fair fit when it reaches a value over 0.90, with 0.95 being indicative of a good fit. Third, the root mean square error of approximation reflects a fair fit with a value of 0.08 or lower. A value of 0.05 or below is considered a good model fit, with $<$0.10 for the upper bound and $<$0.05 for the lower bound. Finally, we added the standardised root mean square residual as another absolute measure of fit. A value of 0.08 or less is considered a good fit [40].

Kline [41] proposes less conservative recommendations, with χ^2/df $<$ 3 being an acceptable fit. The comparative fit index is

Table 1. Demographics, work characteristics, and mean scores of persons with MS and healthy controls on the MSWDQ-23 and its subscales.

	Persons with MS $N = 239$	Healthy controls $N = 59$	Test value	p Value
Gender (% female)	187 (78%)	40 (68%)	$\chi^2 = 2.85$	0.067
Age (*SD*)	42.7 (9.5)	41.5 (11.2)	$U = 7625$	0.332
Education			$U = 6085.5$	0.076
High, *N* (%)	102 (43%)	30 (51%)		
Middle, *N* (%)	96 (40%)	26 (44%)		
Low, *N* (%)	41 (17%)	3 (5%)		
Working hours (*SD*)	26.5 (11.7)	33.4 (9.1)	$U = 4558$	0.001
Job type (MS-group $N = 200$)			$\chi^2 = 2.5$	0.29
Mentally challenging (%)	112 (56%)	39 (66%)		
Physically challenging (%)	20 (10%)	6 (10%)		
Mentally and physically challenging (%)	68 (34%)	14 (24%)		
MSWDQ-23				
Psychological/cognitive barriers	17.0 (13.3)	9.3 (9)	$U = 9492.5$	<0.001
Physical barriers	14.1 (11.1)	5.2 (7.50)	$U = 10846$	<0.001
External barriers	19.9 (18.7)	8.3 (11.32)	$U = 9858.5$	<0.001
Total score	17.0 (12.5)	7.6 (8.08)	$U = 10415.5$	<0.001

Mean (*SD*) are noted.

considered good when it exceeds 0.90. He defined a 90% CI for the root mean square error of approximation with <0.05 for the lower bound and 0.10 for the upper bound. Finally, he considered a standardised root mean square residual value of <0.10 to be a good fit.

Construct validity: hypothesis testing. To assess the construct validity, correlations were calculated between the MSWDQ-23 (sub and overall) and measures of physical disability, fatigue, cognitive/neuropsychiatric functioning, depression, health-related quality of life, and work-related variables (number of working hours, "work ability as compared to lifetime best" and presenteeism due to MS) for the persons with MS, using Spearman's correlation analyses. For the classification of the effect size of Spearman's correlation coefficient, the guidelines of Hopkins [42] were used. A correlation coefficient <0.1 was considered trivial, 0.10–0.30 was considered as small, 0.30–0.50 as moderate, 0.50–0.70 as high, and 0.70–0.90 as very high.

We formulated 48 hypotheses on the strength of the association of the MSWDQ-23 and construct variables (for an overview, see online Supplementary Material). According to previous validation studies, we hypothesised small-to-moderate positive correlations between the MSWDQ-23 total score and measures of physical disability and small positive correlations between measures of physical disability and the external and psychological subscale scores. Given the conceptual similarity, we expected moderate-to-high positive correlations between the physical subscale and measures of physical disability. Since previous research suggested a strong link between fatigue and work outcomes [6], we hypothesised moderate-to-high positive correlations between the MSWDQ-23 and its subscales and measures of fatigue, in line with the previous validation studies [16,17]. Previous research suggests that self-reported cognitive problems are related to adverse work outcomes [9]. Given the conceptual overlap, we expected a moderate-to-high positive correlation between cognitive and neuropsychiatric problems with the psychological subscale and the total MSWDQ-23 score. We expected the correlation between external and physical barriers and cognitive and neuropsychiatric problems to be small to moderate and positive.

As reported previously, depressive symptoms are known to have an impact on work outcomes [10]. Therefore, we expected moderate-to-high positive correlations of the MSWDQ-23 total score and subscale scores with a questionnaire assessing depressive symptoms. We expected moderate-to-high negative correlations between the MSWDQ-23 (total and subscale scores) and measures of health-related quality of life [17]. Moreover, in line with Kahraman et al. [17], we expected small-to-moderate correlations between the MSWDQ-23 and working measures: a negative correlation between the MSWDQ-23 and working hours, work ability and positively correlated to presenteeism. The construct validity was considered as acceptable when the majority (80%) of the hypotheses was confirmed [38].

Construct validity. To determine whether the MSWDQ-23 and its subscales can distinguish between persons with MS and healthy controls, non-parametric Mann–Whitney's *U*-tests were used. We expected the persons with MS to experience more work difficulties than the healthy controls. Moreover, we expected people in the older age group to report more difficulties, since previous research suggests that an older age is predictive of employment loss [7,12].

To verify whether the MSWDQ-23 differentiates between persons with MS in different age groups, gender and education levels, nonparametric Mann–Whitney's tests and Kruskal–Wallis's tests were performed. Also, a Kruskal–Wallis test was used to examine differences between people carrying out a physically challenging job and people carrying out a mentally challenging job or a combination of both.

Predictive validity. In order to assess the predictive validity, two logistic regression analyses were conducted (in the persons with MS) with employment status after one year (deteriorated employment status or stale employment status) as the dependent variable and either the MSWDQ-23 total score or MSWDQ-23 subscales as predictors.

We used a level of significance of $p \leq 0.05$. All the analyses, except for the confirmatory factor analysis were performed using IBM SPSS (Version 23; IBM Corp., Armonk, NY).

Results

Of the 239 participants with relapsing remitting MS who completed the MSWDQ-23, 187 were female and 52 were male, with a mean age of 42.7 years ($SD = 9.5$). EDSS scores ranged between 0 and 6, with a mean of 2.2 ($SD = 1.3$), the mean disease duration was 7.5 years ($SD = 6.7$). On average, they worked 26.5 h a week ($SD = 11.7$). Demographics, work characteristics, and the mean scores on the MSWDQ-23 are presented in Table 1.

Moreover, 59 healthy controls completed the MSWDQ-23. There were no differences in age ($U = 7.625$, $p = 0.33$), education

($U = 6085.5$, $p = 0.076$), gender ($\chi^2(1)=2.84$, $p = 0.092$), and job type ($\chi^2(2)=2.5$, $p = 0.29$) between the healthy controls and the persons with MS. Forty of the healthy controls were female and 19 were male, with a mean age of 41.4 years ($SD = 11.2$). On average, the healthy controls worked 33.4 h a week ($SD = 9.1$) which differed significantly from the persons with MS ($p < 0.001$).

Reliability

Internal consistency

The internal consistency for the Dutch version of the MSWDQ-23 was acceptable ($\alpha = 0.913$, 95% CI = 0.897–0.928). Results of the subscales are presented in Table 2. Results indicate acceptable internal consistency. It can be noted that Cronbach's alpha increases slightly after removal of item 2; however, we decided to keep the item in order to be able to compare the results of the current study with the original MSWDQ-23 [14].

Item-total correlations for the items ranged from 0.37 to 0.73 for psychological/cognitive barriers, from 0.35 to 0.52 for physical barriers and from 0.52 to 0.60 for external barriers (Table 2), indicating acceptable levels.

Floor and ceiling effects

There were no floor and ceiling effects for the total MSWDQ-23 score. None of the persons with MS had the worst possible score of 100 and seven of the persons with MS had the best possible score of zero (2.9%).

Confirmatory factor analysis

A confirmatory factor analysis was conducted to verify the three-factor structure as defined by Honan et al. [14]. The fit statistics were $\chi^2/df = 3.645$ ($p < 0.001$), root mean square error of approximation = 0.105 (lower bound = 0.098, upper bound = 0.113), standardised root mean square residual = 0.0749, comparative fit index = 0.766, indicating a poor fit of the data to the initial three structure model. After inspection of the modification indices, we correlated several error terms of the conceptually linked items with the domains of non-supportive workplace, bladder/bowel difficulties, financial security concerns, prospective memory difficulties, and interpersonal difficulties [13]. Correlating the error terms improved the model. The test of model fit was significant ($p < 0.001$). The χ^2/df was 2.224. Following the assumptions of Hu and Bentler [40], this would exceed the defined 2.0, indicating poor model fit; however, according to Kline [41] the fit is acceptable (<3.0).

In terms of global fit indices, we found a root mean square error of approximation value of 0.072 (lower bound = 0.063, upper bound=0.080), that can be qualified as fair by Hu and Bentler [40]. The upper bound is acceptable in accordance with both recommendations; however, the lower bound is troublesome for both. The comparative fit index (comparative fit index=0.894) was just below the threshold to be qualified as fair according to Hu and Bentler (≥0.90) [40] and Kline (≥0.90) [41]. Both Kline [41] and Hu and Bentler [40] evaluated the standardised root mean square residual as acceptable (standardised root mean square residual = 0.0586). Since all standardised regression weights exceed 0.30 (Figure 1), there is no need for specific item removal. Altogether, the global fit indices showed that the overall goodness of fit was fair.

It has to be noted that the correlations between the three latent factors were high, with the correlation between the external and physical subscale even reaching $r = 0.91$. These results indicate that a one-factor model might show better adjustment to the data. However, fitting a one-factor model ($\chi^2/df = 2.621$, $p < 0.001$, root mean square error of approximation = 0.083 (lower bound = 0.074, upper bound= 0.091), standardised root mean square residual = 0.0646, comparative fit index = 0.857, see Supplementary Figure S1) did not lead to better adjustment ($\chi^2(4)=98.7$, $p < 0.001$) and favours the three-factor model over the one-factor model.

Construct validity

Hypotheses testing

The MSWDQ-23 and its subscales were moderately-to-highly associated with the scores on the EDSS, Modified Fatigue Impact Scale-21

Table 2. Cronbach's alpha if item is deleted and the item-total correlations for the subscales of the MSWDQ-23.

	Cronbach's alpha if item deleted	Corrected item – total correlation
Psychological/cognitive barriers ($\alpha = 0.886$, 95% CI = 0.863–0.906)		
Item 2. I thought that my employer was not very understanding of my needs	0.892	0.37
Item 3. I found it difficult to learn something new	0.873	0.65
Item 4. I thought that my manager or work colleagues were not supportive of me	0.884	0.46
Item 6. I needed to be reminded to do a task at a particular time	0.877	0.59
Item 7. I felt that I could not perform to the level that was expected of me	0.868	0.72
Item 10. I struggled to remember a recent conversation	0.872	0.66
Item 13. I became sleepy whilst trying to undertake a lengthy task	0.874	0.62
Item 15. I had trouble concentrating on a task	0.867	0.73
Item 16. I had difficulty communicating my thoughts to co-workers	0.873	0.65
Item 19. I found it difficult to interact with people	0.876	0.60
Item 22. I forgot what task I had to do next	0.875	0.62
Physical barriers ($\alpha = 0.746$, 95% CI = 0.695–0.792)		
Item 1. I experienced a lack of coordination with my movements	0.713	0.48
Item 5. I felt that disturbances in my bowel or bladder function distracted me from doing a task	0.722	0.43
Item 8. I found it difficult to tolerate the temperature at work	0.739	0.35
Item 9. I found assessing my office or work site difficult	0.735	0.36
Item 11. I experienced pain whilst undertaking a task	0.706	0.52
Item 14. I found it difficult to maintain my balance	0.708	0.50
Item 18. I found it difficult to write or type	0.711	0.49
Item 20. I feared that I would be incontinent	0.724	0.43
External barriers ($\alpha = 0.768$, 95% CI = 0.716–0.813)		
Item 12. I feared I would not be able to support myself if I could no longer work	0.701	0.59
Item 17. I felt it was more difficult to balance work and home duties	0.741	0.52
Item 21. I found it difficult to reduce my work hours because my pay would also be reduced	0.698	0.60
Item 23. I felt that work was becoming harder due to responsibilities at home	0.711	0.59

and its subscales, Multiple Sclerosis Neuropsychological Screening Questionnaire, Hospital Anxiety Depression Scale, and The Multiple Sclerosis Quality of Life-54 composite scores except for a small correlation between the EDSS and the MSWDQ-23 total score and psychological/cognitive subscale (see Table 3), in line with the hypotheses. The correlation between the external subscale and the EDSS was not significant, in contrast to the hypothesis. The significant associations were in the expected direction in that more work difficulties were associated with worse physical functioning, more fatigue, worse self-reported cognitive and neuropsychiatric functioning, more depressive symptoms and lower health-related quality of life.

Also, Spearman's correlation coefficients were calculated for the subscales and the overall score of the MSWDQ-23 and several work-related measures in employed persons with MS ($N = 239$), i.e., working hours, work ability as compared to lifetime best and presenteeism due to MS (Table 3). The MSWDQ-23 and its subscales were moderately correlated with work ability and presenteeism. The MSWDQ-23 psychological and physical barriers subscales were significantly correlated with working hours; both were small relationships. The total score and external barriers did not correlate with working hours, in contrast to the hypotheses. The associations were in the expected direction in that more work difficulties were associated with less working hours, less work ability and more presenteeism. Forty-five of the 48 hypotheses were confirmed (>80%).

Differences in work difficulties between persons with MS and healthy controls

A Mann–Whitney *U* test was conducted to examine differences in scores on the MSWDQ-23 and its subscales between the persons with MS and healthy controls. Persons with MS scored significantly higher than the healthy controls on the total MSWDQ-23 score, psychological barriers, physical barriers, and external barriers. The mean scores of the persons with MS and healthy controls are depicted in Table 1.

Differences in work difficulties between age groups, gender, educational levels, and job types

Scores on the MSWDQ-23 were not significantly different between the age groups, gender, education levels, or job types (See Supplementary Table S1 to S4).

Predictive validity

To assess the predictive validity of the MSWDQ-23, a logistic regression analysis was conducted with employment status after one year as a dependent variable (stable employment status(0)/deteriorated employment status(1)) and either the MSWDQ-23 total score or MSWDQ-23 subscales as predictors. We included only the participants who were employed at baseline and who filled out the questionnaire after one year ($N = 203$). Thirty-three participants had a deteriorated employment status (16%), while the employment of 170 participants (84%) remained stable (SES).

The first model was significant, with a higher total score of the MSWDQ-23 being predictive of employment status deterioration after one year (Table 4).

The second model with only the subscales as predictors was also significant. We found that a higher score on the psychological/cognitive subscale was a significant predictor of a

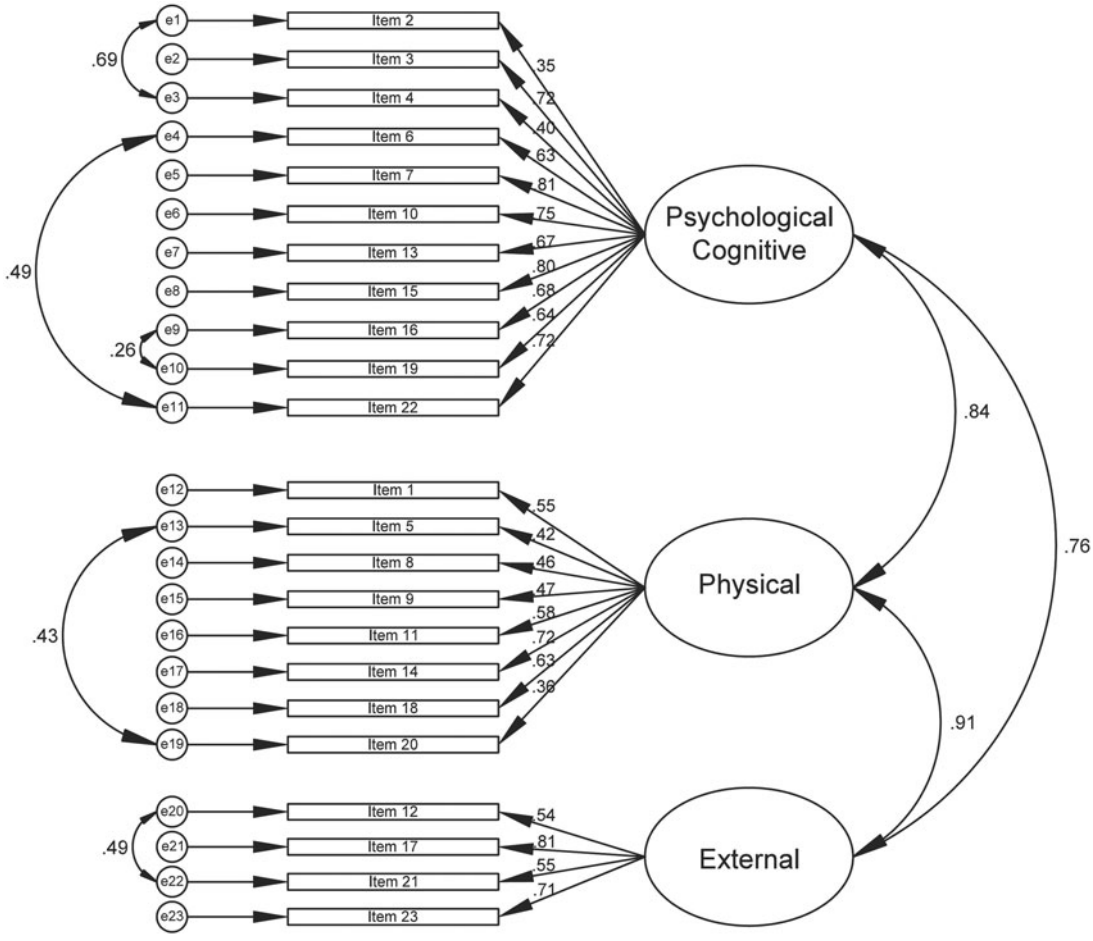

Figure 1. Factor structure of the MSWDQ-23. The three latent factors of the MSWDQ-23 are shown with the items and the corresponding standardised regression weights.

Table 3. Construct validity: Spearman's correlations between the MSWDQ-23 and its subscales and validation variables.

	MSWDQ-23 Total score	Psychological/ cognitive barriers	Physical barriers	External barriers
EDSS	0.21**	0.14*	0.35**	0.13
Modified Fatigue Impact Scale-21				
Total score	0.62**	0.60**	0.56**	0.49**
Physical subscale	0.52**	0.40**	0.52**	0.45**
Cognitive subscale	0.56**	0.68**	0.46**	0.40**
Psychosocial subscale	0.43**	0.37**	0.38**	0.38**
Multiple Sclerosis Neuropsychological Screening Questionnaire	0.55**	0.66**	0.44**	0.38**
Hospital Anxiety Depression Scale-Depression	0.55**	0.53**	0.42**	0.48**
Multiple Sclerosis Quality of Life-54				
Physical health composite score	−0.63**	−0.48**	−0.59**	−0.57**
Mental health composite score	−0.63**	−0.62**	−0.49**	−0.54**
Working hours	−0.12	−0.17**	−0.14*	−0.04
Work ability (lifetime best)	−0.44**	−0.45**	−0.38**	−0.34**
Presenteeism	0.50**	0.49**	0.45**	0.47**

EDSS: Expanded Disability Status Scale.
*$p \leq 0.05$.
**$p \leq 0.01$.

deteriorated employment status after one year. Neither the physical nor the external subscale was a significant predictor (Table 5).

Table 4. Logistic regression analysis model of deteriorated or stable employment after one year (total score).

Model 1. MSWDQ-23 total score					
Included	*B*	S.E.	Exp (*B*)	[95% CI Exp (B)]	*p* Value
Constant	−2.85	0.39			0.001
Total score MSWDQ-23	0.06	0.02	1.07	[1.03–1.10]	0.001

$\chi^2(1)=18.164$, $p < 0.001$. $R^2=0.086$ (Cox and Snell), $R^2=0.145$ (Nagelkerke).

Discussion

The goal of the current study was to verify the three-factor structure and evaluate the psychometric properties of the Dutch version of the MSWDQ-23. The Dutch version of the MSWDQ-23 and its subscales showed an acceptable internal consistency, similar to the original questionnaire [14]. There were no floor or ceiling effects present. Honan et al. [14] concluded that the MSWDQ-23 consists of three higher order factors (based on the original 12 subscales of the MSWDQ), namely psychological/cognitive barriers, physical barriers, and external barriers. Confirmatory factor analysis modelling demonstrated that the overall goodness of fit of the Dutch version of the MSWDQ-23 was fair. The loadings of the individual items on the three factors were adequate, but the factors were highly correlated. However, a three-factor model showed better adjustment to the data than a one-factor model.

Furthermore, the Dutch version of the MSWDQ-23 showed acceptable construct validity. The MSWDQ-23 and its subscales were moderately-to-highly related to measures of fatigue, cognitive and neuropsychiatric problems, depression and health-related quality of life. We found moderate associations between more work difficulties on the one hand and less work ability and more presenteeism due to MS on the other hand. More perceived physical and psychological/cognitive barriers were additionally associated with a lower number of working hours, although the effect size was small. The score on the external subscale and the total score were not related to working hours. Forty-five of the 48 hypotheses were confirmed (>80%), indicating adequate construct validity. In line with the original study [14] and the Turkish validation [17], the MSWDQ-23 was highly correlated with fatigue. These results emphasise the importance of fatigue in MS in relation to work difficulties. Fatigue has often been reported as a predictor of employment status in persons with MS [6,12].

As expected, persons with MS experienced more work difficulties than healthy controls on all subscales and the total scale. These results suggest that the perceived work difficulties are specific to MS. Perceived work difficulties did not differ for persons with MS of different ages, gender, education levels, or with different job types. The lack of differences between female and male persons with MS is in line with previous research on the MSWDQ-23 [16]; however, we did expect to find differences in age. Although previous research suggests that an older age is related to job loss, we did not find differences in perceived work difficulties between age groups. These findings are most likely a consequence of the skewed distribution of age, with only seven persons with MS in the group over 60 years of age.

To our knowledge, the current study is the only prospective longitudinal study examining the association between perceived work difficulties and employment status after one year. We found that more perceived work difficulties predicted a deteriorated employment status after one year. Especially, the subscale psychological and cognitive barriers predicted a deteriorated employment status after one year. The finding that subjective cognitive and psychological functioning is linked to (future) employment, has been reported in previous research [6,7].

Although the MSWDQ-23 total and subscale cognitive/psychological barriers were predictive of employment status in persons with MS after one year, only a small part of the variance was explained. Employment status in persons with MS is known to be a multifactorial problem. The MSWDQ-23 did not take societal, e.g., employer-related factors into account. Also, protective factors that contribute to a positive work environment (e.g., psychological support or a flexible work schedule) were not included in the questionnaire [14]. Thus, while the findings confirm the validity of the MSWDQ-23, they also confirm that it is challenging to predict future employment status.

Strengths and limitations

A limitation of the current study is the fact that we did not examine test–retest reliability. Participants completed the questionnaires yearly. The current design was therefore not suitable for a test–retest reliability examination. Kahraman et al. [17] pointed out the importance of stability of a measurement in clinical practice. Consequently, they reported a high test–retest reliability for the Turkish translation of the MSWDQ-23 and concluded that the scale may be sensitive to detect changes in work difficulty severity. Additionally, the Spanish translation showed a high test–retest

Table 5. Logistic regression analysis model of deteriorated or stable employment after one year (subscales).

Model 2. MSWDQ-23 including subscales only					
Included	*B*	S.E.	Exp (*B*)	[95% CI Exp (*B*)]	*p* Value
Constant	−3.04	0.43			0.001
Psychological/cognitive	0.42	0.02	1.04	[1.00–1.09]	0.033
Physical	0.40	0.03	1.04	[0.99–1.09]	0.119
External	−0.002	0.01	1.00	[0.97–1.03]	0.897

$\chi^2(3)=21.700$, $p < 0.001$. $R^2=0.101$ (Cox and Snell), $R^2=0.172$ (Nagelkerke).

reliability as well [16]. Thus, yielding promising results for the test–retest reliability of the MSWDQ-23 in general. Also, we did not examine concurrent validity in the current study. Future research might consider using the Multiple Sclerosis Questionnaire for Job Difficulties [43] to examine concurrent validity.

Second, the current sample is diagnosed with relapsing remitting MS, has a relatively low level of physical disability (mean EDSS = 2.2), are all in paid employment, and a have relatively low mean score on the MSWDQ-23 (total score = 17.0, $SD = 12.5$). These characteristics need to be taken into consideration in terms of generalisation.

Finally, we used a confirmatory factor analysis technique in the current study to verify the three-factor model structure. We mentioned both Kline's [41] and Hu and Bentler's [40] recommendations to evaluate the goodness of fit. These recommendations vary across different research fields or even individual researchers, and affect the interpretation of the model fit.

A strength of the current study is the prospective longitudinal design. The MSWDQ-23 has only been validated in cross-sectional studies so far [14,16,17]. The usage of a longitudinal design provides more insight into causal relationships between the MSWDQ-23 and work-related measures over time. Additionally, the large sample size of the present study ($N = 239$) can be considered a strength.

Conclusions

The Dutch MSWDQ-23 is an internally consistent and valid instrument to measure perceived work difficulties in persons with MS. The fit of the current data was fair, but the results suggest that the three subscales are strongly related. The MSWDQ-23 can be considered a useful tool for researchers and (occupational) health care professionals to assess self-reported work difficulties in persons with MS in their current work situation. This might help clinicians to offer their patients individualised feedback and appropriate help in order to support employment maintenance.

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Disclosure statement

EvE, CH, MH, JvdK, MR, EB, KdG, JM, HM: declare no conflicts of interest.

D.A.M. van Gorp: received honoraria for presentations from Sanofi Genzyme.

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Data availability statement

The data that support the findings of this study are available from the corresponding author, E.E.A. van Egmond, upon a reasonable request.

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