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Health Consequences of the ‘Great Recession’ on the Employed: Evidence from an Industrial Cohort in Aluminum Manufacturing

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Abstract

While the negative effects of unemployment have been well studied, the consequences of layoffs and downsizing for those who remain employed are less well understood. This study used human resources and health claims data from a large multi-site fully insured aluminum company to explore the health consequences of downsizing on the remaining workforce. We exploit the variation in the timing and intensity of layoff to categorize 30 plants as high or low layoff plants. Next, we select a stably employed cohort of workers with history of health insurance going back to 2006 to 1) describe the selection process into layoff and 2) explore the association between the severity of plant level layoffs and the incidence of four chronic conditions in the remaining workforce. We examined four health outcomes: incident hypertension, diabetes, asthma/COPD and depression for a cohort of approximately 13,000 employees. Results suggest that there was an increased risk of developing hypertension for workers that remain at the plants with the highest level of layoffs, and increased risk of developing diabetes for salaried workers that remain at the plants with the highest level of layoffs. The hypertension results were robust to a several specification tests. In addition, the study design selected only healthy workers, therefore our results are likely to be a lower bound and suggest that adverse health consequences of the current recession may affect a broader proportion of the population than previously expected.

Keywords

Economic recession; Health; Downsizing; Hypertension

Introduction

The 2007–2009 recession, dubbed “The Great Recession”, has been most severe recession in the United States since the Great Depression of the 1930’s with the fastest increase in unemployment rates—108% increase in two years—the longest duration, and the slowest recovery (Goodman & Mance, 2011). While there has been much interest in the experiences of those who lost their jobs during this period, there has been limited interest in those who

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remain employed after downsizing events, hereafter referred to as survivors. Though survivors have fared relatively well, their experience is of interest because this group represents the majority of the population— 79.3% of the labor force remained employed throughout the recession (Johnson & Butrica, 2012). Awareness of the rapidly changing unemployment rate may have increased all remaining workers' perceived job insecurity, but the risk may have been more salient at worksites that experienced layoff or downsizing events. In turn, this may have affected health or health related behaviors.

Indeed, the negative impacts of organizational downsizing and increased job insecurity on employee health have been highlighted in a series of recent reviews. Studies suggest increases in sickness absence, declining self-reported health, more self-reported job insecurity, and worse psychological well-being (Davis et al., 2003; Quinlan & Bohle, 2009). These reviews discuss studies done in many different countries (primarily in Scandinavia), which examine employed and unemployed populations, utilize both cross-sectional and longitudinal designs, and consider a variety of macroeconomic periods. However, neither the longitudinal pattern of change in relation to prior health status, nor long-term consequences have been well characterized.

While most studies suggest that organizational downsizing is bad for employee health, there have several notable limitations, thus making it difficult to draw general conclusions. First, many studies rely on self-reported job insecurity and health, which may inherently be biased (Hellgren & Sverke, 2003). Second, most studies of downsizing include those workers that are eventually laid off, but it has been documented that workers that are laid off are also generally at higher risk for adverse health or health related behavior to begin with (Bockerman & Ilmakunnas, 2009; Deb et al., 2009; Kivimäki et al., 2003). Third, studies often do not account for the macroeconomic condition. Yet during periods of heightened economic uncertainty the effects of organizational downsizing on health may be different than those occurring in a single sector, industry or firm. Finally, only a few studies have focused on the effects of downsizing and job insecurity on survivors (Dragano et al., 2005; Kivimäki et al., 2003; Martikainen et al., 2008; Vahtera et al., 2004).

Another salient issue for studies of survivors is selection in layoff events. An exceptional recent study of job insecurity on survivors used a population-level sampling strategy and examined the affects of an externally constructed measure of job insecurity (as opposed to self-reported) on excess mortality in an eight-year follow-up. This study was conducted during the deep recession in Finland of 1991–1993 (Martikainen et al., 2008), and it found no evidence of excess mortality among those remaining at downsized workplaces. However, the study did document that those who experienced the most severe downsizing at their worksite were actually protected in the eight-year mortality follow-up. The authors suggest that this was likely the result of selection—the survivors may well have been the healthiest workers. Thus, despite having an impressive sample, namely, a population registry, the authors could not account for the selection process into layoff. Our study intends to fill this remaining gap. There have been no studies in the United States of how survivors fared in the context of the 2007–2009 recession using external measure of job insecurity while accounting for previous health. Therefore in this paper, we first examine how survivors and those who were laid off differ, and then discuss the effects of organizational downsizing on survivors of mass layoffs in the context of the peak of the recent global recession.

We examine workers at Alcoa, a large multi-site, geographically diverse, aluminum manufacturing company with rich and uniform insurance benefits. Our study takes advantage of a large on-going cohort study dating back to 1996; therefore we have detailed data on the cohort before, during and after the recession at multiple worksites. Fortuitously we have significant variation on how worksites were affected by the global downturn. As a

consequence of plummeting demand for its products, Alcoa was forced to cut production broadly, with layoffs and accelerated retirements at every level of the organization in 2009 (Alcoa, 2010). However, not all worksites experienced similar levels of layoffs. Some worksites let go of as much as 40% of workers while others let go of only 5% — a similar turnover to that in normal times. Unlike previous studies of downsizing in US manufacturing worksites in the auto and aircraft industries (Hamilton et al., 1993), the Alcoa worksites are distributed across 15 states with largely independent labor markets.

Accordingly for each plant, we categorize the severity of layoffs and/or their timing as an external measure of job insecurity and then evaluate subsequent health outcomes on the remaining workforce at each worksite. Based on the intensity of downsizing, our measure captures the extent to which downsizing induced job insecurity for the remaining workforce, but it cannot account for workers' own appraisal of how secure their job is. These attributes make our measure an imperfect proxy for perceived job insecurity, but also limit the potential for bias if the least healthy workers report the most job insecurity.

Methods

Data Sources

This study relied on a series of administrative datasets including personnel data, health claims data, and earnings data, which have been made available to researchers through an ongoing collaboration between Alcoa and the study investigators. These data have been described in detail in previous publications where they have been used in a variety of studies ranging from validating the use of claims data to evaluate health to examining the association between job characteristics and health outcomes (Clougherty et al., 2009; DeSanto Iennaco et al., 2010; Pollack et al., 2007). The company's personnel dataset was used to construct the cohort of interest, extract basic demographic data, and define our exposure measure of interest, the intensity of downsizing at each plant. In addition to the personnel data, health claims data were used to administratively identify new cases of four health conditions and to control for previous health. We linked these data sources with available information on changes in area-level unemployment rate in our final analyses. Each dataset, its treatment, and linkages are detailed below.

Personnel data, demographic controls, cohort definition, and constructed downsizing measure—The central data set for this study was constructed from personnel data files. For each employee, this dataset included basic demographic variables (sex, race, age), employee type/job category (hourly or salary), employee tenure, plant information (location and union status), employment status (active or retired), and termination date. We used the personnel file to extract demographic control variables, define a cohort (detailed below), and construct external measure of intensity of downsizing as a measure of job insecurity (detailed below).

Cohort Definition

We used the personnel data to select a cohort of approximately 22,000 stably employed workers who were employed on January 1, 2006. Approximately 16,000 of these workers remained working at Alcoa on January 1, 2010. Of these 16,000 survivors of the 2009 layoffs, approximately 14,000 employees worked at plants for which we had a history of health insurance going back to 2006 to verify new onset of disease. Four plants were excluded. This cohort was further selected to exclude individuals who already had significant health issues before the recession (criteria based on risk scores which are detailed below) or for whom we did not have a measure of prior health status in 2008. Our final cohort included 13,393 employees. The cohort selection strategy is outlined in Table 1.

External measure of downsizing

To create an external measure of downsizing, as a proxy for job insecurity, we used two criteria: 1) the change in size of the workforce at each plant from January 1 to December 31, 2009 and 2) plants experiencing a mass termination event. For 30 fully functional US plants with >100 employees in 2008, we calculate the proportion of the workforces that was laid off in 2009. For these same plants we noted dates in 2009 where more than 40 workers had their contract of employment terminated on the same date and classified these dates as mass layoff events. Worksites with 20–40% reductions and at least one mass termination event were categorized as ‘high layoff’ plants. Using this definition, seven plants (five in sample) were considered high layoff plants. The ten plants (nine in sample) that fared the best, with less than 11% layoffs were categorized ‘low layoff’ plants. The remaining thirteen plants (twelve in sample) were categorized as ‘moderate layoff’ plants. These cutoffs were based on natural breaks in the data and selected to be comparable to those used in previous studies (Martikainen et al., 2008; Vahtera et al., 2004).

Health claims data, health outcomes and risk score—As a self-insured firm, Alcoa provides identical health insurance benefits to employees through local preferred provider organization (PPO) subject to choice with respect to family coverage and deductible rates. The company contracts with a single firm to manage its claims data. With the exception of a small number of workers who select a Health Maintenance Organization (HMO), all claims are managed within this database.¹ We obtained claim files for all but four of the thirty plants where a sizable proportion of workers used HMOs. These data provided both a master list of eligible individuals, including spouses and children, and linkable detailed claims records for each inpatient/outpatient medical encounter and for each prescription filled. The claims data also provides both International Classification of Diseases, Ninth Revision (ICD9) and Current Procedural Terminology (CPT) codes.

Health Outcomes

We used the claims data to identify incident cases of four health conditions: hypertension, diabetes, asthma/COPD and depression. These chronic conditions are selected because they may be related to or exacerbated by stress or stress related behaviors. Individuals who had one or more inpatient claims with ICD9 diagnosis codes of 401-404 or two or more outpatient claims with the same ICD9 codes were designated as having hypertension. We used one or more inpatient claim with ICD9 diagnosis code of 250 or two or more outpatient claims with the same ICD9 codes to identify diabetes cases. We explicitly excluded cases of gestational diabetes using ICD9 codes 648 and 790. In addition, we included cases with only one outpatient diagnosis if it was accompanied by one or more prescription filled for glucose-lowering therapies (Sulfonylureas, Meglitinides, Thiazolidinediones, alpha-glucosidase inhibitors, and DPP-4 inhibitors). We identified workers with depression if they had one or more inpatient claim with ICD9 diagnosis codes of 296, 309, or 311 or one or more outpatient claims with the same ICD9 codes. Finally workers we designated as having COPD/Asthma if they had one or more inpatient claim with ICD9 diagnosis code of 493 or 496 or two or more outpatient claims with the same ICD9 codes. In addition, we included cases with only one outpatient diagnosis if it was accompanied by one or more prescriptions filled for inhaled Corticoids, mixed inhaled Corticoids, or Beta2-Antagonists.

¹While both PPOs and HMOs are a type of managed care, PPOs contracts with a network of “preferred” providers from which patients can choose to use at a discounted rate or patients can choose a provider outside the network without the discount. By contrast HMOs contract with a network of providers and patients receive all of their health care services from a provider within the network at discounted co-pay rates.

For all of the four conditions, only outpatient claims with a face-to-face encounter were considered and a three-year run-in period (2006–2008) was used to find and exclude prevalent cases. That is, if an individual was identified as having been diagnosed with a hypertension via our definitions between 2006–2008, he/she could not be considered a new case; our analysis only included workers who were *at risk* of developing the specific condition.

Health Risk Scores

In addition to the health claims data themselves, we use a third-party algorithm to create a health-risk stratification score for each individual. This algorithm is based on a chronic disease model and inputs CPT codes, diagnostic codes, number of eligible months, and overall outpatient health expenditures derived from the claims data and outputs a continuous risk score (Verisk Health Inc, DxCG® Software). A risk score of 1 indicates that the individual is predicted to have the median health expenditure in the following year. Each unit increase indicates a one-fold increase over the median. For example, a score of 3 indicates that the individual is expected to spend three fold over the median the following year. We use the 2008 lagged risk score (which predicts the health of the individual in 2009) and then categorized them into four groups as a summary measure to control for previous underlying health. The three groups were those with scores ranging from 0–1 (the omitted category—generally healthy individuals with predicted health expenditures less than the median), 1–2 (those who are predicted spend at or somewhat more than the median), and 2–4 (those who are predicted to spend at least twice the median but less than 4 times the median). Individual with risk scores greater than 4 were dropped from the analyses because they are likely to be quite unhealthy already and represent the sickest 2.1% of the sample.

Area Control Variables-Area Unemployment

To account for regional (state or county) unemployment and labor market conditions, we created an area-level unemployment rate variable for each plant based on the Bureau of Labor Statistics data. We weighted the unemployment rate of the county and adjacent counties by labor forces size in 2008 to avoid over counting unemployment related to plant layoffs. We then calculated the change in unemployment rate between 2008–2010 and used this measure as a control variable in all the analyses. This measure was included in the model because general unemployment rates may not be as relevant to an individual's sense of job insecurity or stress as the job losses within one's workplace. The latter effect is the one we wanted to isolate. While all the plants in the study were in areas that experienced an increase in the unemployment rate, some areas experienced more rapid changes in unemployment. We wanted to distinguish between the two distinct levels of effects particularly because in our data the counties that had the fastest rate of change of unemployment were not necessarily where the plant that had high layoffs were located.

Linkages—Figure 1 details the linkages of these different data sources in the final analyses. We first linked the extracted cohort to the claims data. In order to have a measure of previous health status, we select only members of the cohort who were insured in the 2008 and have a 2008 health risk score value. Our final sample included 13,393 workers who were actively employed between January 1, 2006 and who were still active as of January 1, 2010 and for whom we had basic demographic information. Despite their older age, the cohort *is selected* to be particularly healthy (still working, not terminated during the recession, not having a high risk score in 2008).

Statistical Analyses

We first characterized the exposure variable of interest. We graphed the layoff patterns and average hours worked by the three categories of plants layoffs using the longitudinal data. We then describe the selection process into layoffs by comparing the health status of those who survived and those who did not before the layoffs occurred. These descriptive analyses aid in the interpretation of our main result. Our main analyses explored whether working at a high layoff plant was associated with a new onset of one of the four chronic conditions. For the four outcomes, we had the advantage of being able to look longitudinally at health and establish a cohort for which we know the previous health status. After excluding prevalent cases (cases first identified between 2006–2008), we estimate the association between working at a high layoff plant and developing a new health condition using the following logistic regression model:

$$\text{New Diagnosis in 2009/2010}_{p,i} = F_{\text{logistic}}(\alpha + \beta_1(\text{High Layoff}_p) + \beta_2(\text{Salary}_i) + \beta_3(X_i) + \beta_4(\text{Lagged Health Score}_{i,2008}) + \beta_5(\Delta \text{Area Unemployment}_p) + \varepsilon_{pi}) \quad (\text{MODEL } 1)$$

The vector of individual-level covariates, X_i , include gender, race, tenure and working at a union plant. The overall error term, $\varepsilon_{pi} = \varepsilon_i + \varepsilon_{pi}$, is modeled using random-effects at the plant-level to account for the interdependence of the observations within plant.

We also explore whether hourly or salaried employees fared differently at high layoff plants. Hourly workers are almost exclusively production workers who are paid by the hour. Those at unionized facilities are, obligatorily, members of the union. Salaried workers represent a range of administrative and supervisory jobs and are compensated by regular salaries. Salaried workers are not represented by unions at any location. To understand the extent to which these differences mattered for health, we estimate models similar Model 1, but add an interaction term between working at a high layoff plant and employee type.

$$\text{New Diagnosis in 2009/2010}_{p,i} = F_{\text{logistic}}(\alpha + \gamma_1(\text{High Layoff}_p) + \gamma_2(\text{Salary}_i) + \gamma_3(\text{Salary}_i * \text{High Layoff}_p) + \gamma_4(X_i) + \gamma_5(\text{Lagged Health Score}_{i,2008}) + \gamma_6(\Delta \text{Area Unemployment}_p) + \varepsilon_{pi}) \quad (\text{MODEL } 2)$$

In addition to the main analyses, we conducted a series of additional sensitivity analyses to test how robust our results were to alternate specifications. First, we limited our analyses to workers who worked at either low or high layoff plants, excluding the middle category. Based on news article counts, the overall uncertainty over the economy and economic policy in the United States was generally elevated compared to the recent years (Baker et al., 2013), thus even those employees not working in high layoff plants were likely to feel some work related stress or anxiety, and so the differential between high layoff plants and all others was likely to be an underestimate. Many workers, especially those working in the mid-level downsized plants, may also have felt elevated anxiety so may not be an appropriate comparison group. Therefore we compared those who experienced little downsizing compared to those who experienced relatively severe downsizing. We expected that this exclusion would strengthen the association between job insecurity and health outcomes if health is indeed related to the level of layoff in one's worksite. Second, we compared hourly workers with particularly long tenure to all the other workers because these workers were either protected completely by their union contracts or essentially irreplaceable because of their long experience. While some long tenured hourly workers were offered an incentive to leave during the recession—the so-called golden handshake—those who survived knew that they were unlikely to be laid off. We examined new onsets in this group versus all other workers. If we were to find an elevated risk of developing a new health condition in this group of relatively protected workers this would undermine our

interpretation that job insecurity at high layoff plants has adverse consequences for health because these workers have contractual job security in the event of future layoffs. Third we looked at spouses. If we found a relationship for spouses whose partner was exposed to high layoffs, this could be due to area-level effects as opposed to plant specific effects. Even though spouses may experience excess stress and insecurity due to substantial layoffs at a spouses' worksite, the experience of stress is likely to be less acute or systematic, so we did not expect to find a relationship. Fourth, we altered the mix of plants categorized as high layoff plants and low layoff plants to examine how robust the results are to small changes in the exposure variable. Finally, we conducted a falsification test where we simulated for 2006 the layoff which later occurred then examined new onsets in 2007 and 2008-- prior to the actual layoff-- to see if we would find a differential in high versus low layoff plants merely as a consequence of the "culling" process at high layoff plants. If so, then this too would undermine our interpretation of any association found and would instead suggest that we were capturing a plant-level effect rather than the effect of job insecurity because there were minimal layoffs in 2007–2008 at these plants.

Institutional Review—The Stanford University's Institutional Review Board approved this study's protocol, invoking the epidemiologic exemption waiving the requirement for individual consent.

Results

Job Insecurity Categories

In Figure 2 we present yearly headcounts from 2006–2011 by the three categories of plants. Of the initial 30 plants considered, 7 were categorized as having had a high level of layoff or severe downsizing, 13 as having a mid level of layoffs or moderate downsizing and 10 as having a low level of layoffs or limited downsizing. Figure 2 also shows that the dynamics of the downsizing process was somewhat different between the plants with mid-level layoff because these plants had changes in headcount between 2008 and 2009 and again between 2009 and 2010. In the high layoff plants, there was a dramatic decline in the number of employees between 2009 and 2010 and a stable number of employees in the three years prior. In the low layoff plants, we see that while there was a decline in employees between 2009 and 2010, the change was limited. In the 2010–2011 period there was little change in the number of employees across all the plant categories. In Figure 3 we present the average number of weekly hours worked in the 3 groups of plant in January of 2006–2010 for hourly workers. We find that between 2006–2008 the high and low layoff plants had a similar number of average hours worked. In the high layoff plants, there was a decline in hours between 2008 and 2009 of as much as 15%. While this results in a decline in wages for hourly workers—possibly a stressor—it also results in more leisure time, quite possibly a health buffer.

Selection into layoff

We show descriptively that there was clear selection into the layoff category. Figure 4 presents the mean and 95% confidence intervals of the risk scores for member of the full cohort, those working on 1/1/2006, by whether or not they survived the layoffs. By 2007, two years before the layoffs, the health risk scores of those who were eventually laid off in 2009 were statistically different from those who survived the 2009 layoffs. More importantly, the health risk scores of those who were eventually laid off were rising faster than those who survived the 2009 layoffs and the difference in the rate of the rise was statistically significant. Appendix Figure A1 shows that there were also differences in wage growth in the period prior to the layoff events, such that survivors had higher wage growth prior to the onset of the recession [INSERT LINK TO ONLINE FILES]. We highlight this

selection issue in order to put the subsequent observations into context. All the comparisons presented below include only those who survived layoffs, but the clear selection into layoff should make finding any result less likely.

Health condition results

We examined the new incidents of the four chronic conditions of interest. We limited our sample to only those individuals who were not previously diagnosed with the conditions throughout 2006–2008, thus only individual who are *at risk* were considered. Table 2 panel A presents the descriptive summary statistic for the cohort. The cohort includes predominately tenured white males who are on average 49 years old. Depending on the sample, either 38% or 64% work in high layoff plants.

Table 2 panel B provides the counts of the new incidents for each condition. We found that about 3.3% of the cohort was diagnosed with hypertension, 1.1% was diagnosis with diabetes, and 1.1% was diagnosed with depression and 0.6% was diagnosed with asthma/COPD in 2009 and 2010. These rates are largely consistent with reported incidence for this older age group of mostly men (Dannenberg et al., 1988; Fox et al., 2006; Murphy et al., 1988). In panel C we present the count of the new onsets by employee type. Salaried workers had lower rates of hypertension, diabetes and depression. Finally in panel D, we present the incidents for the spouses, which are used in the sensitivity analyses. Spouses had lower incidents of hypertension and diabetes, but a slightly higher incidence of depression. These raw percentages do not account for the gender mix, which affect the likelihood of a new incidence of these diseases and are accounted for in the regressions to follow.

Table 3 panel A presents the results of the association of working in a high layoff plant and the four conditions. Columns 1, 3, 5, and 7 present the association between working at a high layoff plant and developing a new condition for all workers (MODEL 1) while columns, 2, 4, 6, and 8, present the analyses with the interaction term which estimates the association of working in a high layoff plant separately for hourly or salaried workers (MODEL 2). We found that those who survived layoffs at high layoff plants did have an elevated risk of being diagnosed with hypertension, diabetes, and depression, but the estimated odds ratio nears statistically significant only for hypertension (OR=1.41, 95% CI=0.97–2.05). In addition, for these same conditions increases in area-level unemployment from 2008–2010 also led to higher risk of a new onset, though the odds ratios were not statistically significant. Comparing hourly or salaried workers, we find some evidence of a differential effect by job type. The overall association found between working at a high layoff plants and being diagnosed with hypertension was concentrated amongst hourly workers who survived layoffs (OR=1.48, 95% CI=1.00–2.19). We also found that while salaried workers were generally at a lower risk of developing diabetes (OR=0.355, 95% CI=0.18–0.67), salaried worker at high layoff plants were more likely to have a new diagnosis of diabetes in 2009 and 2010 (OR=3.11, 95% CI=1.27–7.6).

Sensitivity Analysis

To ensure the robustness of the results, we conducted several sensitivity analyses. First we compare those who experienced little downsizing compared to those who experienced relatively severe downsizing. We expected that excluding workers who experienced moderate layoffs, would strengthen the association between job insecurity and health outcomes if health is indeed related to the level of layoff in one's worksite. Table 3 panel B presents the results of the association of working in a high layoff plant and the four conditions described above. We found that those who survived layoffs at high layoff plants did have an elevated risk of being diagnosed with hypertension, diabetes, COPD and depression, but the estimated coefficients were only statistically significant for hypertension

(OR=1.60, 95% CI=1.04–2.48). In addition, new increases in area-level unemployment were also associated with higher rate of new onset of hypertension. The diabetes result in Panel A, in which salaried workers at higher layoff plants developed excess diabetes, is no longer statistically significant.

Second, we examined long tenured hourly workers separately because they were less likely to be at risk of subsequent layoffs because of union protection and company policy. Given these protections, we would not expect tenured union workers to perceive substantial job instability even when there are massive layoffs. If we found an increased risk for these individuals, then that would suggest that our main results are likely an artifact. Table 4 columns 1–4 present the associations for tenured hourly workers and Table 4 columns 5–8 all other workers. Overall, Table 4 shows essentially no association between hypertension and experiencing high layoff for tenured hourly workers (OR=1.05; 95% CI=0.51–2.15), but a much higher magnitude for the association between hypertension and experiencing high layoff for all other workers (OR=1.91 95% CI=1.12–3.26). While the protected group differs from the remaining work force, particularly by being older, the magnitude of the coefficient on diabetes and depression is less than 1 for protected workers and higher than 1 for those workers not protected. Though none of these coefficients were statistically different from 1, they suggest that our designation of long tenured hourly workers as ‘protected’ is valid.

If the results were driven solely by area-level or plant-level confounders, then we would expect to find a biased relationship for spouses whose partner is exposed to high layoff. While spouse may experience anxiety about their spouse’s work prospects, the affect is likely to be less acute and we did not expect to find any *systematic* increases in health condition on spouses. For the 13,393 workers in our cohort, we were able to link spousal information for 8,909 partners, 67% (we would not expect to capture more than 85% since not all workers in the cohort were married between 2008–2010). Our spousal information comes from the claims data if a workers partner is enrolled in Alcoa’s insurance benefits. While some partners were likely to take other insurance, perhaps through their own employer, the Alcoa benefits are quite generous, so we believe we capture a large proportion of eligible spouses.

In Table 5 we present the new onsets of the 4 conditions for spouses. Columns 1–4 include all 26 plants and compare spouses of workers in high layoff plants to all others, while columns 5–8 include only 14 plants and compares spouses of workers in high layoff plants to low layoff plants (Table 5). We found no association between plant layoff status and the 4 conditions considered in either sample.

Fourth, we altered the mix of plants categorized as high layoff plants and low layoff plants. When we changed the cut-offs and altered the plants that fell into each plant category, we did not change the magnitude of the association between working in a high-layoff plant and hypertension substantially (data not shown).

Finally, as a ‘falsification test’ we examined new onsets of chronic conditions in 2007 & 2008 in high layoff plants for survivors. While the recession started in December 2007, it was not widely publicized until late 2008 and in plants categorized as low or high there was limited layoff in 2008 (Figure 2). We examined those working at high layoff plants and compared them to those working at low layoff plants as in Panel B in Table 3, but instead used new onsets of the four conditions in 2007 or 2008. This changed both the population at risk (the denominator) and the identified cases (numerator). We did not find an association between plant layoff and new onsets (data not shown).

Discussion

Our analysis examined the health consequences of downsizing events on the remaining workforce in the context of the 2009 recession. We found consistent evidence of an increased risk of developing hypertension for workers that remain working at plants where there was severe downsizing. The hypertension results were robust to several specification tests and a falsification test, suggesting that the association may be causal. We found some evidence of an elevated risk of developing diabetes for salaried workers at high layoff plants, but this result was statistically significant in only a subset of analyses. We found no association between working at a plant with high layoffs developing COPD or Asthma. Finally, we found no association between working at a high layoff plant and acquiring a new diagnosis of depression.

Though seemingly contradictory, the hypertension result found in this study is largely consistent with previous results. Particularly, Martikainen et al (2008), using a similar methodology during the severe recession in Finland found no adverse consequences on 8-year mortality. In contrast, in the UK a recent study found a small rise in self-reported poor health status not only for the unemployed, but also among people who remained employed (Astell-Burt & Feng, 2013). Our study found a modest increase in hypertension risk for survivors of layoffs, which is unlikely to affect mortality due to the wide availability of medication to control hypertension in the short run, but may affect self-reported health. Our results are consistent with these previous studies even though we found an association for increased incident hypertension. Other longitudinal studies of downsizing/restructuring or job insecurity have also found increases in blood pressure as workers transition from jobs perceived as secure to insecure (Ferrie et al., 2002; Pollard, 2001).

Surprisingly we did not find an association between downsizing and depression or physiological health as has been found elsewhere (Hellgren & Sverke, 2003; Hellgren et al., 1999; Kivimaki et al., 2007). While the magnitude of the odds ratios for depression at high layoff plants was generally elevated throughout many of the regressions, it is never statistically significant. One reason that we may not have found an association is that our measure of depression is a new diagnosis as compared to many other studies that rely on self-reported symptoms or depression scales. New diagnosis is a much more stringent measure because it excludes recurrent depression cases and requires workers to actively seek care for their symptoms using health resources—and co-pays—above and beyond the free employee assistance programs available at all sites. Given that we show that there was clear selection on health, many workers may have wanted to limit any sign of stigmatized mental health conditions. Finally, as noted above our exposure measure is based on the intensity of layoffs, as opposed to self-reported perceived job insecurity. From our data we have no way to identify workers who felt that their job was at risk and therefore may have had a physiological stress response. This too may have contributed to the lack of association with depression, our only mental health outcome. Future studies will need to assess this further, perhaps using a different marker for mental health.

The current study has several advantages over previous studies. First, the detailed timing of our data allowed us to examine only workers at risk for developing a new condition. Second, we used an external proxy of job security, the severity and observability of layoff events. Third, the analysis of new incidence of disease accounted for lagged baseline health in the year just before the layoffs. Fourth, we examined a population in which we know that on average their work hours were not changed substantially and if anything declined more in the high layoff plants, reinforcing the conservative nature of our inference. Most studies cannot account for these factors. Finally, we have reason to believe that our results are an under estimate of the true effect. Specifically, we selected healthy workers because of

duration of employment (Tenure >4) and because they have lower overall health risk scores (risk score in 2008 <4). We also document the substantial selection on health into being a survivor of the layoff events. We also examined a well-insured population that has had ongoing access to care. Taken together these observations would make it even more unlikely for us to have found any health effect.

Nonetheless, interpretations of these results require caution and further analysis. Foremost, the population under study includes those in the heavy and light manufacturing industries, which were hit quite hard in the current recession. It could be that for different sectors of the economy, where job losses were not so substantial, the results may have been different. With regard to the health outcome variables, we provide evidence that workers in the high layoff plants were more likely to be diagnosed with hypertension in 2009 and 2010. In our analysis we were careful to control for previous health to try to mitigate the problem that those who are otherwise less healthy are also more likely to get a new diagnosis for common health conditions. Nonetheless, we may be attributing health utilization behaviors to manifestations of health outcomes. Another concern is that the selection process we document could induce an artificial association, similar to regression to the mean, between hypertension and working in a high layoff plant. If we assume that most workers will eventually get hypertension and that there was more culling of prevalent cases in high layoff plants, then we could have had a higher rate of diagnosis in high layoff plants. However, this issue should have shown up in the falsification test in which we simulated the selection impact of the (subsequent) layoff, so we do not believe this problem is driving our main result. Finally our most notable weakness is our measure of exposure to job insecurity, plant-level downsizing. In most analyses we used this measure as dichotomous exposure, which has limited variation. In addition, our measure may not capture perceived job insecurity, though results in the sensitivity analysis suggest that it may be a valid proxy.

All in all, our study provides evidence that even those who remained employed through the peak of the recession experienced some adverse health consequence. If the recent wave of downsizing in the recession increased the sense of job insecurity and/or altered health related behaviors of the remaining workforce even modestly, as is suggested by this study, then we may expect to find that the overall health impact of the global recession is much larger than previously anticipated.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Highlights

- Few studies have examined how survivors of layoffs fared in the 2007–2009 recession
- Analysis of longitudinal data shows that survivors of layoffs were healthier
- Survivors at plants with severe downsizing had higher incidence of hypertension
- Surviving salaried workers at downsized plants had higher incidence of diabetes
- Health effects of the 2007–2009 recession may be larger than previously expected

Figure 1.
Sample selection and linkage

Figure 2.
Number of Workers on January 1st from 2006–2011 by plant type

Figure 3.
Average Number of Hours Worked by Hourly workers in January between 2006–2010, by plant type

Figure 4.

Risk Score for Cohort of Employees Working on 1/1/06*

*Includes workers born after 1950 (to avoid retirements) and those with all 3 years of risk scores in data. Standard errors in survivor group is much smaller because of the differences in the sample sizes; 9784 observation were included in the survivor group and 711 observations were included in the in laid off group

Table 1**Sample Selection**

Reason	Reasons for exclusion from analytical sample	
	Observations Excluded	Observation Left
Workers at 30 plant on 1/1/2006		22164
No longer at Alcoa on 1/1/2010	6262	15902
Worked at four plant with high HMO coverage	1753	14149
Could not be matched in claims data	37	14112
Risk score in 2008 missing or >4	719	13393

Table 2

Summary Characteristics for Cohort and Counts of New Incidents of Health Outcomes

Panel A: Individual-Level characteristics		Full Panel		High/Low Layoff plants	
Employee Category		Observations	Mean	Observations	Mean
Salaried in a High Layoff Plant		955	7%	955	12%
Hourly in a High Layoff Plant		4142	31%	4142	52%
Salaried in non-High Layoff Plant		3311	25%	1843	23%
Hourly in a non-High Layoff Plant		4986	37%	977	12%
Risk Group (omitted 0–1)					
RS 0–1		8557	64%	4963	63%
RS 1–2		3509	26%	2171	27%
RS 2–4		1327	10%	783	10%
Gender					
Female		2756	21%	1285	16%
Race					
White		10949	82%	1582	83%
Union Plant		6121	46%	5494	69%
Tenure in 2009 (SD)		13393	19.08 (10.54)	7917	19.32(10.46)
Age in 2009 (SD)		13393	49.07 (8.90)	7917	49.29 (8.79)

Panel B: Number of new onsets in 2009/2010		Full Panel		High/Low Layoff plants	
	Cases	Proportion of those at risk	Cases	Proportion of those at risk	
Hypertension	451	4.52%	283	4.89%	
Diabetes	161	1.30%	103	1.42%	
Depression	164	1.31%	93	1.25%	
Asthma/COPD	86	0.67%	54	0.71%	

Panel C: Number of new onsets in 2009/2010		Hourly		Salary	
	Cases	Proportion of those at risk	Cases	Proportion of those at risk	
Hypertension	354	4.80%	97	3.75%	
Diabetes	137	1.48%	24	0.77%	

Full Panel		Hourly		Salary	
Panel C: Number of new onsets in 2009/2010		Cases	Proportion of those at risk	Cases	Proportion of those at risk
Depression		134	1.43%	30	0.95%
Asthma/COPD		66	0.68%	20	0.63%

Full Panel		Spouses	
Panel D: Number of new onsets in 2009/2010, spouses		Cases	Proportion of those at risk
Hypertension		182	2.52%
Diabetes		80	0.97%
Depression		129	1.63%
Asthma/COPD		62	0.74%

Table 3

Odds ratios and 95% confidence Interval from random-effects logistic regressions for the association of working in a high layoff plant and new onsets of health conditions

	Full Sample							
	Hypertension	Hypertension	Diabetes	Diabetes	Asthma/COPD	Asthma/WCOPD	Depression	Depression
High Layoff	1.412 [0.972 – 2.051]	1.483 * [1.004–2.191]	1.367 [0.815 – 2.292]	1.123 [0.653 – 1.931]	0.959 [0.541 – 1.700]	1.014 [0.543–1.891]	1.205 [0.686–2.117]	1.2 [0.668–2.156]
Salaried	0.816 [0.644 – 1.033]	0.874 [0.660 – 1.157]	0.563 * [0.362 – 0.876]	0.355 ** [0.189 – 0.668]	1.022 [0.613 – 1.701]	1.105 [0.597 – 2.046]	0.653 * [0.435 – 0.979]	0.649 [0.399 – 1.055]
High Layoff × Salaried		0.798 [0.478 – 1.334]		3.114 * [1.271 – 7.630]		0.789 [0.266 – 2.341]		1.02 [0.426 – 2.440]
Change in County Unemployment Rate $\times$	1.193 [0.957 – 1.486]	1.196 [0.959 – 1.491]	1.36 [0.998 – 1.853]	1.354 [0.995 – 1.843]	0.868 [0.577 – 1.307]	0.869 [0.578 – 1.307]	1.144 [0.791 – 1.654]	1.143 [0.790 – 1.654]
Observations	10259	10259	12299	12299	12713	12713	12434	12434
Number of plants	26	26	26	26	26	26	26	26
High Low Layoff Plant Sample								
	Hypertension	Hypertension	Diabetes	Diabetes	Asthma/COPD	Asthma/COPD	Depression	Depression
	1.609 * [1.043 – 2.482]	1.693 * [1.069 – 2.680]	1.417 [0.629 – 3.188]	1.186 [0.513 – 2.745]	1.278 [0.527 – 3.100]	1.491 [0.568 – 3.919]	1.261 [0.639 – 2.485]	1.136 [0.561 – 2.300]
Salaried	0.779 [0.572 – 1.062]	0.867 [0.558 – 1.347]	0.781 [0.469 – 1.302]	0.483 [0.203 – 1.147]	1.054 [0.555 – 1.998]	1.398 [0.565 – 3.460]	0.514 * [0.283 – 0.936]	0.345 * [0.121 – 0.984]
High Layoff × Salaried		0.815 [0.441 – 1.508]		2.281 [0.777 – 6.694]		0.588 [0.165 – 2.101]		1.897 [0.533 – 6.751]
Change in County Unemployment Rate $\times$	1.494 ** [1.110 – 2.011]	1.507 ** [1.118 – 2.032]	1.513 [0.825 – 2.775]	1.473 [0.805 – 2.698]	1.141 [0.584 – 2.228]	1.162 [0.594 – 2.276]	1.088 [0.652 – 1.817]	1.073 [0.642 – 1.792]
Observations	5980	5980	7246	7246	7524	7524	7354	7354
Number of plants	14	14	14	14	14	14	14	14

95% confidence intervals in brackets

** p<0.01,

* p<0.05

All regressions include controls for risk score in 2008, gender, race (white/non-white), tenure, plant size, and plant union status.

& Weighted unemployment rate of county and surrounding counties, results are similar when unweighted county unemployment rates used.

Table 4

Odds ratios and 95% confidence Interval from random-effects logistic regressions for the association of working in a high layoff plant and new onsets of health conditions, by worker type

	High Low Layoff Plant Sample (Protected Workers)				High Low Layoff Plant Sample (Unprotected Workers)			
	Hypertension	Diabetes	Asthma/COPD	Depression	Hypertension	Diabetes	Asthma/COPD	Depression
High layoff plant	1.05 [0.512 – 2.154]	0.768 [0.216 – 2.734]	2.726 [0.439 – 16.95]	0.784 [0.190 – 3.235]	1.907* [1.117 – 3.256]	2.007 [0.798 – 5.047]	0.97 [0.349 – 2.697]	1.484 [0.679 – 3.242]
Observations	1484	1931	2140	2121	4496	5315	5384	5233
Number of plants	13	13	13	13	14	14	14	14

95% confidence intervals in brackets

** p<0.01,
* p<0.05

All regressions include controls for risk score in 2008, gender, race (white/non-white), tenure, plant size, weighted area-level unemployment rate and plant union status.

Table 5

Odds ratios and 95% confidence Interval from random-effects logistic regressions for the association of working in a high layoff plant and new onsets of health conditions, spouse

	Full Sample			High Low Layoff Plant Sample		
	Hypertension	Diabetes	Asthma/COPD	Depression	Hypertension	Diabetes
Spouse works at high layoff plant	1.052 [0.704 – 1.573]	1.04 [0.459 – 2.357]	1.633 [0.830 – 3.216]	1.254 [0.667 – 2.357]	0.939 [0.523 – 1.687]	0.97 [0.253 – 3.719]
Depression						
Observations	7226	8243	8359	7930	4395	5088
Number of plants	26	26	26	26	14	14

95% confidence intervals in brackets

** p<0.01,

* p<0.05

All regressions include controls for risk score in 2008, gender, race (white/non-white), tenure, plant size, weighted area-level unemployment rate and plant union status.