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ORIGINAL ARTICLE

Self-employment, sickness absence, and disability pension in multiple sclerosis

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Objectives: Early withdrawal from work is common among people with multiple sclerosis (PwMS). However, little is known about how this is influenced by the type of employment. The aims were to explore the distributions of self-employed and other types of employment (employed or no earnings from work) before and after MS diagnosis and its associations with sickness absence (SA) and disability pension (DP) among PwMS and matched references without MS.

Materials & Method: A 6-year longitudinal cohort study of 2779 individuals diagnosed with MS in 2008–2012 when aged 20–59 and of 13,863 matched individuals without MS from Sweden's population was conducted. Hazard ratios (HR) of >180 SA and/or DP days/year were compared by employment status among PwMS and references using Cox proportional hazard models with 95% confidence intervals (CI).

Results: Most had no SA or DP. Nevertheless, PwMS had higher SA and DP levels compared with references. PwMS had a higher likelihood to reach >180 days of SA (HR = 4.89, 95% CI = 4.43–5.40) or days of DP (HR = 6.31, 95% CI = 5.46–7.30), irrespective of the employment status. Self-employed references had less likelihood for >180 SA days than employed references. However, self-employed and employed PwMS had a similar likelihood for >180 SA days. Transitions of employees to self-employment were infrequent among PwMS (1.7%) and references (2.6%).

Conclusions: PwMS transit to SA and DP to a higher extent than references. In contrast to individuals without MS, self-employed PwMS had similar SA levels to employed PwMS. Switching to self-employment was not a predominant choice for people recently diagnosed with MS.

KEYWORDS
multiple sclerosis, employment, self-employment, sick leave

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1 | INTRODUCTION

Multiple sclerosis (MS) is the most common chronic inflammatory neurodegenerative disease among working-aged people.[1,2] Despite recent medical advances to reduce disease activity, many people with MS (PwMS) experience reduced work capacity.[3] These limitations can affect the individuals' employment and productivity, reducing the possibility to remain employed or work full-time.[4–7]

Participating in paid work has several positive impacts on PwMS.[8,9] Nevertheless, associations between MS and reduced earnings and increased income from sickness absence (SA) and disability pension (DP) benefits are well-established in Sweden and other countries,[2,3,10–14] even prior to their MS diagnosis.[10,15–17] Furthermore, one Dutch two-year survey study found that employees with a chronic disease, such as MS, had a somewhat higher probability of leaving paid work, e.g., through DP or early retirement pension, whereas employees without a chronic disease more often left employment to become self-employed.[18]

In Sweden, all residents have universal access to social security regardless of the type of employment (although specific rules are applied for each case).[19] Among the working-age population in Sweden in 2020, 9.9% were self-employed compared with 75.4% who were employees.[20] These modest rates of self-employment could be associated with the risks of volatile workload and income flows or possible loss of income when unable to work.[21] However, flexible work hours and relative decisional autonomy may influence one's choice to be self-employed.[21,22] In this regard, lower incidence and shorter extent of absence from work have been reported among self-employed when compared with employed.[23] Altogether, one could postulate that PwMS may consider transitioning to self-employment after their MS diagnosis to facilitate the necessary work environment adjustments for them to remain in work.[24,25]

The impact MS has on work capacity and how to prolong job retainment has been of growing interest, especially as heterogeneity characterizes the course of MS and working life. However, to the best of our knowledge, no previous study has investigated the occurrences of SA and/or DP among self-employed PwMS or have the transitions to or from self-employment to other types of employment following the diagnosis of MS been explored. The aim of this study was to explore the proportions of self-employed and other types of employment (employed or no earnings) before and after MS diagnosis. A further aim was to investigate how the different types of employment are associated with SA and DP among newly diagnosed PwMS and in comparison with matched references without MS.

2 | METHOD

A 6-year longitudinal population-based cohort study of individuals of working ages with and without MS in Sweden was conducted.

2.1 | Data sources

Pseudo-anonymized microdata from six nationwide Swedish registers, linked by unique personal identity numbers, were used. The Swedish MS Registry (SMSReg)[26] was used to identify individuals with MS, diagnosed by a neurologist using the current McDonald criteria.[27–29] The Longitudinal Integration Database for Health Insurance and Labor Market Studies (LISA)[30] held by Statistics Sweden was used to obtain information on socio-demographic variables as well as for the selection of the individuals for the reference group. Data on annual SA and DP days were obtained from the Micro-Data for Analysis of the Social Insurance (MiDAS), held by the Swedish Social Insurance Agency.[31] Year of death was obtained from the Cause of Death Register,[32] held by the National Board of Health and Welfare. Moreover, comorbidity was assessed by constructing a modified Comorbidity Index[33,34] with data from the Swedish Prescribed Drug Register (SPDR)[35] and the Swedish Cancer Register[36] (both held by the National Board of Health and Welfare). MS disease-modifying therapies were excluded from the index.[37]

All of those who, according to the SMSreg, were diagnosed with MS in the years 2008–2012 when aged 20–59 years (upper limit to assure working age during follow-up) were included in the cohort of PwMS. Five individuals without MS from the general population of Sweden were matched to each individual in the PwMS cohort by sex, age, type of living area, and county of residence. A relative annual time scale was created for a 6-year period, with Y_0 representing the diagnosis or cohort entry year and each year of observation (Y_{-1}–Y_{+4}) corresponding to their respective calendar years. Accordingly, if diagnosed with MS in 2008 (Y_0), the follow-up would end in 2012 (Y_{+4}), and, if diagnosed in 2012 (Y_0), the follow-up would end in 2016 (Y_{+4}). Baseline characteristics were obtained from data from December the year before MS diagnosis ($Y_{-1,}$ i.e., 2007–2011). The exclusion was applied if they died in Y_0 or were not living in Sweden in Y_{-1} nor Y_0 (n = 26 and 140, respectively; see Figure S1). From the remaining 17,342 individuals, those already on full-time DP (≥75%) during Y_0 were excluded (n = 700). Therefore, the final cohort included 16,642 individuals (PwMS = 2779; references = 13,863) who were followed until the year of death (n = 67), year of emigration (n = 254), or until the end of follow-up (Y_{+4}). In total, 98.1% of the individuals (PwMS = 99.2%; references = 97.8%) remained at Y_{+4}.

2.2 | Sickness absence and disability pension measures

All residents in Sweden aged above 15 years with income from work, unemployment or parental-leave benefits, or student allowances can obtain sickness absence (SA) and disability pension (DP) benefits if having reduced work capacity due to disease or injury.[31] After an initial uncompensated ('waiting') day, the employer pays for the next 13 days of a SA spell. From day 15, the Social Insurance Agency pays benefits (from day 2 for the unemployed). Self-employed, however, can actively choose their waiting period

(usually 7 days).[31] In this study, we used information on SA-spells ≥15 days. All people aged 19–64 can be granted DP if morbidity reduces their work capacity or if they need more time to complete elementary or secondary school (when aged 19–29). SA benefits amount to 80% and DP to 65% of the lost income, up to a certain limit. Both SA and DP can be granted either full-time (100%) or part-time (25%, 50%, or 75%) of ordinary work hours[31]; thus, part-time SA and DP can be granted simultaneously. Therefore, net days of SA and DP were calculated (i.e., 2 days of 50% SA or DP equals 1 net day of SA/DP).[31] Net days are hereafter referred to as 'days.' Moreover, an extensive variety of measures of SA and DP or other work participation outcomes exist in the literature.[38,39] In this study, we used the total number of days, mean and median of SA or DP days, and the proportion (%) of people with different amounts of SA or DP days at Y_{-1}. Additionally, for every calendar year, we calculated the total amount of SA or DP days (with a threshold of 180 days), as well as the proportion of people reaching over this threshold, respectively.

Individual's status regarding the type of employment and earnings (hereafter referred to as 'employment status'), based on information from LISA, was categorized into employed, self-employed, or no earnings (no earnings from work). No earnings were defined as no income from work or when the income was below the minimum threshold qualifying for SA benefits,[40,41] approximately 1000 Euros/year (average threshold in 2008–2012). Those classified as having no earnings would represent a heterogenous group and could include students, people on long-term parental leave, homemakers, traveling, or unemployed. The rationale for including the category of those with no earnings was to investigate how large that group was and if transitions towards "active" employment occurred after the diagnosis of MS. Moreover, occupations were categorized into the following groups based on a previous study: (1) managers, (2) office work, (3) manual labor, (4) workplace not classified and, (5) not in paid work.[10]

2.3 | Statistical analysis

Descriptive statistics were used to describe the socio-demographic, clinical, and socioeconomic factors at baseline (Y_{-1}) in total and by employment status for each cohort. Comparisons between cohorts and by the type of employment were performed using parametric statistics (T-tests) or non-parametric statistics (Mann–Whitney U test for continuous variables with skewed distributions or Chi-square tests for categorical variables and proportions). All multiple comparisons were adjusted with Bonferroni correction.

The employment status at Y_{-1} was compared with the employment status at end of follow-up (Y_{+4}) using contingency tables to explore transitions in employment status. As a complementary analysis to attempt to disentangle our exploratory results, a prediction of the number of transitions during the study period (Y_{-1} to Y_{+4}) was conducted using a Poisson regression model, adjusting for socio-demographic, clinical variables, and employment status at Y_{-1}.

Survival analyses were conducted to investigate differences in the timing of accumulating >180 SA and/or DP days within a given year among PwMS and references and by their corresponding employment status categories. Baseline characteristics were introduced as covariates and were tested for the models' assumptions. Results were presented as hazard ratios (HR) and 95% confidence intervals (CI). For all analyses, results were deemed significant when $p < .05$. Statistical analyses were performed using SPSS 27.[42]

The project was approved by the Regional Ethical Review Board in Stockholm, Sweden.

3 | RESULTS

Baseline socio-demographic and clinical characteristics of PwMS ($n = 2779$) and references ($n = 13{,}863$), in total and by employment status, are presented in Table 1. Distributions of variables matched by design (age, sex, and residential area) and marital or cohabitant status ($p > .05$) between the PwMS and references were similar. However, a slightly larger proportion of PwMS was born in Sweden, had a higher educational level, office-based occupations, comorbidities, and fewer were living with children, compared with references. Distributions of employment status among PwMS and references were equivalent ($p = .801$). Regarding baseline characteristics, similar proportions were found for both employed and self-employed PwMS. However, self-employed were on average older than the employed among both PwMS and references, whereas those with no earnings were on average younger than both the employed and self-employed. Of the PwMS with no earnings, larger proportions were born in Sweden and had comorbidities compared with references with no earnings, whereas smaller proportions were married/cohabitants.

The distribution of SA and DP days between all PwMS and references and by employment status at baseline are presented in Table 2. The mean annual SA days and the proportion of people having different numbers of SA days were significantly higher among PwMS compared with references, both in total ($p < .001$), and by employment status ($p < .05$). However, it is important to note that the vast majority of the PwMS (80.1%) had no SA at all at baseline and that the median days of SA as well as DP for the PwMS cohort as a whole and by employment status were equal to zero.

To investigate the differences concerning SA and DP between PwMS and references, we initially compared the survival time to reach >180 SA or DP days/year, using Cox regression (Table 3). Baseline characteristics were also introduced to either control for confounding or to assess their predictive value in the model (mutually adjusted). Overall, PwMS were four to six times more likely to reach >180 SA or DP days than the references, respectively (Table 3 and Figure 1). Survival time to SA and DP showed a similar pattern. Namely, a higher probability of reaching >180 SA or DP days among PwMS was observed for women, for older people (when compared with the youngest group), for those with a lower educational level, and for those with a higher number of

TABLE 1 Baseline (Y_{-1}) sociodemographic and clinical descriptives of the people with multiple sclerosis (PwMS) and the reference cohort; all and by type of employment (employed, self-employed, and no earnings) in Y_{-1}

	People with MS				References			
	All	Employed	Self-employed	No earnings	All	Employed	Self-employed	No earnings
Total cohort, *N* (%)	2779 (16.7)	2325 (83.7)	129 (4.6)	325 (11.7)	13,863 (83.3)	11,266 (81.3)	673 (4.9)	1924 (13.9)
Sex								
Women	1934 (69.6)	1634 (70.3)	71 (55)	229 (70.5)	9621 (69.4)	7930 (70.4)	310 (46.1)	1381 (71.8)
Men	845 (30.4)	691 (29.7)	58 (45)	96 (29.5)	4242 (30.6)	3336 (29.6)	363 (52.9)	543 (28.2)
Age categories[d]								
20–24 years	313 (11.3)	244 (10.5)	3 (2.3)	66 (20.3)	1550 (11.2)	1181 (10.5)	22 (3.3)	347 (18)
25–29 years	439 (15.8)	375 (16.1)	14 (10.9)	50 (15.4)	2183 (15.7)	1692 (15.0)	57 (8.5)	434 (22.6)
30–34 years	459 (16.5)	365 (15.7)	13 (10.1)	81 (24.9)	2240 (16.2)	1807 (16.0)	87 (12.9)	346 (18.8)
35–39 years	451 (16.2)	384 (16.5)	27 (20.9)	40 (12.3)	2238 (16.1)	1842 (16.4)	122 (18.1)	274 (14.2)
40–44 years	409 (14.7)	354 (15.2)	24 (18.6)	31 (9.5)	2039 (14.7)	1711 (15.2)	133 (19.8)	195 (10.1)
45–49 years	327 (11.8)	280 (12.0)	18 (14.0)	29 (8.9)	1650 (11.9)	1377 (12.2)	126 (18.7)	147 (7.6)
50–54 years	233 (8.4)	203 (8.7)	17 (13.2)	13 (4.0)	1200 (8.7)	998 (8.9)	86 (12.8)	116 (6.0)
55–59 years	148 (5.3)	120 (5.2)	13 (10.1)	15 (4.6)	763 (5.5)	658 (5.8)	40 (5.9)	65 (3.4)
Age (years), M±SD	37.2 ± 10.1	37.36 ± 10.0	41.2 ± 9.5	33.9 ± 9.9	37.3 ± 10.1	37.6 ± 10.1	41.1 ± 8.9	33.9 ± 9.9
Education level[a]								
Elementary school or high school	1563 (56.2)	1266 (54.5)	83 (64.3)	214 (65.8)	8089 (58.3)	6285 (55.8)	473 (70.3)	1331 (69.2)
College/university	1216 (43.8)	1059 (45.5)	46 (35.7)	111 (34.2)	5774 (41.7)	4981 (44.2)	200 (29.7)	593 (30.8)
Born in Sweden[a,b,c,d]								
Yes	2458 (88.4)	2107 (90.6)	123 (95.3)	228 (70.2)	11,285 (81.4)	9703 (86.1)	565 (84.0)	1017 (52.9)
No	321 (11.6)	218 (9.4)	6 (4.7)	97 (29.8)	2578 (18.6)	1563 (13.9)	108 (16.0)	907 (47.1)
Marital or cohabitant status[d]								
Married or cohabitant	1041 (37.5)	870 (37.4)	68 (52.7)	103 (31.7)	5466 (39.4)	4375 (38.8)	340 (50.5)	751 (39.0)
Single	1738 (62.5)	1455 (62.6)	61 (47.3)	222 (68.3)	8397 (60.0)	6891 (61.2)	333 (49.5)	1173 (61.0)
Children (<18 years living at home)[a,b,c]								
Yes	1208 (43.4)	1018 (43.8)	58 (45.0)	132 (40.6)	6576 (47.5)	5333 (47.3)	395 (58.7)	848 (44.1)
No	1571 (56.5)	1307 (56.2)	71 (55.0)	193 (59.4)	7287 (52.5)	5933 (52.7)	278 (41.3)	1076 (55.9)
Type of living area								
Big cities	1126 (40.5)	931 (40.0)	62 (48.1)	133 (40.9)	5596 (40.4)	4438 (39.4)	286 (42.5)	872 (45.3)
Medium towns	917 (33.0)	780 (33.5)	30 (23.3)	107 (32.9)	4531 (32.7)	3753 (33.3)	201 (29.9)	577 (30.0)
Rural areas	736 (26.5)	614 (26.4)	37 (28.7)	85 (26.2)	3736 (26.9)	3075 (27.3)	186 (27.6)	475 (24.7)
Occupation[a,b,c]								
Managers	104 (3.7)	83 (3.6)	18 (14)	3 (0.9)	542 (3.9)	466 (4.1)	68 (10.1)	8 (0.4)
Office	1153 (41.5)	1096 (47.1)	43 (33.3)	14 (4.3)	5194 (37.5)	4925 (43.7)	184 (27.3)	85 (4.4)
Manual	1139 (41.0)	1051 (45.2)	50 (38.8)	38 (11.7)	5848 (42.2)	5376 (47.7)	288 (42.8)	184 (9.6)
Not classified	143 (5.1)	95 (4.1)	18 (14.0)	30 (9.2)	792 (5.7)	499 (4.4)	133 (19.8)	160 (8.3)
Not in paid work	240 (8.6)	0 (0)	0 (0)	240 (73.8)	1487 (10.7)	0 (0)	0 (0)	1487 (77.3)

TABLE 1 (Continued)

	People with MS				References			
	All	Employed	Self-employed	No earnings	All	Employed	Self-employed	No earnings
Comorbidity index[a,b,c,d]								
0	6888 (24.8)	570 (24.5)	36 (28.9)	82 (25.2)	4648 (33.5)	3583 (31.8)	273 (40.6)	792 (41.2)
1–2 categories	1494 (53.8)	1272 (54.7)	63 (48.8)	159 (48.9)	6959 (50.2)	5853 (52)	315 (46.8)	791 (41.1)
3–4 categories	429 (15.4)	352 (15.1)	22 (17.1)	55 (16.9)	1746 (12.6)	1442 (12.8)	66 (9.8)	238 (12.4)
5+ categories	168 (6.0)	131 (5.6)	8 (6.2)	29 (8.9)	510 (3.7)	388 (3.4)	19 (2.8)	103 (5.4)

Note: The variable "County" used for matching cohorts in the study design is not presented. However, no differences were observed between PwMS and references, in total ("All") nor by employment status. All results correspond to frequency (N) and percentage (%) except for age as a continuous variable, where Mean (M) and standard deviation (±SD) are presented. Distributions of type of employment within each cohort (PwMS and references) are displayed horizontally in the first row. The distribution of the rest of the variables are to be read within each corresponding column.

[a]Differences between all PwMS and all reference groups ($p < .05$).

[b]Differences between employed PwMS and employed references ($p < .05$).

[c]Differences between self-employed PwMS and self-employed references ($p < .05$).

[d]Differences between no earning PwMS and no earning references ($p < .05$).

TABLE 2 Baseline (Y_{-1}) distributions of sickness absence (SA) and disability pension (DP) of people with multiple sclerosis (PwMS) and reference cohorts and type of employment

	PwMS				References			
	All	Employed	Self-employed	No earnings	All	Employed	Self-employed	No earnings
N (%)	2779 (16.7)	2325 (83.7)	129 (4.6)	325 (11.7)	13,863 (83.3)	11,266 (81.3)	673 (4.9)	1924 (13.9)
Annual SA net days[a,b]								
Mean (SD)	18.0 (56.7)	15.9 (48.7)	19.1 (56.7)	32.9 (95.1)	7.8 (37.4)	6.9 (31.1)	3.9 (19.2)	14.6 (65.2)
Median	0	0	0	0	0	0	0	0
Proportions of SA[a,b]								
No SA	80.1%	79.4%	80.6%	85.2%	90.6%	90.0%	93.6%	93.5%
<90 days	13.7%	15.1%	11.6%	4.0%	6.7%	7.7%	4.9%	1.7%
90–180 days	3.1%	3.2%	4.7%	1.8%	1.3%	1.4%	1.2%	0.9%
>180 days	3.1%	2.3%	3.2%	9.0%	1.3%	1.0%	0.3%	3.9%
Annual DP net days								
Mean (SD)	4.7 (31.7)	3.8 (26.1)	2.6 (24.6)	11.5 (58.4)	4.1 (29.8)	3.1 (23.3)	2.7 (22.3)	10.9 (54.6)
Median	0	0	0	0	0	0	0	0
Proportions of DP								
No DP	97.3%	97.5%	98.4%	95.7%	97.7%	98.0%	98.4%	95.4%
<90 days	0.2%	0.2%	0.8%	0%	0.2%	0.2%	0.1%	0.5%
90–180 days	0.8%	0.8%	0%	0.6%	0.6%	0.7%	0.3%	0.4%
>180 days	1.7%	1.4%	0.8%	3.7%	1.5%	1.1%	1.2%	3.7%

Note: Proportions of type of employment within each cohort: PwMS and references are displayed horizontally in the first row. The distribution of the rest of the variables are to be read within each corresponding column. Abbreviations: DP, disability pension; N, sample size; PwMS, people with multiple sclerosis; SA, sickness absence; SD, standard deviation.

[a]Differences between all PwMS and all reference groups ($p \leq .001$).

[b]Differences between each PwMS and reference employment status category ($p < .05$).

comorbidities. In addition, a higher probability to reach DP was shown for those living in medium-sized towns or rural areas, compared to big cities. Finally, numbers of SA or DP days in Y_{-1} were included in their respective SA or DP survival models to control for previous SA or DP, showing a positive association with reaching >180 SA or DP days.

TABLE 3 Cox proportional hazards regressions (HR) with 95% confidence intervals (CI) for associations between first ever reaching more than 180 days of annual SA or DP and type of employment

		>180 SA net days		>180 DP net days	
		Groups	Employment status	Groups	Employment status
	N	HR (95% CI)	HR (95% CI)	HR (95% CI)	HR (95% CI)
Unadjusted models					
Groups					
PwMS	2779	**4.89 (4.43–5.40)**		**6.31 (5.46–7.30)**	
References	13,863	1		1	
Type of employment					
Non-MS employed	11,266		1		1
Non-MS self-employed	673		**0.48 (0.20–0.76)**		0.81 (0.41–1.58)
Non-MS no earnings	1924		**1.54 (1.30–1.83)**		**4.65 (3.70–5.78)**
MS employed	2325		**5.08 (4.55–5.67)**		**7.92 (6.59–9.51)**
MS self-employed	129		**5.38 (3.85–7.52)**		**10.47 (6.73–16.29)**
MS no earnings	325		**5.20 (4.15–6.52)**		**18.41 (14.29–23.70)**
Mutually adjusted models					
Group					
PwMS	2779	**3.94 (3.56–4.37)**		**6.11 (5.26–7.10)**	
References	13,863	1		1	
Type of employment					
Non-MS employed	11,266		1		1
Non-MS self-employed	673		**0.49 (0.31–0.78)**		0.79 (0.40–1.54)
Non-MS no/low income	1924		1.13 (0.94–1.37)		**2.78 (2.15–3.59)**
MS employed	2325		**4.27 (3.81–4.77)**		**7.64 (6.35–9.19)**
MS self-employed	129		**3.83 (2.73–5.38)**		**6.84 (4.36–10.74)**
MS no earnings	325		**2.41 (1.89–3.07)**		**10.06 (7.51–13.47)**
Sex					
Women	11,555	**1.19 (1.05–1.34)**	**1.17 (1.04–1.32)**	1.12 (0.94–1.33)	1.09 (0.92–1.30)
Men	5087	1	1	1	1
Age categories					
20–24 years	1863	1	1	1	1
25–29 years	2622	**1.51 (1.15–1.98)**	**1.50 (1.14–1.97)**	0.64 (0.41–0.99)	0.67 (0.43–1.04)
30–34 years	2699	**1.80 (1.38–2.34)**	**1.82 (1.40–2.38)**	1.00 (0.66–1.52)	1.03 (0.68–1.56)
35–39 years	2689	**1.99 (1.53–2.60)**	**2.00 (1.53–2.61)**	1.29 (0.87–1.92)	1.40 (0.93–2.08)
40–44 years	2448	**2.24 (1.72–2.91)**	**2.22 (1.71–2.89)**	**1.96 (1.35–2.83)**	**2.18 (1.51–3.16)**
45–49 years	1977	**2.16 (1.66–2.82)**	**2.16 (1.65–2.82)**	**1.96 (1.35–2.85)**	**2.22 (1.53–3.23)**
50–54 years	1433	**2.19 (1.66–2.88)**	**2.17 (1.65–2.86)**	**2.86 (1.97–4.13)**	**3.16 (2.18–4.58)**
55–59 years	911	**2.24 (1.67–2.99)**	**2.20 (1.64–2.94)**	**3.41 (2.32–5.02)**	**3.96 (2.68–5.85)**
Education level					
Elementary or high school	9652	**1.49 (1.33–1.66)**	**1.51 (1.36–1.69)**	**1.78 (1.49–2.12)**	**1.71 (1.43–2.05)**
College/university	6990	1	1	1	1
Born in Sweden					
No	2899	**1.22 (1.06–1.40)**	**1.22 (1.05–1.41)**	0.89 (0.71–1.10)	**0.74 (0.60–0.93)**
Yes	13,743	1	1	1	1
Marital or cohabitant status					
Married or cohabitant	10,135	1.00 (0.90–1.12)	1.016 (0.91–1.13)	0.970 (0.83–1.14)	0.985 (0.84–1.16)

TABLE 3 (Continued)

		>180 SA net days		>180 DP net days	
		Groups	Employment status	Groups	Employment status
	N	HR (95% CI)	HR (95% CI)	HR (95% CI)	HR (95% CI)
Single	6507	1	1	1	1
Children (<18 years)					
Yes	8858	1.06 (0.93–1.19)	1.048 (0.93–1.18)	0.897 (0.75–1.07	0.886 (0.74–1.06)
No	7784	1	1	1	1
Type of living area					
Big cities	6722	1	1	1	1
Medium towns	5448	1.12 (0.99–1.27)	**1.13 (1.01–1.28)**	**1.34 (1.11–1.61)**	**1.31 (1.10–1.58)**
Rural areas	4472	1.05 (0.92–1.19)	1.06 (0.93–1.20)	**1.51 (1.25–1.82)**	**1.55 (1.28–1.87)**
Comorbidity index					
0	5336	1	1	1	1
1–2	8453	**1.46 (1.26–1.70)**	**1.45 (1.25–1.69)**	**1.42 (1.12–1.80)**	**1.46 (1.15–1.85)**
3–4	2175	**2.28 (1.93–2.70)**	**2.27 (1.92–2.69)**	**2.83 (2.21–3.64)**	**2.81 (2.19–3.61)**
5+	678	**2.57 (2.10–3.14)**	**2.55 (2.09–3.12)**	**2.73 (2.04–3.65)**	**2.93 (2.20–3.92)**
SA or DP net days in Y_{-1}	16,642	**1.02 (1.01–1.02)**	**1.02 (1.01–1.02)**	**1.02 (1.02–1.02)**	**1.02 (1.02–1.02)**

Note: The inclusion of matching variables (age, gender, and type of living area) in the group comparison models is justified by the need for control for their confounding effect, moreover, exclusion criteria were applied after exact matching. All attributes introduced in the models correspond to Y_{-1}. To note, comorbidity index resulted in a time-dependent variable in all mutually adjusted models except for when comparing >180 SA net days among groups. The reference category for each categorical variable is indicated as 1. Bold numbers indicate a $p < .05$, two-sided test. Abbreviations: CI, confidence interval; DP, disability pension; HR, hazard ratio; N, sample size; PwMS, people with multiple sclerosis; SA, sickness absence.

Thereafter, survival functions were applied to having >180 annual days of SA or DP for all employment status categories (employed, self-employed, and no earnings) among PwMS and references. When compared with employed references, all three employment status categories of PwMS were significantly more likely to reach either >180 SA or DP days within a given year (Table 3; Figures 2A,B, respectively). Covariates in the model indicated a higher probability of reaching >180 SA and DP days if being older, having lower educational level, living in medium-sized town or rural areas, having more comorbidities, and prior SA or DP days, respectively, in Y_{-1}. Contrarily to SA, individuals born outside of Sweden were less likely to reach >180 DP days (Table 3). The self-employed and employed PwMS had a similar probability to reach >180 SA and DP days, respectively, whereas self-employed references were less likely to reach >180 SA days when compared with their employed peers (Figure 2A). The no earnings group with MS was less likely to reach SA (HR = 0.78; 95% CI [0.61, 0.99]) but more likely to reach DP levels of >180 days earlier (HR = 2.33; 95% CI [1.18, 3.05]) than the employed PwMS.

Transition rates of employment status one year before and 4 years after diagnosis year (Y_{-1} vs. Y_{+4}) were calculated for all individuals with follow-up to Y_{+4} (Table 4). Overall, employment status distributions indicated that PwMS had a twofold transition rate from working status (employed or self-employed) to no earnings when compared with references. The complementary analysis confirmed that working PwMS who transited to no earnings 6 years after Y_{-1}, had significant higher proportions of DP (both employed and self-employed) and SA days in Y_{+4} (employed) when compared to the references with similar transitions (see Figure S2 in the Supplementary Material).

For the rest of possible transitions (either the same employment status in Y_{-1} and Y_{+4} or transitions from one employment status in Y_{-1} to a different one in Y_{+4}), similar distributions were found among PwMS and references. Furthermore, transition rates from employed to self-employed or from no earning to self-employed were low among both PwMS and references.

To investigate whether these results were associated with on the number of transitions of employment status between Y_{-1} and Y_{+4}, we performed several sensitivity analyses. These analyses confirmed that overall, a high proportion of PwMS (70.9%) and of references (76.9%) remained in the same employment status throughout the 6-year study period (Y_{-1} to Y_{+4}). This absence of transition between employment statuses was more evident among the employed PwMS (76.5%) and the employed references (84.7%). Nevertheless, PwMS had in general significantly more transitions compared with references ($\chi 2 = 44{,}415$; $p < .001$). Similar results were found when excluding individuals granted full-time DP (≥75%) during the follow-up years. We further confirmed this by using Poisson regression and adjusting for socio-demographic variables and employment status at Y_{-1} (see Table S1).

Finally, we investigated the distribution of SA and DP benefits during the whole 6-year study period (Y_{-1} through Y_{+4}). Results

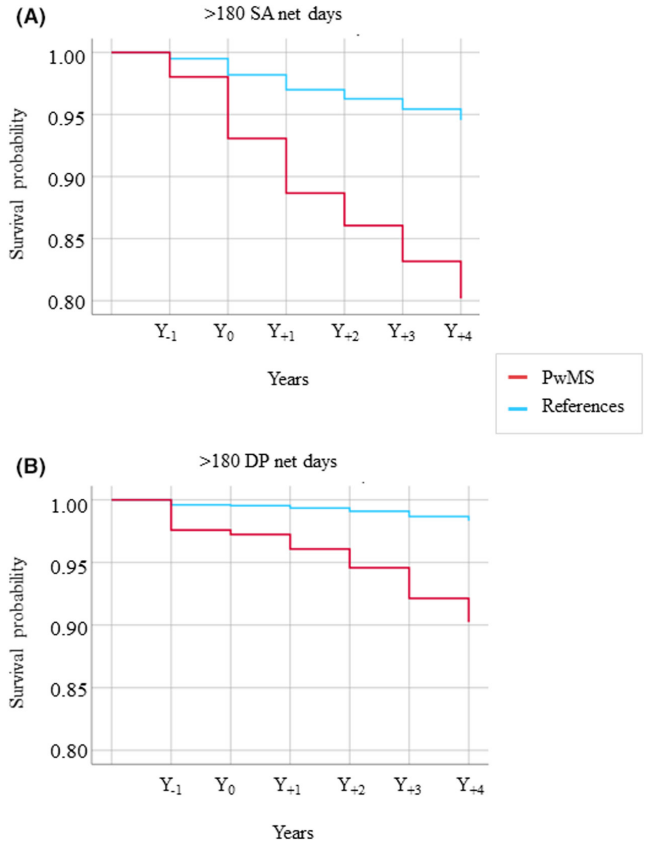

FIGURE 1 (A, B) Survival probability plots to reach >180 net days/year of SA (A) or DP (B) among PwMS (red) and references (blue). Timeline corresponds to the 6-year study period (Y_{-1} to Y_{+4}), where Y_0 represents diagnosis year or cohort entry

indicated that all employment status categories of PwMS presented two to three times higher proportions with SA benefits than their corresponding reference groups (Figure S3), despite remaining in the same employment status throughout the study period. These differences were even larger for DP benefits.

4 | DISCUSSION

In this longitudinal cohort study, we explored the associations between employment status (employed, self-employed, no earnings) and SA and DP among newly diagnosed PwMS and among matched references without MS over a 6-year period. The distribution of employment status at baseline was equivalent among PwMS and references. PwMS had overall higher proportions of SA and DP net days in all three employment status groups, when compared with references. Importantly, self-employed PwMS did not differ from employed PwMS regarding having >180 SA days after MS diagnosis. Conversely, among the references, there were significantly less self-employed with >180 SA days than employed. Moreover, PwMS had more employment status transitions than references before and shortly after their MS diagnosis, with most transitions occurring from working to non-working status.

Early withdrawal from the workforce due to MS limitations is common as the disease progresses over time.[1,6,16] Reduced work capacity due to MS can affect the productivity and employment status of PwMS.[4,5] Depending on the country's welfare system arrangements, PwMS with reduced work capacity may receive social benefits, such as SA or DP benefits. Overall, a higher proportion of PwMS has SA/DP benefits than in the general population, and this increases, as MS progresses, in line with previous Swedish and other Nordic studies.[2,3,10–17]

Concerning the employment status and SA/DP benefits, we observed that PwMS, irrespective of being employed, self-employed, or having no earnings, were also more likely to reach >180 SA or DP days close in time to their diagnosis when compared with references. Our results of lower probability for SA among self-employed references than among employed were consistent with previous findings.[25] Nevertheless, we did not find this among the self-employed PwMS in Sweden, who had a similar probability of reaching >180 SA days as the employed PwMS. This finding of earlier >180 days than reference peers is indicative of the consequences of MS disease and the challenges of remaining in the workforce across the clinical course. However, and most importantly, it also emphasizes that in Sweden, in comparison to many other welfare systems, self-employed also have equitable access to SA/DP benefits, and that this access and uptake extends to self-employed PwMS. Further, the PwMS with no earnings had a lower probability to reach >180 SA days but not DP when compared to the employed PwMS. These lower levels of SA potentially reflect the income requirements to access SA benefits and the absence of them for DP benefits.

Furthermore, employment status transitions before and shortly after the MS diagnosis were more likely to occur among PwMS than among references, even when accounting only for individuals remaining in the workforce (i.e., with no full-time DP). Transitions occurred particularly between working status (employed or self-employed) to non-working status (no earnings), probably corresponding with withdrawal from the workforce into SA and/or DP, as inferred from our complementary analysis. These transitions to SA or DP could also imply temporary or permanent work incapacity associated with MS disabilities,[2,43] as fatigue and relapse rates are known to be related to SA peaks around MS diagnosis.[7] Whereas, the high percentages of transitions between no earnings to employed before and 4 years after diagnosis year (Y_{-1} vs. Y_{+4}) in both groups might be capturing a higher percentage of students or younger adults entering the workforce or individuals on parental leave returning to work. Further research is needed to explore the effects of having newly diagnosed MS when entering the labor market.

Moreover, employed or self-employed PwMS who remained in the same employment status also showed a higher number of SA and DP days during the whole study period compared with their respective references. This finding might be partly explained by the fact that many PwMS work part-time,[1,6] particularly in Sweden, where part-time SA and DP benefits can be granted.[10] In this context, transitioning to self-employment could be another choice of remaining in paid work whilst adjusting for MS limitations.[21,22] Although, we initially

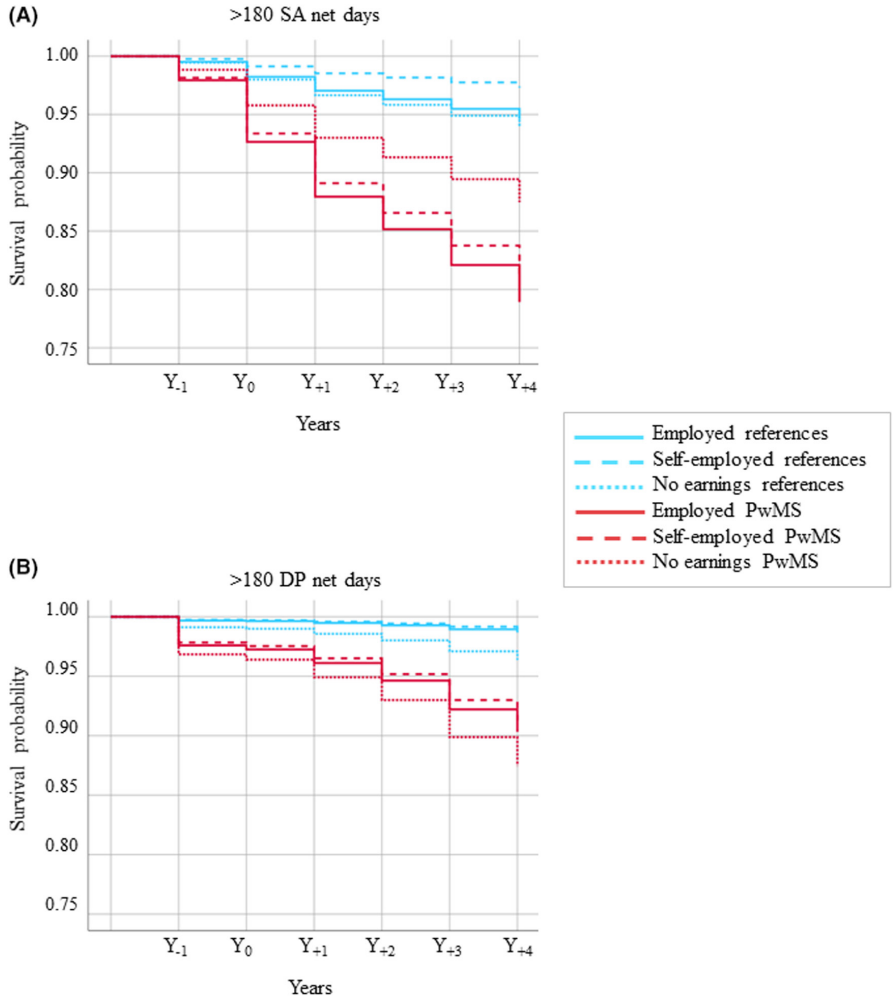

FIGURE 2 (A, B) Survival probability plots to reach >180 net days/year of SA (A) or DP (B) by employment status of each cohort, PwMS in red and references in blue. Timeline corresponds to the 6-year study period (Y_{-1} to Y_{+4}), where Y_0 represents diagnosis year or cohort entry

TABLE 4 Contingency table of the transitions of employment statuses from the year before the diagnosis to the fourth year after the diagnosis year (Y_{-1} vs. Y_{+4})

	People with MS			References		
Y_{-1} Y_4	Employed	Self-employed	No earnings	Employed	Self-employed	No earnings
Employed to	84.6%	1.7%	13.7%	91.9%	2.6%	5.6%
Self-employed to	33.3%	56.6%	10.1%	30.7%	64.2%	5.1%
No earnings to	41.1%	3.4%	55.5%	49.8%	3.4%	46.8%

Note: the descriptive percentages above represent the overall "picture" of employment status before diagnosis year (Y_{-1}) versus 4 years after diagnosis (Y_{+4}). Thus, censored participants due to migration or death are not included. This distribution does not consider the possible number of transitions between Y_{-1} and Y_{+4}.

hypothesized a greater transition among PwMS from employment to self-employment, our findings did not support this. Transitions from employed to self-employed among PwMS were scarce and did not differ from references. It is conceivable that such transitions might occur later as MS disease progresses, and that our follow-up period thus did not capture these changes. Another explanation could be that more experience or resources are needed for this transition, as implied from a higher mean age of our self-employed compared with the other employment statuses. Furthermore, fluctuating MS symptoms may make self-employment difficult to manage. Adverse health effects from long working hours, time, economical pressure, and the type of work or occupation, may also discourage this transition.[21,22] Moreover, the employers' obligations to facilitate adjustments for their employees could be another potential reason to remain employed or why PwMS might display less labor market mobility because of already having a secure employment. Altogether, this could hypothetically explain why the large majority of employed PwMS remained employed as opposed to self-employed in Sweden. However, this was also the case for the vast majority of employed references and could thus imply that many other factors are involved. Although

reasons for employment status transitions were beyond the scope of this study, these findings suggest that future studies are needed to further understand transitions to or from self-employment following an MS diagnosis, as well as possible consequences of such transitions.

The strength of this study lies in the longitudinal cohort design using high-quality register data covering several years,[44–47] that all the residents in a country fulfilling the inclusion criteria, and not only a sample, were included, and that the cohort was large enough to allow for sub-group analyses. In addition, several SA and DP measures were used as a proxy for reduced work capacity and thus reinforcing our findings of higher SA and DP levels for every type of employment among PwMS when compared to their reference peers. Further strengths are that there were no drop-outs, that administrative data were used rather than possibly biased self-reports, and that net days could be used.

Nevertheless, some limitations should also be considered. First, in the analysis of survival curves, the only outcome was when first having reached >180 days of SA or DP days/year. Of course, other such thresholds could have been used (e.g., 90 days of 365 days), possibly giving other results. Future studies could explore this. Second, short SA spells (≤14 days) were not included, yet the uncertainty of small disruptions could also be relevant for work choices. Third, survival functions to >180 SA or DP were explored assuming individuals held the same employment status during the follow-up. However, this assumption was held for a short follow-up period and was the case for both PwMS and references. To overcome this, complementary analyses of SA and DP levels considering employment status transitions before and after MS diagnosis and when remaining in the same employment status throughout the 6-year study period (i.e., no transitions) were conducted. In both scenarios, our findings indicated that PwMS had higher levels of SA and DP when compared to their peer references. This was also found after selecting only individuals who remained in the workforce (i.e., no full-time DP) 4 years after MS diagnosis. Fourth, several other factors might be of importance when studying the transitions and other outcomes, for example, other lifestyle and clinical aspects, e.g., the Expanded Disability Status Scale (EDSS). Finally, the choice of our reference group (with all other possible types of morbidity except diagnosed MS) instead of another chronic disease group is motivated by the sole need of interpreting the consequences of having MS per se when employed or self-employed, information that to the best of our knowledge, is still unexplored.

5 | CONCLUSIONS

We conclude that although PwMS more often transit between employment statuses compared with their non-MS references, this does not influence their risk of long-term SA and DP. The higher risk for SA and/or DP around time of MS diagnosis among PwMS compared to references was irrespective the type of employment. Nevertheless, the absolute majority of newly diagnosed PwMS had no SA or DP. Moreover, transitioning to self-employment was not a predominant choice for people recently diagnosed with MS. The findings of this study also indicate the need for further research related to the diverse employment situations among newly diagnosed PwMS and the need to explore and provide further work options (e.g., job transitions, work adaptations, etc.).

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CONFLICT OF INTEREST

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DATA AVAILABILITY STATEMENT

The data cannot be made publicly available due to privacy regulations. According to the General Data Protection Regulation, the Swedish Data Protection Act, the Swedish Ethical Review Act, and the Swedish Public Access to Information and Secrecy Act, data can only be made available for specific purposes, including research that meets the criteria for access to this type of sensitive and confidential data as determined by a legal review. Readers may contact Professor Kristina Alexanderson (kristina.alexanderson@ki.se) regarding the data.

PEER REVIEW

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REFERENCES

1. Brundin L, Kobelt G, Berg J, Capsa D, Eriksson J. New insights into the burden and costs of multiple sclerosis in Europe: results for Sweden. *Mult Scler J*. 2017;*23*(2_suppl):179-191. doi:10.1177/1352458517708682
2. Hilt Pfleger CC, Meulengracht Flachs E, Koch-Henriksen N. Social consequences of multiple sclerosis (1): early pension and temporary unemployment-a historical prospective cohort study. *Mult Scler*. 2010;*16*(1):121-126. doi:10.1177/1352458509352196

3. Tinghög P, Hillert J, Kjeldgård L, Wiberg M, Glaser A, Alexanderson K. High prevalence of sickness absence and disability pension among multiple sclerosis patients: a nationwide population-based study. *Mult Scler J*. 2013;*19*(14):1923-1930. doi:10.1177/1352458513488234
4. Coyne KS, Boscoe AN, Currie BM, Landrian AS, Wandstrat TL. Understanding drivers of employment changes in a multiple sclerosis population. *Int J MS Care*. 2015;*17*(5):245-252. doi:10.7224/1537-2073.2014-051
5. Kobelt G, Thompson A, Berg J, Gannedahl M, Eriksson J. New insights into the burden and costs of multiple sclerosis in Europe. *Mult Scler J*. 2017;*23*(8):1123-1136. doi:10.1177/1352458517694432
6. Moore P, Harding KE, Clarkson H, Pickersgill TP, Wardle M, Robertson NP. Demographic and clinical factors associated with changes in employment in multiple sclerosis. *Mult Scler J*. 2013;*19*(12):1647-1654. doi:10.1177/1352458513481396
7. Doesburg D, Vennegoor A, Uitdehaag BMJ, van Oosten BW. High work absence around time of diagnosis of multiple sclerosis is associated with fatigue and relapse rate. *Mult Scler Relat Disord*. 2019;*31*:32-37. doi:10.1016/J.MSARD.2019.03.011
8. Lehmann AI, Rodgers S, Kamm CP, et al. Factors associated with employment and expected work retention among persons with multiple sclerosis: findings of a cross-sectional citizen science study. *J Neurol*. 2020;*267*:3069-3082. doi:10.1007/s00415-020-09973-3
9. Dorstyn DS, Roberts RM, Murphy G, Haub R. Employment and multiple sclerosis: a meta-analytic review of psychological correlates. *J Health Psychol*. 2019;*24*(1):38-51. doi:10.1177/1359105317691587
10. Wiberg M, Murley C, Tinghög P, et al. Earnings among people with multiple sclerosis compared to references, in total and by educational level and type of occupation: a population-based cohort study at different points in time. *BMJ Open*. 2019;*9*(7):e024836. doi:10.1136/bmjopen-2018-024836
11. Murley C, Yang F, Gyllensten H, Alexanderson K, Friberg E. Disposable income trajectories of working-aged individuals with diagnosed multiple sclerosis. *Acta Neurol Scand*. 2018;*138*(6):490-499. doi:10.1111/ane.13001
12. Murley C, Mogard O, Wiberg M, et al. Trajectories of disposable income among people of working ages diagnosed with multiple sclerosis: a nationwide register-based cohort study in Sweden 7 years before to 4 years after diagnosis with a population-based reference group. *BMJ Open*. 2018;*8*(5):20392. doi:10.1136/bmjopen-2017-020392
13. Kavaliunas A, Wiberg M, Tinghög P, et al. Earnings and financial compensation from social security systems correlate strongly with disability for multiple sclerosis patients. *PLoS One*. 2015;*10*(12):e0145435. doi:10.1371/journal.pone.0145435
14. Jennum P, Wanscher B, Frederiksen J, Kjellberg J. The socioeconomic consequences of multiple sclerosis: a controlled national study. *Eur Neuropsychopharmacol*. 2012;*22*(1):36-43. doi:10.1016/j.euroneuro.2011.05.001
15. Gyllensten H, Wiberg M, Alexanderson K, Hillert J, Tinghög P. How does work disability of patients with MS develop before and after diagnosis? A nationwide cohort study with a reference group. *BMJ Open*. 2016;*6*(11):e012731. doi:10.1136/bmjopen-2016-012731
16. Landfeldt E, Castelo-Branco A, Svedbom A, Löfroth E, Kavaliunas A, Hillert J. Sick leave and disability pension before and after diagnosis of multiple sclerosis. *Mult Scler J*. 2016;*22*(14):1859-1866. doi:10.1177/1352458516667567
17. Murley C, Karampampa K, Alexanderson K, Hillert J, Friberg E. Diagnosis-specific sickness absence and disability pension before and after multiple sclerosis diagnosis: an 8-year nationwide longitudinal cohort study with matched references. *Mult Scler Relat Disord*. 2020;*42*:102077. doi:10.1016/j.msard.2020.102077
18. De Boer AGEM, Geuskens GA, Bültmann U, et al. Employment status transitions in employees with and without chronic disease in The Netherlands. *Int J Public Health*. 2018;*63*(6):713-722. doi:10.1007/s00038-018-1120-8
19. European Commission. *Employment Social Affairs & Inclusion. Your Social Security Rights in Sweden*. ©European Union; 2013. Accessed December 21, 2021. https://ec.europa.eu/employment_social/empl_portal/SSRinEU/Your%20social%20security%20rights%20in%20Sweden_en.pdf
20. OECD. Self-employment rate (indicator). Published 2021. Accessed May 19, 2021. https://data.oecd.org/emp/self-employment-rate.htm
21. Martins P, Goncalves J. *The Effect of Self-Employment on Health: Evidence from Longitudinal Social Security Data*. IZA Institute of Labor Economics; 2020 Discussion paper series. Accessed May 14, 2021. https://ideas.repec.org/p/iza/izadps/dp11305.html
22. Nikolova M. Switching to self-employment can be good for your health. *J Bus Ventur*. 2019;*34*(4):664-691. doi:10.1016/j.jbusvent.2018.09.001
23. Lechmann DSJ, Schnabel C. Absence from work of the self-employed: a comparison with paid employees. *Kyklos*. 2014;*67*(3):368-390. doi:10.1111/kykl.12059
24. Fleischmann M, Carr E, Xue B, et al. Changes in autonomy, job demands and working hours after diagnosis of chronic disease: a comparison of employed and self-employed older persons using the English longitudinal study of ageing (ELSA). *J Epidemiol Community Health*. 2018;*72*(10):951-957. doi:10.1136/jech-2017-210328
25. Pagán R. Self-employment among people with disabilities: evidence for Europe. *Disabil Soc*. 2009;*24*(2):217-229. doi:10.1080/09687590802652504
26. Hillert J, Stawiarz L. The Swedish MS registry-clinical support tool and scientific resource. *Acta Neurol Scand*. 2015;*139*(Suppl. 199):11-19. doi:10.1111/ane.12425
27. McDonald WI, Compston A, Edan G, et al. Recommended diagnostic criteria for multiple sclerosis: guidelines from the international panel on the diagnosis of multiple sclerosis. *Ann Neurol*. 2001;*50*(1):121-127. doi:10.1002/ANA.1032
28. Polman CH, Reingold SC, Edan G, et al. Diagnostic criteria for multiple sclerosis: 2005 revisions to the "McDonald Criteria". *Ann Neuro*. 2005;*58*(6):840-846. doi:10.1002/ANA.20703
29. Polman CH, Reingold SC, Banwell B, et al. Diagnostic criteria for multiple sclerosis: 2010 revisions to the McDonald criteria. *Ann Neurol*. 2011;*69*(2):292-302. doi:10.1002/ana.22366
30. Ludvigsson JF, Svedberg P, Olén O, Bruze G, Neovius M. The longitudinal integrated database for health insurance and labour market studies (LISA) and its use in medical research. *Eur J Epidemiol*. 2019;*34*(4):423-437. doi:10.1007/S10654-019-00511-8
31. Swedish Social Insurance Agency [Försäkringskassan]. *Social Insurance in Figures 2020.*. Swedish Social Insurance Agency; 2020. Accessed June 14, 2021. https://www.forsakringskassan.se/wps/wcm/connect/cf56c741-1668-43c2-887d-10dd6c243cde/social-insurance-in-figures-2020.pdf?MOD=AJPERES&CVID=.
32. Brooke HL, Talbäck M, Hörnblad J, et al. The Swedish cause of death register. *Eur J Epidemiol*. 2017;*32*(9):765-733. doi:10.1007/S10654-017-0316-1
33. Pratt NL, Kerr M, Barratt JD, et al. The validity of the Rx-risk comorbidity index using medicines mapped to the anatomical therapeutic chemical (ATC) classification system. *BMJ Open*. 2018;*8*:e021122. doi:10.1136/bmjopen-2017-021122
34. Lalic S, Bell JS, Gyllensten H, et al. Trajectories of sickness absence and disability pension before and after opioid initiation for noncancer pain: a 10-year population-based study. *Pain*. 2019;*160*(5):1224-1233. doi:10.1097/J.PAIN.0000000000001500
35. Wettermark B, Hammar N, Fored CM, et al. The new Swedish Prescribed Drug Register--opportunities for pharmacoepidemiological research and experience from the first six months. *Pharmacoepidemiol Drug Saf*. 2007;*16*(7):726-735. doi:10.1002/PDS.1294

36. Barlow L, Westergren K, Holmberg L, Tälback M. The completeness of the Swedish cancer register: a sample survey for year 1998. *Acta Oncol*. 2009;*48*(1):27-33. doi:10.1080/02841860802247664
37. Murley C, Tinghög P, Karampampa K, Hillert J, Alexanderson K, Friberg E. Types of working-life sequences among people recently diagnosed with multiple sclerosis in Sweden: a nationwide register-based cohort study. *BMJ Open*. 2020;*10*:e039228. doi:10.1136/bmjopen-2020-039228
38. Hensing G, Alexanderson K, Bjurulf P, Allebeck P. How to measure sickness absence? Literature review and suggestion of five basic measures. *Scand J Public Health*. 1998;*26*(2):133-144. doi:10.1177/14034948980260020201
39. Ravinskaya M, Verbeek JH, Langendam M, et al. Extensive variability of work participation outcomes measured in randomized controlled trials: a systematic review. *J Clin Epidemiol*. 2022;*142*:60-99. doi:10.1016/J.JCLINEPI.2021.10.013
40. Price Base Amount. Accessed May 4, 2021. https://www.scb.se/en/finding-statistics/statistics-by-subject-area/prices-and-consumption/consumer-price-index/consumer-price-index-cpi/pong/tables-and-graphs/price-basic-amount/price-base-amount/
41. Sickness benefit qualifying income - Försäkringskassan. Accessed May 5, 2021. https://www.forsakringskassan.se/english/moving-to-working-studying-or-newly-arrived-in-sweden/introduction-to-the-swedish-social-insurance-and-forsakringskassan/sickness-benefit-qualifying-income
42. IBM Corp. *IBM SPSS Statistics for Windows, Version 27.0*. IBM Corp; 2020.
43. Chruzander C, Tinghög P, Ytterberg C, et al. Longitudinal changes in sickness absence and disability pension, and associations between disability pension and disease-specific and contextual factors and functioning, in people with multiple sclerosis. *J Neurol Sci*. 2016;*367*:319-325. doi:10.1016/j.jns.2016.05.055
44. Ludvigsson J, Almqvist C, Bonamy A, et al. Registers of the Swedish total population and their use in medical research. *Eur J Epidemiol*. 2016;*31*(2):125-136. doi:10.1007/S10654-016-0117-Y
45. Wallerstedt S, Wettermark B, Hoffmann M. The first decade with the Swedish prescribed drug register - a systematic review of the output in the scientific literature. *Basic Clin Pharmacol Toxicol*. 2016;*119*(5):464-469. doi:10.1111/BCPT.12613
46. Ludvigsson JF, Andersson E, Ekbom A, et al. External review and validation of the Swedish national inpatient register. *BMC Public Health*. 2011;*11*:1-16. doi:10.1186/1471-2458-11-450
47. Ljungdahl L, Bjurulf P. The accordance of diagnoses in a computerized sick-leave register with doctor's certificates and medical records. *Scand J Soc Med*. 1991;*19*(3):148-153. doi:10.1177/140349489101900302

SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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