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

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Unemployment is strongly associated with mortality on the individual level. The reasons for this association are not fully established. The authors estimated the effects of unemployment and workplace downsizing on mortality during periods of low (1989) and high (1994) unemployment in Finland. They used prospective population registration data containing detailed socioeconomic and demographic information on two cohorts aged 35–64 years at the beginning of 1989 (N = 87,317) and 1994 (N = 72,419) followed up for mortality in 1990–1997 and 1995–2002, respectively. Unemployment was found to be associated with a 2.38-fold increase in the hazard of mortality after 1989 and with a 1.25-fold increase after 1994. No excess mortality was observed among those who, at baseline, were employed at workplaces that had experienced large reductions in employment. Furthermore, the association between unemployment and mortality was weaker among those working in establishments that had been strongly downsized. By showing that, in the context of either a high level of unemployment or rapid downsizing, the effects of unemployment on mortality are modest, this study provides strong evidence of unaccounted confounding. Individual-level studies may thus overestimate the causal effects of unemployment on mortality.

The effects of unemployment on different domains of mental health are well established, but its effects on physical health are more difficult to quantify. The most consistent evidence of the physical health effects of unemployment comes from mortality studies. Several individual-level observational follow-up studies have shown that, after adjusting for age, mortality is higher among the unemployed than among the employed (1–6). Consistent with the evidence from studies on mental health, the effects are usually strong with respect to suicide (1–3, 7–9) as well as accidents and violence (1–3). Excess mortality is sometimes also observed at least for lung cancer (1–3) and cardiovascular diseases (2, 3, 6). Unemployment appears to be more strongly associated with mortality among younger rather than older people (1, 2, 4) and among those unemployed for extended periods of time (3). To a varying extent, these studies have adjusted for possible confounders measured at baseline. These adjustments include factors describing the demographic (age and sex), socioeconomic (education, social class, and income), family (marital status), and baseline health status of the individuals. After adjustment for these factors, the effects of unemployment on mortality were attenuated but remained significant in most, but not all, of the studies.

However, strong inferences about the causal effects of unemployment on mortality are still not warranted, because the possibility that individuals who have a high risk of mortality might be selected for unemployment cannot be fully ruled out. Although direct selection for unemployment because of ill health seems to be of little relevance (3, 6), even
the most detailed follow-up studies are unlikely to have been able to fully adjust for the effects of selection based on personality and psychosocial characteristics, lifestyle, and earlier labor market experiences.

Unemployment in Finland increased from 4–5 percent in the late 1980s to a peak of about 19 percent in 1994. Those who became unemployed for the first time during the period of mass unemployment in the 1990s have lower excess mortality than those unemployed during low levels of unemployment (5). Mortality has also developed similarly in occupational groups with varying rates of increase in unemployment levels (10). This finding suggests that the causal effect of unemployment on excess mortality may have been overestimated in many follow-up studies, and that the effects of selection have been underestimated.

In this study, we analyzed the effects of unemployment and workplace downsizing on mortality in the context of low and high levels of unemployment. We did so to avoid problems of inference in observational epidemiologic studies on the effects of unemployment and mortality and thus gain a fuller understanding of the relative contributions of selection and causation in explaining excess mortality among the unemployed. The rationale of our study design is that the chances of being laid off when workplace staffing levels are drastically reduced, especially when the workplace shuts down altogether, are unlikely to strongly depend on the characteristics of the employed individuals. Such naturally occurring “experiments” provide for a powerful study design when the random experimental allocation of subjects to exposure is impossible. A comparison of the “naturally” exposed group—in this study, those who became unemployed because of workplace downsizing—with an unexposed reference group closely resembles a controlled experiment. Under such conditions, inferences about causality are strong. However, previous analyses of workplace closures have suffered from a lack of power in terms of mortality analysis.

To overcome the limitations of previous studies on factory closure and downsizing, we used large-scale, register-based, individual-level data on employed Finnish men and women, linked with data on the workplace level. We followed the individuals for workplace downsizing, experience with unemployment, and mortality. The unique contribution of our study is the use of workplace-level information on changing staffing levels. By comparing the mortality of those who became unemployed from strongly downsized workplaces with that of those who became unemployed from more stable workplaces, we were able to assess the importance of the selection effect as an explanation for the high excess mortality of the unemployed more effectively than previous studies did.

The specific research questions addressed in this study were the following:

1. How strongly is the experience of unemployment and workplace downsizing associated with mortality?
2. Is unemployment more weakly associated with mortality at a high level of unemployment or among those employed in workplaces that have been strongly downsized?

MATERIALS AND METHODS

Participants and study design

The target population consisted of men and women born between 1924 and 1959, living in Finland between 1987 and 2000, and working in establishments that had five or more employees. Because of the data protection regulations of Statistics Finland covering both individuals and workplaces, the research team obtained a sample of the target population. The sample consisted of three parts: 1) a 50-percent random sample of people who had worked at an establishment between 1988 and 1994 but had died before the end of 2002; 2) a 20-percent random sample of workers whose establishment had reduced its workforce by at least half between two adjacent years during the period 1988–1994; and 3) a 10-percent random sample of the population in the period 1988–1994. The complex sampling design did not bias our results since we were studying mortality conditioned on the persons being employed at baseline and further conditioned on the change in the size of the labor force of the workplace. We also used weighting in the analyses to account for the different sampling probabilities.

For the purposes of this study, two cohorts were extracted from this data file. Participants in both were aged 35–64 years at their respective baselines and were followed regarding mortality for 8 years (figure 1). The first study cohort—the 1989 cohort—included all sample participants who were alive on January 1, 1989; were working in an establishment; and were aged 35–64 years. For this cohort, we measured unemployment and workplace downsizing for 1989, and we followed mortality from the beginning of 1990 to the end of 1997. Mortality follow-up applied to all those employed at the workplace at baseline regardless of whether they remained employed or became unemployed. We followed 87,317 individuals and observed 9,586 deaths altogether. A corresponding study cohort—the 1994 cohort—was also established, and we followed 72,419 individuals and observed 6,577 deaths in the period 1995–2002.

Measurements

For every sampled person, we included information from three different data sources at Statistics Finland, which linked the individual records by using personal identification codes. It also provided us with an anonymized version of the data.

The first data source used for the study was the Statistics Finland labor market data file, which combines basic demographic and socioeconomic information on all persons living in Finland and detailed information on labor market participation from different sources on an annual basis. It covers all employment and unemployment episodes on an individual basis. Statistics Finland acquires unemployment information from the Ministry of Labor records on registered unemployment periods. The data source can be considered reliable because payment of unemployment benefits is based on it. Months of unemployment during the calendar year are available for analysis. For this study, we classified those experiencing unemployment in the year following study baseline into two groups: 1) employed throughout
the year or unemployed for less than 1 month, and 2) experiencing 1–12 months of unemployment.

All sampled persons were also allocated to a workplace. Information on all workplaces in Finland (about 47,000 in 1989 and 37,000 in 1994) was taken from the Statistics Finland establishment register, which provides detailed data on the turnover, production, industry, and staffing levels of each workplace measured on an annual basis. We calculated the percentage change in the size of the workforce in the year following baseline as \( \left( \frac{e_{b+1} - e_b}{e_b} \right) \), where \( e_b \) and \( e_{b+1} \) are numbers of employees at baseline and 1 year later. The workplace register also provided information on the branch of industry and the geographic location of the establishment.

Mortality follow-up was based on the Statistics Finland register of cause-of-death certificates. From these certificates, we extracted the date and cause of death. Deaths were classified according to the *International Statistical Classification of Diseases and Related Health Problems*, Tenth Revision. Fewer than 0.5 percent of all deaths could not be linked to the Statistics Finland labor market data.

**Statistical analyses**

The data were analyzed by means of Cox regression analysis, and the STATA statistical package was used in fitting the models (11). In this paper, the results of the Cox models are presented as hazard ratios, with one category of each explanatory variable considered the reference group. We combined data on men and women in the analyses, and we adjusted for sex and age (5-year categories) in all of the regression models. In further confirmatory analyses, we also adjusted for branch of industry and geographic location of the workplace, but, because these adjustments did not substantially change our results, we present the unadjusted figures below.

**RESULTS**

Those who had worked in an establishment that experienced extensive downsizing were also more likely to have experienced unemployment (table 1). The differences were modest in 1989, but they were much more substantial in 1994.

Table 2 shows unemployment to be strongly associated with mortality and that this association was stronger in the first cohort that experienced low unemployment. The degree to which the establishment shed its workforce was only weakly associated with mortality. Mortality was lower among those who had worked in a closed or substantially downsized establishment than among those working in establishments with a stable workforce size. The association of downsizing with mortality was similar in periods of low and high unemployment. Results not presented here suggest that these associations were stronger for accidental and violent causes of death.

**FIGURE 1.** Structure of the data by study cohort, year, and age for men and women in Finland, 1989–2002.

![Graph showing structure of the data by study cohort, year, and age for men and women in Finland, 1989–2002.](https://example.com/graph.png)

**TABLE 1. Experience with unemployment by level of workplace downsizing* among those aged 35–64 years at the beginning of 1989 and 1994, Finland**

<table>
<thead>
<tr>
<th>Downsizing</th>
<th>1989 cohort</th>
<th>1994 cohort</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No.</td>
<td>% unemployed</td>
</tr>
<tr>
<td>Employment secure (less than 9%)</td>
<td>67,828 2</td>
<td>50,321 4</td>
</tr>
<tr>
<td>Moderate downsizing (–10% to –29%)</td>
<td>12,064 4</td>
<td>10,799 10</td>
</tr>
<tr>
<td>Severe downsizing (–30% to –49%)</td>
<td>3,086 6</td>
<td>3,182 15</td>
</tr>
<tr>
<td>Workplace closure (–50% to –100%)</td>
<td>4,339 5</td>
<td>8,117 20</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>87,317 3</td>
<td>72,419 7</td>
</tr>
</tbody>
</table>

* Unemployment for more than 1 month and level of downsizing in the year following baseline.
In both the 1989 and 1994 study cohorts, the experience of unemployment was relatively weakly associated with mortality for those who had worked in establishments that had undergone rapid downsizing (table 3).

In further analyses not presented here, we tested for gender interactions of the effects of unemployment and downsizing on mortality. In most instances, these interactions were small and statistically not significant. Only in the 1989 cohort did the effect of individual-level unemployment on mortality appear to be slightly larger among the men (hazard ratio = 2.61, 95 percent confidence interval: 2.27, 2.99) than among the women (hazard ratio = 1.59, 95 percent confidence interval: 1.24, 2.03).

**DISCUSSION**

**Main findings and their interpretation**

This study confirms the association of unemployment with mortality on the individual level. The results further show that this association was much weaker during the recession of the early 1990s, a period of very high unemployment in Finland (5). Previous studies with sufficient power that have directly assessed the effects of national or regional unemployment as a modifier of the association between unemployment and mortality have shown that the excess mortality of the unemployed tends to be lower mainly at times and in regions of high unemployment (2, 5). Similar results have been observed for several self-reported health outcomes, for example, self-rated health (12), but the overall results are somewhat less consistent.

We extended these findings and used information from workplace registers to study the modifying effects of downsizing. These analyses also showed a weaker association between unemployment and mortality on the individual level for those who had been working in establishments in which the workforce was substantially reduced. Thus, on a much closer and relevant level of contextual environment, our results expand earlier findings suggesting a weaker effect of unemployment on mortality in the context of high unemployment risk. Overall, these observations suggest that the association between unemployment and mortality observed at low unemployment levels may be largely due to selection into unemployment. By way of contrast, in the context of high levels of unemployment, the risk of unemployment is more evenly distributed and may provide a more accurate gauge of the true causal effects of unemployment on mortality.

**TABLE 2. Numbers of deaths and age- and gender-adjusted hazard ratios and their 95% confidence intervals by experience with unemployment and downsizing* among those aged 35–64 years at the beginning of 1989 and 1994, Finland**

<table>
<thead>
<tr>
<th>Experience with unemployment</th>
<th>1989 cohort</th>
<th>1994 cohort</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No.</td>
<td>No. of deaths</td>
</tr>
<tr>
<td>Employed</td>
<td>84,868</td>
<td>9,039</td>
</tr>
<tr>
<td>Unemployed</td>
<td>2,449</td>
<td>547</td>
</tr>
<tr>
<td>Downsizing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Employment secure (less than –9%)</td>
<td>67,828</td>
<td>7,567</td>
</tr>
<tr>
<td>Moderate downsizing (–10% to –29%)</td>
<td>12,064</td>
<td>1,377</td>
</tr>
<tr>
<td>Severe downsizing (–30% to –49%)</td>
<td>3,086</td>
<td>320</td>
</tr>
<tr>
<td>Workplace closure (–50% to –100%)</td>
<td>4,339</td>
<td>322</td>
</tr>
</tbody>
</table>

* Unemployment for more than 1 month and level of downsizing in the year following baseline.
† HR, hazard ratio; CI, confidence interval.

**TABLE 3. Age- and gender-adjusted hazard ratios and their 95% confidence intervals for the unemployed by level of downsizing* among those aged 35–64 years at the beginning of 1989 and 1994, Finland**

<table>
<thead>
<tr>
<th>Downsizing</th>
<th>1989 cohort</th>
<th>1994 cohort</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No.</td>
<td>HR†</td>
</tr>
<tr>
<td>Employment secure (less than –9%)</td>
<td>67,828</td>
<td>2.45</td>
</tr>
<tr>
<td>Moderate downsizing (–10% to –29%)</td>
<td>12,064</td>
<td>2.68</td>
</tr>
<tr>
<td>Severe downsizing (–30% to –49%)</td>
<td>3,086</td>
<td>0.90, 2.53</td>
</tr>
<tr>
<td>Workplace closure (–50% to –100%)</td>
<td>4,339</td>
<td>0.77, 2.81</td>
</tr>
<tr>
<td>Total</td>
<td>87,317</td>
<td>2.38</td>
</tr>
</tbody>
</table>

* Unemployment for more than 1 month and level of downsizing in the year following baseline.
† HR, hazard ratio; CI, confidence interval.
Alternative explanations for the small excess mortality among those who have become unemployed during periods of high unemployment include the possibility that, in such situations, either the stigma associated with unemployment is low or population groups, such as workers within particular regions or within particular economic sectors, have subcultural characteristics that enable the unemployed to cope better with job loss. However, these explanations are unlikely to be a major factor in accounting for the contextual effect found in this study on both empirical and theoretical grounds.

First, a previous Finnish study that aimed to directly assess the viability of such explanations found the experience of unemployment at low unemployment rates to be associated with very high excess mortality even if the persons were reemployed later (5). Second, in the Finnish context of the present study, the unemployment rate increased by about 15 percentage points in a period of 9 months, a period we consider too short to witness large changes in deep-rooted perceptions about the value of work or subcultural coping strategies. More generally, explanations of the contextual effects of levels of unemployment based on stigma or resilience seem to be more plausible for analyses of regional-level variations than for analyses of short-term temporal variations. Finally, during the Finnish recession, unemployment affected industries and socioeconomic groups that had traditionally been largely insulated from the risk of unemployment, such as white-collar and public-sector employees. If stigma had an impact on the contextual differences in the excess mortality of the unemployed, we should have observed increasing rather than decreasing associations between unemployment and mortality, because unemployment touched the lives of persons who had thought they were largely sheltered from the risk of unemployment and were culturally not adapted to handling it (10).

From the perspective of natural experimental design, the group of employees who had experienced extensive downsizing and closure (staffing levels reduced by more than 50 percent) is of particular interest because most of them had the direct experience of unemployment or the threat of it. We observed that in instances of both low and high unemployment rates, mortality among those who were employed in workplaces that experienced a major staff reduction or closure was not elevated. On the contrary, mortality among those experiencing extensive downsizing appeared to have been even lower during the follow-up period than among those working in stable establishments. These results are broadly in line with the largest known study on factory closure conducted so far—a study of a meat processing plant in New Zealand that closed in 1986 (N = 2,000 in the closed factory) (13). In that study, the association between unemployment and suicide was the strongest (hazard ratio = 2.15, 95% confidence interval: 0.56, 8.36), but unemployment was unrelated to other causes of death. Self-inflicted harm leading to first-time hospital admission after workplace closure was statistically significantly higher among those who had worked in the closed plant; however, again, hospital use for heart disease, cerebrovascular disease, cancer, and respiratory illness was unaffected.

In workplaces that experienced more modest levels of downsizing (less than a 50 percent reduction in staff), the majority of employees were not directly affected by unemployment. Any adverse health effects were thus also likely to be more modest. In fact, in addition to unemployment and the threat of it, these adverse health effects could be hypothesized to be the result of adverse changes in the work environment of those remaining at work, such as more busy work schedules (14, 15). In our study, people employed at workplaces that had experienced more modest downsizing had mortality rates similar to those for people employed in stable workplaces. These results thus indicate that the combined effect of downsizing on those becoming unemployed and those remaining at work was probably small. However, further research is needed to more carefully assess the impact of different levels of downsizing separately on those who became unemployed and those who remained at work.

Methodological considerations

The data used for this study are of high quality, with practically none missing and no recall bias. They cover a large sample of the Finnish population aged 30–59 years working in establishments that had five or more employees at the beginning of follow-up. Uniquely, the sample combines individual-level data on unemployment and workplace downsizing, and it is large enough to assess mortality within a study design that takes advantage of natural experimental strategies.

The results of the study can be directly extended to men and women working in establishments employing five or more employees. Employees of smaller workplaces were not analyzed here, because changes in employment in such establishments are difficult to estimate reliably. This choice of study population excluded approximately 11–13 percent of all salaried employees. However, this exclusion does not appear to limit the generalizability of our results because the individual-level associations between unemployment and mortality are very similar to those observed in a previous study on the entire economically active population (5). With register-based data, hidden unemployment is impossible to detect.

One problem with studies on workplace downsizing and closure that is difficult to quantify is that rumors of closure may circulate before major decisions are made. The employees who are best positioned to find a new job elsewhere might therefore have left the company before the closure or downsizing occurred. As a result of such “attrition” in a workplace about to experience a major reduction in its workforce, the remaining workers would become a select group and the estimated effects of unemployment on mortality would be biased upward (16). Because we found that workers in drastically downsized or closed establishments had lower rather than higher mortality rates, this effect would not appear to be important in this setting.

Conclusion

On the individual level, the experience of unemployment is a strong indicator of disadvantage and a measure of
a disrupted labor market career (14), and it is strongly associated with mortality. The strength of the causal effects of unemployment remains uncertain, however, because the effects of selection cannot be accounted for in individual-level studies. Our results provide evidence of unaccounted confounders by showing that, in the context of either a high level of unemployment or rapidly downsizing workplaces, the effects of unemployment on mortality are modest. We further showed that severe downsizing is not associated with increased mortality. Although a causal association between unemployment and mortality, particularly accidental and violent death, remains possible, it is thus also likely that most individual-level studies overestimate the causal effects of unemployment on mortality. A challenge for future research is to more accurately quantify the effects of unemployment and to reliably identify the causes of death that are affected. The public health impact of economic recession and increasing unemployment cannot be inferred from the excess mortality ratios of the unemployed observed at a time of low unemployment.

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Conflict of interest: none declared.

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