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Worker and workplace determinants of employment exit: a register study

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ABSTRACT

Background Workers with chronic illness are in higher risk of unemployment. This article investigated the worker and workplace characteristics associated with labour market inclusion for workers with a diagnosed chronic illness.

Methods Linked employer-employee register data covering all Norwegian employers and employees each month from February 2015 to December 2019 were merged with patient data from specialist healthcare (136 196 observations (job spells); 70 923 individual workers). Survival analysis was used to estimate the risk of employment exit, with age, gender, chronic illness, full-time/part-time employment, skill level, marital status, children in household, branch, share of chronically ill workers, firm size and unemployment rate as covariates.

Results 85% of the study population was employed in December 2019; 58% remain employed throughout the follow-up period. Mental illness, male gender, young age, part-time employment and lower skill levels were the worker-level predictors of labour market exit. Employments in secondary industries, in firms with high shares of chronically ill workers and, to some extent, in larger firms were the significant workplace-level determinants.

Conclusion Only a minority of our sample of workers with chronic illness experienced labour market exclusion. Targeted measures should be considered towards workers with poor mental health and/or low formal skills. Chronically ill workers within public administration have the best labour market prospects, while workplaces within the education branch have an unfulfilled potential.

STRENGTHS AND LIMITATIONS OF THIS STUDY

⇒ The study population selected for this article is based on nationwide patient register data for the entire Norwegian population, including all inpatient and outpatient contacts.
⇒ Data from several registers are merged to obtain information on employment, education, demographics and the workplace.
⇒ Individual-level employment data are updated on a monthly basis.
⇒ Working conditions are not measured in the register data, but indicated by proxies.
⇒ The study population is based on healthcare utilisation; certain condition, demographic or socioeconomic groups may be over-represented or under-represented in these data.

INTRODUCTION

Sick people work less. Through economic upturns and downturns, people with poor health are vulnerable to labour market exclusion, for example, through hardened working conditions or mass lay-offs.[1 2] Inclusion of people with chronic illnesses in the workforce has advantages at the societal level, since the share of the working-age population with a chronic illness is increasing, as well as for individuals, both by increasing their income and through other more latent functions (eg, sense of community and self-sustainability).[3 4] In this article, we aim to investigate worker and particularly workplace features that are associated with labour market inclusion for workers with chronic illness.

Health selection occurs when people are 'selected' to social positions, such as employment, based on their health status.[5] This is a mechanism that is likely to contribute to the social health gradient, which is observable also in Norway.[6–9] Health selection *into* employment can occur if workers' poor health has a 'scarring effect', that is, leads to employment gaps or other proxies that signal lower productivity to the employers, thus making chronically ill people less attractive to hire. Chronic illness may also affect one's job-seeking ability. Second, there may be health selection *out of* employment: if the chronically ill worker is unable to cope with the demands of working life—and/or the employer does not make sufficient efforts to prevent this. Recent research suggests that there is substantial variation between employers in labour market inclusion of chronically ill workers.[10 11] In Norway, the important role of the employer is emphasised by the Tripartite Agreement for a More Inclusive Working Life (the IA Agreement), which gives employers access to services and subsidies that aim to reduce sickness absence and increase work participation. However, evaluations suggest that effects are mixed.[12 13]

In this article, we do not test the extent or degree of health selection but make an

incremental contribution by investigating the determinants of labour market exit for the chronically ill. We use Norwegian linked employer-employee (LEE) register data to select a study population of chronically ill workers who all are employed at the start of our study period, and follow their labour market trajectories over 59 months, with the purpose of identifying worker-level and particularly workplace-level determinants of labour market inclusion.

Previous research has suggested some worker characteristics that could influence the risk of employment exit for people with health problems. One is workers' required skill level or achieved education, which indicates the actual tasks the workers are set to do, for example, manual or sedentary work.[5 14–16] There is also evidence of heterogeneity between different chronic conditions,[16] with a recent study emphasising mental and substance disorders as the number one cause of health-related productivity loss in Norway.[17]

Second, there may be branch-specific characteristics that impact workers' prospects of participation. For instance, employment in wholesale and retail has been associated with higher risk of employment exit, while employment in public administration has been associated with the opposite.[10 11 18] Certain occupations and skill levels are of course over-represented in certain branches, but, as this article will show, branches significantly differ in the inclusion of the chronically ill, also when the composition of workers is adjusted for.

Third, workplaces may vary in the extent to which they implement policies to keep their chronically ill employees. Example of supply-side measures is education or training to increase workers' competence or health behaviour. Examples of the demand-side measures are wage subsidies and physical or psychological support. In previous register studies, the extent of demand-side policies and workplace adjustments has been approximated by different measures. Administrative registries usually cover the full population, but a drawback is the lack of explicit indicators of working conditions.[19] This article draws on previous register studies when we construct proxies for workplaces' policies to include workers with chronic illness. One commonly used proxy measure is the firms' share of workers with health problems. On the one hand, a higher share is indicative of the firm's experience and/or success in work inclusion. On the other hand, a high share of chronically ill workers may simply indicate a workplace with poor material and psychosocial working conditions. Empirical evidence indicates both positive[10 18] and negative[11] associations with employment.

Firm size has in previous research often been significantly associated with employment for workers with health problems, but with inconsistent results.[18] On the one hand, large companies may have a developed human resources bureaucracy tailored to deal with work inclusion of the chronically ill or disabled (cf ref 20). On the other hand, bureaucratisation and standardisation may imply more rigid schemes for the workers to comply, thereby leading to less autonomy and flexibility (cf ref 21). Workers at small workplaces could also be considered indispensable, which could make (1) employers go to greater lengths to keep them in their workforce, or (2) the workers 'internalize the adverse consequences of their own absence',[22] that is, feel more obligated to remain at work when their absence is more noticeable.

DATA AND METHODS

We use LEE data (from database FD-Trygd) from February 2015 to December 2019, which we merge with patient data from the National Patient Registry. The LEE data are based on Norwegian employers' legally obliged reports to the tax authorities and include all employees of the given month. Healthcare utilisation is our marker of chronic illness; this is a validated indicator which, unlike, for example, disability benefits, is not directly related to an assessment of work ability. We adopt the concept of 'index hospitalization' (ie, index use of specialist healthcare), meaning that only the first healthcare episode is registered, and no one is registered with more than one diagnosis.

Individuals are included in our study population if they were (1) in contact with specialist healthcare in 2014 and diagnosed with one of the following chronic conditions (based on ref 23): cancer (lymphoma, metastatic and non-metastatic cancers), cardiovascular diseases (atrial fibrillation, chronic heart failure, hypertension, myocardial infarction, stroke), diabetes, mental health issues (dementia, depression, schizophrenia), musculoskeletal conditions (chronic pain, rheumatoid arthritis) and respiratory conditions (asthma, chronic obstructive pulmonary disease); (2) employed in February 2015; and (3) alive in December 2019. The purpose of these criteria is to construct a homogenous sample that included individuals with chronic health conditions likely to affect their work capacity in the following years, but whose health was 'good enough' to be employed at the start of the study period and alive at the end of the period. The youngest person in our dataset is 16 years old, and we censor at 62 years of age, which is when most Norwegian workers can start to claim early retirement pensions. We do not want to overestimate health-related employment exit risks by including these exits that are potentially more voluntary than disability retirement. Some occupations are characterised by seasonal work and appear less as traditional workplaces (eg, agriculture and fishing, and a very heterogenous 'other' category); job spells in these groups are therefore excluded. Self-employed are not registered in the LEE data. Job spells where employees also are registered with work assessment allowance, full-time disability pension or ongoing education are excluded. Out of a total of 192 295 patients with chronic illness in 2014, 83 771 are employed and under the age of 62 in February 2015. All exclusions, also due to lacking values on other covariates, leave us with a study population of 136 196 job spells

distributed on 70 923 individual workers (37% of patients with baseline chronic illness) and 50 810 workplaces.

Employment is defined by being present in the LEE data, meaning that a break in the employment spell indicates exit. Employment exits could therefore include both worklessness, attainment in education, participation in labour market programmes and disability retirement. Workers on parental leave (where salary is 100% replaced in 49 weeks, divided between parents) are registered as employed. Each person is registered with one employer per month; if several employment relations are listed, we choose the one with the highest employment percentage. This implies that a worker will still be registered as employed if they make monthly transitions between part-time employments at different workplaces. Chronic illness is categorised into six disease groups, which we include in the models to explore risk heterogeneity. Employees' skill level is retrieved from the LEE, where we code International Standard Classification of Occupation 2008 codes into four categories that indicate the skill demanded to perform the job: (1) no particular skill demanded, (2) corresponding to secondary or vocational education, (3) corresponding to lower degree tertiary education (3 years or less) and (4) corresponding to higher degree tertiary education (4 years or more). Workers' full-time or part-time employment, as reported by the employer, is controlled for in the model, where we expect that part-time work for many chronically ill workers is a last step before leaving the labour market. Age, age squared, gender, marital status (with unmarried as the reference category), presence of children under age 18 in household and partial disability (expressed as a percentage) are also included as covariates(table 1).

In the registers, establishments (Norwegian: *virksomhet*) are the units that most closely resembles a physical workplace. On this level, we include three variables. First, a sixfold branch categorisation based on the Nomenclature of Economic Activities standard. Second, the firms' share of employees with a chronic illness coded into quartile groups; these are defined by the values 3.4%, 5.4% and 10%. Third, the firms' number of employees classified by European Union[24] standards into micro (<10 employees), small (10–49), medium (50–249) and large (>249). To adjust analyses for variations in the demand for labour, we include the yearly municipal unemployment rate.[25]

For descriptive purposes, we estimate the mean survival time (number of months) for our independent categorical variables. Preliminary analyses indicate violations of the proportional hazards assumption being violated for certain variables. We therefore fit models where gender, part-time/full-time employment, branch, the share of chronically ill workers, firm size and unemployment rate are interacted with a function of time to produce time-varying coefficients. Note that for these variables, the HR should be interpreted as the risk at the beginning of the employment spell. To account for correlation between spells within the same individual, SEs are clustered at the worker level. Results are presented as HRs in table 2.

Table 1 Descriptive statistics

	%	Restricted mean survival	95% CI
Chronic illness			
Cardiovascular	7.66	55.2	55.0–55.5
Muscular/skeletal	31.9	54.4	54.2–54.6
Mental	27.4	52.6	52.3–52.8
Respiratory	7.95	54.5	54.2–54.9
Diabetes	17.7	54.7	54.5–54.9
Cancer	7.41	55.5	55.2–55.8
Gender			
Female	55.3	54.3	54.1–54.4
Male	44.7	54.2	54.0–54.3
Age*	45.5 (11.3)		
Marital status			
Unmarried	59.1	53.4	53.3–53.5
Married	40.9	55.2	55.0–55.3
Children aged <18 in household			
No	57.4	54.1	54.0–54.2
Yes	42.6	54.4	54.3–54.5
Disability degree*	1.12 (8.15)		
Full-time/part-time employment			
<20%	6.30	35.2	34.3–36.2
20–39%	5.70	45.7	44.8–46.5
40–59%	8.05	52.9	52.5–53.3
60–79%	6.90	54.2	53.8–54.6
80–99%	7.96	55.2	54.9–55.5
≥100%	65.1	55.4	55.3–55.5
Skill level			
Low skill	14.6	53.4	53.1–53.6
Secondary education	48.8	53.3	53.1–53.4
Short higher education	22.6	55.3	55.1–55.4
Long higher education	14.0	56.0	55.8–56.1
Branch/industry			
Public administration	6.17	56.1	55.9–56.4
Secondary	16.0	54.6	54.4–54.8
Service/ transportation	37.3	53.3	53.1–53.5
Education	8.90	55.2	54.9–55.5
Health /social work	27.9	54.5	54.3–54.7
Recreation/ household	3.77	53.0	52.4–53.6
Share of chronically ill workers			
1st quartile	24.0	54.6	54.4–54.8
2nd quartile	22.5	55.1	55.0–55.3
3rd quartile	25.1	54.5	54.3–54.7
4th quartile	28.4	52.7	52.5–52.9

Continued

Table 1 Continued

	%	Restricted mean survival	95% CI
Firm size			
Micro	19.2	52.0	51.7–52.3
Small	37.3	54.1	54.0–54.3
Medium	28.5	54.8	54.7–55.0
Large	15.0	55.4	55.2–55.5
Unemployment rate*	2.10 (0.645)		
Observations			136 196
Individuals			70 923

*Continuous variable, presented as mean (SD); no restricted mean survival calculated.

To further explore heterogeneity in employment exit risks, we also perform sensitivity analyses stratified by age groups, presented in the online supplemental appendix.

Our workplace variables of interest are categorical and thus sensitive to the choice of reference group. We therefore perform pairwise comparisons reported in the online supplemental appendix. In addition, we plot the unemployment risks for the different categories of the workplace variables against the overall mean risk of unemployment in figure 1. Here, we compare the estimated risks from model 2 (Workplace) and model 3 (Full), that is, before and after we adjust for worker composition.

Patient and public involvement

Patients or public were not involved in the design or interpretation of this study.

RESULTS

At baseline, February 2015, the study population consists of 54% women and has a mean age of 44. The most common chronic diagnosis is musculoskeletal disorders (32%). 65% of the study population is employed full time, and 14% has a high-skill occupation. The largest branch is service and transport with 37% of the workers. 15% of the workers are employed in a large firm, while 19% are in a micro firm. At the end of the study period, December 2019, 85% of the study population is employed.

Some worker characteristics are significantly associated with labour market survival. There are small differences between different chronic conditions, but (unreported) pairwise comparisons reflect the unadjusted mean survival time from table 1: workers with mental health problems have a higher risk of employment exit compared with all other conditions, with a 27% higher risk compared with workers with diabetes. Male workers have a 33% higher risk of employment exit compared with women, while the risk of employment exit decreases by 4% per year of age. High-skilled chronically ill workers are on average employed longer (table 1) and have a smaller risk of

Table 2 Cox regression results, HRs

	(1) Worker	(2) Workplace	(3) Full model
Chronic illness			
Cardiovascular	1		1
Musculoskeletal	1.024		1.017
Mental	1.267***		1.276***
Respiratory	0.945		0.955
Diabetes	0.927		0.931
Cancer	0.913		0.907
Male	1.392***		1.327***
Age	0.951***		0.957***
Age squared	1.000*		1.000+
Married	0.899***		0.889***
Children aged <18 in household	0.978		0.974
Disability degree	0.999		0.999
Full-time/part-time employment			
0–19%	1		1
20–39%	0.585***		0.570***
40–59%	0.308***		0.307***
60–79%	0.252***		0.259***
80–99%	0.186***		0.187***
≥100%	0.162***		0.163***
Skill level			
Low skill	1		1
Secondary education	0.821***		0.840***
Short higher education	0.653***		0.707***
Long higher education	0.540***		0.608***
Branch/industry			
Public administration		1	1
Secondary		1.987***	1.556***
Service/transportation		2.124***	1.389**
Education		1.479**	1.389*
Health/social work		1.898***	1.273*
Recreation/household		2.246***	1.496**
Share of chronically ill workers			
1st quartile group		1	1
2nd quartile group		0.826**	0.875*
3rd quartile group		0.987	1.030
4th quartile group		1.250*	1.240*
Firm size			
Micro		1	1
Small		0.827*	0.842*
Medium		0.758**	0.834+
Large		0.618***	0.807+
Unemployment rate	1.697***	1.837***	1.690***
Observations	136 196	136 196	136 196

Continued

Table 2 Continued

	(1) Worker	(2) Workplace	(3) Full model
Individuals	70923	70923	70923

+p<.1, *p<0.05, **p<0.01, ***p<0.001, ****p<0.1.
SEs clustered at the individual worker.

employment exit (table 2). Full-time employees have a longer mean survival time (table 1) and a lower risk of employment exit (table 2). Partial disability is not significantly associated with the risk of exit. Married workers have 11% lower risk of exit, while there is no significant association with living with children under 18. A higher unemployment rate is associated with higher exit risk.

When we turn to the estimated risks associated with the workplace-level variables, HR coefficients in table 2, model 2 suggests that public administration employees have lower risk of employment exit than workers in all other branches. These coefficients become smaller when we in model 3 also include worker variables (ie, control for the composition of workers in the different branches) but remain significant. The biggest gap is between employees in public administration and in the secondary industries, the latter have a 56% higher risk of employment exit. Pairwise comparisons (online supplemental appendix table A.1) show that workers in secondary industries also have significantly higher risk of employment exit than service/transport and health and social work branches. In the unadjusted model, workers in the service and transport, health and social work, and the recreation and household branches all have a higher than average risk of employment exit, but these associations are not robust to the inclusion of worker-level variables. In the full model, workers in the secondary industry and education have a higher risk of employment exit compared with the mean, while workers in public administration and health and social services have a significantly lower risk.

In the survival models, workers in the group of firms with the largest share (4th quartile) of chronically ill employees have a 24% higher risk of employment exit than workers in the 1st quartile group, while workers in the 2nd quartile group have a 12% lower risk. Pairwise HR comparisons (online supplemental appendix table A.2) indicate that workers in the 4th quartile group have a higher risk than all other groups, and workers in the 3rd quartile group have a higher risk than those in the 2nd quartile group. Compared with the grand mean (figure 1), the 2nd quartile group is associated with 15% lower risk, while the 4th quartile group is associated with 21% higher risk of employment exit.

When we compare restricted mean survival times, firm size and mean labour market survival appear to be

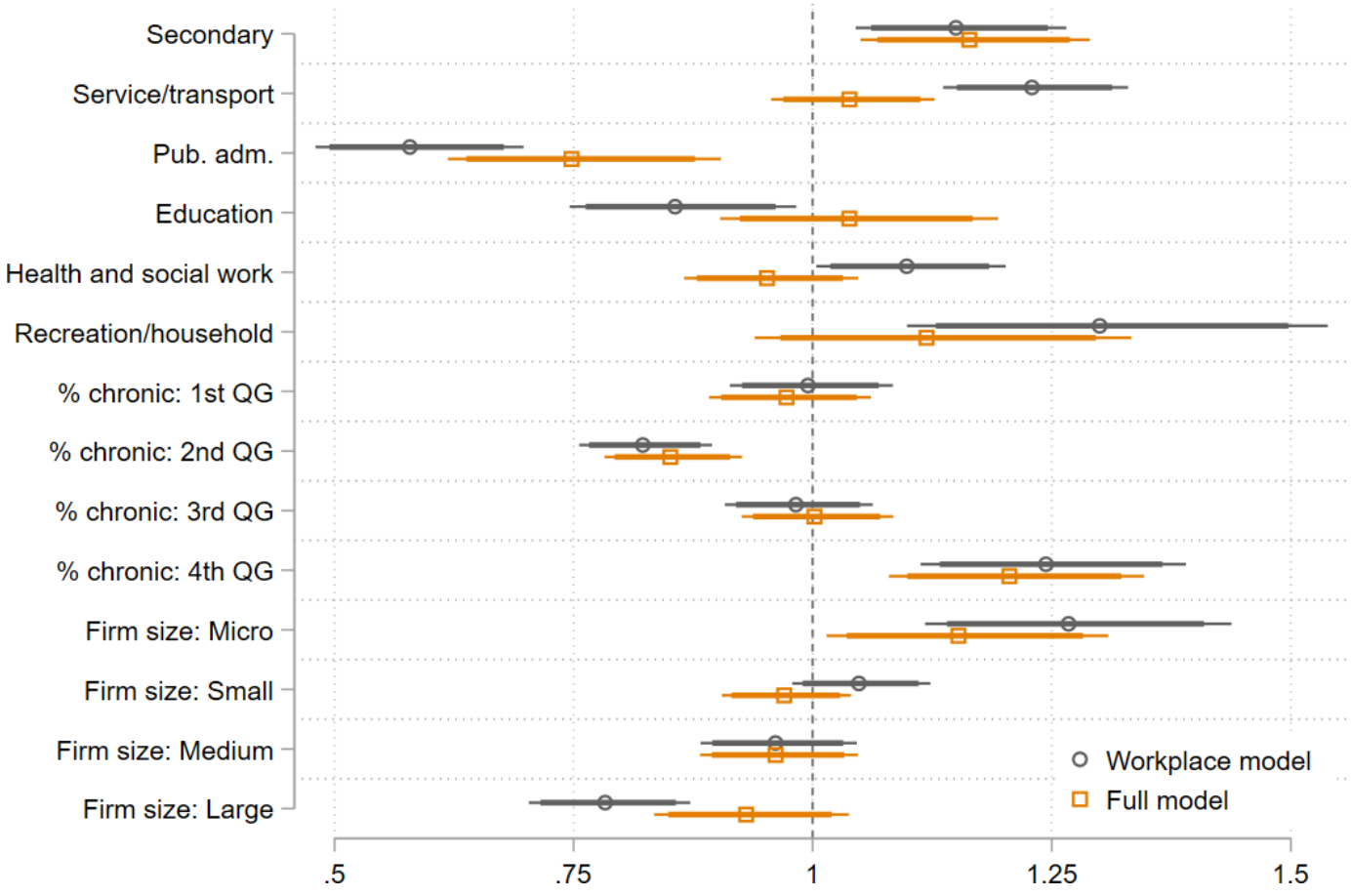

Figure 1 Workplace variables, comparisons to mean (HRs, 90 and 95% CI). QG, quartile group.

positively correlated in these data. In the full model, small, medium and large firms significantly differ from the micro firms, with respectively 16%, 17% and 20% lower risks. Pairwise comparisons (online supplemental appendix table A.3) show that these categories do not differ from each other. Compared with the mean risk of employment exit in the full model (figure 1), workers in micro firms have a 15% higher risk of employment exit.

The time interaction coefficients for our workplace variables (not reported) all show statistically significant HRs below 1 (between 0.975 and 0.999) for full-time/part-time employment, firm share of chronically ill workers, firm size and unemployment rate, which imply that for these variables, the estimated risks decrease during the study period. For the branch variable, the interaction with time is not significant.

Online supplemental appendix table A.4 shows HR coefficients when we stratify by three age groups: 16–30, 31–45 and 46–62. Many HR coefficients are similar to the main model in direction, size and statistical significance, but there are some notable differences: marital status is only significant in the oldest age group; living with children significantly reduces the employment exit risk for the middle age group only; branch differences are only significant in the middle age group; the variable measuring the firms' share of chronically ill workers, and the firm size variable, is not significant in youngest nor middle age group.

DISCUSSION

In this descriptive study, we use rich population-wide and monthly updated register data and a strong definition of chronic illness to study the labour market inclusion of a vulnerable group—workers with a chronic health problem. The study contributes to existing literature by estimating both worker-level and workplace-level determinants on the risk of labour market exit, and by comparing the contribution of workplace determinants before and after the models are adjusted for worker composition. We find relatively low prevalence of labour market exclusion among Norwegian workers with a chronic illness—85% are employed at the end of the 5-year follow-up period, and 58% are employed throughout the period—all 59 months. This could imply that the low employment rates among people with chronic health problems are driven not by chronically ill workers' labour market exits, but potentially due to these workers experiencing a high threshold for entering employment. Nevertheless, we find some worker and workplace covariates that significantly correlate with the risk of labour market exit: Men, workers of young age, workers with mental health problems, workers with part-time contracts, unmarried workers and workers with a low skill level are at higher risk of exit; these are findings that support previous research.[16 26–28] A notable point here is that the robust association between mental health problems and employment exit indicates that mental health problems affect work ability across all skill levels, branches and other workplace characteristics. Government actors as well as employers should consider measures targeted towards employees' mental health. Mental health has also proved to be an important predictor of unemployment in survey-based studies, with a somewhat stronger association.[26–28] This difference could, for one, be due to survey attrition,[29] but also the choice of comparison groups could play a part here—as we in our register study only include workers with a health problem. Chronically ill workers in public administration have good labour market prospects, with lower risk of unemployment compared with all other branches. This does not necessarily imply that the public sector per se is better at work inclusion; the education and health and social branch also includes a majority of public employers. Figure 1 indicates that compared with the grand mean, some branches change their association with labour market exit after we control for the composition of employees. This could imply that some workplaces have 'unfulfilled potential' with regard to work inclusion. For instance, the education branch is associated with a lower risk of employment exit in the workplace model than in the full model, which may suggest that although the education workplaces (ie, schools) are composed of employees with characteristics favourable to labour market survival, these workers are still not coping with the demands of this certain branch. For the service/transport and the health and social work branch, the opposite appears to be the case; the HR coefficients (compared with the mean) differ between the workplace and the full model.

Results have been mixed in previous research using the aforementioned proxy for implemented policies.[10 11 18] Our results suggest that employment in firms with higher shares of chronically ill employees is associated with higher risk of employment exit for the individual worker. This association is significant also in (unreported) sensitivity analyses where the share is entered in its original for as well as log transformed, and when we stratify analyses by firm size. One explanation for this finding could be that a high share of chronically ill employees, and the higher sickness absence and productivity loss likely to follow, may have adverse consequences for the work environment. It may put pressure on the productivity of the present employees, potentially increasing their risk of labour market exit. Selection mechanisms could also play a part: firms that are more sensitive to economic fluctuations may first experience staff shortages, and thus be more willing to hire workers with health problems who later may be the first to leave if the firms experience a downturn. In addition, a high share of chronically ill employees in a firm could also indicate poor material or psychosocial working conditions. Lastly, a limitation with this proxy is that within a firm's share of chronically ill may include a variety of conditions and functional levels—the needs for workplace adaptions may differ greatly between workers with, for instance, musculoskeletal problems, cancer and mental health problems. The use of disability

status as a basis for policy proxy (cf ref 18) could be more relevant.

We described two competing hypotheses with regard to the association between firm size and labour market survival. The full model suggests that only workers in the smallest category of firms, with less than 10 employees, have higher risk of employment exit compared with both larger firms and the grand mean. Our results thus lend some support to the hypothesis stating that a less developed human resources bureaucracy in smaller workplaces may could imply less inclusion of chronically ill employees.

Sensitivity analyses suggest that certain results are driven by certain age groups. The exit risks appear to be equally distributed across all branches for the youngest and oldest workers, while the mechanisms related to share of chronically ill workers and firm size appear to be more relevant for older workers. Employment exit is likely to mean different things at different ages. In the main model, age decreases the risk of employment exit. One potential reason behind this result could be a likely correlation between age, work experience and seniority. Second, there may be higher exit rates among young workers due to educational attainment. Third, it may indicate selection: workers who have remained employed until older ages may be in relatively good health compared with other age groups. Our sensitivity analyses suggest a complex relationship, as the age coefficient is not statistically significant in the two older age groups, while exit risk significantly increases by age in the youngest age group. The inverted age risk, together with the lack of significant associations with the workplace covariates in the youngest age group, could suggest that employment exits among the youngest first and foremost are related to education or family commitments.

A strength of this study is the use of monthly updated register data covering all Norwegian employees over the course of 5 years. This is beneficial for the validity of the results since we eliminate the issue of response rates or attrition that is prominent in cohort studies relying on survey data. Previous research has also suggested that respondents of poor health are more prone to drop out between survey waves.[29] The large sample also enhances the statistical power of our analyses. One strength of survival modelling, rather than, for example, linear regression with employment at different time points or the total number of months employed as a dependent variable, is that we can use every job spell an individual worker has over the follow-up period and merge each spell with information from our rich register data.

Our study, of course, has several limitations. First, our workplace indicators are well established, but nevertheless proxies for workplaces' ability to include chronically ill employees. There may also be other workplace variables, omitted or unobservable in the registry data, that are stronger determinants of labour market inclusion. Surveys may be rich on these types of variables, such as workplace accommodations, physical workload, psychological and emotional job demands, job autonomy and social support from managers and coworkers.[26 30] However, the risk of bias is present when survey respondents are asked to rate, for instance, the working conditions of their previous job. A way of combining the two approaches is to use survey data to create a job exposure matrix, and operationalise this as a variable in analyses of register data.[19]

Further, although the data from administrative registers are rich, it is not without weaknesses. Self-employed workers are not included in the LEE data, we can therefore not assume that our results can be generalised to this specific group. Employers' incentives to promote inclusion of their employees differ between those on a temporary contract and those on a fixed term. Around 10% of the Norwegian labour force is on a temporary contract, but this information is unfortunately only available in the registers from 2021 and onwards. Another potential data limitation relates to the fact that individuals may be listed as employed but be at sick leave. We therefore risk to overestimate the actual work participation in our models. However, Norwegian employees cannot receive sick leave benefits for more than 1 year, after which they usually get transferred to a labour market programme and thus are not registered as employed in our data. We follow these chronically ill workers for 5 years, and if our assumption that sick leave is equally distributed across employment spells is correct, the risk of overestimating participation should be smaller. We measure chronic illness through use of specialist healthcare; this may be prone to selection bias. Although the Norwegian healthcare system is universal and with an aim to provide treatment according to each citizen's need, there have been reports of socioeconomic inequalities,[31] and we can also assume that certain chronic conditions are overrepresented in specialist healthcare utilisation. Lastly, to use index episodes to register specialist healthcare use is an established method, but not without drawbacks. Future research on similar topics could benefit from also including measures of severity and/or comorbidity.

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Competing interests None declared.

Patient and public involvement Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

Patient consent for publication Not applicable.

Ethics approval In Norway, an ethical review statement is not required for studies based solely on administrative register data. We followed good scientific practice, data protection guidelines and ethical standards in collecting and analysing the data and in reporting the results. Data from the different registers were linked by Statistics Norway and pseudoanonymised before delivered to the researchers.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement Data are available upon reasonable request. Data may be obtained from a third party and are not publicly available.

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Table A.1: Pairwise comparisons, branch.

	Secondary	Service/ transport	Pub. adm.	Education	Health and social work	Recreation/ household
Secondary	1	0.892^{+}	0.643***	0.892	0.818**	0.962
Service/transport		1	0.720**	1.000	0.917	1.078
Pub. adm.			1	1.389*	1.273*	1.496**
Education				1	0.917	1.078
Health and social work					1	1.175
Recreation/household						1

Hazard ratios, corresponding to model 3 in table 2. Reference category in column, comparison category in row.
$^{+}$ $p < .1$, * $p < .05$, ** $p < .01$, *** $p < .001$
Standard errors clustered at the individual worker.

Table A.2: Pairwise comparisons, share of chronically ill workers.

	1st quartile	2nd quartile	3rd quartile	4th quartile
1st quartile	1	0.875**	1.030	1.240**
2nd quartile		1	1.177**	1.417***
3rd quartile			1	1.203**
4th quartile				1

Hazard ratios, corresponding to model 3 in table 2. Reference category in column, comparison category in row.
$^{+}$ $p < .1$, * $p < .05$, ** $p < .01$, *** $p < .001$
Standard errors clustered at the individual worker.

Table A.3: Pairwise comparisons, firm size

	Micro	Small	Medium	Large
Micro	1	0.842**	0.834^{+}	0.807^{+}
Small		1	0.991	0.959
Medium			1	0.968
Large				1

Hazard ratios, corresponding to model 3 in table 2. Reference category in column, comparison category in row.
$^{+}$ $p < .1$, * $p < .05$, ** $p < .01$, *** $p < .001$
Standard errors clustered at the individual worker.

Table A.4: Cox regression results stratified by age group, hazard ratios

	(1) Age 16-30	(2) Age 31-45	(3) Age 46-62
Chronic illness			
Cardiovascular	1	1	1
Musculoskeletal	1.130	1.049	0.984
Mental	1.460+	1.225*	1.303***
Resipatory	1.216	0.944	0.895
Diabetes	1.017	0.864	0.983
Cancer	1.234	0.810	0.927
Male	1.160	1.359***	1.410***
Age	1.279*	1.014	0.859
Age squared	0.994**	0.999	1.001
Married	0.987	0.948	0.845***
Children age < 18 in household	1.098+	0.855**	1.040
Disability degree	0.996	0.999	0.998
Full-/part-time employment			
0-19%	1	1	1
20-39%	0.507***	0.734*	0.497***
40-59%	0.455***	0.318***	0.203***
60-79%	0.332***	0.284***	0.176***
80-99%	0.270***	0.211***	0.109***
=>100%	0.212***	0.170***	0.115***
Skill level			
Low skill	1	1	1
Secondary edu.	0.789**	0.876*	0.854**
Short higher edu.	0.633***	0.749***	0.730***
Long higher edu.	0.562***	0.728***	0.562***
Branch/industry			
Public administration	1	1	1
Secondary	0.878	2.757***	1.338+
Service/transportation	0.770	2.587***	1.210
Education	1.413	2.339***	0.984
Health / social work	0.828	2.299***	0.962
Recreation/household	0.877	2.622***	1.246
Share of chronically ill workers			
1st quartile group	1	1	1
2nd quartile group	0.981	0.854	0.839+
3rd quartile group	1.164	0.992	0.977
4th quartile group	1.281	1.177	1.269
Firm size			
Micro	1	1	1
Small	0.963	0.867	0.773*
Medium	1.043	0.884	0.724*
Large	1.092	0.818	0.682*
Unemployment rate	1.283***	1.810***	1.838***
Observations	22545	48740	64911
Individuals			

+ $p < .1$, * $p < .05$, ** $p < .01$, *** $p < .001$
Standard errors clustered at the individual worker.