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EFFECTIVENESS OF INTRODUCTION OF NEW LEGISLATION OF PARTIAL SICKNESS BENEFIT ON WORK PARTICIPATION: A QUASI- EXPERIMENT IN FINLAND

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Abstract

Objectives The objective of the study was to examine the effect of new legislation on partial sickness benefit on subsequent work participation of Finns with long term sickness absence. Additionally, we investigated whether the effect differed by sex, age, or diagnostic category.

Design A register based quasi-experimental study. We compared the intervention (partial sick leave) group with the comparison (full sick leave) group regarding their pre-post differences in the outcome. The pre-intervention and post-intervention study period each consisted of 365 days.

Setting Nationwide, individual level data on the beneficiaries of partial or full sickness benefit in 2008 were obtained from national sickness insurance, pension and earnings registers.

Participants 1 738 persons in the intervention and 56 754 persons in the comparison group.

Outcome Work participation, measured as the proportion (%) of time within 365 days when participants were in gainful employment and did not receive either partial or full ill-health-related or unemployment benefits.

Results Although the overall work participation declined in both groups during the study period, the decline was 5% (absolute difference-in-differences) smaller in the intervention group than in the comparison group, with a minor sex difference. The beneficial effect of partial sick leave was seen especially among those aged from 45 to 54 (5%) and 55 to 65 (6%) and in mental disorders (13%). When the groups were rendered more exchangeable (propensity score-matching), the effects on work participation were doubled and seen in all age groups and in other diagnostic categories than traumas.

Conclusions The results suggest that the new legislation has potential to increase work participation of the population with long term sickness absence in Finland. If applied in a larger

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scale, partial sick leave may turn out to be a useful tool in reducing the withdrawal of workers from the labor market due to health reasons.

For peer review only

Article Summary

Strengths and limitations of the study:

- Applying nationally representative population register based data with valid information on the payment of health- and unemployment-related allowances in Finland.
- Applying a quasi-experimental study-design with difference-in differences and propensity score analysis to control for selection on both observed and unobserved factors.
- Registers provided only a limited number of background characteristics.

Introduction

The need to increase work participation of working age people is currently a matter of concern in many Western countries. In Finland, delayed or lacking labor market attachment of young people, absence from work during later years and early exit from labor market have all raised alarm. To counteract these trends, an active labor market policy has been adopted, including the introduction of partial social security benefits and other tools to increase the so called flexicurity of the labor market [1]. In Finland, legislation on partial sickness benefit was introduced in 2007. The new benefit allowed for the first time to combine part-time sick-leave with part-time work.

The Finnish social insurance is based on the Nordic Model. Everyone who is aged from 16 to 67, non-retired and living permanently in the country (employees, self-employed, students, unemployed job seekers and those on sabbatical or alternation leave) and also nonresidents working for at least four months in Finland are covered by statutory sickness insurance. The sickness allowances are financed by employers, employees and the state and they are administrated by the Social Insurance Institution of Finland (SII). Statutory benefits can rest on previous earnings or benefits or the minimum allowance can be granted. For the earnings-related occupational sickness benefits, a minimum of three months of employment is required.

At present, the Finnish national sickness benefit scheme includes a full and a partial sickness benefit. A medical certificate is an absolute requirement for the two sickness benefits to be granted. In order to be eligible for the partial benefit an employee has to be eligible for a full benefit as well, but according to medical judgment partial return to work is safe enough. Partial sick leave is thus alternative to full sick leave and it is always medically certified. During the first years after introducing the partial sickness benefit in Finland, a partial sick leave had to be directly preceded by a period of full sick leave of at least 60 days and the partial sickness benefit could be granted from a minimum of 12 to a maximum of 72 working days. During partial sick leave, work time and salary are reduced by 40 – 60% of the regular work hours and work tasks can be modified if necessary. The employee and the employer sign a fixed term

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4 work contract for the part-time work. In Finland, the use of partial sick leave is voluntary for
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6 the individual. The employer, as well, is entitled to decline the use of the benefit in case the
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8 work arrangements needed at the work place are not feasible.
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11 Sickness absence rates are in many countries higher among women compared with men [2].
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13 Also partial sick leave has been more frequently used by women [3]. It is known that sickness
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15 absence increases with age [2]. It is also recognized that challenges of return to work are
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17 different for example in musculoskeletal diseases and mental disorders. In the latter category,
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19 the outflow from disability benefits due to recovery has been lower [4].
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23 The current evidence on the effects of partial sick leave on return to work or work participation
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25 is partly inconsistent. In the other Nordic countries, partial sick leave has been found to
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27 increase the likelihood of return to regular working hours [5, 6] and to be associated with
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29 higher subsequent employment rate [7]. No effect of active sick leave (return to work to
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31 modified duties) on the average number of sick leave days or long term disability was detected
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33 in a Norwegian cluster randomized controlled trial [8]. There is some discrepancy in the
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35 findings on the effectiveness of partial sick leave in mental disorders. A Danish study [9] found
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37 no effect, whereas a Swedish study [10] reported a weak effect of partial sick leave on full
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39 recovery in the beginning of work disability due to mental disorders and a stronger effect when
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41 partial sick leave was assigned after 60 days of full sick leave.
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45 In a randomized controlled trial among persons with musculoskeletal disorders we found that
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47 early part-time sick leave predicted faster sustained return to work than full sick leave [11].
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49 The beneficial effect of partial sick leave on work retention was also observed at population
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51 level [12, 13]. Partial sick leave was associated in the short term with decreased work
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53 retention, in terms of increased subsequent sickness absence. In the long term it was
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55 associated with increased work retention, in terms of increased subsequent use of partial
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57 disability pension and decreased use of full disability pension. These findings imply the
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59 necessity to use an outcome that simultaneously accounts for different indicators of work
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1 participation. Some of these previous observational studies have suffered from limited data
2 samples and narrow generalizability of findings [5, 9], self-reported data [9], and
3 incomprehensive operationalization and measurement of work participation [5, 6, 10, 12, 13].
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10 In order for policy makers to be able to make well informed decisions in the area of social and
11 health policies, scientific evaluation of the effectiveness of population level interventions, e.g.
12 introducing new legislation or policy change is needed [14]. Natural or quasi-experiments
13 have successfully been used in connection with various population level interventions in the
14 field of public health when planned experimentation, i.e. manipulation of exposure, has not
15 been possible [15]. In the field of work disability research, this approach has, however been
16 rare [2].
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25 This study examined the effects of the new Finnish legislation on partial sickness benefit on
26 subsequent work participation. For this we compared beneficiaries of partial sickness benefit
27 with those receiving full sickness benefit a year after the law on partial sick leave was enacted.
28 We utilized a quasi-experimental design with an integrated measure of work participation.
29 Analyses were carried out in an individual level register based data representative of the
30 Finnish working population with long-term sickness absence. We examined whether the effects
31 of partial sick leave on subsequent work participation differed by sex, age, or diagnostic
32 category of the benefit receivers.
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45 **Methods**

46 *Study design and setting*

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49 The population level intervention of interest in this study was the introduction of partial sick
50 leave in Finland in 2007. We conducted a quasi-experimental study following recent guidelines
51 on evaluating population health interventions [15]. This design was chosen to minimize the
52 effect of both measured and unmeasured confounding. We compared the intervention (partial
53 sick leave) group with the comparison (full sick leave) group regarding their pre-post
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1 differences in work participation. The pre-intervention (T1) and post-intervention (T2) study
2 period each consisted of 365 days. A wash-out-period of one year was set between the sick
3 leave period and T1 and T2 periods in order to obtain a robust effect of the intervention on
4 work participation (Figure 1). These time-windows were allowed to move according to the
5 timing of the individual's sick leave period.
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17 Individual level data were derived from the national sickness insurance register of the SII and
18 the pension and earnings registers of the Finnish Centre for Pensions. Data from these three
19 registers were linked on the basis of social security numbers of the participants. The social
20 insurance register provided information on all medically certified and compensated sickness
21 absence spells, temporary and permanent national disability pensions, and old age pensions in
22 Finland. The registers of the Finnish Centre for Pensions contained information on employment
23 periods, earnings-related pensions and unsalaried periods due to disability, rehabilitation or
24 unemployment. Written consent from the individuals was not needed as only encrypted
25 register data were obtained by the researchers carrying out the analyses in the Finnish
26 Institute of Occupational Health.
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39 *Participants*

40 Participants that were granted a partial sickness benefit (intervention group) were compared
41 with those who received a full sickness benefit (comparison group). A total sample of
42 individuals who had received either partial sickness benefit (n = 1 838) or full sickness benefit
43 (n = 67 086) in 2007 - 2008 and whose compensated sickness absence period had ended
44 between 1 January and 31 December 2008 was drawn from the national sickness insurance
45 register. Since a full time sickness absence of 60 working days had to precede partial sick
46 leave, only those with full sick leave ending with an uninterrupted period of at least 60 days of
47 payment of the benefit were included in the total sample. Thus, in our sample, receivers of full
48 sickness benefit had not received partial sickness benefit, but they would have been entitled to
49 it as for the length of the preceding full time sickness absence.
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4 Since eligibility for a partial sickness benefit required a prior work contract, we excluded from
5 the analyses those who did not have any employment periods (n=2 and n=4 923) during the
6 entire study period. We additionally excluded those who had died (n=24 in the partial sick
7 leave group and n=2 600 in the full sick leave group) or moved to old age pension (n=1 and
8 n=354, respectively), had not turned 16 at the time of the first data collection period (T1)
9 (n=3) or whose sickness absence periods (ending in 2008) extended beyond the time-frame of
10 data collection (n=66 and n=1 024). The final sample included 1 738 participants in the partial
11 sick leave group and 56 754 participants in the full sick leave group. We focused our analyses
12 in the four main diagnostic groups in which partial sickness benefit has most frequently been
13 used, i.e. musculoskeletal diseases, mental disorders, traumas and tumors (M, F, S and T, and
14 C and D-categories in ICD-10, respectively). All other diagnoses were merged in one group.
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27 *Outcome measure*

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30 Work participation was operationalized as the time the individuals were likely to have actually
31 participated in gainful employment. It was approximated as the proportion (%) of time within
32 365 days when participants had an employment contract and did not receive either partial or
33 full ill-health-related benefits (sickness benefits, rehabilitation allowances, disability pensions)
34 or unemployment benefits. Work participation was calculated for T1 and T2. It was assumed
35 that when receiving partial benefits, the participants worked half of the work time (which is
36 typically the case in Finland).
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45 *Covariates*

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48 Data on sex, dates of birth and death, insurance district (region), annual gross income in
49 2007, diagnostic codes (ICD-10), and occupational branch were obtained from the sickness
50 insurance register. Information on occupation was available for all participants in the
51 intervention group and for a random sample of 7.7% of the participants in the comparison
52 group.
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Data analyses

The distributions of all variables were compared between the total full sickness benefit group (n = 67 086) and the subsample of those participants in the full sickness benefit group for whom the registers provided information on occupational branch (n = 4 347). Since no differences in the distributions were detected, we assumed that information on occupational branch was missing at random. Multiple imputation was used to compensate for the missing data on occupational branch in the comparison group. For this, we generated multiple imputed data sets (n=10) using the *proc mi* of SAS. The imputation model included all covariates.

Propensity score with 1:1 matching was used to match individuals on the probability that they would belong to the intervention (partial sick leave) group. Individuals that were matched to each other had equal or nearly equal (close enough) estimated propensity scores.

Difference-in differences- (DID-) and propensity score- (PS-) analyses are methods that are complementary to each other and can be applied in causal inference to counter selection bias and confounding [16]. We applied the DID method alone and in combination with PS-matching. Combining methods to counter bias and confounding from different sources and comparing the results has been encouraged [15]. The DID-method can be applied to control for fixed unobserved individual differences and common trends.

The DID-method allows one to estimate the difference in pre-post, within subject, differences between the intervention and the comparison group. The effect of partial sick leave on work participation was consequently estimated as the difference in pre-post-differences (differences between T2 and T1) between partial and full sick leave groups. The effect was estimated using general linear model with repeated measures design. F-statistic for the interaction term between the group assignment and change of work participation in time was applied as the difference-in-differences statistic.

Propensity score is defined as conditional probability of being exposed to a certain intervention given observed covariates [15, 17, 18]. It is applied to balance the covariates in two groups

1 and thus to reduce bias. We computed PS (i.e. probability of being exposed to partial sick
2 leave) by logistic regression for all participants. The following set of variables and their
3 interaction terms were included in the logistic regression model: age, sex, diagnostic category,
4 income, occupation, insurance district, and work participation, sickness absence, rehabilitation
5 periods and unemployment at T1. The model that balanced the covariates and work
6 participation at T1 between the intervention and comparison group best and had the best
7 model fit was chosen.
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17 Thereafter we matched the partial sick leave and full sick leave groups on the estimated
18 propensity score using local optimal (greedy) algorithm [19]. The matching was performed
19 within (sex x diagnostic category)-strata. Subsequently DID-analysis was also carried out in
20 the matched subsample.
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27 Several sensitivity analyses were carried out. The analyses were run separately for participants
28 for whom the registers provided information on occupational branch and for the total sample in
29 which imputed data on occupational branch were utilized for the comparison group. To
30 examine the group difference in work participation at T1 (due to unemployment or sick leave)
31 as source of reduced group comparability, the analyses were carried out separately among
32 participants who did not receive unemployment benefits at T1 and among participants with
33 100% of work participation at T1.
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45 **Results**

46 *Descriptive characteristics of the study population*

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48 Information on the background characteristics of the intervention and comparison group in the
49 total analysed sample is shown in Table 1. Women constituted 71% of the partial sick leave
50 group and 53% of the full sick leave group. The partial benefit was most common among those
51 who were aged between 35 and 54, whereas the full benefit among those aged from 45 to 65.
52 The income level of those in the partial sick leave group was higher than of those in the full
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1 sick leave group. The partial sickness benefit was most often used in connection with mental
2 disorders and musculoskeletal diseases, while the full benefit was most often used in
3 musculoskeletal diseases. The use of the partial benefit was most frequent in social and
4 healthcare services and administrative and office work, whereas the full benefit was most
5 commonly used in industrial and service work. No large regional differences in the use of the
6 benefits were detected.
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19 *Difference-in-differences in work participation between partial and full sick leave group*
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23 In both groups the level of work participation decreased during the follow up, the absolute
24 reduction being larger in the full sick leave group (-26.5%) compared with the partial sick
25 leave group (-21.2%) (Table 2). The absolute overall difference-in-differences in work
26 participation was 5.3% (95% CI 3.1% to 7.5%).
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33 The difference-in-differences in work participation tended to be larger in men than in women.
34 In all age categories, work participation declined more in the full than in the partial sick leave
35 group. The difference in the decline was significant in age-categories 45-54 and 55-65. There
36 was no effect in those aged 35-44. In the youngest age category (16-34 years) the difference-
37 in-differences was large but statistically non-significant.
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45 A statistically significantly larger effect was found in mental disorders compared with the other
46 diagnostic categories.
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54 The results found in the subsample of participants for whom the registers provided information
55 on occupational branch were very similar to those in the total sample (data not shown). The
56 exclusion of the participants who received unemployment benefits at T1 led to an absolute
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1 increase in the difference-in-differences in work participation (DID 7.6%, 95% CI 5.4% to
2 9.7%). The difference-in- differences in work participation increased further (DID 9.5%, 95%
3 CI 6.8% to 12.1%) when participants with reduced work participation (for any reason) at T1
4 were excluded from the analyses.
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12 *Difference-in-differences in work participation in the propensity score-matched subsample*
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16 The matching procedure resulted in a total of 1 660 matched pairs of participants. The
17 propensity score matched partial sickness benefit receivers did not differ from full sickness
18 benefit receivers with regard to age, gross income, number of unemployment days, sickness
19 absence days, rehabilitation days or work participation at T1. There were some differences
20 between the groups in the distribution of occupational branches and insurance districts
21 (Appendix Table 1).
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29 The results from the DID-analysis in the PS-matched subsample are presented in Table 3. The
30 absolute overall difference-in-differences was increased to 9.8% (95% CI 5.9 to 13.7). A
31 tendency for a larger DID in men than in women was also found in this subsample. The DID
32 was still largest in those participants aged over 45 years, but in contrast to the total sample an
33 effect was seen in the younger age categories as well. Differences between the diagnostic
34 categories were reduced as compared to the total sample. The largest effect was still found in
35 mental disorders. In addition, a statistically significant DID was also found in musculoskeletal
36 diseases and tumours. Further adjustment for the differences in the distribution of occupation
37 and insurance district between the intervention and comparison group, had no effect on the
38 results of the DID-analysis.
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Discussion

Principal findings

We applied a quasi-experimental design to study the population level effects of the introduction of partial sickness benefit in Finland among a working population with long term sickness absence. It was found that partial sick leave had a positive effect on work participation. Although the overall work participation declined from T1 to T2, at the population level the decline was 5% (absolute difference) smaller among the receivers of partial sickness benefit (intervention group) than among the receivers of full sickness benefit (comparison group). The beneficial effect of partial sick leave was seen especially among those aged from 45 to 54 and 55 to 65 and in mental disorders. No major sex difference was detected. When the groups were rendered more exchangeable, the effect on work participation was doubled, and effects were seen in other diagnostic categories than traumas and all age groups.

Validity of the study

An observational quasi-experimental study design can be applied to assess the effects of a planned event or intervention, when randomized controlled trials are not ethical or feasible. Observational studies can also better simulate real-world settings and offer more relevant information in view of policy-making [20]. The internal validity of observational studies is lower than that of randomized controlled trials due to possible selection according to exposure. For this reason, an analytical approach called potential outcomes or counterfactual framework was chosen. The term refers to the fact that in an ideal situation the exposed would be compared to themselves when unexposed. Since this comparison is impossible, we need a comparable or exchangeable comparison group. We utilized two methods (DID and PS) that have been previously recommended and applied to control for selection on both observed factors and unobserved fixed factors [15, 20, 21].

1 In the DID- method, it is assumed that the unobserved characteristics in the studied groups
2 are stable and that the outcomes would change identically in these groups in the absence of
3 intervention. Consequently, the intervention and comparison groups should be identical,
4 except for the intervention status. However, it is sufficient that the groups are closely, though
5 not exactly, similar [15]. We included in the comparison group only participants who would
6 have been entitled to partial sickness benefit as for the length of the preceding sickness
7 absence. We also applied a short wash-out period, to minimize the intragroup differences
8 between the two time points. However, as full information on the eligibility of the participants
9 for partial sickness benefit was not available in the registers (e.g. severity of the health
10 problem and degree of remaining workability), we utilized matching on PS to further increase
11 the exchangeability of the groups.
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25 We utilized nationwide population data with comprehensive individual level register based
26 information on ill-health- and unemployment-related absences from work. Personal
27 identification (social security) numbers enabled linking information from three separate source
28 registers. These registers have originally been established for administrative purposes, but the
29 data can also be used for research [22]. Among the advantages of register based studies is a
30 low likelihood of selection and attrition bias. The source registers of this study provided valid
31 information on the receivers and payment days of the benefits. A weakness of the registers is
32 that they typically provide only a limited number of background characteristics of the
33 participants and other covariates. The process of assignment to partial sick leave is complex
34 and it is affected by many actors (the patient, physician, employer, and workplace) for which
35 information cannot be found in the national registers. Nevertheless, the factors that were
36 included in the analyses have earlier been found to be important predictors of the use of
37 health-related social security benefits and also associated with work disability and return to
38 work.
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55 Information on diagnoses for sickness benefits was as well retrieved from registers and was
56 based on medical assessment. In case of a long term sickness absence (lasting more than 60
57 days) in Finland, the sickness benefit is paid in shorter periods, each being covered with a
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separate medical certificate. Diagnostic codes are transferred from these certificates to the administrative registers. We used the latest (and presumably the most accurate) diagnostic code provided for each long term sickness absence in 2007-2008. Data on occupational branch had to be imputed for the majority of participants in the comparison group. Nevertheless, the sensitivity analyses suggested that using imputed data on occupation did not affect the results. In contrast to earlier studies on the topic, work participation was approximated in the current study by taking simultaneously into account the rate of different ill-health- and unemployment-related benefits. We operationalized work participation as proportion of time within a year not receiving ill-health related or unemployment benefits. Hence we had a relatively comprehensive indicator of the availability of the participants for the labour market.

Results in relation to earlier findings

The overall results of this study are congruent with earlier findings, indicating positive effects of partial sick leave on return to work and work retention [5-7, 12]. We found that partial sick leave had a positive effect on future work participation especially in mental disorders, but the results of the analyses in the subgroup suggested that the overall effect in the total sample might be underestimated.

Our findings on the usefulness of partial sick leave in mental disorders, though not directly comparable, are congruent with a study showing beneficial effects of partial sick leave on RTW in mental disorders after 60 days of full sick leave [10], but differ from an earlier study reporting no effect [9]. The literature suggests that returning and continuing at work may be more challenging for those with mental disorders than with somatic problems (e.g. musculoskeletal diseases) [23-25]. In addition, the outflow from disability benefits due to recovery has been lower among those with mental disorders than with musculoskeletal diseases [4]. However, in our previous study we found an effect of partial sick leave on work disability pension in both diagnostic categories, the effect tending to be larger in mental disorders than in musculoskeletal diseases [12]. The diagnostic groups of musculoskeletal

1 diseases and mental disorders may differ in the degree of comparability of the partial and full
2 sick leave groups with regard to the background characteristics, severity of the health problem
3 and remaining work ability, number of sickness absences as well as in transition to
4 rehabilitation and unemployment. When the exchangeability of the groups was increased with
5 propensity score matching, a beneficial effect on work participation was detected also in
6 persons with musculoskeletal diseases and those with tumours.
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15 Sickness absence is known to increase with age [26]. In addition, it has been found that return
16 to work after long term sickness absence is less likely at higher ages [27, 28]. Partial sick
17 leave was found to be most frequently used and also most effective among middle-aged and
18 older workers. It may well be that work arrangements associated with partial sick leave are
19 more easily implemented by employees in a more established or stable work situation.
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29 **Conclusions**

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33 The overall results of the effectiveness of partial sick leave on work participation suggest that
34 the new legislation on partial sickness benefit introduced in 2007 has potential to increase
35 work participation of the working population with long term sickness absence in Finland. A
36 positive effect was seen especially in mental disorders. In the future – if applied in a larger
37 scale – partial sick leave may turn out to be an effective tool in reducing temporary and
38 permanent withdrawal of workers from the labour market due to health reasons.
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46 **Figure legend**

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50 Figure. Schematic presentation of the study design and difference-in-differences method. (T1
51 corresponds to pre-intervention period, T2 corresponds to post-intervention period).
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CONTRIBUTORSHIP STATEMENT

JK, SS, EVJ, LJV and AK designed the study. All authors were involved in data collection. JK, SS and AK conducted the analyses, all contributed to the interpretation of the results and JK, SS and EVJ drafted the manuscript. All authors accepted the final version of the manuscript.

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None

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No additional data available

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Table 1. Characteristics of participants in partial and full sick leave group at the time of intervention (n, %).

	Partial sick leave n =1738	Full sick leave n = 56 754
Sex (%)		
Female	1 236 (71.1)	30 058 (53.0)
Age (years) (%)		
16–34	217 (12.5)	10 901 (19.2)
35–44	430 (24.7)	11 231 (19.8)
45–54	753 (43.3)	18 740 (33.0)
55–65	338 (19.5)	15 882 (28.0)
Mean (SD)	46.2 (9.0)	45.7 (11.3)
Annual gross income (€) (%)		
- 30 000	1 237 (71.2)	46 119 (81.3)
30 001 – 60 000	409 (23.5)	9 593 (16.9)
60 001 -	39 (2.2)	732 (1.3)
Missing	53 (3.1)	310 (0.5)
Median	24 618	20 668
Diagnostic categories (%)		
Mental disorders	663 (38.2)	14 255 (25.1)
Musculoskeletal diseases	624 (35.9)	20 613 (36.3)
Tumours	112 (6.4)	3 031 (5.4)
Traumas	136 (7.8)	8 416 (14.8)
Other	203 (11.7)	10 439 (18.4)
Insurance district (%)		
Northern	219 (12.6)	7 764 (13.7)
Western	259 (14.9)	7 824 (13.8)
Eastern	194 (11.2)	8 525 (15.0)
South-Western	410 (23.6)	13 254 (23.3)
Southern	656 (37.7)	19 349 (34.1)
Missing	0 (0.0)	38 (0.1)
Occupational branch (%)		(non-imputed subsample n = 4 347)
Technical and scientific work etc.	193 (11.1)	409 (9.4)
Social and healthcare services	516 (29.7)	719 (16.5)
Administration and office work	293 (16.9)	413 (9.5)
Commercial work	113 (6.5)	288 (6.6)
Agriculture and forestry	50 (2.9)	214 (4.9)
Transport	60 (3.4)	269 (6.2)
Industrial and construction work, mining	309 (17.8)	1 146 (26.4)
Service work	204 (11.7)	889 (20.5)

Table 2. Comparison of work participation (%) between partial and full sick leave group (GLM repeated measures design).

Work participation (%)								
	n	Pre-intervention period (T1) Mean (95%CI)	Post-intervention period (T2) Mean (95%CI)	Post-Pre difference (T2-T1) Mean (95%CI)	p	Difference in differences Mean (95%CI)	F-statistic	p
All¹								
Partial sick leave	1 685	86.6 (85.2 to 88.1)	65.4 (63.4 to 67.4)	-21.2 (-23.4 to -19.1)	0.001	5.3 (3.1 to 7.5)	22.8	0.001
Full sick leave	56 406	79.4 (79.1 to 79.6)	52.9 (52.5 to 53.2)	-26.5 (-26.9 to -26.2)	0.001			
Males²								
Partial sick leave	490	86.6 (84.0 to 89.1)	62.7 (59.0 to 66.5)	-23.9 (-27.9 to -19.9)	0.001	6.3 (2.3 to 10.3)	9.3	0.002
Full sick leave	26 507	80.3 (80.0 to 80.7)	50.2 (49.7 to 50.7)	-30.1 (-30.7 to -29.6)	0.001			
Females²								
Partial sick leave	1 195	85.4 (83.7 to 87.0)	66.9 (64.6 to 69.3)	-18.4 (-21.0 to -15.9)	0.001	4.9 (2.4 to 7.5)	14.2	0.001
Full sick leave	29 889	78.6 (78.2 to 78.9)	55.2 (54.7 to 55.7)	-23.4 (-23.9 to -22.9)	0.001			
16-34 years¹								
Partial sick leave	210	89.3 (85.8 to 92.8)	75.5 (70.2 to 80.9)	-13.8 (-19.6 to -8.0)	0.001	2.8 (-1.1 to 10.6)	2.5	0.111
Full sick leave	10 759	84.6 (84.1 to 85.1)	66.1 (65.3 to 66.8)	-16.6 (-20.8 to -12.5)	0.001			
35-44 years¹								
Partial sick leave	424	84.7 (81.9 to 87.5)	68.1 (64.2 to 72.0)	-16.6 (-20.8 to -12.5)	0.001	2.0 (-2.2 to 6.2)	0.9	0.352
Full sick leave	11 177	78.4 (77.9 to 79.0)	59.8 (59.1 to 60.5)	-18.6 (-19.4 to -17.8)	0.001			
45-54 years¹								
Partial sick leave	725	86.9 (84.7 to 89.0)	65.7 (62.6 to 68.8)	-21.1 (-24.4 to -17.9)	0.001	4.7 (1.4 to 8.0)	7.9	0.005
Full sick leave	18 659	77.6 (77.2 to 78.1)	51.8 (51.2 to 52.4)	-25.9 (-26.5 to -25.2)	0.001			
55-65 years¹								
Partial sick leave	326	89.6 (86.3 to 92.9)	57.0 (52.3 to 61.7)	-32.6 (-37.7 to -27.5)	0.001	5.7 (0.5 to 10.8)	4.7	0.03
Full sick leave	15 811	78.5 (78.0 to 78.9)	40.2 (39.5 to 40.8)	-38.3 (-39.0 to -37.6)	0.001			
Musculoskeletal diseases³								
Partial sick leave	598	87.0 (84.8 to 89.3)	60.3 (57.0 to 63.6)	-26.7 (-30.3 to -23.2)	0.001	0.7 (-2.9 to 4.3)	0.14	0.712
Full sick leave	20 537	79.7 (79.4 to 80.1)	52.3 (51.7 to 52.9)	-27.4 (-28.0 to -26.8)	0.001			
Mental disorders³								
Partial sick leave	645	84.6 (82.2 to 87.1)	67.0 (63.8 to 70.3)	-17.6 (-21.3 to -13.9)	0.001	12.8 (9.0 to 16.5)	43.8	0.001
Full sick leave	14 136	74.6 (74.0 to 75.1)	44.2 (43.5 to 44.9)	-30.4 (-31.1 to -29.6)	0.001			

Table 2. Continued.

Work participation (%)								
	n	Pre-intervention period (T1) Mean (95%CI)	Post-intervention period (T2) Mean (95%CI)	Post-Pre difference (T2-T1) Mean (95%CI)	p	Difference in differences Mean (95%CI)	F- statistic	p
Traumas³								
Partial sick leave	132	86.7 (82.0 to 91.3)	68.1 (61.5 to 74.6)	-18.6 (-25.3 to -11.8)	0.001	-3.2 (-10.0 to 3.5)	0.89	0.348
Full sick leave	8 312	82.9 (82.3 to 91.3)	67.6 (66.7 to 68.4)	-15.3 (-16.2 to -14.5)	0.001			
Tumours³								
Partial sick leave	109	90.6 (85.9 to 95.4)	75.0 (67.4 to 82.5)	-15.7 (-23.5 to -7.9)	0.001	5.3 (-2.6 to 13.2)	1.7	0.190
Full sick leave	3 021	87.2 (86.3 to 88.1)	66.2 (64.8 to 67.6)	-21.0 (-22.4 to -19.5)	0.001			
Other diagnostic categories³								
Partial sick leave	201	87.4 (83.4 to 91.4)	63.6 (57.8 to 69.4)	-23.8 (-30.0 to -17.6)	0.001	6.2 (-0.05 to 12.5)	3.8	0.052
Full sick leave	10 400	80.2 (79.6 to 80.7)	50.1 (49.3 to 50.9)	-30.0 (-30.9 to -29.2)	0.001			

Adjusted for ¹ age, sex, income, diagnosis, occupational group, insurance district, ² age, income, diagnosis, occupational group, insurance district, ³ age, sex, income, occupational group, insurance district.

Table 3. Comparison of work participation (%) between partial and full sick leave group (GLM repeated measures design) in the PS-matched subsample.

Work participation (%)				
	n (pairs)	Difference in differences Mean (95% CI)	F-statistic	p
All¹	1 660	9.8 (5.9 to 13.7)	60.8	0.0001
Males²	489	12.4 (6.9 to 17.9)	28.1	0.002
Females²	1 171	7.2 (3.1 to 11.4)	34.0	0.0001
16-34 years	209	8.5 (0.5 to 16.6)	9.5	0.002
35-44 years	422	6.7 (0.7 to 12.6)	9.8	0.002
45-54 years	708	11.1 (6.3 to 15.9)	30.3	0.0001
55-65 years	321	12.9 (6.5 to 19.4)	12.2	0.001
Musculoskeletal diseases³	598	6.3 (1.5 to 11.2)	6.0	0.015
Mental disorders³	621	18.9 (14.2 to 23.5)	59.9	0.0001
Traumas³	131	0.3 (-9.3 to 9.9)	0.0	0.99
Tumours³	109	12.5 (1.8 to 23.2)	5.9	0.016
Other diagnostic categories³	201	11.1 (3.3 to 18.9)	7.6	0.006

Adjusted for

¹ age, sex, income, diagnosis, occupational group, insurance district,

² age, income, diagnosis, occupational group, insurance district,

³ age, sex, income, occupational group, insurance district.

APPENDIX

Table 1. Characteristics of participants in partial and full sick leave group at the time of intervention (n, %). Propensity score-matched subsample (n=1660 pairs).

	Partial sick leave	Full sick leave
Female (%)	1 171 (70.5)	1 171 (70.5)
Age (years)		
Mean (95% CI)	46.1 (45.7 to 46.5)	46.0 (45.5 to 46.5)
Annual gross income (€)		
Mean (95% CI)	27 302 (26 754 to 27 850)	26 274 (25 637 to 26 910)
Diagnostic categories (%)		
Mental disorders	621 (37.4)	621 (37.4)
Musculoskeletal diseases	598 (36.0)	598 (36.0)
Tumours	109 (6.6)	109 (6.6)
Traumas	131 (7.9)	131 (7.9)
Other	201 (12.1)	201 (12.1)
Occupational branch (%)		
Technical and scientific work etc.	178 (10.7)	223 (13.4)
Social and healthcare services	492 (29.6)	402 (24.2)
Administration and office work	281 (16.9)	230 (13.9)
Commercial work	112 (6.7)	137 (8.3)
Agriculture and forestry	490 (3.0)	71 (4.3)
Transport	58 (3.5)	79 (4.8)
Industrial and construction work, mining	300 (18.3)	301 (18.1)
Service work	190 (11.4)	217 (13.1)
Insurance district (%)		
Northern	206 (12.4)	234 (14.1)
Western	253 (15.2)	221 (13.3)
Eastern	188 (11.3)	258 (15.5)
South-Western	392 (23.6)	347 (20.9)
Southern	621 (37.4)	600 (36.1)
Number of unemployment days, T1		
Mean (95% CI)	2.8 (1.8 to 3.8)	3.6 (2.5 to 4.6)
Number of full sick leave days, T1		
Mean (95% CI)	17.0 (15.3 to 18.7)	17.9 (16.0 to 19.9)
Number of rehabilitation days, T1		
Mean (95% CI)	1.7 (0.9 to 2.5)	1.6 (0.8 to 2.4)
Work participation, T1		
Mean (95% CI)	94.1 (93.6 to 94.7)	93.7 (93.0 to 94.3)

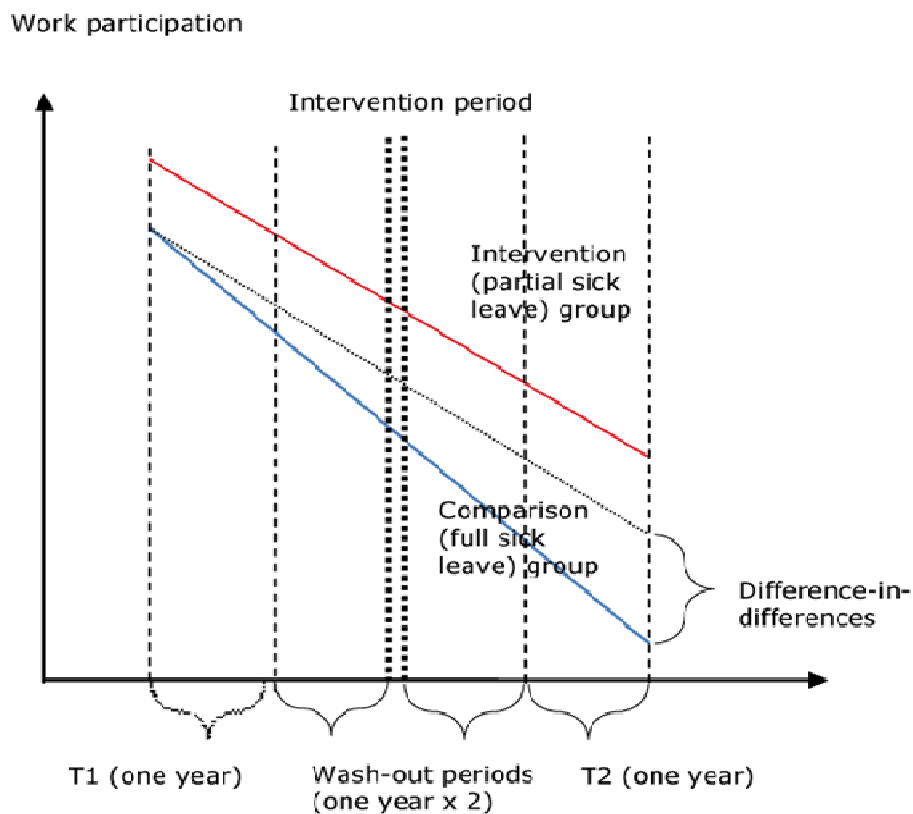


Figure. Schematic presentation of the study design and difference-in-differences method. (T1 corresponds to pre-intervention period, T2 corresponds to post-intervention period).

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Effectiveness of introduction of new legislation of partial sickness benefit on work participation: A quasi-experiment in Finland

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1 **EFFECTIVENESS OF INTRODUCTION OF NEW LEGISLATION OF**
2 **PARTIAL SICKNESS BENEFIT ON WORK PARTICIPATION: A QUASI-**
3 **EXPERIMENT IN FINLAND**

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42 Abstract

43
44 **Objectives** To examine the effect of new legislation on partial sickness benefit on subsequent
45 work participation of Finns with long-term sickness absence. Additionally, we investigated
46 whether the effect differed by sex, age, or diagnostic category.

47 **Design** A register-based quasi-experimental study compared the intervention (partial sick
48 leave) group with the comparison (full sick leave) group regarding their pre-post differences in
49 the outcome. The pre-intervention and post-intervention-period each consisted of 365 days.

50 **Setting** Nationwide, individual-level data on the beneficiaries of partial or full sickness benefit
51 in 2008 were obtained from national sickness insurance, pension and earnings registers.

52 **Participants** 1738 persons in the intervention and 56754 persons in the comparison group.

53 **Outcome** Work participation, measured as the proportion (%) of time within 365 days when
54 participants were gainfully employed and did not receive either partial or full ill-health-related
55 or unemployment benefits.

56 **Results** Although work participation declined in both groups, the decline was 5% (absolute
57 difference-in-differences) smaller in the intervention than in the comparison group, with a
58 minor sex difference. The beneficial effect of partial sick leave was seen especially among
59 those aged 45 to 54 (5%) and 55 to 65 (6%) and in mental disorders (13%). When the groups
60 were rendered more exchangeable (propensity score-matching on age, sex, diagnostic
61 category, income, occupation, insurance district, work participation, sickness absence,
62 rehabilitation periods and unemployment prior to intervention and their interaction terms), the
63 effects on work participation were doubled and seen in all age groups and in other diagnostic
64 categories than traumas.

65 **Conclusions** The results suggest that the new legislation has potential to increase work
66 participation of the population with long-term sickness absence in Finland. If applied in a larger
67 scale, partial sick leave may turn out to be a useful tool in reducing withdrawal of workers
68 from the labor market due to health reasons.

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Article Summary

Strengths and limitations of the study:

- Applying nationally representative population register-based data with valid information on the payment of health- and unemployment-related allowances in Finland.
- Applying a quasi-experimental study-design with difference-in differences and propensity score analysis to control for selection on both observed and unobserved factors.
- Registers provided only a limited number of background characteristics.

87 Introduction

88

89 The need to increase work participation of working age people is currently a matter of concern
90 in many Western countries. In Finland, delayed or lacking labor market attachment of young
91 people, absence from work during later years and early exit from labor market have all raised
92 alarm. To counteract these trends, an active labor market policy has been adopted, including
93 the introduction of partial social security benefits and other tools to increase the so called
94 flexicurity of the labor market [1]. In Finland, legislation on partial sickness benefit was
95 introduced in 2007. The new benefit allowed for the first time to combine part-time sick-leave
96 with part-time work.

97

98 The Finnish social insurance is based on the Nordic Model. Everyone who is aged from 16 to
99 67, non-retired and living permanently in the country (employees, self-employed, students,
100 unemployed job seekers and those on sabbatical or alternation leave) and also nonresidents
101 working for at least four months in Finland are covered by statutory sickness insurance. The
102 sickness allowances are financed by employers, employees and the state and they are
103 administrated by the Social Insurance Institution of Finland (SII). Statutory benefits can rest
104 on previous earnings or benefits or the minimum allowance can be granted. For the earnings-
105 related occupational sickness benefits, a minimum of three months of employment is required.

106

107 At present, the Finnish national sickness benefit scheme includes a full and a partial sickness
108 benefit. A medical certificate is an absolute requirement for the two sickness benefits to be
109 granted. In order to be eligible for the partial benefit an employee has to be eligible for a full
110 benefit as well, but according to medical judgment partial return to work is safe enough.

111 Partial sick leave is thus alternative to full sick leave and it is always medically certified. During
112 the first years after introducing the partial sickness benefit in Finland, a partial sick leave had
113 to be directly preceded by a period of full sick leave of at least 60 days and the partial sickness
114 benefit could be granted from a minimum of 12 to a maximum of 72 working days. During
115 partial sick leave, work time and salary are reduced by 40 – 60% of the regular work hours
116 and work tasks can be modified if necessary. The employee and the employer sign a fixed term

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4 118 work contract for the part-time work. In Finland, the use of partial sick leave is voluntary for
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6 119 the individual. The employer, as well, is entitled to decline the use of the benefit in case the
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8 120 work arrangements needed at the work place are not feasible.
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10 121
11 122 Sickness absence rates are in many countries higher among women compared with men [2].
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13 123 Also partial sick leave has been more frequently used by women [3]. It is known that sickness
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15 124 absence increases with age [2]. It is also recognized that challenges of return to work are
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17 125 different for example in musculoskeletal diseases and mental disorders. In the latter category,
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19 126 the outflow from disability benefits due to recovery has been lower [4].
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23 128 The current evidence on the effects of partial sick leave on return to work or work participation
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25 129 is partly inconsistent. In the other Nordic countries, partial sick leave has been found to
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27 130 increase the likelihood of return to regular working hours [5, 6] and to be associated with
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29 131 higher subsequent employment rate [7]. No effect of active sick leave (return to work to
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31 132 modified duties) on the average number of sick leave days or long-term disability was detected
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33 133 in a Norwegian cluster randomized controlled trial [8]. There is some discrepancy in the
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35 134 findings on the effectiveness of partial sick leave in mental disorders. A Danish study [9] found
36
37 135 no effect, whereas a Swedish study [10] reported a weak effect of partial sick leave on full
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39 136 recovery in the beginning of work disability due to mental disorders and a stronger effect when
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41 137 partial sick leave was assigned after 60 days of full sick leave.
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45 139 In a randomized controlled trial among persons with musculoskeletal disorders we found that
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47 140 early part-time sick leave predicted faster sustained return to work than full sick leave [11].
48
49 141 The beneficial effect of partial sick leave on work retention was also observed at population
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51 142 level [12, 13]. Partial sick leave was associated in the short term with decreased work
52
53 143 retention, in terms of increased subsequent sickness absence. In the long-term it was
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55 144 associated with increased work retention, in terms of increased subsequent use of partial
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57 145 disability pension and decreased use of full disability pension. These findings imply the
58
59 146 necessity to use an outcome that simultaneously accounts for different indicators of work
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1
2 147 participation. Some of these previous observational studies have suffered from limited data
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4 148 samples and narrow generalizability of findings [5, 9], self-reported data [9], and
5
6 149 incomprehensive operationalization and measurement of work participation [5, 6, 10, 12, 13].

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10 151 In order for policy makers to be able to make well informed decisions in the area of social and
11
12 152 health policies, scientific evaluation of the effectiveness of population level interventions, e.g.
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14 153 introducing new legislation or policy change is needed [14]. Natural or quasi-experiments
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16 154 have successfully been used in connection with various population level interventions in the
17
18 155 field of public health when planned experimentation, i.e. manipulation of exposure, has not
19
20 156 been possible [15]. In the field of work disability research, this approach has, however been
21
22 157 rare [2].

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25
26 159 This study examined the effects of the new Finnish legislation that enabled the use of partial
27
28 160 sickness benefit on subsequent work participation. For this we compared beneficiaries of partial
29
30 161 sickness benefit with those receiving full sickness benefit a year after the law on partial sick
31
32 162 leave was enacted. We utilized a quasi-experimental design with an integrated measure of
33
34 163 work participation. Analyses were carried out in an individual-level register-based data
35
36 164 representative of the Finnish working population with long-term sickness absence. We
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38 165 examined whether the effects of partial sick leave on subsequent work participation differed by
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40 166 sex, age, or diagnostic category of the benefit receivers.

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45 169 **Methods**

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48 49 171 *Study design and setting*

50
51 172 The population level intervention of interest in this study was the introduction of partial sick
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53 173 leave in Finland in 2007. We conducted a quasi-experimental study following recent guidelines
54
55 174 on evaluating population health interventions [15]. This design was chosen to minimize the
56
57 175 effect of both measured and unmeasured confounding. We compared the intervention (partial
58
59 176 sick leave) group with the comparison (full sick leave) group regarding their pre-post
60

1
2 177 differences in work participation. The pre-intervention (T1) and post-intervention (T2) study
3
4 178 period each consisted of 365 days. A wash-out-period of one year was set pre and post
5
6 179 intervention (Figure 1) in order to obtain a robust effect of the intervention on work
7
8 180 participation. These time-windows were allowed to move according to the timing of the
9
10 181 individual's sick leave period.

11 182

13 183 <Figure 1>

15 184

17 185 Individual-level data were derived from the national sickness insurance register of the SII and
18 186 the pension and earnings registers of the Finnish Centre for Pensions. Data from these three
19 187 registers were linked on the basis of social security numbers of the participants. The social
20 188 insurance register provided information on all medically certified and compensated sickness
21 189 absence spells, temporary and permanent national disability pensions, and old age pensions in
22 190 Finland. The registers of the Finnish Centre for Pensions contained information on employment
23 191 periods, earnings-related pensions and unsalaried periods due to disability, rehabilitation or
24 192 unemployment. Written consent from the individuals was not needed as only encrypted
25 193 register data were obtained by the researchers carrying out the analyses in the Finnish
26 194 Institute of Occupational Health.

27 195

29 196 *Participants*

31 197 Participants that were granted a partial sickness benefit (intervention group) were compared
32 198 with those who received a full sickness benefit (comparison group). A total sample of
33 199 individuals who had received either partial sickness benefit (n = 1 838) or full sickness benefit
34 200 (n = 67 086) in 2007 - 2008 and whose compensated sickness absence period had ended
35 201 between 1 January and 31 December 2008 was drawn from the national sickness insurance
36 202 register. Since a full time sickness absence of 60 working days had to precede partial sick
37 203 leave, only those with full sick leave ending with an uninterrupted period of at least 60 days of
38 204 payment of the benefit were included in the total sample. Thus, in our sample, receivers of full
39 205 sickness benefit had not received partial sickness benefit, but they would have been entitled to
40 206 it as for the length of the preceding full time sickness absence.

1
2 207 Since eligibility for a partial sickness benefit required a prior work contract, we excluded from
3
4 208 the analyses those who did not have any employment periods (n=2 and n=4 923) during the
5
6 209 entire study period. We additionally excluded those who had died (n=24 in the partial sick
7
8 210 leave group and n=2 600 in the full sick leave group) or moved to old age pension (n=1 and
9
10 211 n=354, respectively), had not turned 16 at the time of the first data collection period (T1)
11
12 212 (n=3) or whose sickness absence periods (ending in 2008) extended beyond the time-frame of
13
14 213 data collection (n=66 and n=1 024). The final sample included 1 738 participants in the partial
15
16 214 sick leave group and 56 754 participants in the full sick leave group. We focused our analyses
17
18 215 in the four main diagnostic groups in which partial sickness benefit has most frequently been
19
20 216 used, i.e. musculoskeletal diseases, mental disorders, traumas and tumors (M, F, S and T, and
21
22 217 C and D-categories in ICD-10, respectively). All other diagnoses were merged in one group.

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26 219 *Outcome measure*

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28 220 Work participation was operationalized as the time the individuals were likely to have actually
29
30 221 participated in gainful employment. It was approximated as the proportion (%) of time within
31
32 222 365 days when participants had an employment contract and did not receive either partial or
33
34 223 full ill-health-related benefits (sickness benefits, rehabilitation allowances, disability pensions)
35
36 224 or unemployment benefits. Work participation was calculated for T1 and T2. It was assumed
37
38 225 that when receiving partial benefits, the participants worked half of the work time (which is
39
40 226 typically the case in Finland).

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42 227

43 228 *Covariates*

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46 229 Data on sex, dates of birth and death, insurance district (region), annual gross income in
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48 230 2007, diagnostic codes (ICD-10), and occupational branch were obtained from the sickness
49
50 231 insurance register. Information on occupation was available for all participants in the
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52 232 intervention group and for a random sample of 7.7% of the participants in the comparison
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54 233 group.

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235 *Data analyses*

236 The distributions of all variables were compared between the total full sickness benefit group
237 (n = 67 086) and the subsample of those participants in the full sickness benefit group for
238 whom the registers provided information on occupational branch (n = 4 347). Since no
239 differences in the distributions were detected, we assumed that information on occupational
240 branch was missing at random. Multiple imputation was used to compensate for the missing
241 data on occupational branch in the comparison group. For this, we generated multiple imputed
242 data sets (n=10) using the *proc mi* of SAS. The imputation model included all covariates.
243
244 Propensity score with 1:1 matching was used to match individuals on the probability that they
245 would belong to the intervention (partial sick leave) group. Individuals that were matched to
246 each other had equal or nearly equal (close enough) estimated propensity scores.

247

248 Difference-in differences- (DID-) and propensity score- (PS-) analyses are methods that are
249 complementary to each other and can be applied in causal inference to counter selection bias
250 and confounding [16]. We applied the DID method alone and in combination with PS-
251 matching. Combining methods to counter bias and confounding from different sources and
252 comparing the results has been encouraged [15]. The DID-method can be applied to control
253 for fixed unobserved individual differences and common trends.

254

255 The DID-method allows one to estimate the difference in pre-post, within subject, differences
256 between the intervention and the comparison group. The effect of partial sick leave on work
257 participation was consequently estimated as the difference in pre-post-differences (differences
258 between T2 and T1) between partial and full sick leave groups. The effect was estimated using
259 general linear model with repeated measures design. F-statistic for the interaction term
260 between the group assignment and change of work participation in time was applied as the
261 difference-in-differences statistic.

262

263 Propensity score is defined as conditional probability of being exposed to a certain intervention
264 given observed covariates [15, 17, 18]. It is applied to balance the covariates in two groups

1
2 265 and thus to reduce bias. We computed PS (i.e. probability of being exposed to partial sick
3
4 266 leave) by logistic regression for all participants. The following set of variables and their
5
6 267 interaction terms were included in the logistic regression model: age, sex, diagnostic category,
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8 268 income, occupation, insurance district, and work participation, sickness absence, rehabilitation
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10 269 periods and unemployment at T1. The best fit model was chosen.

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12 270

13 271 Thereafter we matched the partial sick leave and full sick leave groups on the estimated
14
15 272 propensity score using local optimal (greedy) algorithm [19]. The matching was performed
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17 273 within (sex x diagnostic category)-strata. Subsequently DID-analysis was also carried out in
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19 274 the matched subsample.

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23 276 Several sensitivity analyses were carried out. The analyses were run separately for participants
24
25 277 for whom the registers provided information on occupational branch and for the total sample in
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27 278 which imputed data on occupational branch were utilized for the comparison group. To
28
29 279 examine the group difference in work participation at T1 (due to unemployment or sick leave)
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31 280 as source of reduced group comparability, the analyses were carried out separately among
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33 281 participants who did not receive unemployment benefits at T1 and among participants with
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35 282 100% of work participation at T1.

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40 41 285 **Results**

42 43 44 286 *Descriptive characteristics of the study population*

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46 287 Information on the background characteristics of the intervention and comparison group in the
47
48 288 total analysed sample is shown in Table 1. Women constituted 71% of the partial sick leave
49
50 289 group and 53% of the full sick leave group. The partial benefit was most common among those
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52 290 who were aged between 35 and 54, whereas the full benefit among those aged from 45 to 65.
53
54 291 The income level of those in the partial sick leave group was higher than of those in the full
55
56 292 sick leave group. The partial sickness benefit was most often used in connection with mental
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58 293 disorders and musculoskeletal diseases, while the full benefit was most often used in
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1
2 294 musculoskeletal diseases. The use of the partial benefit was most frequent in social and
3
4 295 healthcare services and administrative and office work, whereas the full benefit was most
5
6 296 commonly used in industrial and service work. No large regional differences in the use of the
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8 297 benefits were detected.

9 298

10
11 299 <Table 1>

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13 300

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15 301 *Difference-in-differences in work participation between partial and full sick leave group*

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17 302

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19 303 In both groups the level of work participation decreased during the follow up, the absolute
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21 304 reduction being larger in the full sick leave group (-26.5%) compared with the partial sick
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23 305 leave group (-21.2%) (Table 2). The absolute overall difference-in-differences in work
24
25 306 participation was 5.3% (95% CI 3.1% to 7.5%).

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27 307

28
29 308 The difference-in-differences in work participation tended to be larger in men than in women.

30
31 309 In all age categories, work participation declined more in the full than in the partial sick leave

32
33 310 group. The difference in the decline was significant in age-categories 45-54 and 55-65. There

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35 311 was no effect in those aged 35-44. In the youngest age category (16-34 years) the difference-

36
37 312 in-differences was large but statistically non-significant.

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41 314 A statistically significantly larger effect (12.8% 95% CI 9.0% to 16.5%) was found in mental

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43 315 disorders compared with the other diagnostic categories.

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47 317 <Table 2>

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51 319 The results found in the subsample of participants for whom the registers provided information

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53 320 on occupational branch were very similar to those in the total sample (data not shown). The

54
55 321 exclusion of the participants who received unemployment benefits at T1 led to an absolute

56
57 322 increase in the difference-in-differences in work participation (DID 7.6%, 95% CI 5.4% to

58
59 323 9.7%). The difference-in- differences in work participation increased further (DID 9.5%, 95%

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1
2 324 CI 6.8% to 12.1%) when participants with reduced work participation (for any reason) at T1
3
4 325 were excluded from the analyses.

5 326

6 327

8 328 *Difference-in-differences in work participation in the propensity score-matched subsample*

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11 330 The matching procedure resulted in a total of 1 660 matched pairs of participants. The

13 331 propensity score matched partial sickness benefit receivers did not differ from full sickness

15 332 benefit receivers with regard to age, gross income, number of unemployment days, sickness

17 333 absence days, rehabilitation days or work participation at T1. There were some differences

19 334 between the groups in the distribution of occupational branches and insurance districts

21 335 (Appendix Table 1).

23 336

25 337 The results from the DID-analysis in the PS-matched subsample are presented in Table 3. The

27 338 absolute overall difference-in-differences was increased to 9.8% (95% CI 5.9 to 13.7). A

29 339 tendency for a larger DID in men than in women was also found in this subsample. The DID

31 340 was still largest in those participants aged over 45 years, but in contrast to the total sample an

33 341 effect was seen in the younger age categories as well. Differences between the diagnostic

35 342 categories were reduced as compared to the total sample. The largest effect was still found in

37 343 mental disorders. In addition, a statistically significant DID was also found in musculoskeletal

39 344 diseases and tumours. Further adjustment for the differences in the distribution of occupation

41 345 and insurance district between the intervention and comparison group, had no effect on the

43 346 results of the DID-analysis.

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49 349 < Table 3 >

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1
2 352 **Discussion**

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5 353 *Principal findings*

6
7 354 We applied a quasi-experimental design to study the population level effects of the
8
9 355 introduction of partial sickness benefit in Finland among a working population with long-term
10
11 356 sickness absence. It was found that partial sick leave had a positive effect on work
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13 357 participation. Although the overall work participation declined from T1 to T2, at the population
14
15 358 level the decline was 5% (absolute difference) smaller among the receivers of partial sickness
16
17 359 benefit (intervention group) than among the receivers of full sickness benefit (comparison
18
19 360 group). The beneficial effect of partial sick leave was seen especially among those aged from
20
21 361 45 to 54 and 55 to 65 and in mental disorders. No major sex difference was detected. When
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23 362 the groups were rendered more exchangeable, the effect on work participation was doubled,
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25 363 and effects were seen in other diagnostic categories than traumas and all age groups.
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31 366 *Validity of the study*

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35 368 An observational quasi-experimental study design can be applied to assess the effects of a
36
37 369 planned event or intervention, when randomized controlled trials are not ethical or feasible.
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39 370 Observational studies can also better simulate real-world settings and offer more relevant
40
41 371 information in view of policy-making [20]. The internal validity of observational studies is lower
42
43 372 than that of randomized controlled trials due to possible selection according to exposure. For
44
45 373 this reason, an analytical approach called potential outcomes or counterfactual framework was
46
47 374 chosen. The term refers to the fact that in an ideal situation the exposed would be compared
48
49 375 to themselves when unexposed. Since this comparison is impossible, we need a comparable or
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51 376 exchangeable comparison group. We utilized two methods (DID and PS) that have been
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53 377 previously recommended and applied to control for selection on both observed factors and
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55 378 unobserved fixed factors [15, 20, 21].

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1
2 380 In the DID- method, it is assumed that the unobserved characteristics in the studied groups
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4 381 are stable and that the outcomes would change identically in these groups in the absence of
5
6 382 intervention. Consequently, the intervention and comparison groups should be identical,
7
8 383 except for the intervention status. However, it is sufficient that the groups are closely, though
9
10 384 not exactly, similar [15]. We included in the comparison group only participants who would
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12 385 have been entitled to partial sickness benefit as for the length of the preceding sickness
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14 386 absence. We also applied a short wash-out period, to minimize the intragroup differences
15
16 387 between the two time points. However, as full information on the eligibility of the participants
17
18 388 for partial sickness benefit was not available in the registers (e.g. severity of the health
19
20 389 problem and degree of remaining workability), we utilized matching on PS to further increase
21
22 390 the exchangeability of the groups. Moreover, at the time of the study, the national rates in
23
24 391 sickness absence were rather stable. The unemployment rate in Finland was relatively low
25
26 392 during the intervention in 2008 (6.4%), however the rates were similar at T1 (7.7%-8.4%)
27
28 393 and T2 (7.8%-8.4%).

29 394

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31 395 We utilized nationwide population data with comprehensive individual-level register-based
32
33 396 information on ill-health- and unemployment-related absences from work. Personal
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35 397 identification (social security) numbers enabled linking information from three separate source
36
37 398 registers. These registers have originally been established for administrative purposes, but the
38
39 399 data can also be used for research [22]. Among the advantages of register-based studies is a
40
41 400 low likelihood of selection and attrition bias. The source registers of this study provided valid
42
43 401 information on the receivers and payment days of the benefits. A weakness of the registers is
44
45 402 that they typically provide only a limited number of background characteristics of the
46
47 403 participants and other covariates. The process of assignment to partial sick leave is not
48
49 404 random. Most likely it is complex and it is affected by many actors (the patient, physician,
50
51 405 employer, and workplace) for which information cannot be found in the national registers.
52
53 406 Nevertheless, the factors that were included in the analyses have earlier been found to be
54
55 407 important predictors of the use of health-related social security benefits and also associated
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57 408 with work disability and return to work.

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1
2 410 Information on diagnoses for sickness benefits was as well retrieved from registers and was
3
4 411 based on medical assessment. In case of a long-term sickness absence (lasting more than 60
5
6 412 days) in Finland, the sickness benefit is paid in shorter periods, each being covered with a
7
8 413 separate medical certificate. Diagnostic codes are transferred from these certificates to the
9
10 414 administrative registers. We used the latest (and presumably the most accurate) diagnostic
11
12 415 code provided for each long-term sickness absence in 2007-2008. Data on occupational branch
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14 416 had to be imputed for the majority of participants in the comparison group. Nevertheless, the
15
16 417 sensitivity analyses suggested that using imputed data on occupation did not affect the results.
17
18 418 In contrast to earlier studies on the topic, work participation was approximated in the current
19
20 419 study by taking simultaneously into account the rate of different ill-health- and
21
22 420 unemployment-related benefits. We operationalized work participation as proportion of time
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24 421 within a year not receiving ill-health related or unemployment benefits. Hence we had a
25
26 422 relatively comprehensive indicator of the availability of the participants for the labour market.

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31 425 *Results in relation to earlier findings*32
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34
35 427 The overall results of this study are congruent with earlier findings, indicating positive effects
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37 428 of partial sick leave on return to work and work retention [5-7, 12]. We found that partial sick
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39 429 leave had a positive effect on future work participation especially in mental disorders, but the
40
41 430 results of the analyses in the subgroup suggested that the overall effect in the total sample
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43 431 might be underestimated.

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45 432

46
47 433 Our findings on the usefulness of partial sick leave in mental disorders, though not directly
48
49 434 comparable, are congruent with a study showing beneficial effects of partial sick leave on RTW
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51 435 in mental disorders after 60 days of full sick leave [10], but differ from an earlier study
52
53 436 reporting no effect [9]. The literature suggests that returning and continuing at work may be
54
55 437 more challenging for those with mental disorders than with somatic problems (e.g.
56
57 438 musculoskeletal diseases) [23-25]. In addition, the outflow from disability benefits due to
58
59 439 recovery has been lower among those with mental disorders than with musculoskeletal

1
2 440 diseases [4]. However, in our previous study we found an effect of partial sick leave on work
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4 441 disability pension in both diagnostic categories, the effect tending to be larger in mental
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6 442 disorders than in musculoskeletal diseases [12]. The diagnostic groups of musculoskeletal
7
8 443 diseases and mental disorders may differ in the degree of comparability of the partial and full
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10 444 sick leave groups with regard to the background characteristics, severity of the health problem
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12 445 and remaining work ability, number of sickness absences as well as in transition to
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14 446 rehabilitation and unemployment. When the exchangeability of the groups was increased with
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16 447 propensity score matching, a beneficial effect on work participation was detected also in
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18 448 persons with musculoskeletal diseases and those with tumours.

19 449
20
21 450 Sickness absence is known to increase with age [26]. In addition, it has been found that return
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23 451 to work after long-term sickness absence is less likely at higher ages [27, 28]. Partial sick
24
25 452 leave was found to be most frequently used and also most effective among middle-aged and
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27 453 older workers. It may well be that work arrangements associated with partial sick leave are
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29 454 more easily implemented by employees in a more established or stable work situation.

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31 456

32 457 **Conclusions**

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39 459 The overall results of the effectiveness of partial sick leave on work participation suggest that
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41 460 the new legislation on partial sickness benefit introduced in 2007 has potential to increase
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43 461 work participation of the working population with long-term sickness absence in Finland. A
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45 462 positive effect was seen especially in mental disorders. In the future – if applied in a larger
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47 463 scale – partial sick leave may turn out to be an effective tool in reducing temporary and
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49 464 permanent withdrawal of workers from the labour market due to health reasons.

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1
2 470 **Contributors:** JK, SS, EVJ, LJV and AK designed the study. All authors were involved in data
3
4 471 collection. JK, SS and AK conducted the analyses, all contributed to the interpretation of the
5
6 472 results and JK, SS and EVJ drafted the manuscript. All authors accepted the final version of the
7
8 473 manuscript.

9 474

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12
13 476 (grant no: 67/26/2011)

14 477

17 478 **Competing interests:** Authors declare having no competing interests.

18 479

21 480 **Ethical approval:** Ethical approval was not necessary as only encrypted data were analysed.

22 481

25 482 **Data sharing:** No additional data available.

26 483

29 484 **Figure legend**

31 485 Figure 1. Schematic presentation of the study design and difference-in-differences method. (T1
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33 486 corresponds to pre-intervention period, T2 corresponds to post-intervention period).

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2 5003
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568 Table 1. Characteristics of participants in partial and full sick leave group at the time of
569 intervention (n, %).

	Partial sick leave n =1738	Full sick leave n = 56 754
Sex (%)		
Female	1 236 (71.1)	30 058 (53.0)
Age (years) (%)		
16–34	217 (12.5)	10 901 (19.2)
35–44	430 (24.7)	11 231 (19.8)
45–54	753 (43.3)	18 740 (33.0)
55–65	338 (19.5)	15 882 (28.0)
Mean (SD)	46.2 (9.0)	45.7 (11.3)
Annual gross income (€) (%)		
- 30 000	1 237 (71.2)	46 119 (81.3)
30 001 – 60 000	409 (23.5)	9 593 (16.9)
60 001 -	39 (2.2)	732 (1.3)
Missing	53 (3.1)	310 (0.5)
Median	24 618	20 668
Diagnostic categories (%)		
Mental disorders	663 (38.2)	14 255 (25.1)
Musculoskeletal diseases	624 (35.9)	20 613 (36.3)
Tumours	112 (6.4)	3 031 (5.4)
Traumas	136 (7.8)	8 416 (14.8)
Other	203 (11.7)	10 439 (18.4)
Insurance district (%)		
Northern	219 (12.6)	7 764 (13.7)
Western	259 (14.9)	7 824 (13.8)
Eastern	194 (11.2)	8 525 (15.0)
South-Western	410 (23.6)	13 254 (23.3)
Southern	656 (37.7)	19 349 (34.1)
Missing	0 (0.0)	38 (0.1)
Occupational branch (%)		(non-imputed subsample n = 4 347)
Technical and scientific work etc.	193 (11.1)	409 (9.4)
Social and healthcare services	516 (29.7)	719 (16.5)
Administration and office work	293 (16.9)	413 (9.5)
Commercial work	113 (6.5)	288 (6.6)
Agriculture and forestry	50 (2.9)	214 (4.9)
Transport	60 (3.4)	269 (6.2)
Industrial and construction work, mining	309 (17.8)	1 146 (26.4)
Service work	204 (11.7)	889 (20.5)

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Table 2. Comparison of work participation (%) between partial and full sick leave group (GLM repeated measures design).

Work participation (%)								
	n	Pre-intervention period (T1) Mean (95%CI)	Post-intervention period (T2) Mean (95%CI)	Post-Pre difference (T2-T1) Mean (95%CI)	p	Difference in differences Mean (95%CI)	F-statistic	p
All¹								
Partial sick leave	1 685	86.6 (85.2 to 88.1)	65.4 (63.4 to 67.4)	-21.2 (-23.4 to -19.1)	0.001	5.3 (3.1 to 7.5)	22.8	0.001
Full sick leave	56 406	79.4 (79.1 to 79.6)	52.9 (52.5 to 53.2)	-26.5 (-26.9 to -26.2)	0.001			
Males²								
Partial sick leave	490	86.6 (84.0 to 89.1)	62.7 (59.0 to 66.5)	-23.9 (-27.9 to -19.9)	0.001	6.3 (2.3 to 10.3)	9.3	0.002
Full sick leave	26 507	80.3 (80.0 to 80.7)	50.2 (49.7 to 50.7)	-30.1 (-30.7 to -29.6)	0.001			
Females²								
Partial sick leave	1 195	85.4 (83.7 to 87.0)	66.9 (64.6 to 69.3)	-18.4 (-21.0 to -15.9)	0.001	4.9 (2.4 to 7.5)	14.2	0.001
Full sick leave	29 889	78.6 (78.2 to 78.9)	55.2 (54.7 to 55.7)	-23.4 (-23.9 to -22.9)	0.001			
16-34 years¹								
Partial sick leave	210	89.3 (85.8 to 92.8)	75.5 (70.2 to 80.9)	-13.8 (-19.6 to -8.0)	0.001	2.8 (-1.1 to 10.6)	2.5	0.111
Full sick leave	10 759	84.6 (84.1 to 85.1)	66.1 (65.3 to 66.8)	-16.6 (-20.8 to -12.5)	0.001			
35-44 years¹								
Partial sick leave	424	84.7 (81.9 to 87.5)	68.1 (64.2 to 72.0)	-16.6 (-20.8 to -12.5)	0.001	2.0 (-2.2 to 6.2)	0.9	0.352
Full sick leave	11 177	78.4 (77.9 to 79.0)	59.8 (59.1 to 60.5)	-18.6 (-19.4 to -17.8)	0.001			
45-54 years¹								
Partial sick leave	725	86.9 (84.7 to 89.0)	65.7 (62.6 to 68.8)	-21.1 (-24.4 to -17.9)	0.001	4.7 (1.4 to 8.0)	7.9	0.005
Full sick leave	18 659	77.6 (77.2 to 78.1)	51.8 (51.2 to 52.4)	-25.9 (-26.5 to -25.2)	0.001			
55-65 years¹								
Partial sick leave	326	89.6 (86.3 to 92.9)	57.0 (52.3 to 61.7)	-32.6 (-37.7 to -27.5)	0.001	5.7 (0.5 to 10.8)	4.7	0.03
Full sick leave	15 811	78.5 (78.0 to 78.9)	40.2 (39.5 to 40.8)	-38.3 (-39.0 to -37.6)	0.001			
Musculoskeletal diseases³								
Partial sick leave	598	87.0 (84.8 to 89.3)	60.3 (57.0 to 63.6)	-26.7 (-30.3 to -23.2)	0.001	0.7 (-2.9 to 4.3)	0.14	0.712
Full sick leave	20 537	79.7 (79.4 to 80.1)	52.3 (51.7 to 52.9)	-27.4 (-28.0 to -26.8)	0.001			
Mental disorders³								
Partial sick leave	645	84.6 (82.2 to 87.1)	67.0 (63.8 to 70.3)	-17.6 (-21.3 to -13.9)	0.001	12.8 (9.0 to 16.5)	43.8	0.001
Full sick leave	14 136	74.6 (74.0 to 75.1)	44.2 (43.5 to 44.9)	-30.4 (-31.1 to -29.6)	0.001			

Table 2. Continued.

Work participation (%)								
	n	Pre-intervention period (T1) Mean (95%CI)	Post-intervention period (T2) Mean (95%CI)	Post-Pre difference (T2-T1) Mean (95%CI)	p	Difference in differences Mean (95%CI)	F- statistic	p
Traumas³								
Partial sick leave	132	86.7 (82.0 to 91.3)	68.1 (61.5 to 74.6)	-18.6 (-25.3 to -11.8)	0.001	-3.2 (-10.0 to 3.5)	0.89	0.348
Full sick leave	8 312	82.9 (82.3 to 91.3)	67.6 (66.7 to 68.4)	-15.3 (-16.2 to -14.5)	0.001			
Tumours³								
Partial sick leave	109	90.6 (85.9 to 95.4)	75.0 (67.4 to 82.5)	-15.7 (-23.5 to -7.9)	0.001	5.3 (-2.6 to 13.2)	1.7	0.190
Full sick leave	3 021	87.2 (86.3 to 88.1)	66.2 (64.8 to 67.6)	-21.0 (-22.4 to -19.5)	0.001			
Other diagnostic categories³								
Partial sick leave	201	87.4 (83.4 to 91.4)	63.6 (57.8 to 69.4)	-23.8 (-30.0 to -17.6)	0.001	6.2 (-0.05 to 12.5)	3.8	0.052
Full sick leave	10 400	80.2 (79.6 to 80.7)	50.1 (49.3 to 50.9)	-30.0 (-30.9 to -29.2)	0.001			

Adjusted for ¹ age, sex, income, diagnosis, occupational group, insurance district, ² age, income, diagnosis, occupational group, insurance district, ³ age, sex, income, occupational group, insurance district.

Table 3. Comparison of work participation (%) between partial and full sick leave group (GLM repeated measures design) in the PS-matched subsample.

Work participation (%)				
	n (pairs)	Difference in differences Mean (95% CI)	F-statistic	p
All¹	1 660	9.8 (5.9 to 13.7)	60.8	0.0001
Males²	489	12.4 (6.9 to 17.9)	28.1	0.002
Females²	1 171	7.2 (3.1 to 11.4)	34.0	0.0001
16-34 years	209	8.5 (0.5 to 16.6)	9.5	0.002
35-44 years	422	6.7 (0.7 to 12.6)	9.8	0.002
45-54 years	708	11.1 (6.3 to 15.9)	30.3	0.0001
55-65 years	321	12.9 (6.5 to 19.4)	12.2	0.001
Musculoskeletal diseases³	598	6.3 (1.5 to 11.2)	6.0	0.015
Mental disorders³	621	18.9 (14.2 to 23.5)	59.9	0.0001
Traumas³	131	0.3 (-9.3 to 9.9)	0.0	0.99
Tumours³	109	12.5 (1.8 to 23.2)	5.9	0.016
Other diagnostic categories³	201	11.1 (3.3 to 18.9)	7.6	0.006

Adjusted for

¹ age, sex, income, diagnosis, occupational group, insurance district,

² age, income, diagnosis, occupational group, insurance district,

³ age, sex, income, occupational group, insurance district.

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1 **EFFECTIVENESS OF INTRODUCTION OF NEW LEGISLATION OF**
2 **PARTIAL SICKNESS BENEFIT ON WORK PARTICIPATION: A QUASI-**
3 **EXPERIMENT IN FINLAND**

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For peer review only

Abstract

Objectives To examine the effect of new legislation on partial sickness benefit on subsequent work participation of Finns with long-term sickness absence. Additionally, we investigated whether the effect differed by sex, age, or diagnostic category.

Design A register-based quasi-experimental study compared the intervention (partial sick leave) group with the comparison (full sick leave) group regarding their pre-post differences in the outcome. The pre-intervention and post-intervention-period each consisted of 365 days.

Setting Nationwide, individual-level data on the beneficiaries of partial or full sickness benefit in 2008 were obtained from national sickness insurance, pension and earnings registers.

Participants 1738 persons in the intervention and 56754 persons in the comparison group.

Outcome Work participation, measured as the proportion (%) of time within 365 days when participants were gainfully employed and did not receive either partial or full ill-health-related or unemployment benefits.

Results Although work participation declined in both groups, the decline was 5% (absolute difference-in-differences) smaller in the intervention than in the comparison group, with a minor sex difference. The beneficial effect of partial sick leave was seen especially among those aged 45 to 54 (5%) and 55 to 65 (6%) and in mental disorders (13%). When the groups were rendered more exchangeable (propensity score-matching on age, sex, diagnostic category, income, occupation, insurance district, work participation, sickness absence, rehabilitation periods and unemployment prior to intervention and their interaction terms), the effects on work participation were doubled and seen in all age groups and in other diagnostic categories than traumas.

Conclusions The results suggest that the new legislation has potential to increase work participation of the population with long-term sickness absence in Finland. If applied in a larger scale, partial sick leave may turn out to be a useful tool in reducing withdrawal of workers from the labor market due to health reasons.

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2 35 **Article Summary**
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5 38 Strengths and limitations of the study:
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8 40 • Applying nationally representative population register-based data with valid information
9 41 on the payment of health- and unemployment-related allowances in Finland.
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11 43 • Applying a quasi-experimental study-design with difference-in differences and
12 44 propensity score analysis to control for selection on both observed and unobserved
13 45 factors.
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15 47 • Registers provided only a limited number of background characteristics.
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50 Introduction

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52 The need to increase work participation of working age people is currently a matter of concern
53 in many Western countries. In Finland, delayed or lacking labor market attachment of young
54 people, absence from work during later years and early exit from labor market have all raised
55 alarm. To counteract these trends, an active labor market policy has been adopted, including
56 the introduction of partial social security benefits and other tools to increase the so called
57 flexicurity of the labor market [1]. In Finland, legislation on partial sickness benefit was
58 introduced in 2007. The new benefit allowed for the first time to combine part-time sick-leave
59 with part-time work.

60

61 The Finnish social insurance is based on the Nordic Model. Everyone who is aged from 16 to
62 67, non-retired and living permanently in the country (employees, self-employed, students,
63 unemployed job seekers and those on sabbatical or alternation leave) and also nonresidents
64 working for at least four months in Finland are covered by statutory sickness insurance. The
65 sickness allowances are financed by employers, employees and the state and they are
66 administrated by the Social Insurance Institution of Finland (SII). Statutory benefits can rest
67 on previous earnings or benefits or the minimum allowance can be granted. For the earnings-
68 related occupational sickness benefits, a minimum of three months of employment is required.

69

70 At present, the Finnish national sickness benefit scheme includes a full and a partial sickness
71 benefit. A medical certificate is an absolute requirement for the two sickness benefits to be
72 granted. In order to be eligible for the partial benefit an employee has to be eligible for a full
73 benefit as well, but according to medical judgment partial return to work is safe enough.
74 Partial sick leave is thus alternative to full sick leave and it is always medically certified. During
75 the first years after introducing the partial sickness benefit in Finland, a partial sick leave had
76 to be directly preceded by a period of full sick leave of at least 60 days and the partial sickness
77 benefit could be granted from a minimum of 12 to a maximum of 72 working days. During
78 partial sick leave, work time and salary are reduced by 40 – 60% of the regular work hours
79 and work tasks can be modified if necessary. The employee and the employer sign a fixed term

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4 81 work contract for the part-time work. In Finland, the use of partial sick leave is voluntary for
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6 82 the individual. The employer, as well, is entitled to decline the use of the benefit in case the
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8 83 work arrangements needed at the work place are not feasible.

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11 85 Sickness absence rates are in many countries higher among women compared with men [2].

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13 86 Also partial sick leave has been more frequently used by women [3]. It is known that sickness
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15 87 absence increases with age [2]. It is also recognized that challenges of return to work are
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17 88 different for example in musculoskeletal diseases and mental disorders. In the latter category,
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19 89 the outflow from disability benefits due to recovery has been lower [4].

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23 91 The current evidence on the effects of partial sick leave on return to work or work participation
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25 92 is partly inconsistent. In the other Nordic countries, partial sick leave has been found to
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27 93 increase the likelihood of return to regular working hours [5, 6] and to be associated with
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29 94 higher subsequent employment rate [7]. No effect of active sick leave (return to work to
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31 95 modified duties) on the average number of sick leave days or long-term disability was detected
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33 96 in a Norwegian cluster randomized controlled trial [8]. There is some discrepancy in the
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35 97 findings on the effectiveness of partial sick leave in mental disorders. A Danish study [9] found
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37 98 no effect, whereas a Swedish study [10] reported a weak effect of partial sick leave on full
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39 99 recovery in the beginning of work disability due to mental disorders and a stronger effect when
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41 100 partial sick leave was assigned after 60 days of full sick leave.

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45 102 In a randomized controlled trial among persons with musculoskeletal disorders we found that
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47 103 early part-time sick leave predicted faster sustained return to work than full sick leave [11].

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49 104 The beneficial effect of partial sick leave on work retention was also observed at population
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51 105 level [12, 13]. Partial sick leave was associated in the short term with decreased work
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53 106 retention, in terms of increased subsequent sickness absence. In the long-term it was
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55 107 associated with increased work retention, in terms of increased subsequent use of partial
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57 108 disability pension and decreased use of full disability pension. These findings imply the
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59 109 necessity to use an outcome that simultaneously accounts for different indicators of work
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2 110 participation. Some of these previous observational studies have suffered from limited data
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4 111 samples and narrow generalizability of findings [5, 9], self-reported data [9], and
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6 112 incomprehensive operationalization and measurement of work participation [5, 6, 10, 12, 13].

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10 114 In order for policy makers to be able to make well informed decisions in the area of social and
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12 115 health policies, scientific evaluation of the effectiveness of population level interventions, e.g.
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14 116 introducing new legislation or policy change is needed [14]. Natural or quasi-experiments
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16 117 have successfully been used in connection with various population level interventions in the
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18 118 field of public health when planned experimentation, i.e. manipulation of exposure, has not
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20 119 been possible [15]. In the field of work disability research, this approach has, however been
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22 120 rare [2].

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25 122 This study examined the effects of the new Finnish legislation **that enabled the use of partial**
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27 123 **sickness benefit** on subsequent work participation. For this we compared beneficiaries of partial
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29 124 sickness benefit with those receiving full sickness benefit a year after the law on partial sick
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31 125 leave was enacted. We utilized a quasi-experimental design with an integrated measure of
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33 126 work participation. Analyses were carried out in an individual-level register-based data
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35 127 representative of the Finnish working population with long-term sickness absence. We
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37 128 examined whether the effects of partial sick leave on subsequent work participation differed by
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39 129 sex, age, or diagnostic category of the benefit receivers.

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44 132 **Methods**

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47 134 *Study design and setting*

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49 135 The population level intervention of interest in this study was the introduction of partial sick
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51 136 leave in Finland in 2007. We conducted a quasi-experimental study following recent guidelines
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53 137 on evaluating population health interventions [15]. This design was chosen to minimize the
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55 138 effect of both measured and unmeasured confounding. We compared the intervention (partial
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57 139 sick leave) group with the comparison (full sick leave) group regarding their pre-post
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2 140 differences in work participation. The pre-intervention (T1) and post-intervention (T2) study
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4 141 period each consisted of 365 days. A wash-out-period of one year was set **pre and post**
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6 142 **intervention (Figure 1)** in order to obtain a robust effect of the intervention on work
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8 143 participation. These time-windows were allowed to move according to the timing of the
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10 144 individual's sick leave period.

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12
13 146 <Figure 1>

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17 148 Individual-level data were derived from the national sickness insurance register of the SII and
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19 149 the pension and earnings registers of the Finnish Centre for Pensions. Data from these three
20
21 150 registers were linked on the basis of social security numbers of the participants. The social
22
23 151 insurance register provided information on all medically certified and compensated sickness
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25 152 absence spells, temporary and permanent national disability pensions, and old age pensions in
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27 153 Finland. The registers of the Finnish Centre for Pensions contained information on employment
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29 154 periods, earnings-related pensions and unsalaried periods due to disability, rehabilitation or
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31 155 unemployment. Written consent from the individuals was not needed as only encrypted
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33 156 register data were obtained by the researchers carrying out the analyses in the Finnish
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35 157 Institute of Occupational Health.

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38 39 159 *Participants*

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41 160 Participants that were granted a partial sickness benefit (intervention group) were compared
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43 161 with those who received a full sickness benefit (comparison group). A total sample of
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45 162 individuals who had received either partial sickness benefit (n = 1 838) or full sickness benefit
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47 163 (n = 67 086) in 2007 - 2008 and whose compensated sickness absence period had ended
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49 164 between 1 January and 31 December 2008 was drawn from the national sickness insurance
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51 165 register. Since a full time sickness absence of 60 working days had to precede partial sick
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53 166 leave, only those with full sick leave ending with an uninterrupted period of at least 60 days of
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55 167 payment of the benefit were included in the total sample. Thus, in our sample, receivers of full
56
57 168 sickness benefit had not received partial sickness benefit, but they would have been entitled to
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59 169 it as for the length of the preceding full time sickness absence.

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2 170 Since eligibility for a partial sickness benefit required a prior work contract, we excluded from
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4 171 the analyses those who did not have any employment periods (n=2 and n=4 923) during the
5
6 172 entire study period. We additionally excluded those who had died (n=24 in the partial sick
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8 173 leave group and n=2 600 in the full sick leave group) or moved to old age pension (n=1 and
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10 174 n=354, respectively), had not turned 16 at the time of the first data collection period (T1)
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12 175 (n=3) or whose sickness absence periods (ending in 2008) extended beyond the time-frame of
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14 176 data collection (n=66 and n=1 024). The final sample included 1 738 participants in the partial
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16 177 sick leave group and 56 754 participants in the full sick leave group. We focused our analyses
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18 178 in the four main diagnostic groups in which partial sickness benefit has most frequently been
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20 179 used, i.e. musculoskeletal diseases, mental disorders, traumas and tumors (M, F, S and T, and
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22 180 C and D-categories in ICD-10, respectively). All other diagnoses were merged in one group.

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25 182 *Outcome measure*

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28 183 Work participation was operationalized as the time the individuals were likely to have actually
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30 184 participated in gainful employment. It was approximated as the proportion (%) of time within
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32 185 365 days when participants had an employment contract and did not receive either partial or
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34 186 full ill-health-related benefits (sickness benefits, rehabilitation allowances, disability pensions)
35
36 187 or unemployment benefits. Work participation was calculated for T1 and T2. It was assumed
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38 188 that when receiving partial benefits, the participants worked half of the work time (which is
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40 189 typically the case in Finland).

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43 191 *Covariates*

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46 192 Data on sex, dates of birth and death, insurance district (region), annual gross income in
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48 193 2007, diagnostic codes (ICD-10), and occupational branch were obtained from the sickness
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50 194 insurance register. Information on occupation was available for all participants in the
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52 195 intervention group and for a random sample of 7.7% of the participants in the comparison
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54 196 group.

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198 *Data analyses*

199 The distributions of all variables were compared between the total full sickness benefit group
200 (n = 67 086) and the subsample of those participants in the full sickness benefit group for
201 whom the registers provided information on occupational branch (n = 4 347). Since no
202 differences in the distributions were detected, we assumed that information on occupational
203 branch was missing at random. Multiple imputation was used to compensate for the missing
204 data on occupational branch in the comparison group. For this, we generated multiple imputed
205 data sets (n=10) using the *proc mi* of SAS. The imputation model included all covariates.
206
207 Propensity score with 1:1 matching was used to match individuals on the probability that they
208 would belong to the intervention (partial sick leave) group. Individuals that were matched to
209 each other had equal or nearly equal (close enough) estimated propensity scores.

210

211 Difference-in differences- (DID-) and propensity score- (PS-) analyses are methods that are
212 complementary to each other and can be applied in causal inference to counter selection bias
213 and confounding [16]. We applied the DID method alone and in combination with PS-
214 matching. Combining methods to counter bias and confounding from different sources and
215 comparing the results has been encouraged [15]. The DID-method can be applied to control
216 for fixed unobserved individual differences and common trends.

217

218 The DID-method allows one to estimate the difference in pre-post, within subject, differences
219 between the intervention and the comparison group. The effect of partial sick leave on work
220 participation was consequently estimated as the difference in pre-post-differences (differences
221 between T2 and T1) between partial and full sick leave groups. The effect was estimated using
222 general linear model with repeated measures design. F-statistic for the interaction term
223 between the group assignment and change of work participation in time was applied as the
224 difference-in-differences statistic.

225

226 Propensity score is defined as conditional probability of being exposed to a certain intervention
227 given observed covariates [15, 17, 18]. It is applied to balance the covariates in two groups

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2 228 and thus to reduce bias. We computed PS (i.e. probability of being exposed to partial sick
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4 229 leave) by logistic regression for all participants. The following set of variables and their
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6 230 interaction terms were included in the logistic regression model: age, sex, diagnostic category,
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8 231 income, occupation, insurance district, and work participation, sickness absence, rehabilitation
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10 232 periods and unemployment at T1. **The best fit model was chosen.**

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12 233

13 234 Thereafter we matched the partial sick leave and full sick leave groups on the estimated
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15 235 propensity score using local optimal (greedy) algorithm [19]. The matching was performed
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17 236 within (sex x diagnostic category)-strata. Subsequently DID-analysis was also carried out in
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19 237 the matched subsample.

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23 239 Several sensitivity analyses were carried out. The analyses were run separately for participants
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25 240 for whom the registers provided information on occupational branch and for the total sample in
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27 241 which imputed data on occupational branch were utilized for the comparison group. To
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29 242 examine the group difference in work participation at T1 (due to unemployment or sick leave)
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31 243 as source of reduced group comparability, the analyses were carried out separately among
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33 244 participants who did not receive unemployment benefits at T1 and among participants with
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35 245 100% of work participation at T1.

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40 41 248 **Results**

42 43 44 249 *Descriptive characteristics of the study population*

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46 250 Information on the background characteristics of the intervention and comparison group in the
47
48 251 total analysed sample is shown in Table 1. Women constituted 71% of the partial sick leave
49
50 252 group and 53% of the full sick leave group. The partial benefit was most common among those
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52 253 who were aged between 35 and 54, whereas the full benefit among those aged from 45 to 65.
53
54 254 The income level of those in the partial sick leave group was higher than of those in the full
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56 255 sick leave group. The partial sickness benefit was most often used in connection with mental
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58 256 disorders and musculoskeletal diseases, while the full benefit was most often used in

1
2 257 musculoskeletal diseases. The use of the partial benefit was most frequent in social and
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4 258 healthcare services and administrative and office work, whereas the full benefit was most
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6 259 commonly used in industrial and service work. No large regional differences in the use of the
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8 260 benefits were detected.

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11 262 <Table 1>

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15 264 *Difference-in-differences in work participation between partial and full sick leave group*

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19 266 In both groups the level of work participation decreased during the follow up, the absolute
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21 267 reduction being larger in the full sick leave group (-26.5%) compared with the partial sick
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23 268 leave group (-21.2%) (Table 2). The absolute overall difference-in-differences in work
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25 269 participation was 5.3% (95% CI 3.1% to 7.5%).

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29 271 The difference-in-differences in work participation tended to be larger in men than in women.

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31 272 In all age categories, work participation declined more in the full than in the partial sick leave
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33 273 group. The difference in the decline was significant in age-categories 45-54 and 55-65. There
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35 274 was no effect in those aged 35-44. In the youngest age category (16-34 years) the difference-
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37 275 in-differences was large but statistically non-significant.

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41 277 A statistically significantly larger effect (12.8% 95% CI 9.0% to 16.5%) was found in mental
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43 278 disorders compared with the other diagnostic categories.

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47 280 <Table 2>

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51 282 The results found in the subsample of participants for whom the registers provided information
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53 283 on occupational branch were very similar to those in the total sample (data not shown). The
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55 284 exclusion of the participants who received unemployment benefits at T1 led to an absolute
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57 285 increase in the difference-in-differences in work participation (DID 7.6%, 95% CI 5.4% to
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59 286 9.7%). The difference-in- differences in work participation increased further (DID 9.5%, 95%

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2 287 CI 6.8% to 12.1%) when participants with reduced work participation (for any reason) at T1
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4 288 were excluded from the analyses.

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8 291 *Difference-in-differences in work participation in the propensity score-matched subsample*

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11 293 The matching procedure resulted in a total of 1 660 matched pairs of participants. The

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13 294 propensity score matched partial sickness benefit receivers did not differ from full sickness

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15 295 benefit receivers with regard to age, gross income, number of unemployment days, sickness

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17 296 absence days, rehabilitation days or work participation at T1. There were some differences

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19 297 between the groups in the distribution of occupational branches and insurance districts

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21 298 (Appendix Table 1).

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25 300 The results from the DID-analysis in the PS-matched subsample are presented in Table 3. The

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27 301 absolute overall difference-in-differences was increased to 9.8% (95% CI 5.9 to 13.7). A

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29 302 tendency for a larger DID in men than in women was also found in this subsample. The DID

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31 303 was still largest in those participants aged over 45 years, but in contrast to the total sample an

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33 304 effect was seen in the younger age categories as well. Differences between the diagnostic

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35 305 categories were reduced as compared to the total sample. The largest effect was still found in

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37 306 mental disorders. In addition, a statistically significant DID was also found in musculoskeletal

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39 307 diseases and tumours. Further adjustment for the differences in the distribution of occupation

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41 308 and insurance district between the intervention and comparison group, had no effect on the

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43 309 results of the DID-analysis.

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49 312 < Table 3 >

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2 315 **Discussion**

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5 316 *Principal findings*

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7 317 We applied a quasi-experimental design to study the population level effects of the
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9 318 introduction of partial sickness benefit in Finland among a working population with long-term
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11 319 sickness absence. It was found that partial sick leave had a positive effect on work
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13 320 participation. Although the overall work participation declined from T1 to T2, at the population
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15 321 level the decline was 5% (absolute difference) smaller among the receivers of partial sickness
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17 322 benefit (intervention group) than among the receivers of full sickness benefit (comparison
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19 323 group). The beneficial effect of partial sick leave was seen especially among those aged from
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21 324 45 to 54 and 55 to 65 and in mental disorders. No major sex difference was detected. When
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23 325 the groups were rendered more exchangeable, the effect on work participation was doubled,
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25 326 and effects were seen in other diagnostic categories than traumas and all age groups.

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31 329 *Validity of the study*

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35 331 An observational quasi-experimental study design can be applied to assess the effects of a
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37 332 planned event or intervention, when randomized controlled trials are not ethical or feasible.
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39 333 Observational studies can also better simulate real-world settings and offer more relevant
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41 334 information in view of policy-making [20]. The internal validity of observational studies is lower
42
43 335 than that of randomized controlled trials due to possible selection according to exposure. For
44
45 336 this reason, an analytical approach called potential outcomes or counterfactual framework was
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47 337 chosen. The term refers to the fact that in an ideal situation the exposed would be compared
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49 338 to themselves when unexposed. Since this comparison is impossible, we need a comparable or
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51 339 exchangeable comparison group. We utilized two methods (DID and PS) that have been
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53 340 previously recommended and applied to control for selection on both observed factors and
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55 341 unobserved fixed factors [15, 20, 21].

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2 343 In the DID- method, it is assumed that the unobserved characteristics in the studied groups
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4 344 are stable and that the outcomes would change identically in these groups in the absence of
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6 345 intervention. Consequently, the intervention and comparison groups should be identical,
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8 346 except for the intervention status. However, it is sufficient that the groups are closely, though
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10 347 not exactly, similar [15]. We included in the comparison group only participants who would
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12 348 have been entitled to partial sickness benefit as for the length of the preceding sickness
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14 349 absence. We also applied a short wash-out period, to minimize the intragroup differences
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16 350 between the two time points. However, as full information on the eligibility of the participants
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18 351 for partial sickness benefit was not available in the registers (e.g. severity of the health
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20 352 problem and degree of remaining workability), we utilized matching on PS to further increase
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22 353 the exchangeability of the groups. Moreover, at the time of the study, the national rates in
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24 354 sickness absence were rather stable. The unemployment rate in Finland was relatively low
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26 355 during the intervention in 2008 (6.4%), however the rates were similar at T1 (7.7%-8.4%)
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28 356 and T2 (7.8%-8.4%).

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31 358 We utilized nationwide population data with comprehensive individual-level register-based
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33 359 information on ill-health- and unemployment-related absences from work. Personal
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35 360 identification (social security) numbers enabled linking information from three separate source
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37 361 registers. These registers have originally been established for administrative purposes, but the
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39 362 data can also be used for research [22]. Among the advantages of register-based studies is a
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41 363 low likelihood of selection and attrition bias. The source registers of this study provided valid
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43 364 information on the receivers and payment days of the benefits. A weakness of the registers is
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45 365 that they typically provide only a limited number of background characteristics of the
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47 366 participants and other covariates. The process of assignment to partial sick leave is not
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49 367 random. Most likely it is complex and it is affected by many actors (the patient, physician,
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51 368 employer, and workplace) for which information cannot be found in the national registers.
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53 369 Nevertheless, the factors that were included in the analyses have earlier been found to be
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55 370 important predictors of the use of health-related social security benefits and also associated
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57 371 with work disability and return to work.

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2 373 Information on diagnoses for sickness benefits was as well retrieved from registers and was
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4 374 based on medical assessment. In case of a long-term sickness absence (lasting more than 60
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6 375 days) in Finland, the sickness benefit is paid in shorter periods, each being covered with a
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8 376 separate medical certificate. Diagnostic codes are transferred from these certificates to the
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10 377 administrative registers. We used the latest (and presumably the most accurate) diagnostic
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12 378 code provided for each long-term sickness absence in 2007-2008. Data on occupational branch
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14 379 had to be imputed for the majority of participants in the comparison group. Nevertheless, the
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16 380 sensitivity analyses suggested that using imputed data on occupation did not affect the results.
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18 381 In contrast to earlier studies on the topic, work participation was approximated in the current
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20 382 study by taking simultaneously into account the rate of different ill-health- and
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22 383 unemployment-related benefits. We operationalized work participation as proportion of time
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24 384 within a year not receiving ill-health related or unemployment benefits. Hence we had a
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26 385 relatively comprehensive indicator of the availability of the participants for the labour market.

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29 388 *Results in relation to earlier findings*

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33 390 The overall results of this study are congruent with earlier findings, indicating positive effects
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35 391 of partial sick leave on return to work and work retention [5-7, 12]. We found that partial sick
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37 392 leave had a positive effect on future work participation especially in mental disorders, but the
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39 393 results of the analyses in the subgroup suggested that the overall effect in the total sample
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41 394 might be underestimated.

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45 396 Our findings on the usefulness of partial sick leave in mental disorders, though not directly
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47 397 comparable, are congruent with a study showing beneficial effects of partial sick leave on RTW
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49 398 in mental disorders after 60 days of full sick leave [10], but differ from an earlier study
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51 399 reporting no effect [9]. The literature suggests that returning and continuing at work may be
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53 400 more challenging for those with mental disorders than with somatic problems (e.g.
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55 401 musculoskeletal diseases) [23-25]. In addition, the outflow from disability benefits due to
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57 402 recovery has been lower among those with mental disorders than with musculoskeletal

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2 403 diseases [4]. However, in our previous study we found an effect of partial sick leave on work
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4 404 disability pension in both diagnostic categories, the effect tending to be larger in mental
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6 405 disorders than in musculoskeletal diseases [12]. The diagnostic groups of musculoskeletal
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8 406 diseases and mental disorders may differ in the degree of comparability of the partial and full
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10 407 sick leave groups with regard to the background characteristics, severity of the health problem
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12 408 and remaining work ability, number of sickness absences as well as in transition to
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14 409 rehabilitation and unemployment. When the exchangeability of the groups was increased with
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16 410 propensity score matching, a beneficial effect on work participation was detected also in
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18 411 persons with musculoskeletal diseases and those with tumours.

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21 413 Sickness absence is known to increase with age [26]. In addition, it has been found that return
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23 414 to work after long-term sickness absence is less likely at higher ages [27, 28]. Partial sick
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25 415 leave was found to be most frequently used and also most effective among middle-aged and
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27 416 older workers. It may well be that work arrangements associated with partial sick leave are
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29 417 more easily implemented by employees in a more established or stable work situation.

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31 419

32 420 **Conclusions**

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35 422 The overall results of the effectiveness of partial sick leave on work participation suggest that
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37 423 the new legislation on partial sickness benefit introduced in 2007 has potential to increase
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39 424 work participation of the working population with long-term sickness absence in Finland. A
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41 425 positive effect was seen especially in mental disorders. In the future – if applied in a larger
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43 426 scale – partial sick leave may turn out to be an effective tool in reducing temporary and
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45 427 permanent withdrawal of workers from the labour market due to health reasons.

46 428

47 429 **Figure legend**

48 430

49 431 Figure. Schematic presentation of the study design and difference-in-differences method. (T1
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51 432 corresponds to pre-intervention period, T2 corresponds to post-intervention period).

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500

501 Table 1. Characteristics of participants in partial and full sick leave group at the time of
502 intervention (n, %).

	Partial sick leave n =1738	Full sick leave n = 56 754
Sex (%)		
Female	1 236 (71.1)	30 058 (53.0)
Age (years) (%)		
16–34	217 (12.5)	10 901 (19.2)
35–44	430 (24.7)	11 231 (19.8)
45–54	753 (43.3)	18 740 (33.0)
55–65	338 (19.5)	15 882 (28.0)
Mean (SD)	46.2 (9.0)	45.7 (11.3)
Annual gross income (€) (%)		
- 30 000	1 237 (71.2)	46 119 (81.3)
30 001 – 60 000	409 (23.5)	9 593 (16.9)
60 001 -	39 (2.2)	732 (1.3)
Missing	53 (3.1)	310 (0.5)
Median	24 618	20 668
Diagnostic categories (%)		
Mental disorders	663 (38.2)	14 255 (25.1)
Musculoskeletal diseases	624 (35.9)	20 613 (36.3)
Tumours	112 (6.4)	3 031 (5.4)
Traumas	136 (7.8)	8 416 (14.8)
Other	203 (11.7)	10 439 (18.4)
Insurance district (%)		
Northern	219 (12.6)	7 764 (13.7)
Western	259 (14.9)	7 824 (13.8)
Eastern	194 (11.2)	8 525 (15.0)
South-Western	410 (23.6)	13 254 (23.3)
Southern	656 (37.7)	19 349 (34.1)
Missing	0 (0.0)	38 (0.1)
Occupational branch (%)		(non-imputed subsample n = 4 347)
Technical and scientific work etc.	193 (11.1)	409 (9.4)
Social and healthcare services	516 (29.7)	719 (16.5)
Administration and office work	293 (16.9)	413 (9.5)
Commercial work	113 (6.5)	288 (6.6)
Agriculture and forestry	50 (2.9)	214 (4.9)
Transport	60 (3.4)	269 (6.2)
Industrial and construction work, mining	309 (17.8)	1 146 (26.4)
Service work	204 (11.7)	889 (20.5)

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Table 2. Comparison of work participation (%) between partial and full sick leave group (GLM repeated measures design).

Work participation (%)								
	n	Pre-intervention period (T1) Mean (95%CI)	Post-intervention period (T2) Mean (95%CI)	Post-Pre difference (T2-T1) Mean (95%CI)	p	Difference in differences Mean (95%CI)	F-statistic	p
All¹								
Partial sick leave	1 685	86.6 (85.2 to 88.1)	65.4 (63.4 to 67.4)	-21.2 (-23.4 to -19.1)	0.001	5.3 (3.1 to 7.5)	22.8	0.001
Full sick leave	56 406	79.4 (79.1 to 79.6)	52.9 (52.5 to 53.2)	-26.5 (-26.9 to -26.2)	0.001			
Males²								
Partial sick leave	490	86.6 (84.0 to 89.1)	62.7 (59.0 to 66.5)	-23.9 (-27.9 to -19.9)	0.001	6.3 (2.3 to 10.3)	9.3	0.002
Full sick leave	26 507	80.3 (80.0 to 80.7)	50.2 (49.7 to 50.7)	-30.1 (-30.7 to -29.6)	0.001			
Females²								
Partial sick leave	1 195	85.4 (83.7 to 87.0)	66.9 (64.6 to 69.3)	-18.4 (-21.0 to -15.9)	0.001	4.9 (2.4 to 7.5)	14.2	0.001
Full sick leave	29 889	78.6 (78.2 to 78.9)	55.2 (54.7 to 55.7)	-23.4 (-23.9 to -22.9)	0.001			
16-34 years¹								
Partial sick leave	210	89.3 (85.8 to 92.8)	75.5 (70.2 to 80.9)	-13.8 (-19.6 to -8.0)	0.001	2.8 (-1.1 to 10.6)	2.5	0.111
Full sick leave	10 759	84.6 (84.1 to 85.1)	66.1 (65.3 to 66.8)	-16.6 (-20.8 to -12.5)	0.001			
35-44 years¹								
Partial sick leave	424	84.7 (81.9 to 87.5)	68.1 (64.2 to 72.0)	-16.6 (-20.8 to -12.5)	0.001	2.0 (-2.2 to 6.2)	0.9	0.352
Full sick leave	11 177	78.4 (77.9 to 79.0)	59.8 (59.1 to 60.5)	-18.6 (-19.4 to -17.8)	0.001			
45-54 years¹								
Partial sick leave	725	86.9 (84.7 to 89.0)	65.7 (62.6 to 68.8)	-21.1 (-24.4 to -17.9)	0.001	4.7 (1.4 to 8.0)	7.9	0.005
Full sick leave	18 659	77.6 (77.2 to 78.1)	51.8 (51.2 to 52.4)	-25.9 (-26.5 to -25.2)	0.001			
55-65 years¹								
Partial sick leave	326	89.6 (86.3 to 92.9)	57.0 (52.3 to 61.7)	-32.6 (-37.7 to -27.5)	0.001	5.7 (0.5 to 10.8)	4.7	0.03
Full sick leave	15 811	78.5 (78.0 to 78.9)	40.2 (39.5 to 40.8)	-38.3 (-39.0 to -37.6)	0.001			
Musculoskeletal diseases³								
Partial sick leave	598	87.0 (84.8 to 89.3)	60.3 (57.0 to 63.6)	-26.7 (-30.3 to -23.2)	0.001	0.7 (-2.9 to 4.3)	0.14	0.712
Full sick leave	20 537	79.7 (79.4 to 80.1)	52.3 (51.7 to 52.9)	-27.4 (-28.0 to -26.8)	0.001			
Mental disorders³								
Partial sick leave	645	84.6 (82.2 to 87.1)	67.0 (63.8 to 70.3)	-17.6 (-21.3 to -13.9)	0.001	12.8 (9.0 to 16.5)	43.8	0.001
Full sick leave	14 136	74.6 (74.0 to 75.1)	44.2 (43.5 to 44.9)	-30.4 (-31.1 to -29.6)	0.001			

Table 2. Continued.

Work participation (%)								
	n	Pre-intervention period (T1) Mean (95%CI)	Post-intervention period (T2) Mean (95%CI)	Post-Pre difference (T2-T1) Mean (95%CI)	p	Difference in differences Mean (95%CI)	F-statistic	p
Traumas³								
Partial sick leave	132	86.7 (82.0 to 91.3)	68.1 (61.5 to 74.6)	-18.6 (-25.3 to -11.8)	0.001	-3.2 (-10.0 to 3.5)	0.89	0.348
Full sick leave	8 312	82.9 (82.3 to 91.3)	67.6 (66.7 to 68.4)	-15.3 (-16.2 to -14.5)	0.001			
Tumours³								
Partial sick leave	109	90.6 (85.9 to 95.4)	75.0 (67.4 to 82.5)	-15.7 (-23.5 to -7.9)	0.001	5.3 (-2.6 to 13.2)	1.7	0.190
Full sick leave	3 021	87.2 (86.3 to 88.1)	66.2 (64.8 to 67.6)	-21.0 (-22.4 to -19.5)	0.001			
Other diagnostic categories³								
Partial sick leave	201	87.4 (83.4 to 91.4)	63.6 (57.8 to 69.4)	-23.8 (-30.0 to -17.6)	0.001	6.2 (-0.05 to 12.5)	3.8	0.052
Full sick leave	10 400	80.2 (79.6 to 80.7)	50.1 (49.3 to 50.9)	-30.0 (-30.9 to -29.2)	0.001			

Adjusted for ¹ age, sex, income, diagnosis, occupational group, insurance district, ² age, income, diagnosis, occupational group, insurance district, ³ age, sex, income, occupational group, insurance district.

Table 3. Comparison of work participation (%) between partial and full sick leave group (GLM repeated measures design) in the PS-matched subsample.

Work participation (%)				
	n (pairs)	Difference in differences Mean (95% CI)	F-statistic	p
All¹	1 660	9.8 (5.9 to 13.7)	60.8	0.0001
Males²	489	12.4 (6.9 to 17.9)	28.1	0.002
Females²	1 171	7.2 (3.1 to 11.4)	34.0	0.0001
16-34 years	209	8.5 (0.5 to 16.6)	9.5	0.002
35-44 years	422	6.7 (0.7 to 12.6)	9.8	0.002
45-54 years	708	11.1 (6.3 to 15.9)	30.3	0.0001
55-65 years	321	12.9 (6.5 to 19.4)	12.2	0.001
Musculoskeletal diseases³	598	6.3 (1.5 to 11.2)	6.0	0.015
Mental disorders³	621	18.9 (14.2 to 23.5)	59.9	0.0001
Traumas³	131	0.3 (-9.3 to 9.9)	0.0	0.99
Tumours³	109	12.5 (1.8 to 23.2)	5.9	0.016
Other diagnostic categories³	201	11.1 (3.3 to 18.9)	7.6	0.006

Adjusted for

¹ age, sex, income, diagnosis, occupational group, insurance district,

² age, income, diagnosis, occupational group, insurance district,

³ age, sex, income, occupational group, insurance district.

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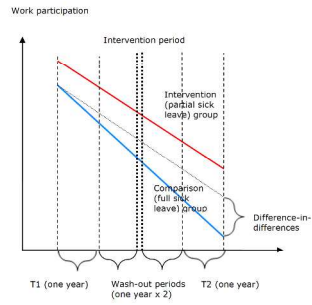


Figure. Schematic presentation of the study design and difference-in-differences method. (T1 corresponds to pre-intervention period, T2 corresponds to post-intervention period).

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APPENDIX

Table 1. Characteristics of participants in partial and full sick leave group at the time of intervention (n, %). Propensity score-matched subsample (n=1660 pairs).

	Partial sick leave	Full sick leave
Female (%)	1 171 (70.5)	1 171 (70.5)
Age (years)		
Mean (95% CI)	46.1 (45.7 to 46.5)	46.0 (45.5 to 46.5)
Annual gross income (€)		
Mean (95% CI)	27 302 (26 754 to 27 850)	26 274 (25 637 to 26 910)
Diagnostic categories (%)		
Mental disorders	621 (37.4)	621 (37.4)
Musculoskeletal diseases	598 (36.0)	598 (36.0)
Tumours	109 (6.6)	109 (6.6)
Traumas	131 (7.9)	131 (7.9)
Other	201 (12.1)	201 (12.1)
Occupational branch (%)		
Technical and scientific work etc.	178 (10.7)	223 (13.4)
Social and healthcare services	492 (29.6)	402 (24.2)
Administration and office work	281 (16.9)	230 (13.9)
Commercial work	112 (6.7)	137 (8.3)
Agriculture and forestry	490 (3.0)	71 (4.3)
Transport	58 (3.5)	79 (4.8)
Industrial and construction work, mining	300 (18.3)	301 (18.1)
Service work	190 (11.4)	217 (13.1)
Insurance district (%)		
Northern	206 (12.4)	234 (14.1)
Western	253 (15.2)	221 (13.3)
Eastern	188 (11.3)	258 (15.5)
South-Western	392 (23.6)	347 (20.9)
Southern	621 (37.4)	600 (36.1)
Number of unemployment days, T1		
Mean (95% CI)	2.8 (1.8 to 3.8)	3.6 (2.5 to 4.6)
Number of full sick leave days, T1		
Mean (95% CI)	17.0 (15.3 to 18.7)	17.9 (16.0 to 19.9)
Number of rehabilitation days, T1		
Mean (95% CI)	1.7 (0.9 to 2.5)	1.6 (0.8 to 2.4)
Work participation, T1		
Mean (95% CI)	94.1 (93.6 to 94.7)	93.7 (93.0 to 94.3)