Original article

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Employees' drug purchases before and after organizational downsizing: a natural experiment on the Norwegian working population (2004–2012)

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Objectives This study investigated the association between organizational downsizing and purchases of prescribed drugs by private sector employees in Norway.

Methods A natural experiment was constructed using individual-level employer and employee data linked to the national prescription database for the period 2004–2012. The study population comprised 144 089 employees who had been exposed to major downsizing in the same period. Random effects logistic regression models were used to investigate relative changes in drug purchases (antidepressants, hypnotics/sedatives, anxiolytics, and anti-psychotics, as well as anti-obesity, anti-diabetic, cardiovascular, and thyroid drugs, anti-inflammatory drugs, opioids, and analgesics/antipyretics) in the five-year-period before and after exposure to downsizing.

Results Compared with the situation three years before exposure, the odds ratios (OR) of purchasing psychotropic drugs one year after exposure increased for antidepressants (OR 1.44, 95% CI 1.34–1.55), hypnotics/sedatives (OR 1.39, 95% CI 1.29–1.49), anxiolytics (OR 1.32, 95% CI 1.22–1.43), and antipsychotics (OR 1.34, 95% CI 1.19–1.52). Similar associations were found for cardiovascular, anti-diabetic, and thyroid drugs. Stratified analyses showed that the odds of purchasing psychotropic, anti-diabetic, and cardiovascular drugs in the years around downsizing was more pronounced in men compared with women. Elevated odds were also found for employees in the oldest age group and those with less than tertiary education.

Conclusions Exposure to organizational downsizing increased the odds of purchasing prescribed psychotropic, cardiovascular, anti-diabetic, and thyroid drugs. The clinical implications of these results might be systematic involvement from medical personnel and occupational health services in workforce reduction processes.

Key terms cardiovascular disease; diabetes; job loss; mental health; psychotropic medication; sleep; somatic health; unemployment; workforce reduction.

There is considerable empirical evidence of job loss being related both to deterioration in mental health and increased risk of suicide (1–4). Accordingly, policies that take into consideration the health consequences of workforce reduction and unemployment have been advocated, especially in the wake of the recent economic downturn (5–8).

The direction of causality between unemployment and health is still debated and seems context-sensitive (2). Even in the most generous welfare states, there is evidence to suggest there is health selection into unemployment (9–10) and that job insecurity and job loss have negative effects on health in the months before and during unemployment (10–12). The threat of job loss could be expected to affect a number of conditions that may be triggered or worsened by psychosocial stress, such as anxiety, sleeping problems, hypertension, and pain. However, in the existing literature on health in

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relation to unemployment or job insecurity, outcomes are rarely studied beyond suicide (3), depression (1, 12), alcohol-related diagnoses (10), and cardiovascular disease (10, 13–15). The current study takes a broad health perspective, acknowledging that organizational downsizing may exert a negative influence on both mental and somatic health domains for those affected.

As people with poor health are more likely to become unemployed (9, 16), it is difficult to assess the causal impact of job loss. Investigations of employees exposed to organizational downsizing have been used as natural experiments in a number of studies in order to distinguish confounding resulting from health selection from the causal effects of job insecurity on health (12, 17–20). In this type of experimental design, it is assumed that when companies undergo major downsizing, the downsizing decision is not very likely to be due to the employees' poor health, but rather to strategic decisions based on market forces.

For our study, we aimed to investigate possible causal effects of organizational downsizing on employees' health. We set up a natural experiment on the Norwegian working population, employed in the period 2004–2012, using information from registry data relating to organizational workforce reductions – downsizing – in all private companies as a proxy for exposure to job insecurity and unemployment. We aimed to investigate how exposure to major downsizing was related to changes in employees' health in terms of their purchases of prescribed psychotropic drugs and drugs for somatic conditions and pain. Based on findings from a previous study of unemployment in Norway, we expected purchases of psychotropic drugs to increase after exposure to downsizing, and to a greater extent than purchases of drugs for somatic and pain conditions (11).

Methods

Data provision

The target population comprised all employees in the age group 18–67 years who were resident in Norway between 2004 and 2012 (N=3 159 196). Using the State Register of Employers and Employees (Aa-registeret) (nav.no), we identified each individual's organizational number (unique for each company), collected annually by Statistics Norway. We also sourced data for the period 1992–2012 from Statistics Norway on sex, age, educational level, income (from tax authorities), and exact dates of unemployment spells, sick leave spells, emigration, and death. We sourced the exact dates of drug purchases during the observation period 2004–2012 from the Norwegian Prescription Database (NorPD) (norpd.no). The drugs were grouped according to the Anatomical Therapeutic Chemical Classification System (ATC) (whocc.no). All registries were linked through the personal identification number unique to all residents in Norway.

Design and study population

We combined information about years of major downsizing in companies with individual-level data on drug purchases, which allowed for comparison of drug purchases within exposed employees before and after downsizing. A panel data set was set up with annual observations for each individual on company affiliation, drug purchases, age, sex, educational level, and income. For each individual, the data set also included information on the number of employees, and both down- and upsizing rates in the company for the years that the individual was affiliated with it.

Individuals were enrolled in the study throughout the observation period if they were eligible for analysis on the basis of the following criteria: (i) The employee's company underwent ≥25% downsizing between two consecutive years (major downsizing), and the employee worked for the company in the year before downsizing. Given Norwegian labor market characteristics, with many small companies (measured in number of employees), we suspected that a downsizing cut-off lower than 25% would imply an unreliable downsizing measure. (ii) The company had ≥10 employees the year before downsizing. Companies with <10 employees would easily fulfil the downsizing criterion, with only one or two employees changing job between years (18). (iii) The employee worked in the private sector in the year before downsizing. An employee who had moved from a private to a public sector job after the downsizing could still be included in the analysis. In the registry data, large corporations with partial public ownership are coded as private sector companies. Public sector employees were excluded because employment protection is traditionally high in the Norwegian public sector. Public sector employees can often be reallocated to other departments, and we were concerned that this would lead to measurement error given our assessment of downsizing. (iv) The employee was aged 25–66 years at the time of inclusion. Labor market attachment is typically weaker for those aged <25 years (who are, for example, receiving an education or working part-time). In Norway, the old age pension was set at 67 years. (v) Income from labor was ≥NOK 100 000 (≈ EUR 11 800 in 2004) in the year before downsizing. This cut-off was set to ensure that employees included in the analysis were actually working and had at least one year of tenure. (vi) Employees were excluded from the year of their death or emigration.

Exposure – time of organizational downsizing

To identify individuals who had been exposed to downsizing, we counted the number of employees in each company for each year and calculated the net workforce change between each consecutive year starting with 2004–2005 through to 2011–2012. Employees were considered exposed to major downsizing regardless of whether they lost or changed their job or stayed in the same company. For a sensitivity analysis, we also studied those exposed to a 5–10% and a 50–100% workforce reduction between one year and the next (21, 19).

Following Browning & Heinesen (17), we decided that if ≥30% of a company's employees were displaced, but continued to work together as a group at another company the following year, the company was not considered downsized. This was done to avoid potential misclassification because some companies may change their registered organization number or be split into a number of units from one year to the next. For an employee registered as exposed to downsizing several times during the observation period, only the first time was considered for analysis. We calculated a time-from-exposure variable for each observation to indicate the time in years from the downsizing exposure, ranging from a maximum of −8 to +7. For a person working in a company undergoing major downsizing between 2006–2007, the time-variable would take the values (-3) in 2004, (-2) in 2005, (-1) in 2006, (0) in 2007, (1) in 2008, (2) in 2009, (3) in 2010, (4) in 2011, and (5) in 2012.

Outcome – prescribed drug purchase

Based on the date of purchase, the outcome variable was dichotomized into whether (1) or not (0) an employee purchased the drug in each of the years from 2004–2012. Four ATC groups of prescribed psychotropic drugs were analyzed: N05A – antipsychotics; N05B – anxiolytics; N05C – hypnotics and sedatives, and N06A – antidepressants. We also explored how downsizing related to changes in purchases of the following drugs for somatic conditions and pain: N08A – anti-obesity preparations; A10A – insulins; any cardiovascular drugs available in the data (C01/C02/C03/C07/C08/C09/C10 cardiac therapy/antihypertensive drugs/diuretics/beta-blocking agents); H03A – thyroid therapy; M01A + M02A – anti-inflammatory and anti-rheumatic products, whichever occurred first; N02A – opioids; N02B – other analgesics and antipyretics. A list specifying the drugs and defined daily doses (DDD)/1000 inhabitants/day in each group is given in the supplementary material (table A, www.sjweh.fi/index.php?page=data-repository).

Empirical strategy

We used random effects logistic regression models (taking into account repeated measures for each individual) to estimate odds ratios (OR) with 95% confidence intervals (95% CI), as a measure of the relative change in drug purchase over time according to temporal proximity to downsizing. Year −3 before downsizing was chosen as the reference time point. We chose a reference time not too far from the exposure, but not so close that job insecurity was likely to be an issue. Hence, the odds of purchasing drugs each year before and/or after the year of downsizing (0) was related to the odds of purchasing the drug three years before downsizing.

All analyses were adjusted for age during follow-up, sex, and educational level. A set of dummies (calendar year) was added to account for time trends. Age was modelled with a restricted cubic spline with five knots to account for non-linear associations with age. In the subgroup (stratified) analyses, age was categorized as 25–39, 40–54, and 55–66 years. Education was measured in three categories: (i) compulsory education (primary school, lower secondary school or less), (ii) intermediate education (upper secondary school and post-secondary non-tertiary education), (iii) tertiary education (undergraduate, graduate, and postgraduate). For statistical software, we used Stata/MP 13 (StataCorp, College Station, TX, USA).

Subgroup and sensitivity analyses

The analyses of psychotropic drugs were stratified by sex, age, and educational level. Somatic and pain-related drugs were stratified by sex. Following Hanson et al (12), we also investigated whether the odds of purchasing psychotropic drugs differed according to previous health status. We identified employees who had ≥30 days of sickness absence or who purchased a psychotropic drug in 2004 or 2005. We then excluded those exposed to major downsizing between 2004–2005 and ran the analysis with an observation period from 2006–2012. We also changed the downsizing exposure cut-off from ≥25% to ≥50% and 5–10% workforce reduction, respectively. Further, we changed the reference time point from year -3 to a collapse of years -2, -3, and -4 before downsizing.

Ethics approval

The Norwegian Regional Committees for Medical Research Ethics approved the study (REK ref. 2012/1941b).

Results

In the observation period (2004–2012), the Norwegian working population totaled 3 159 196 employees in 467 142 different companies (including self-employed persons). The study population comprised a maximum of 144 089 individuals (who met the eligibility criteria at some point in the observation period) who were employed in 7813 private companies that underwent major downsizing (≥25%). Of these, 1295 private companies and 24 946 employees were involved in downsizing ≥50% and eligible for analysis. Since the data relating to the employees were used in the analysis at different stages in the observation period, depending on eligibility, the number of individual observations at year -5 (N=81 823) and +5 (N=44 889) was lower than in the years closer to downsizing (N=144 089 at year -1 and year 0). More employees experienced downsizing late in the observation period, which is why the number of employees at year +5 was lower than the number at year -5.

Table 1 lists the baseline characteristics for the whole population in 2004 and at the year of inclusion for those eligible for analysis and exposed to major downsizing. As the analyses were done for the private sector only, the share of women (35–37%) was relatively low.

The mean number of days with registered unemployment per year among those exposed to downsizing was 15.6 days three years before exposure, 14.1 days at the year of exposure, increasing to 21.3 and 22.5 at days one and two years after exposure, respectively. Figure 1 shows the OR of purchasing psychotropic drugs in the period from five years before to five years after exposure to major downsizing related to the situation three years before the downsizing exposure. The OR for purchasing antidepressant drugs increased from around 1 in the years before downsizing to OR 1.12 (CI 1.06–1.20) at year -1, OR 1.27 (CI 1.19–1.36) at year 0, and OR 1.44 (CI 1.34–1.55) at year +1 after downsizing. The estimates remained at a higher level after downsizing. Similar trends were observed for the other psychotropic drugs; the estimates of anxiolytic drugs showed approximately the same results as antidepressants. Somewhat higher effect estimates were observed for hypnotic/sedative drugs and antipsychotic drugs. Exact point estimates are given in supplementary table B (model 1, www.sjweh.fi/index.php?page=data-repository).

The results of the analyses of purchases of prescribed

Table 1. Descriptive statistics at baseline (2004) for the Norwegian working population (2004–2012) and at the year of inclusion for the study population, respectively. Prevalence = the number of employees in the study population eligible for analysis and purchasing the drug in year 0 (the year of downsizing). [N=number of employees; SD=standard deviation].

	Working population				Study population				Prevalence of drugs in study population	
	2004				Year of inclusion				Year of downsizing (0)	
	N	%	Mean	SD	N	%	Mean	SD	N	%
N (total)	3 159 196				144 089				144 089	
Women	1 493 033	48			50 915	35				
Age category (years)										
25–39	1 821 030	58			83 813	58				
40–54	881 869	28			47 559	33				
55–67	428 372	14			12 717	9				
Missing, sex/age	27 925	0			0	0				
Education										
Compulsory	689 078	22			30 512	21				
Intermediate	1 193 608	38			67 935	47				
Tertiary	766 000	24			31 094	22				
Missing	510 510	16			14 548	10				
Prescribed medication										
Antidepressants	145 096	5			5066	4			6275	4
Hypnotics/sedatives	133 238	4			4670	3			7104	5
Anxiolytics	105 440	3			3506	2			4711	3
Antipsychotics	37 459	1			1130	1			1561	1
Anti-obesity drugs	27 757	1			1144	1			1023	1
Anti-diabetic drugs (insulins)	43 096	1			1790	1			3072	2
Cardiovascular drugs	272 066	9			10 456	7			18 288	13
Thyroid drugs	66 063	2			2136	1			3189	2
Anti-inflammatory drugs	572 736	18			26 903	19			30 542	21
Opioids	241 054	8			10 724	7			14 306	10
Other analgesics/antipyretics	60 393	2			2311	2			5990	4
Age			36.3	15			37.6	11		
Number of days unemployed			20.3	67			20.7	66.3		
Number of days on sick leave			13.1	46			12.0	42.0		

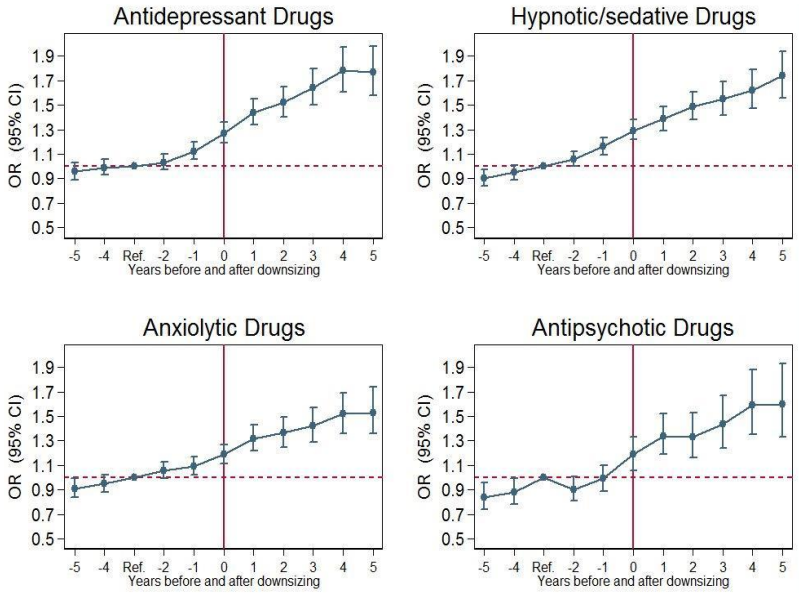

Figure 1. Odds ratio with 95% confidence intervals of purchasing antidepressants, hypnotic/sedative drugs, anxiolytic drugs and antipsychotic drugs, respectively, in the years before and after exposure of major downsizing (year 0=vertical straight line) with year -3 as the reference year (dashed line OR=1). Observation period: 1 January 2004 to 31 December 2012. Adjusted for age, sex, education and time-trends.

drugs for somatic conditions and pain are presented in figure 2. Estimates for anti-diabetic drugs showed an OR of 1.34 (CI 1.13–1.59) at year -1, OR 1.69 (CI 1.402.03) at year 0, and OR 2.11 (CI 1.72–2.60) at year +1. For thyroid drugs, the increase in OR was similar to those for antidepressants in the years -1 to +3 in relation to downsizing. A steady increase in cardiovascular drugs was noted throughout the observation period: OR 1.12 (CI 1.05–1.19) at year -1, OR 1.21 (CI 1.13–1.30) at year 0, and OR 1.31 (CI 1.20–1.42) at year +1. Obesity drugs, anti-inflammatory drugs, opioids, and other analgesics/antipyretics had OR close to 1 throughout the observation period, with a small increase in OR at year 1 and onwards for opioid drugs [OR 1.13 (CI 1.09–1.17) in year +1].

Stratified and supplemental analyses

The results of the stratified analyses of purchased psychotropic drugs are presented in the supplementary files (www.sjweh.fi/index.php?page=data-repository): figure A (sex), figure B (age) and figure C (education). The results of the sex-stratified analyses of purchased drugs for somatic conditions and pain are presented in figure D. The OR of purchasing psychotropic drugs showed the same trends among men and women, with somewhat more elevated OR among men. Stratifying the analyses by three age groups did not reveal profound differences, but the oldest age group (55–66 years) had slightly higher estimates for antidepressants and anxiolytic drugs. The results of analyses stratified by educational level showed a tendency towards a gradient from compulsory education (highest estimates) to tertiary education (lowest estimates) in the odds of purchasing psychotropic drugs in the years after exposure. Regarding somatic drugs, men had higher OR than women for anti-diabetic and cardiovascular drug purchases from the time of downsizing. Women had higher OR than men for thyroid drugs; at year +1 the OR for women was 1.32 (CI 1.06–1.64) compared with OR 1.10 (CI 0.78–1.66) for men. The results for purchases of drugs for other somatic conditions and pain showed only minor differences between the sexes (figure D). In the stratified analyses, the CI were generally wider and therefore the observed trends should be interpreted with caution.

The results of supplemental analyses in the period 2006–2012, which took previous health status into account (figure E), indicated that compared with their situation three years before downsizing, employees with no previous sickness absence or psychotropic drug purchases were more likely to have purchased antidepressants by the time of downsizing, compared with those with previous sickness absences or psychotropic drug purchases. By contrast, the estimates for hypnotic/sedative, anxiolytic, and antipsychotic drugs were somewhat weaker for employees without previous health problems.

Sensitivity analyses

The results from analyses of heavier downsizing processes (≥50%) are shown in supplementary figure F. Compared with the main analysis (≥25%), the heavy downsizing estimates around the time of downsizing (and after) were weaker for antidepressants, hypnotics/sedatives, and antipsychotics, while OR for anxiolytic drugs were more or less the same in the two groups.

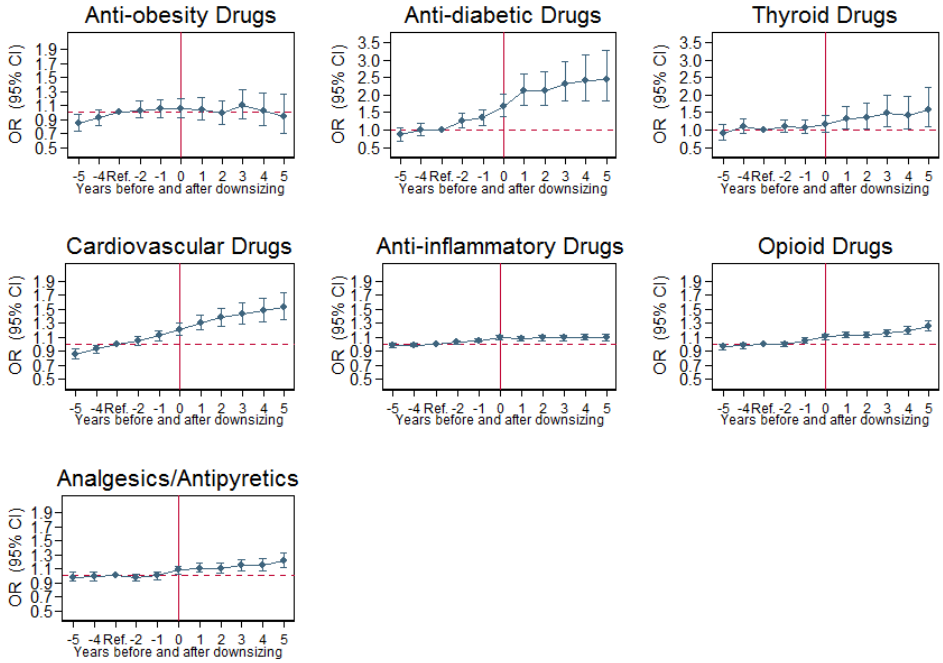

Figure 2. Odds ratio (OR) with 95% confidence intervals (95% CI) of purchasing drugs for somatic conditions and pain in the years before and after exposure of major downsizing (year 0=vertical straight line) with year -3 as the reference year (dashed line OR=1). Note that anti-diabetic and thyroid drugs have a different scale. Observation period: 1 January 2004 to 31 December 2012. Adjusted for age, sex, education and time-trends.

Analysis of a subset of the employees that had experienced 5–10% downsizing resulted in a flat trend line for most of the outcomes (figures G and H).

Changing the reference time point from three years before downsizing (-3) to the period two to four years before downsizing (mean of time points -2, -3, and - 4) hardly changed the estimates (table B).

Discussion

In this study, private sector employees in Norway who were exposed to downsizing in the period 2004–2012 showed an increased likelihood of purchasing antidepressants, hypnotics/sedatives, anxiolytics, and antipsychotics, as well as anti-diabetic drugs, thyroid drugs, cardiovascular drugs, and to some extent opioids, in the years around and after their exposure to downsizing, compared with three years before downsizing. There was a somewhat stronger response for men than women, especially concerning purchases of psychotropic drugs, anti-diabetic drugs, and cardiovascular drugs. Stratified analyses of purchases of psychotropic drugs by age and educational level did not reveal profound differences, but there was a tendency for employees in the oldest age group and employees with compulsory education to have higher OR in the years after downsizing than employees in the youngest age group and those with higher education.

Strength and limitations

Linking detailed registry data on labor market attachment to purchases of a wide range of prescribed drugs over time and for a whole population was one of the study's major strengths. We had no missing information on outcome variables; hence, information relating to eligible employees was obtained throughout the observation period. The panel data enabled us to set up the natural experiment with an "intention-to-treat (/layoff)" approach to study the average effects on all employees working in companies that underwent downsizing. The design decreased reverse causality problems and confounding caused by factors being common causes of both job loss and purchases of prescription drugs. Natural experiments do not provide such strong evidence for causal relations as randomized controlled trials, but under certain assumptions, causal inferences can be made in the absence of other plausible explanations for the observed effects (22).

Although physicians' prescriptions for drugs are based on clinical indications, purchases of prescription drugs do not fully equate to the health status of the individual because they are influenced by a mix of the patient's subjective complaints and health-seeking behavior and the physician's medical evaluation (23). Also, the drugs assessed in the study differ in their characteristics regarding use: some are prescribed for short-time use (eg, sleeping pills and painkillers), whereas others may be prescribed for longer periods (antidepressants, antipsychotics, anti-obesity drugs)

or even life-long use (thyroid therapy, insulins, heart medication). Hence, causal inference must be made with these aspects in mind. The rise in anti-diabetic drugs and thyroid drugs might be due to the detection of new cases. When there is downsizing at their workplace, employees may visit their doctor more often (due to increases in their mental and somatic symptoms). In a general practice, an initial assessment of unspecific symptoms and fatigue will often include tests of blood sugar levels and thyroid function, thereby increasing the possibility to detect dysfunctions that would otherwise not be detected or would be detected at a later stage. These mechanisms are mentioned by Jin et al (24) in an early review of the literature.

The current measure of exposure reduces the potential confounding from health selection, as displacement of several employees at the same time is more likely to happen because of market forces rather than the individual employees' health status prior to displacement. However, employees with health problems may lose their job more often than their healthy peers (9, 12), and confounding by health selection is likely to be an issue in the different groups of downsizers: those who become unemployed, those who stay in their company, and those who immediately leave to work elsewhere. For this reason, we chose to study average changes over time within the downsizing group as a whole, using an intention-to-treat approach.

Some companies gradually downsize over several years, which could cause job insecurity already at year -3 before the year of major downsizing (our reference year). In such cases, our effect estimates might have been conservative, since the initial increase in drug consumption could have started earlier than the reference year. We found that estimates of psychotropic drug purchases by those who experienced heavier downsizing processes (50–100%) were weaker than for the downsizing cut-off of 25%. This finding may be partly due to reduced sense of stigma when the majority of employees lose their job at the same time (10). It is also possible that more resources are being used in health prevention strategies and re-employment initiatives in the heaviest downsizing or closure processes, and this hypothesis should be considered in future research.

We based the downsizing measures on workforce reduction within private companies that had the same organization number between two years. There was a risk of misclassification if companies changed their organization number, such as when a company was absorbed into another company. We tried to account for this by ignoring downsizing processes in which ≥30% of the employees continued to work together as a group in another company. However, cases when a company decided to move one or more of its departments to other parts of the country, while keeping the same organization number, we would not necessarily have captured the job insecurity experienced by employees who did not move, but had to find a new job. Data relating to new employees at the new location would have masked the downsizing exposure if the number of employees in the company remained constant (or increased) despite newly-hired employees. Likewise, if companies had laid off employees prior to a merger, we would not have been able to identify the potential job insecurity experienced by those employees. In such cases, exposed individuals would have been treated as unexposed, which would have resulted in our effect estimates being conservative.

Interpretation and comparison with previous studies

Although the first epidemiological studies to show a negative effect of downsizing on health came from Sweden (15) and Finland (25) as early as the 1990s, the authors of a systematic review published in 2012 concluded that there was insufficient evidence to draw any conclusions about the mental health effects of organizational downsizing (7). Our study is the first to explore the effects of the use of a broad range of commonly prescribed drugs. Our findings confirm the results from a recent Swedish study regarding antidepressant drug purchases (12): we found similar trends for hypnotics/sedatives, anxiolytics, antipsychotics, and anti-diabetic drugs; we also found similar results for thyroid drugs and cardiovascular drugs, and to some extent opioids (drugs not considered in the Swedish study). Kivimäki et al (26) studied downsizing and purchases of antidepressants, anxiolytics, and hypnotics in Finland made in the period 1994–2000 (N=26 653). The highest rate of psychotropic purchases was found among men who had lost their job. Further, Kivimäki et al found that employees, especially men, who kept their job after downsizing had an increased risk of being prescribed drugs (particularly hypnotics in the case of men) than a comparable group of employees not exposed to downsizing. For women, exposure to organizational downsizing gave a slightly increased risk of being prescribed psychotropic drugs (anxiolytics in particular for women) (26). Our study revealed higher estimates for men than women for all purchases of psychotropic drugs around the time of downsizing.

A study investigating the health consequences of job loss due to plant closures in Sweden revealed an increased risk of hospitalization due to alcohol-related diagnoses, traffic accidents, and self-harm, while no such effects were found for myocardial infarction or stroke (13). In a separate study, analyses of Danish data confirmed the aforementioned results regarding death and hospitalization due to traffic accidents and alcohol, but also showed an increased risk of overall mortality, cardiovascular mortality, suicide, suicide attempts, and

mental illness (17). Similar findings have been found in Austria (27).

Stress related to possible consequences of downsizing, such as job insecurity, conflicts at work, increased workload when colleagues are laid off, and feelings of helplessness and injustice may trigger, worsen, or lead to detection of somatic diseases (14, 28, 29). The results of a systematic review and meta-analysis performed by Virtanen et al (14) suggested that perceived job insecurity is at most a modest risk factor for coronary heart disease with an association partly due to lower socio-economic position and worse health profiles among those exposed to the perceived insecurity (14). In a previous case-crossover study of *incident* drug purchases, we found an increase in OR for cardiovascular drugs 1–3 months before unemployment (11). In the study reported here, we found that cardiovascular drug purchases increased steadily throughout the observation period, with no clear breakpoint by the time of downsizing or in the year after downsizing. This might reflect that the drugs were prescribed for long-term illnesses that required substantial rises in incident cases to reveal long-term average effects (and breakpoints) within employees exposed to downsizing.

Context and generalizability

Some Norwegian labor market characteristics may have affected our findings and their generalizability. The analyses related only to private sector employees and the results are not necessarily representative of employees in the public sector. Future research on the relationship between downsizing and health in Norway should consider potential differences between state, municipal, and private sector employees.

The Scandinavian welfare model is characterized by high levels of social security and unemployment benefits, which can be expected to mitigate the negative effects of downsizing on health (2, 6, 30). During the entire observation period, unemployment rates in Norway were <4%, which was lower than in most European countries and the USA at the time (see supplementary figure I). Unlike most European countries, Norway was not heavily affected by the financial crisis, but the risk of being exposed to downsizing and unemployment was highest between 2008–2009, when registered unemployment in Norway increased from 1.7% to 2.7% of the workforce. Martikainen et al (21) point out that there are greater health selection effects when unemployment rates are low, and such effects have previously been found in Norway (9). We expected that our study design and strict downsizing measure would account for potential health selection regarding observed trend effects, but the effect size of these relative measures might have been susceptible to underlying differences in the composition of the studied employees, and therefore health selection could not be completely ruled out.

The study adds further evidence to the observation of detrimental effects on workers' mental health caused by organizational downsizing. In addition, purchases of some drugs for somatic disease and pain increased around the time of downsizing. We do not know whether this was due to an adverse effect of downsizing on somatic health or due to increased detection of somatic health problems when companies lay off employees. Our results emphasize the importance of health perspectives in organizational downsizing processes and suggest the possible benefits of systematic use of medical personnel and occupational health services in organizations either planning or making workforce reductions.

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References

1. Paul KI, Moser K. Unemployment impairs mental health: Meta-analyses. J Vocat Behav. 2009;74:264–82. https://doi.org/10.1016/j.jvb.2009.01.001.

2. Norstrom F, Virtanen P, Hammarstrom A, Gustafsson, PE, Janlert, U. How does unemployment affect self-assessed health? A systematic review focusing on subgroup effects. BMC Public Health. 2014;14:1310. https://doi.org/10.1186/1471-2458-14-1310.

3. Chang SS, Stuckler D, Yip P, Gunnell, D. Impact of 2008 global economic crisis on suicide: time trend study in 54 countries. BMJ. 2013;347:f5239. https://doi.org/10.1136/bmj.f5239.

4. Stuckler D, Basu S, Suhrcke M, McKee, M. The health implications of financial crisis: a review of the evidence. Ulster Med J. 2009;78:142–5.

5. Wahlbeck K, McDaid D. Actions to alleviate the mental health

impact of the economic crisis. World Psychiatry. 2012;11:139–45. https://doi.org/10.1002/j.2051-5545.2012.tb00114.x.

6. Labonte R, Stuckler D. The rise of neoliberalism: how bad economics imperils health and what to do about it. J Epidemiol Community Health. 2016;70:312–8. https://doi.org/10.1136/jech-2015-206295.

7. Bamberger SG, Vinding AL, Larsen A, Nielsen P, Fonager K, Nielsen RN et al. Impact of organisational change on mental health: a systematic review. Occup Environ Med. 2012;69:592–8. https://doi.org/10.1136/oemed-2011-100381.

8. Stuckler D, Basu S, Suhrcke M, Coutts A, McKee, M. The public health effect of economic crises and alternative policy responses in Europe: an empirical analysis. Lancet. 2009;374:315–23. https://doi.org/10.1016/S0140-6736(09)61124-7.

9. Kaspersen SL, Pape K, Vie GA, Ose SO, Krokstad S, Gunnell D, et al. Health and unemployment: 14 years of follow-up on job loss in the Norwegian HUNT Study. Eur J Public Health. 2016;26:312–7. https://doi.org/10.1093/eurpub/ckv224.

10. Vagero D, Garcy AM. Does unemployment cause long-term mortality? Selection and causation after the 1992-96 deep Swedish recession. Eur J Public Health. 2016 Oct;26(5):778–83. https://doi.org/10.1093/eurpub/ckw053.

11. Kaspersen SL, Pape K, Ose SO, Gunnell D, Bjorngaard JH. Unemployment and initiation of psychotropic medication: a case-crossover study of 2 348 552 Norwegian employees. Occup Environ Med. 2016 Nov;73(11):719–26. https://doi.org/10.1136/oemed-2016-103578.

12. Magnusson Hanson LL, Westerlund H, Chungkham HS, Vahtera J, Sverke M, Alexanderson K. Purchases of Prescription Antidepressants in the Swedish Population in Relation to Major Workplace Downsizing. Epidemiology. 2016;27:257–64.

13. Eliason M, Storrie D. Job loss is bad for your health - Swedish evidence on cause-specific hospitalization following involuntary job loss. Soc Sci Med. 2009;68:1396–406. https://doi.org/10.1016/j.socscimed.2009.01.021.

14. Virtanen M, Nyberg ST, Batty GD, Jokela M, Heikkilä K, Fransson EI, et al. Perceived job insecurity as a risk factor for incident coronary heart disease: systematic review and meta-analysis. BMJ. 2013;347:f4746. https://doi.org/10.1136/bmj.f4746.

15. Mattiasson I, Lindgarde F, Nilsson JA, Theorell T. Threat of unemployment and cardiovascular risk factors: longitudinal study of quality of sleep and serum cholesterol concentrations in men threatened with redundancy. BMJ. 1990;301:461–6. https://doi.org/10.1136/bmj.301.6750.461.

16. Schuring M, Robroek SJ, Otten FW, Arts CH, Burdorf A. The effect of ill health and socioeconomic status on labor force exit and re-employment: a prospective study with ten years follow-up in the Netherlands. Scand J Work Environ Health 2013;39:134–43. https://doi.org/10.5271/sjweh.3321.

17. Browning M, Heinesen E. Effect of job loss due to plant closure on mortality and hospitalization. J Health Econ. 2012;31:599–616. https://doi.org/10.1016/j.jhealeco.2012.03.001.

18. Osthus S. Health effects of downsizing survival and job loss in Norway. Soc Sci Med. 2012;75:946–53. https://doi.org/10.1016/j.socscimed.2012.04.036.

19. Rege M, Telle K, Votruba M. The Effect of Plant Downsizing on Disability Pension Utilization J Journal of the European Economic Association. 2009;7:754–85. https://doi.org/10.1162/JEEA.2009.7.4.754.

20. Bratberg E, Monstad K. Worried sick? Worker responses to a financial shock. Labour Economics. 2015;33:111–20. https://doi.org/10.1016/j.labeco.2015.02.003.

21. Martikainen P, Maki N, Jantti M. The effects of unemployment on mortality following workplace downsizing and workplace closure: a register-based follow-up study of Finnish men and women during economic boom and recession. Am J Epidemiol. 2007;165:1070–5. https://doi.org/10.1093/aje/kwm057.

22. Kivimäki M, Vahtera J, Pentti J, Ferrie JE. Factors underlying the effect of organisational downsizing on health of employees: longitudinal cohort study. BMJ 2000;320:971–5. https://doi.org/10.1136/bmj.320.7240.971.

23. Overland S. Unemployment and mental health. Occup Environ Med. 2016;73(11):717–18. https://doi.org/10.1136/oemed-2016-103831.

24. Jin RL, Shah CP, Svoboda TJ. The impact of unemployment on health: a review of the evidence. CMAJ. 1995;153:529–40.

25. Vahtera J, Kivimaki M, Pentti J. Effect of organisational downsizing on health of employees. Lancet. 1997;350:1124–8. https://doi.org/10.1016/S0140-6736(97)03216-9.

26. Kivimaki M, Honkonen T, Wahlbeck K, Elovainio M, Pentti J, Klaukka T, et al. Organisational downsizing and increased use of psychotropic drugs among employees who remain in employment. J Epidemiol Community Health. 2007;61:154–8. https://doi.org/10.1136/jech.2006.050955.

27. Kuhn A, Lalive R, Zweimuller J. The public health costs of job loss. J Health Econ. 2009;28:1099–115. https://doi.org/10.1016/j.jhealeco.2009.09.004.

28. Ferrie JE, Virtanen M, Jokela M, Madsen IEH, Heikkilä K, Alfredsson L, et al. Job insecurity and risk of diabetes: a meta-analysis of individual participant data. CMAY. 2016; 188(17-18): E447–E455. https://doi.org/10.1503/cmaj.150942.

29. Knardahl S, Johannessen HA, Sterud T, Härmä M, Rugulies R, Seitsamo J, et al. The contribution from psychological, social, and organizational work factors to risk of disability retirement: a systematic review with meta analyses. BMC Public Health. 2017;17(1):176. https://doi.org/10.1186/s12889-017-4059-4.

30. Cylus J, Glymour MM, Avendano M. Health effects of unemployment benefit program generosity. Am J Public Health. 2015;105:317–23. https://doi.org/10.2105/AJPH.2014.302253.

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