

# Partial sick leave associated with disability pension: propensity score approach in a register-based cohort study

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## ABSTRACT

**Objectives:** To support sustainability of the welfare society enhanced work retention is needed among those with impaired work ability. Partial health-related benefits have been introduced for this target. The aim was to estimate the effects of partial sick leave on transition to disability pension applying propensity score methods.

**Design:** Register-based cohort study.

**Setting:** Sample from the national sickness insurance registers representative of the Finnish working population (full-time workers) with long-term sickness absence due to musculoskeletal disorders, mental disorders, traumas or tumours.

**Participants:** All recipients of partial or full sickness benefit whose sick leave period had ended between 1 May and 31 December 2007 were included. The sample was limited to four most prevalent diagnostic groups—mental and musculoskeletal disorders, traumas and tumours. The total sample consisted of 1047 subjects on partial sick leave (treatment group) and 28 380 subjects on full sick leave (control group). A subsample (1017 and 25 249 subjects, respectively) was formed to improve the comparability of the two groups.

**Outcome measures:** A three-category measure and a binary measure for the occurrence of disability pension on the last day of 2008 were computed.

**Results:** Partial sickness benefit reduced the risk (change in absolute risk) of full disability pension by 6% and increased the risk of partial disability pension by 8% compared with full sick leave. The effects did not differ markedly for the two main diagnostic groups of musculoskeletal and mental disorders. In men, the use of full disability pension was reduced by 10% with a 5% increase in the use of partial disability pension, while in women the effects were close to those of the total sample.

**Conclusions:** Our findings suggest that combining work with partial sick leave may provide one means to increase work retention at population level. The use of partial sick leave could be encouraged among men.

## INTRODUCTION

Current focus in disability management is on timely return to work (RTW) and enhanced work retention. In many European countries

## ARTICLE SUMMARY

### Article focus

- There is preliminary evidence that partial sick leave may enhance return to work, nevertheless the effects of partial sick leave on the use of disability pension remain largely unknown.
- The aim was to estimate the association between partial sick leave and disability pensions applying propensity score (PS) methods.

### Key messages

- Partial sick leave reduced the risk of full disability pension by 6% and increased the risk of partial disability pension by 8% compared with full sick leave; however, there was no effect on the total rate of disability pensions.
- Since the majority of those on partial disability pension work part-time, results suggest an increase in work retention.

### Strengths and limitations of this study

- A register-based prospective study design with comprehensive access to the total population of those with long-term sickness absence (lasting for at least 60 weekdays) was utilised.
- Applying PS method it was possible to explicitly assess the validity of the model, and to estimate the consequential success in eliminating confounding.
- The number of covariates was limited and follow-up time was short.

disability benefit schemes have been transformed correspondingly.<sup>1</sup> Partial sickness and disability benefits are designed to be tools to increase work retention since they allow combining part-time work with partial absence from work. So far, studies on the effects of partial sick leave on RTW or work retention are limited in number.<sup>2–7</sup> Although the indicators of outcome are inconsistent across these studies, they suggest that the use of partial sick leave enhances RTW. Little evidence exists on the effects of partial sick leave on transition to disability pension.<sup>4</sup>

In Finland, roughly one-third of the working-age population has a longstanding

health problem affecting work ability.<sup>8</sup> The proportion is one of the highest in OECD-countries. A little more than half of the full sickness benefit periods in Finland are granted to women. In contrast, the incidence of disability pensions is in general 11% higher among men than among women. The more frequent use of partial sickness and disability benefits among women (around 70% of the total) than men may be to some extent explained by occupational gender segregation: women work more frequently in occupations where combining work with disability benefits is plausible. Musculoskeletal and mental disorders are leading causes for both sickness benefits and disability pensions.

In evaluating the effects of a health policy (or a treatment or a conduct), a controlled trial with random assignment (RCT) of subjects into treatment and control conditions is desirable in order to obtain unbiased estimates. A shortcoming of RCTs is the use of selected samples often of small size, which limits the applicability of the results outside the study population. In addition, it has been recognised that randomisation is not always successful in eliminating differences in characteristics between the study groups.<sup>9</sup> Observational studies can better represent real-world settings than RCTs. However, a concern is that the treatment and control groups may not be well comparable, that is, there can be selection to treatment. As a result, systematic differences between the groups in observed or unobserved covariates may be mistaken for treatment effects.<sup>10</sup> Multivariate regression is commonly applied in observational studies to estimate association between treatment and outcome controlling for confounders in order to increase the comparability and to reduce bias. However, when there are large differences in the distribution of covariates between the groups, adjusting for these differences by conventional regression may result in residual bias and limit causal inference.<sup>11</sup>

Propensity score (PS) is defined as conditional probability of assignment to a treatment given observed covariates. Thus, it serves as a composite confounder and can be used to balance the covariates in two groups and reduce bias. In addition, the true treatment effect can be better approximated with the PS method. When groups of subjects with equal estimated PSs are compared, an observational study approximates a randomised trial. A number of methods can be used to apply the estimated PS. Proper implementation of the methods has been emphasised.<sup>11–15</sup>

We carried out previously a prospective observational register study to examine the effects of partial sick leave on the use of health-related benefits.<sup>4</sup> The results showed that in comparison with full sick leave partial sick leave was less frequently followed by full disability pension and more often by partial disability pension. As it is possible that the use of partial sick leave is a treatment or conduct that is prone to selection, the objective of the present study was to apply PS methods to estimate the association between partial sick leave and disability pensions. The analyses were

carried separately in the main diagnostic categories since the disability and associated challenges in work retention may depend on the nature of the health problem.<sup>16 17</sup> Moreover, we aimed to estimate the size of the absolute and relative effects of partial sickness benefit on transition to disability pension using PS matching.

## METHODS

### Institutional setting

In the Finnish national sickness benefit scheme, two sickness benefits are available: a full and a partial benefit. If part-time work is not anticipated to compromise recovery, employees or self-employed who are aged from 16 to 67 and unable to work full time (and thus entitled to full sickness benefit) are eligible for partial sickness benefit. Receivers must have been working full time before work incapacity and during the present study they had to be paid the regular full sickness benefit uninterrupted for at least 60 days of payment (weekdays) immediately prior to partial sick leave. No other factors limited the eligibility. The use of partial sickness benefit is voluntary and the decision between partial and full sick leave (in the following referred to as treatment assignment) is taken in collaboration by the patient, the employer and the physician. During partial sick leave, work hours and salary are reduced to 40–60% of the regular. The amount of the partial sickness benefit is 50% of the preceding full benefit. The length of a partial sick leave period cannot exceed 72 weekdays. Full sickness benefit is obtainable for a maximum of 300 weekdays. The compensation rate in case of full sickness benefit is progressive varying from 25% to 70% of regular salary.

In case of continuing work disability, a partial or a full disability pension can be granted either for a specified or for an indefinite period. The Finnish pension scheme consists of both an earnings-related and a national pension. A partial disability pension can be granted on the basis of earnings-related pensions only. The examining physician has to find the work ability of the worker to be reduced by at least 3/5 in order to be eligible for full disability pension and by at least 2/5 for partial disability pension. Roughly 70% of those on partial disability pension specifically apply for the benefit and 60% of the receivers work part-time. In case reduction in work ability of the applicant for full disability pension does not meet the eligibility criterion, a partial pension can be granted instead.

### Data source and population

The study population was drawn from the national sickness insurance registers. We included in the initial full sample all recipients of partial sickness benefit whose sick leave period had ended between 1 May and 31 December 2007. The sample was limited to four most prevalent diagnostic groups—mental and musculoskeletal disorders, traumas and tumours. All recipients of full sickness benefit, whose sick leave had ended with a

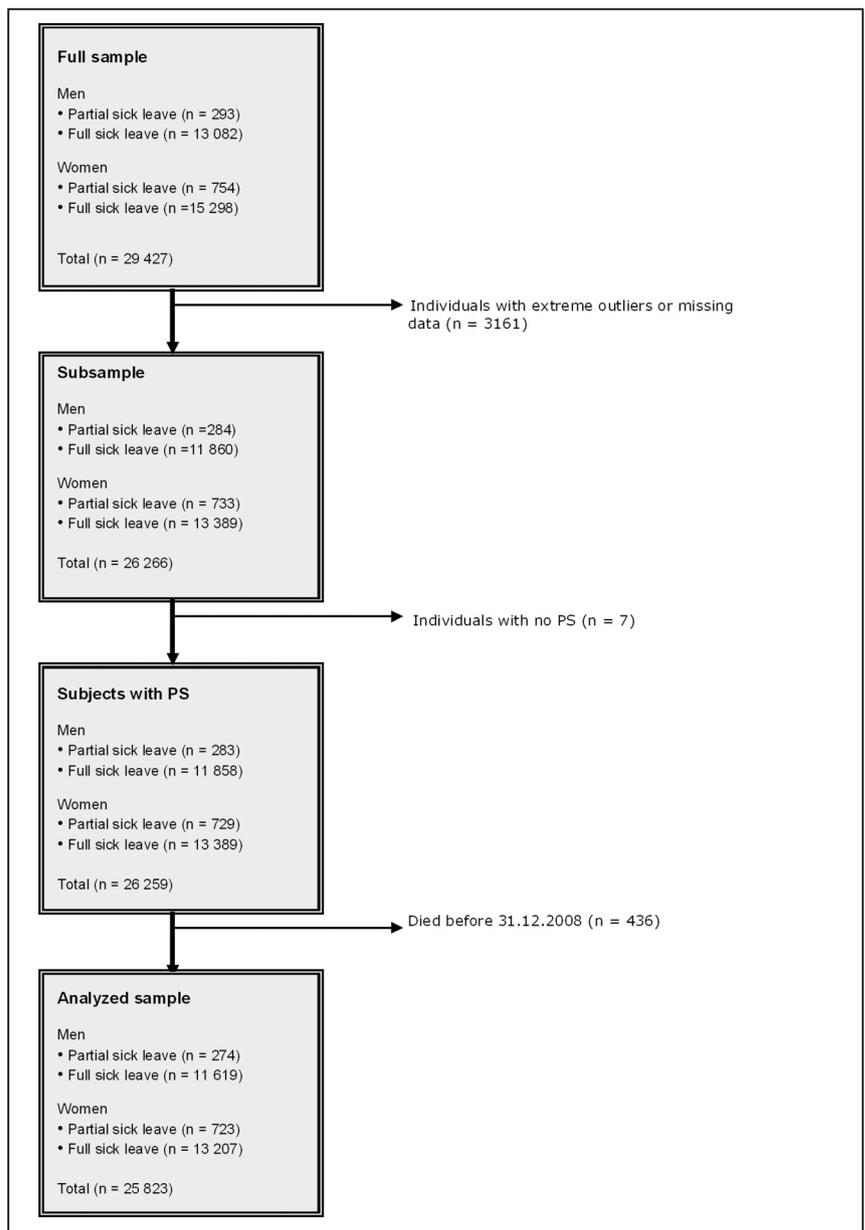
continuous phase of at least 60 days of payment with the abovementioned diagnoses within the same calendar period, were drawn to the control group.

All in all, 1047 subjects on partial sick leave (the treatment group) and 28 380 subjects on full sick leave (the control group) formed the initial study sample. A detailed description of the participants has been presented earlier.<sup>4</sup> Subjects with lower than minimum income, unclear occupational group, those whose sickness benefit was based on other than work income, and subjects with missing data on diagnosis or previous sickness absence were removed from the sample. Thus, the PS analyses were carried out among 1017 subjects in the partial sick leave group and 25 249 subjects in the full sick leave group (figure 1). Descriptive data on the initial full sample, subsample and the analysed sample are shown in table 1.

**Covariates**

Variables that were considered as possible confounders in the association between partial sick leave and disability pensions and were obtainable from the registers were retrieved. They included gender, date of birth (to calculate age at the start of the follow-up), diagnostic group (diagnoses were categorised according to the ICD10), insurance district (area of residence), annual gross income in 2006 and total number of compensated full sickness benefit days during 2 years preceding the treatment assignment (length of sickness absence before treatment assignment). In addition, we retrieved starting and ending dates of all compensated sickness absence periods during the follow-up. Registers provided information on occupational group for all subjects in the partial sick leave group, whereas in the full sick leave group an occupational code was provided only to a random sample of 5%.

**Figure 1** Build-up of the study sample.



**Table 1** Descriptive data of different groups formed during building up the study sample (mean±SD, %)

	Full sample (n=29 427)	Subsample (n=26 266)	Analysed (n=25 823)
Age (years)	47±11	48±11	48±11
Women (%)	54	54	54
Gross income (€)	23 676±13 110	23 938±11 772	23 901±11 676
Sickness absence prior to treatment assignment (days)	26±50	26±50	26±50
Sickness absence in connection with treatment assignment (days)	156±85	156±85	155±85
Diagnostic groups of sick leave (%)			
Mental disorders (%)	27	27	27
Musculoskeletal disorders (%)	46	47	47
Tumours (%)	9	8	8
Traumas (%)	18	18	18
Occupational group (%)			
Technical and scientific work etc (%)	6	6	6
Social and healthcare (%)	10	11	11
Administration and office work (%)	12	13	13
Commercial work (%)	15	16	16
Agriculture and forestry (%)	15	17	17
Transport (%)	13	14	14
Industrial and construction work, mining (%)	13	14	14
Service work (%)	8	9	9
Not defined (%)	8		
Insurance district (%)			
Northern (%)	13	13	13
Western (%)	13	13	13
Eastern (%)	15	15	15
South-Western (%)	24	24	24
Southern (%)	35	35	35
Partial sick leave (%)	4	4	4
Full sick leave (%)	96	96	96
No disability pension (%)	74	74	73
Partial disability pension (%)	4	4	4
Full disability pension (%)	22	22	23

### Outcome measures

Status information on whether an individual received disability pension (full or partial) on the last day of 2008 was obtained from the registers. The exact date when the pension (partial or full) was granted was not, unfortunately, obtainable. A variable for the occurrence of disability pension was computed (1=no disability pension, 2=partial disability pension and 3=full disability pension). In addition, we used a binary outcome measure (1=no disability pension and 2=any disability pension). In total, 436 individuals had died before 31 December 2008 and were censored from the analyses (figure 1).

### Improving comparability of the studied groups

In the treatment group, the partial sick leave must have been preceded by a continuous phase of sickness

absence of at least 60 days. In addition, partial sick leave period cannot exceed 72 days. In the control group, due to our sampling criteria, the full sick leave period must have ended with a continuous phase of at least 60 days of payment and the maximum length of the period is 300 days. This resulted in discrepancy of the covariates indicating length of sickness absence prior to and in connection with treatment assignment in the studied groups. Thus in order to make the variables comparable in the studied groups, the variable indicating length of sickness absence before treatment assignment was modified in the partial sick leave group by subtracting 60 days from the original variable. Respectively, the length of sick leave in connection with treatment assignment was divided by two in the partial sick leave group (to make the amount of sick leave comparable between the groups).

## Statistical methods

### Imputing missing data

As occupation is a likely determinant of treatment assignment and outcome, we carried out multiple imputations for the variable indicating occupational group. Missing values were predicted using, in addition to existing values of the variable, a set of other variables. The imputations were carried out separately for the genders.

### Modelling PS

We followed the recommendations from a systematic review for logistic model development and assessment in connection with PS analyses.<sup>18</sup>

Associations of potential covariates with treatment assignment and outcomes were evaluated by  $\chi^2$  tests in the case of categorical variables and with analysis of variance in the case of continuous variables. Collinearity of the covariates was assessed by correlation coefficients. To compute PS we conducted hierarchical logistic regression with observed covariates obtained from registers (age, gender, diagnostic group, occupational group, gross income, insurance district, length of sickness absence before treatment assignment and length of sickness absence in connection with treatment assignment) and treatment assignment (0=partial sick leave, 1=full sick leave) as a dependent variable. The covariates were entered to the model at the first step and the interaction terms at the second step. To maximise comparability of the treatment assignment groups, the logistic model was revised several times by including theoretically reasonable interaction and non-linear terms. Fitness of the model was assessed with the Hosmer and Lemeshow test.

### Assessing covariance balance

Covariate balance was assessed as recommended.<sup>12 15 19</sup> First, we examined the overlap of the PS in the studied groups in order to get a rough idea of the covariate balance and to eliminate extreme outliers in the distributions.<sup>19 20</sup> The subjects were then stratified to the quintiles of the PS distribution and the box-plots of the estimated PS distributions for the studied groups were compared within each quintile. The Kolmogorov-Smirnov test was applied to test the differences. Matching on PS was performed using local optimal (greedy) algorithm<sup>21</sup> separately for gender  $\times$  diagnostic group strata. Covariate balance between the studied groups was compared before and after stratification and PS matching.

### Estimating treatment effects

In order to estimate the association between partial sick leave and disability pensions among all subjects eligible for the treatment, we used covariate adjustment with linear PS, in addition to traditional covariance adjustment. PS stratification could not be used because of too few observations in the strata of the partial sick leave group. PS matching was used as a method in order to estimate the effects among the subpopulation of those

who either had been granted partial sickness benefit or were comparable to them on the measured covariates.

We carried out a set of multinomial regression analyses: crude analysis, direct regression adjustment (adjusted for the measured covariates) and adjustment for PS (linear term) and the variables with residual imbalance. Generalised estimating equation was used in computing the treatment effect with PS matching in order to be able to properly take into account the matching pairs design. Results were reported for the main diagnostic groups of mental and musculoskeletal disorders.

As the PS method mimics a controlled trial, it was possible to compute absolute and relative risk reduction (ARR and RRR) of the use of disability pension and the number needed to treat (NNT) to prevent transition to disability pension in the matched sample. ARR refers to the difference in the event rates (%) between the treatment assignment groups, that is, the effectiveness of the treatment. RRR is a proportional measure (%) of efficacy referring to the extent to which the treatment decreases the risk of future events among treated subjects as compared with the untreated subjects. RRR does not discriminate between small (in the case of a rare outcome) and large (in the case of a common outcome) treatment effects. NNT is defined as the number of subjects needed to be treated in order to prevent one additional event, that is, it reflects the likelihood that a subject will benefit from the treatment. The smaller the NNT is, the more effective is the treatment.

The parameters were computed as follows:<sup>22</sup>

$$\begin{aligned} \text{ARR} &= p_{\text{control}} - p_{\text{treatment}} \\ \text{RRR} &= (p_{\text{control}} - p_{\text{treatment}}) / p_{\text{control}} \\ \text{NNT} &= 1 / \text{ARR} \end{aligned}$$

where  $p_{\text{treatment}}$  and  $p_{\text{control}}$  denote the prevalence of the outcome in the treatment and control groups. Positive values indicate a reduction in risk and negative values an increase in risk. Statistical analyses were performed using SPSS, V.18.0 and SAS, V.9.1.

## RESULTS

### PS modelling

Most of the covariates were strongly correlated with both the treatment assignment and the outcome. Age and income were only weakly correlated with treatment assignment and gender and income with the outcome. Female gender, higher number of sickness absence days prior to and lower number of sick leave days in connection with treatment assignment were associated with assignment to partial sick leave. Those belonging to the diagnostic groups of mental disorders, musculoskeletal disorders or tumours, had a higher probability of being assigned to partial sick leave than those with traumas. In occupational categories and in insurance districts there were also some differences in the treatment assignment.

The correlation coefficients between the covariates varied from -0.02 to 0.20.

The final logistic regression model for estimating PS included eight covariates (age, gender, diagnostic group, occupational group, gross income, insurance district, length of sickness absence before treatment assignment and length of sick leave in connection with treatment assignment), 19 two-way and 3 three-way interaction terms. The Hosmer and Lemeshow tests for the fitness of the model was  $\chi^2(8)=29.6$ ,  $p=0.000$ .

Due to missing data on the predictors, PS could not be estimated for five subjects in the partial sick leave group and two subjects in the full sick leave group. We assumed that these observations were missing at random and excluded the subjects from the analyses. The overlap of PS distributions was satisfactory and there was thus no need to remove any more subjects from the analyses. Thus, the final subsample included 1012 subjects in the partial sick leave group and 25 247 subjects in the full sick leave group (figure 1).

Box-plots of the estimated PS by the quintiles are shown in figure 2. The distributions of the PS in the studied groups were similar in the first three quintiles indicating a satisfactory covariate balance. In the fourth and fifth quintiles there was some evidence of residual imbalance: Kolmogorov-Smirnov  $Z=1.4$ ,  $p=0.04$  and Kolmogorov-Smirnov  $Z=15.1$ ,  $p=0.001$ , respectively. In order to identify individual covariates with residual imbalance, they were compared before and after PS stratification (table 2). The results indicate that working in social and healthcare and belonging to the diagnostic

group of tumours were not balanced between the studied groups. In addition, some imbalance was seen in the distribution of the genders and musculoskeletal disorders. In contrast, covariate balance was found to be satisfactory after PS matching (table 3).

**Table 2** Comparison of covariates in the treatment assignment groups before and after PS stratification (F statistics)

Covariate	Before stratification (n=26 266) F†	After stratification (n=26 259) F‡
Age	4.9*	0.1
Gender	143.4***	4.3*
Gross income	77.0***	3.7
Sickness absence prior to treatment assignment	2825.4***	0.1
Sickness absence right after treatment assignment	767.5***	3.0
Mental disorders	131.0***	0.1
Musculoskeletal disorders	25.5***	4.8*
Tumours	1.8	27.8***
Traumas	57.0***	1.7
Technical and scientific work, etc	68.8***	0.0
Social and healthcare	431.3***	23.4***
Administration and office work	23.4***	0.1
Commercial work	58.5***	0.7
Agriculture and forestry	164.6***	1.5
Transport	103.4***	1.4
Industrial and construction work, mining	11.8***	0.9
Service work	0.08	0.1
Northern insurance district	0.7	0.0
Western insurance district	10.5***	3.6
Eastern insurance district	7.7**	0.4
South-Western insurance district	1.1	0.0

†Unadjusted ANOVA.

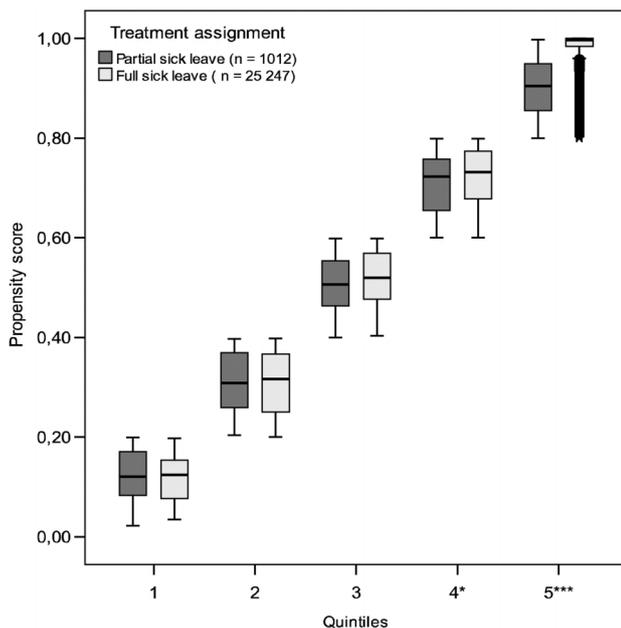
‡ANOVA adjusted for PS quintiles and the cross product of treatment assignment and PS quintiles.

\* $p < 0.05$ .

\*\* $p < 0.01$ .

\*\*\* $p < 0.001$ .

ANOVA, analysis of variance; PS, propensity score.



\*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$

**Figure 2** Box-plot graphs of propensity scores in the treatment assignment groups by quintiles.

**Association between treatment assignment and disability pensions**

There were differences in the associations between type of sick leave and disability pension using conventional multivariate regression and PS regression (table 4). As compared with full sick leave group, those on partial sick leave had a 70% lower crude risk for full disability pension and a threefold crude risk for partial disability pension. Conventional multivariate regression adjusted for covariates and PS regression resulted in equal, but weaker effects than the crude regression model. The estimated risk of partial disability pension in the PS matching analysis approximated the crude risk, while the risk of full disability pension estimated in the matched subsample was comparable with the risk observed in conventional regression and PS regression analyses.

The risk for full disability pension was around 0.5-fold in the partial sick leave group compared with the control group in both genders. Using PS with the two different methods did not affect the results. As compared with the full sick leave group, both men and women on partial sick leave had a roughly twofold risk

for partial disability pension when adjusted for the covariates or PS and covariates with residual imbalance. In the PS-matched subsample, the risk was somewhat reduced in men and increased to threefold in women.

The association between the use of partial sick leave and partial disability pension was statistically significant among subjects with mental disorders and musculoskeletal disorders. The effect was stronger in the PS-matched subsample than in the total study sample. The results concerning full disability pension did not differ in these diagnostic groups as compared with the full sample. Neither did the choice of PS method have any effect on the results. There was no association between treatment assignment and the disability pensions among tumours and traumas.

**Absolute and relative treatment effects**

In the matched subsample, 78 subjects in the partial sick leave group (8%) and 144 subjects in the full sick leave group (14%) were on full disability pension at the end of year 2008. The respective proportions among those on partial disability pension were 12% and 4%. The prevalence of partial disability pension was roughly

**Table 3** Comparison of covariates in the treatment assignment groups in the total and the matched sample (mean±SD, %)

Covariate	Subjects with PS (n=26 259)		After PS matching (n=2024)	
	Partial sick leave (n=1 012)	Full sick leave (n=25 247)	Partial sick leave (n=1 012)	Full sick leave (n=1 012)
Age (years)	47±9	48±11	47±9	47±9
Women (%)	72%	53%	72%	72%
Gross income (€)	27 128±11 541	23 811±11 764	27 128±11 541	27 557±15 099
Sickness absence prior to treatment assignment (days)	93.9±63.8	21.0±41.8	93.9±63.8	85.6±79.7
Sickness absence in connection with treatment assignment (days)	27.0±9.4	100.1±84.2	27.0±9.4	24.5±25.5
Diagnostic groups of sick leave				
Mental disorders (%)	42.2	26.0	42.2	42.2
Musculoskeletal disorders (%)	38.8	47.0	38.8	38.8
Tumours (%)	9.8	8.5	9.8	9.8
Traumas (%)	9.2	18.4	9.2	9.2
Occupational group				
Technical and scientific work, etc (%)	12.0	5.7	12.0	14.7
Social and healthcare (%)	30.7	10.2	30.7	27.2
Administration and office work (%)	18.4	13.1	18.4	20.3
Commercial work (%)	7.5	16.5	7.5	6.6
Agriculture and forestry (%)	2.1	17.3	2.1	2.0
Transport (%)	3.6	15.0	3.6	4.0
Industrial and construction work, mining (%)	17.5	13.7	17.5	17.0
Service work (%)	8.3	8.5	8.3	8.3
Insurance district				
Northern insurance district (%)	13.3	12.5	13.3	13.0
Western insurance district (%)	16.7	13.1	16.7	16.1
Eastern insurance district (%)	11.8	14.8	11.8	12.4
South-Western insurance district (%)	22.8	24.2	22.8	25.1
Southern insurance district (%)	35.4	35.3	35.4	33.4

PS, propensity score.

**Table 4** ORs (95% CI) for associations between partial sick leave and disability pensions (OR for full sick leave=1.0).

	Full disability pension	Partial disability pension
<b>Full sample</b>		
Crude (n=25 830)	0.3 (0.2 to 0.4)	2.9 (2.4 to 3.5)
Adjusted* (n=25 823)	0.6 (0.4 to 0.8)	2.1 (1.6 to 2.7)
Adjusted† (n=25 823)	0.6 (0.4 to 0.7)	2.3 (1.8 to 3.0)
PS matching‡ (n=2024)	0.6 (0.4 to 0.7)	2.8 (2.0 to 4.0)
<b>Men</b>		
Crude (n=11 896)	0.4 (0.3 to 0.6)	3.2 (2.1 to 5.0)
Adjusted* (11 893)	0.6 (0.4 to 1.0)	2.7 (1.6 to 4.5)
Adjusted† (n=11 893)	0.5 (0.3 to 0.8)	2.5 (1.4 to 4.4)
PS matching‡ (n=558)	0.5 (0.3 to 0.8)	2.1 (1.1 to 4.3)
<b>Women</b>		
Crude (n=13 934)	0.3 (0.2 to 0.4)	2.5 (1.9 to 3.1)
Adjusted* (13 930)	0.6 (0.4 to 0.8)	1.9 (1.4 to 2.5)
Adjusted† (13 930)	0.5 (0.4 to 0.8)	2.3 (1.7 to 3.1)
PS matching‡ (n=1456)	0.6 (0.4 to 0.8)	3.1 (2.0 to 4.7)
<b>Mental disorders</b>		
Crude (n=7003)	0.3 (0.2 to 0.4)	3.2 (2.3 to 4.5)
Adjusted* (n=7001)	0.6 (0.4 to 0.8)	3.2 (2.1 to 4.8)
Adjusted† (n=7001)	0.6 (0.4 to 0.8)	3.3 (2.2 to 5.0)
PS matching‡ (n=858)	0.5 (0.4 to 0.8)	5.2 (2.6 to 10.3)
<b>Musculoskeletal disorders</b>		
Crude (n=12 261)	0.2 (0.1 to 0.3)	2.4 (1.8 to 3.2)
Adjusted* (n=12 257)	0.5 (0.3 to 0.8)	1.7 (1.2 to 2.5)
Adjusted† (n=12 257)	0.5 (0.3 to 0.8)	1.9 (1.3 to 2.7)
PS matching‡ (n=792)	0.5 (0.3 to 0.8)	2.1 (1.3 to 3.4)
<b>Traumas and tumours</b>		
Crude (n=6682)	0.6 (0.4 to 1.0)	3.7 (2.0 to 6.9)
Adjusted* (n=6682)	0.7 (0.4 to 1.4)	1.3 (0.6 to 2.9)
Adjusted† (n=6682)	0.8 (0.4 to 1.5)	1.2 (0.5 to 3.2)
PS matching‡ (n=384)	0.8 (0.4 to 1.6)	2.0 (0.7 to 5.7)

\*Multinomial regression adjusted for: covariates, reference=no disability pension.

†Multinomial regression adjusted for: PS and variables with residual imbalance, reference=no disability pension.

‡GEE-analysis in the matched subsample.

GEE, generalised estimating equation; PS, propensity score.

1.5-fold in women compared with men. The prevalence of full and partial disability pension did not differ between subjects with mental and musculoskeletal disorders (7% vs 10% and 79% vs 81%, respectively).

Table 5 shows the estimated absolute and relative risk changes in the use of full and partial disability pension. Using partial sickness benefit reduced statistically significantly the absolute and relative risks of full disability pension by 6% and 41%, respectively. Both effects were more pronounced in men than in women. The absolute effect was larger in mental than in musculoskeletal disorders, while the opposite was true for the relative effect. The absolute and relative risks of partial disability pension increased among those who had been on partial sick leave compared with those who had been on full sick leave by 8% and 159%, respectively. This effect was stronger in women than in men and in mental than in musculoskeletal disorders. Having been on partial sick leave had neither absolute nor relative effect on risk reduction in transition to any disability pension (partial and full disability pension combined, data not shown). Worthy of notice, we observed a 5% reduction in

absolute risk and a 21% reduction in relative risk of any type of disability pension among men. However, these effects were not statistically significant.

## DISCUSSION

We found that the use of partial sickness benefit reduced the risk of full disability pension by 6% (absolute risk reduction in per cent units) and increased the risk for partial disability pension by 8% compared with full sick leave. The use of partial sick leave due to musculoskeletal or mental disorders reduced fairly equally full disability pensions. However, there was a larger increase in receiving partial disability pension after partial sick leave due to mental disorders compared with musculoskeletal disorders. Partial sick leave due to traumas and tumours had no effect on disability pensions. We saw a major gender difference in the effects. In men, the risk of the use of full disability pension was reduced by 10% with a 5% increase in the risk of the use of partial disability pension (ie, reverse effects compared with those in the total population), while in

**Table 5** Absolute and relative risk reduction (a risk difference between partial and full sick leave groups, ARR\* and RRR\*) of the use of partial and full disability pension with 95% CIs in the matched subsample

	Full disability pension				NNT	Partial disability pension				NNT
	ARR (%)	95% CI	RRR (%)	95% CI		ARR (%)	95% CI	RRR (%)	95% CI	
Total	6	3 to 9	41	24 to 55	16	-8	-10 to (-5)	-159	-264 to (-84)	-14
Men	10	4 to 16	47	20 to 65	10	-5	-10 to (-0)	-102	-302 to (-2)	-21
Women	4	15 to 7	38	13 to 55	26	-9	-12 to (-6)	-180	-315 to (-89)	-12
Mental disorders	8	3 to 13	42	17 to 59	12	-10	-14 to (-7)	-361	-795 to (-138)	-10
Musculoskeletal disorders	6	2 to 11	51	19 to 70	15	-7	-12 to (-2)	-94	-202 to (-24)	-15
Traumas and tumours	2	-4 to 8	17	-54 to 56	53	0	-8 to 2	-95	-409 to 25	-31

\*Negative values indicate an increase in risk.

\*NNT, number needed to treat to prevent full disability pension.

women the effects were close to those of the total sample. No effect on the total rate of disability pensions was seen.

In this study we used occurrence of disability pension as an indicator of impaired work ability. To our knowledge, this is the first study to address the association between partial sick leave and disability pension applying PS matching in order to simulate an RCT. Direct comparison of our current findings with those from other studies is not possible, though it has been suggested that different measures of RTW are highly correlated and comparable.<sup>23</sup> The overall results of this study, suggesting enhanced work retention after partial sick leave, are in agreement with a Danish study showing beneficial effects of graded RTW on work participation.<sup>3</sup> Our results concerning musculoskeletal disorders are congruent with Swedish findings and a recent Finnish RCT indicating beneficial effect of partial sick leave on earlier RTW.<sup>6, 7</sup> Our findings showed a weaker effect of partial sick leave in the prevention of full disability pension and a remarkably increased risk of partial disability pension in mental compared with musculoskeletal disorders. The only previous study—that we are aware of—on the effects of partial sick leave in mental disorders showed no effect.<sup>5</sup>

Of the partial disability pensions in Finland, 67% are granted in musculoskeletal disorders, while in mental disorders the benefit is much less frequently used. Unfortunately, we could not estimate the cause-specific associations between sick leaves and disability pensions, since we did not have access to the diagnoses of the disability pensions. Somatic disorders or pain and mental disorders tend to co-occur in the general population, especially among women. In Finland, 10% of working men and 19% of working women report musculoskeletal pain and depressive symptoms simultaneously. Such co-occurrence is known to affect work disability<sup>24-26</sup> and may have affected the results of our study regarding partial disability pensions.

In Finland, the incidence of partial disability pension has increased somewhat in recent years. More than 60% of the receivers of partial disability pension in

musculoskeletal or mental disorders work part-time. Thus, in order to increase work retention, the use of partial disability pension is encouraged among those with long-term health problems instead of transition to full disability pension. Our results showed that the use of partial sick leave increased the rate of partial disability pension and simultaneously reduced the incidence of full disability pensions with no effect on the total rate of disability pensions. Although the absolute increase in partial disability pensions was slightly higher than the absolute decrease in full disability pensions, the fact that the majority of those on partial disability pension are working part-time suggests that the use of partial sick leave likely increased work retention.

There are several potential explanations for the detected associations. Partial sick leave has previously been shown to enhance RTW. This finding is congruent with the knowledge that staying active is beneficial in many diseases and—on the other hand—lengthy periods of sickness absence are associated with an increased risk of permanent disability and disability pension.<sup>27-29</sup> It is also plausible that a successful experience of combining modified work with part-time sick leave will have a positive effect on the illness perceptions and behaviour of the individual, which in turn may play an important role in work participation.<sup>30</sup>

The advantages of PS methods in comparison with traditional methods have been discussed.<sup>15, 31</sup> In applying PS methods it is possible to explicitly assess the validity of the model, that is, assess the covariate balance between the studied groups and to estimate the consequential success in eliminating confounding. The number of covariates was limited in this register-based study. However, many essential confounders were included. No harmful collinearity between the covariates was detected. It is known that the goodness-of-fit statistics is sensitive to large sample size; therefore we have used the PS model with the lowest goodness-of-fit value. In the total study sample, there was some residual imbalance in the covariates between the treatment assignment groups, while the balance was satisfactory in the

matched subsample. The criteria for modelling the PS were met and thus we believe that we succeeded in constructing a valid PS.

The PS approach is encouraged to be used in observational studies in addition to conventional methods in order to better reduce the bias caused by selection into treatment. Although criticised, covariate adjustment using PS has been the most frequently used PS method in health research.<sup>31</sup> We used two different approaches—covariate adjustment with linear PS and PS matching. Stratification could not be used in the present study because of the relatively small sample size in the partial sick leave group. As in previous studies<sup>20 31</sup> we found that the degree of bias reduction depended on the methodology used in PS analyses, that is, matching resulted in a more exact covariance balance between the studied groups and thus improved exchangeability between them. As removing unmatched subjects reduced data to the sample of those individuals who either had been granted partial sickness benefit or were equal to them on the measured covariates, the results of the PS matching cannot be generalised to the whole eligible population.

In general, regression analysis as a method is sensitive to the relative difference in the sample size between the treated and untreated. That is, if the prevalence of the outcome is lower in the larger, non-treated group, the treatment effect will be underestimated.<sup>12</sup> In the present study, the number of non-treated (subjects on full sick leave) exceeded by 10-fold the number of treated (those on partial sick leave). The prevalence of partial disability pension was roughly three times lower among the non-treated as compared with the treated. As expected, the ORs for partial disability pension estimated by covariate adjustment with PS were lower than the ones estimated using PS matching. Thus, PS adjustment is more likely to produce biased effect estimates, whereas PS matching may result in unbiased but imprecise effect estimates.<sup>12 14</sup>

There are some limitations in using the PS approach. While randomisation generally balances both observed and unobserved covariates between the groups, in PSs, as in conventional methods, unobserved confounders are a source of residual bias.<sup>9</sup> Thus, there are potential unobserved confounders that could not be covered in this study using register data. It is likely that some factors associated with employee, physician, employer, workplace or the larger societal context, are related to choosing between partial and full sick leave. There may be some selection to partial disability pension, as well. In fact, we found that, for example, female gender, higher number of earlier sickness absence days, sickness absence for mental or musculoskeletal disorders or tumours, and working in social care and healthcare were associated with receiving partial sickness benefit. However, the impact of residual confounding tends to be smaller in large samples, indicating support for causal inference in the present data.<sup>11</sup>

The present study has several strengths. We utilised a register-based prospective study design with comprehensive access to the total population of those with long-term sickness absence (lasting for at least 60 weekdays). As a consequence, the study sample was rather homogeneous and this was an asset in balancing the covariates between the treatment assignment groups. Roughly 10% of the full sample was excluded from the analyses due to unreliable or missing information. Still, the sample used in the analyses represented well enough the initial full sample with regard to all variables. However, our results must be interpreted taking into consideration the following weaknesses: a limited number of covariates, a short follow-up time, and a low prevalence of partial sick leave.

## CONCLUSIONS

The results of this study using the PS approach provide further evidence that combining work with partial health-related benefits will provide a means to increase work retention among those with long-term sickness absence due to mental or musculoskeletal disorders, traumas or tumours. So far, partial sick leave has been used mostly by women, but the results of this study suggest that the use of the benefit could be encouraged among men. Furthermore, it can be concluded that the use of partial sick leave in subjects with mental and musculoskeletal disorders is more beneficial than in traumas and tumours.

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