

- 6 Crowther NJ, Cameron N, Trusler J, Gray IP. Association between poor glucose tolerance and rapid post natal weight gain in seven-year-old children. *Diabetologia* 1998;41:1163-7.
- 7 Avon longitudinal study of pregnancy and childhood. Children of the nineties. alspac2.ich.bris.ac.uk/alspacext/Default (accessed 25 Oct 1999).
- 8 Brook CG. Determination of body composition of children from skinfold measurements. *Arch Dis Child* 1971;46:182-4.
- 9 Siri WE. Body composition from fluid spaces and density: analysis of methods. *Nutrition* 1993;9:480-91.
- 10 Freeman JV, Cole TJ, Chinn S, Jones PR, White EM, Preece MA. Cross sectional stature and weight reference curves for the UK, 1990. *Arch Dis Child* 1995;73:17-24.
- 11 Reilly JJ, Dorosty AR, Emmett PM. Prevalence of overweight and obesity in British children: cohort study. *BMJ* 1999;319:1039.
- 12 Tanner JM. Growth as a target-seeking function: catch-up and catch-down growth in man. In: Falkner F ed. *Human growth; a comprehensive treatise*. New York: Plenum, 1986:167-79.
- 13 Karlberg J, Albertsson Wikland K. Growth in full-term small-for-gestational-age infants: from birth to final height. *Pediatr Res* 1995;38:733-9.
- 14 Rogers I, Emmett P. Diet during pregnancy in a population of pregnant women in south west England. ALSPAC study team. Avon longitudinal study of pregnancy and childhood. *Eur J Clin Nutr* 1998;52:246-50.
- 15 Rogers I, Emmett P, Baker D, Golding J. Financial difficulties, smoking habits, composition of the diet and birthweight in a population of pregnant women in the south west of England. ALSPAC study team. Avon longitudinal study of pregnancy and childhood. *Eur J Clin Nutr* 1998;52:251-60.
- 16 Walton A, Hammond J. The maternal effects on growth and conformation in Shire horse-Shetland pony crosses. *Proc R Soc Lond* 1938;125:311-35.
- 17 Ounsted M, Scott A, Ounsted C. Transmission through the female line of a mechanism constraining human fetal growth. *Ann Hum Biol* 1986;13:143-51.
- 18 Casteels K, Ong KK, Phillips DI, Bednarz A, Bendall H, Woods KA, et al. Mitochondrial 16189 variant, thinness at birth and type 2 diabetes. *Lancet* 1999;353:1499-500.
- 19 Haig D. Altercation of generations: genetic conflicts of pregnancy. *Am J Reprod Immunol* 1996;35:226-32.
- 20 Ounsted M, Sleight G. The infant's self-regulation of food intake and weight gain. Difference in metabolic balance after growth constraint or acceleration in utero. *Lancet* 1975;1:1393-7.
- 21 Ong KK, Ahmed ML, Sherriff A, Woods KA, Watts A, Golding J, et al. Cord blood leptin is associated with size at birth and predicts infancy weight gain in humans. *J Clin Endocrinol Metab* 1999;84:1145-8.
- 22 Freedman DS, Serdula MK, Srinivasan SR, Berenson GS. Relation of circumferences and skinfold thicknesses to lipid and insulin concentrations in children and adolescents: the Bogalusa heart study. *Am J Clin Nutr* 1999;69:308-17.
- 23 Vanhala M, Vanhala P, Kumpusalo E, Halonen P, Takala J. Relation between obesity from childhood to adulthood and the metabolic syndrome: population based study. *BMJ* 1998;317:319-20.
- 24 Serdula MK, Ivery D, Coates RJ, Freedman DS, Williamson DF, Byers T. Do obese children become obese adults? A review of the literature. *Prev Med* 1993;22:167-77.
- 25 Jennings BJ, Ozanne SE, Dorling MW, Hales CN. Early growth determines longevity in male rats and may be related to telomere shortening in the kidney. *FEBS Letters* 1999;448:4-8.

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Factors underlying the effect of organisational downsizing on health of employees: longitudinal cohort study

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Abstract

Objective To explore the underlying mechanisms between organisational downsizing and deterioration of health of employees.

Design Longitudinal cohort study. Data were assembled from before downsizing (time 1); during major downsizing affecting some job categories (time 2); and after downsizing (time 3). Contributions of changes in work, support, and health related behaviours between time 1 and time 2 to the relation between downsizing and sickness absence at time 3 were assessed by multilevel modelling. Mean length of follow up was 4.9 years.

Setting Raisio, a town in Finland.

Subjects 764 municipal employees who remained in employment after downsizing.

Main outcome measures Records of absences from work from all causes with medical certificate.

Results Downsizing was associated with negative changes in work, impaired support from spouse, and increased prevalence of smoking. Sickness absence rate from all causes was 2.17 (95% confidence interval 1.54 to 3.07) times higher after major downsizing than after minor downsizing. Adjustment for changes in work (for instance, physical demands, job control, and job insecurity) diminished the relation between downsizing and sickness absence by 49%. Adjustments for impaired social support or increased smoking did not alter the relation between downsizing and sickness absence. The findings were unaffected by sex and income.

Conclusions The exploration of potential mediating factors provides new information about the possible causal pathways linking organisational downsizing and health. Downsizing results in changes in work, social relationships, and health related behaviours. The observed increase in certificated sickness absence was partially explained by concomitant increases in physical demands and job insecurity and a reduction in job control. A considerable proportion of the increase, however, remained unexplained by the factors measured.

Introduction

Driven by alterations in the national and global economy, international competition, and the rapid pace of technological change organisational downsizing (that is, reduction in numbers of staff by businesses and other organisations) became an important aspect of working life in developed countries in the last decades of the 20th century.¹ Regardless of whether downsizing is an effective business strategy resulting in better corporate performance, its potential deleterious consequences on the health of employees have become apparent.²⁻⁴ Vahtera et al, for example, reported that the health of those who kept their jobs depended on the extent to which staffing levels were reduced in the category of job concerned.³ Medically certified long term sickness absences, irrespective of cause, were twice as common after major downsizing (>18%) than after minor downsizing (<8%).

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Although the association between organisational downsizing and the health of employees has been shown, much remains to be discovered about the mechanisms through which downsizing affects health. Only indirect evidence has hitherto been available. This evidence comes, on the one hand, from studies of the relation between downsizing and changes in factors related to employees' working and private lives⁵⁻⁶ and, on the other, from research into relations between such factors and health outcomes.⁷⁻¹⁰ From results of the two groups of studies three mechanisms that may link downsizing and health can be identified: firstly, alterations in characteristics of work, increasing perceived job insecurity and job demands and decreasing job control; secondly, adverse effects on social relationships—for example, reduction in social support; and, thirdly, behaviour prejudicial to health—for example, smoking and excessive alcohol consumption may become more prevalent.

We prospectively investigated associations between downsizing, changes related to work and other aspects of life, and medically certified sickness absence from 1990 to 1995. The target population was municipal staff in the town of Raisio in south western Finland. Unemployment gradually declined in Finland in the 1980s, reaching its lowest level in 1990.¹¹ At that time, employees with permanent public sector contracts had come to expect their jobs to be safe.¹² From 1991 to 1995, however, Finland faced its most severe economic decline since the first world war. According to the International Labour Organisation/European Union definition, unemployment rose from 3% in 1990 to 16% in 1993 and was still 15% in 1995.¹¹ The number of Finnish municipal employees fell by 12% from 1990 to 1993, after which it slightly increased. At the same time, days worked in Raisio decreased by 15% from 1991 to 1993 and increased 4% from 1993 to 1995.³ Downsizing was related to socioeconomic status, employees with low income being most at risk.³⁻¹⁰

Methods

Participants and design

In 1990 we began a prospective cohort study to investigate the impact of the psychosocial work environment on health. In total 1110 full time municipal employees (95% of a total staff of 1168 employees) in Raisio responded to the baseline survey. Of the respondents, 892 were still working three years later at the time of follow up survey, and 812 of them (91%) responded to the follow up.¹⁰ Another cohort, based on the employer's registers of contracted days worked for at least six months in 1991 before major changes and for at least six months in 1993 when the most extensive downsizing occurred, was established to study the effect of organisational downsizing on health.³ Of this cohort, 764 (189 men, 575 women) belonged to the original cohort and had completed the 1990 and 1993 questionnaires designed to allow assessment of characteristics of work, social relationships, and health behaviours. They comprised the final cohort of the present study: 29% were higher grade white collar workers (for example, managers, physicians, teachers), 45% lower grade white collar workers (for example, technicians, registered nurses, office workers), and 26% blue collar workers (for example, cleaners, maintenance workers, kitchen assist-

ants). The mean (range) age was 41.4 (20-62) years, and the average organisational tenure was 11.5 (1-33) years. Data covered 936 person years of follow up for men and 2800 person years of follow up for women. Approval from the ethics committee of the Finnish Institute of Occupational Health was obtained for the study.

Data were assembled for three periods: before downsizing (1990-1); during major downsizing affecting some job categories (1993); and when downsizing slowed down (1993-5).³ Data relating to the first period consisted of questionnaire survey information from 1990 and records on sickness absence from 1 January to 31 December 1991. Data for the second period consisted of information obtained by questionnaire survey and information about the extent of downsizing (for instance, reductions in contracted days worked in different job categories from 1991 to 1993). For the third period, data consisted of records relating to sickness absence from 1 January 1993 to 31 December 1995.

Measures

We noted the extent of downsizing for each job category, as in our earlier study.³ Information obtainable from the employer's records for all periods included dates of commencement and, when appropriate, termination of employment, job titles, places of work, and dates on which each period of sickness absence began and ended. We calculated the number of contracted days worked by subtracting days equivalent to number of days off work, irrespective of cause, from total possible working days for each job category from 1 January to 31 December 1991 and from 1 January to 31 December 1993. Job categories were those used by Statistics Finland (32 occupational groups). Person years worked in 1991 and 1993 were calculated for each job category. Percentage reductions in the number of contracted days worked from 1991 to 1993 were calculated for each job category as a measure of the extent of downsizing. The mean extent of downsizing was 14.5%.

Changes in characteristics of work, social relationships, and health behaviours were assessed by using the information obtained by questionnaire surveys in 1990 and 1993. Characteristics of work were measured by internally consistent sets of questions relating to physical and psychological demands of work¹³; skill discretion, authority to take decisions, and opportunities to participate in decision making as elements in job control¹⁰⁻¹³; and job insecurity (measured only in 1993).¹⁰ Sets of questions on social relationships covered topics such as support from supervisor, colleagues, and spouse.¹³ We also determined whether subjects smoked regularly (yes or no), how much alcohol each consumed (g of alcohol per week), the level of physical activity, and height and weight to assess body mass index.¹⁴⁻¹⁵ A detailed description of the survey measures used is available in the studies cited.

Data on sick leave were collected from computer based records kept by the Raisio occupational health-care unit. They include data for each employee on when sick leave begins and ends. All certificates relating to sick leave, irrespective of place of issue, must be forwarded for recording. For periods of absence of up to three days employees may complete their own certificates. For absences of more than three days medical certificates are required. This paper deals only with medically certified

absences. We grouped all periods of sickness absence that occurred before downsizing (from 1 January to 31 December 1991) and all such periods that occurred after downsizing (from 1 January 1993 to 31 December 1995). We checked records for inconsistencies and combined any overlapping or consecutive periods of sickness absence.

Other variables included were sex, age, and income (median split for high versus low income; medians were 126 000 and 114 000 Finnish markka (£12 764 and £11 548) per year for men and women, respectively).

Statistical analyses

The first step of the analysis compared changes in characteristics of work, social relationships, and health behaviours for employees who had experienced a minor downsizing (reduction of less than 8% of the work force in a person's job category) with employees who had experienced either intermediate downsizing (8-18% reduction) or a major downsizing (> 18% reduction). Such data cannot be analysed by comparing simple differences because the magnitude of the change would depend on the level at baseline (that is, characteristics of work, social relationships, and health behaviours before downsizing).⁴ An imbalance in the means (or percentages) at baseline between employees facing minor, intermediate, or major downsizing would result in the comparisons being biased. Thus for continuous variables differences after downsizing were assessed by analysis of covariance with age, sex, and baseline level of the variable of interest as covariates. For the dichotomous variable smoking, logistic regression was used to compare employees who faced different degrees of downsizing in terms of odds ratios and to adjust for age, sex, and the level of the variable of interest before downsizing. Because the association between downsizing and health is linear, only linear trends between downsizing, on one hand, and changes in characteristics of work, social relationships, and health behaviours, on the other hand, were tested. Tests for linear trends were performed by modelling the group score of downsizing (minor=1; intermediate=2; major=3) as one variable.¹⁶ To explore

whether the associations between downsizing and characteristics of work, social relationships, and health behaviours were dependent on sex or income, we tested the interactions between downsizing, sex, and income as suggested by Cohen and Cohen.¹⁷

We calculated number of long periods of sickness absence (more than three days) and person years of follow up for each employee. Ratios of rates of sickness absence after minor, intermediate, and major downsizing and corresponding 95% confidence intervals were calculated. Poisson regression models were fitted to the data relating to number of sickness absence spells.^{3 9 18} We used multilevel modelling, individual employees representing the first level and work units (n=23) the second level, to adjust for the potential bias resulting from the fact that employees' responses to questionnaires on work characteristics, social relationships, and health behaviours could be affected by other employees in the same work unit.¹⁹ Such effects violate the assumption of independent observations underlying the traditional Poisson modelling strategy.

For analyses of the linking mechanisms between downsizing and sickness absence we selected those characteristics of work, social relationships, and health behaviours that we found to change according to the level of downsizing. In the first step, sickness absence after downsizing was adjusted for sickness absence before downsizing, age, and sex (we did not adjust for income because of its association with downsizing). Next, we assessed the contributions made by changes in characteristics of work, social relationships, and health behaviours to the association between downsizing and sickness absence by inclusion in the model of the level before and after downsizing in characteristics of work, social relationships, and health behaviours. To study whether the linking mechanisms were dependent on sex or socioeconomic status, men and women and employees with high and low income were analysed separately.

For all statistical analyses we used the SAS program package complemented by the program prompt GLIMMIX to carry out multilevel analyses for Poisson models calculated by using the GENMOD procedure.^{20 21}

Table 1 Means (SE) of work characteristics, social support, and health habits after downsizing (adjusted for their means before downsizing, age, and sex)

Detail	Degree of downsizing			Test for linear trend*	
	Minor (n=231)	Intermediate (n=390)	Major (n=143)	F _{df}	P value
Work characteristics					
Physical demands	63.7 (0.7)	65.5 (0.6)	73.0 (0.9)	48.1 _{1,758}	<0.001
Psychological demands	61.1 (0.9)	58.6 (0.7)	63.3 (1.2)	0.9 _{1,757}	0.343
Autonomy	57.6 (1.1)	58.1 (0.9)	54.1 (1.4)	2.9 _{1,754}	0.091
Skill discretion	74.1 (0.8)	69.6 (0.6)	67.9 (1.0)	23.1 _{1,756}	<0.001
Participation	49.8 (1.1)	43.5 (0.9)	44.3 (1.4)	10.9 _{1,755}	<0.001
Job insecurity	11.7 (0.3)	13.0 (0.2)	14.3 (0.4)	26.7 _{1,753}	<0.001
Social relationships					
Support from supervisor	66.4 (0.9)	67.3 (0.7)	66.0 (1.2)	0.0 _{1,750}	0.898
Support from colleagues	68.2 (1.0)	67.9 (0.8)	65.0 (1.3)	3.1 _{1,747}	0.077
Support from spouse	58.2 (1.3)	56.2 (1.0)	53.0 (1.6)	6.0 _{1,744}	<0.01
Health habits					
Alcohol consumption (g/week)	127.7 (5.5)	106.9 (4.2)	119.8 (6.9)	1.7 _{1,743}	0.189
Exercise	8.2 (0.2)	8.3 (0.2)	8.8 (0.3)	1.8 _{1,727}	0.182
Body mass index	24.9 (0.1)	24.9 (0.1)	24.8 (0.1)	0.6 _{1,735}	0.450
Smoking†	1.00	1.37 (0.66 to 2.83)	2.55 (1.03 to 6.32)	4.0 (1)‡	<0.05

*The trend was dependent on sex in participation (F_{1,754}=4.1, P<0.05) and on income in physical demands (F_{1,756}=6.8, P<0.01).

†Logistic regression, odds ratios (95% confidence intervals). ‡χ² (df).

Table 2 Rate ratios (95% confidence interval) for sickness absence from all causes after downsizing (adjusted for sickness absence before downsizing, age and sex, work characteristics, social support, and health habits). In all cases the rate ratio for minor downsizing* (n=231) was 1.00

Adjustment	Effect of downsizing* on sickness absence	
	Intermediate downsizing (n=391)	Major downsizing (n=143)
Baseline†	1.69 (1.24 to 2.26)	2.17 (1.54 to 3.07)
Baseline and work‡	1.41 (1.05 to 1.91)	1.60 (1.12 to 2.30)
Baseline and support§	1.69 (1.24 to 2.27)	2.16 (1.52 to 3.06)
Baseline and health habits¶	1.69 (1.25 to 2.29)	2.18 (1.54 to 3.09)
Fully adjusted	1.42 (1.05 to 1.93)	1.59 (1.11 to 2.29)

*Minor downsizing 1127 person years, intermediate downsizing 1916 person years, major downsizing 693 person years.

†Sickness absence before downsizing, age, and sex.

‡Physical demands, skill discretion, and possibilities for participation before and after downsizing, and job insecurity after downsizing.

§Spouse support before and after downsizing.

¶Smoking before and after downsizing.

Table 3 Rate ratios (95% confidence interval) for sickness absence after downsizing by sex and socioeconomic status (adjusted for sickness absence before downsizing, age and sex, work characteristics, social support, and health habits). In all cases the rate ratio for minor downsizing was 1.00

Adjustment	Effect of downsizing on sickness absence	
	Intermediate downsizing	Major downsizing
Men (n=189)		
Baseline*	1.22 (0.82 to 1.80)	1.99 (1.11 to 3.56)
Baseline and work†	0.94 (0.62 to 1.44)	1.46 (0.80 to 2.75)
Baseline and support‡	1.22 (0.82 to 1.81)	1.99 (1.11 to 3.59)
Baseline and health habits§	1.24 (0.83 to 1.86)	2.03 (1.12 to 3.66)
Fully adjusted	0.95 (0.62 to 1.47)	1.47 (0.77 to 2.79)
Women (n=575)		
Baseline*	2.15 (1.45 to 3.18)	2.73 (1.76 to 4.24)
Baseline and work†	1.85 (1.26 to 2.73)	1.97 (1.25 to 3.10)
Baseline and support‡	2.15 (1.45 to 3.20)	2.71 (1.73 to 4.24)
Baseline and health habits§	2.15 (1.46 to 3.17)	2.73 (1.76 to 4.22)
Fully adjusted	1.86 (1.26 to 2.73)	1.96 (1.24 to 3.10)
High income (n=327)		
Baseline*	1.19 (0.81 to 1.76)	1.87 (1.01 to 3.46)
Baseline and work†	0.99 (0.68 to 1.48)	1.45 (0.78 to 2.69)
Baseline and support‡	1.18 (0.79 to 1.76)	1.85 (1.00 to 3.44)
Baseline and health habits§	1.20 (0.81 to 1.78)	1.99 (1.07 to 3.72)
Fully adjusted	0.87 (0.57 to 1.33)	1.51 (0.80 to 2.94)
Low income (n=437)		
Baseline*	1.88 (1.10 to 3.23)	2.51 (1.41 to 4.47)
Baseline and work†	1.70 (0.99 to 2.91)	1.82 (1.02 to 3.25)
Baseline and support‡	1.89 (1.09 to 3.24)	2.51 (1.40 to 4.51)
Baseline and health habits§	1.89 (1.09 to 3.25)	2.51 (1.40 to 4.51)
Fully adjusted	1.72 (0.99 to 3.00)	1.83 (1.01 to 3.34)

*Sickness absence before downsizing, age, and sex.

†Physical demands, skill discretion, and possibilities for participation before and after downsizing, job insecurity after downsizing.

‡Spouse support before and after downsizing.

§Smoking before and after downsizing.

Table 4 Rate ratios (95% confidence interval) for sickness absence for all causes after downsizing (adjusted for sickness absence before downsizing, age and sex, and separate work characteristics). In all cases the rate ratio for minor downsizing (n=231) was 1.00

Adjustment	Effect of downsizing on sickness absence	
	Intermediate downsizing (n=391)	Major downsizing (n=143)
Baseline*	1.69 (1.24 to 2.26)	2.17 (1.54 to 3.07)
Baseline and physical demands†	1.58 (1.18 to 2.13)	1.84 (1.30 to 2.61)
Baseline and skill discretion‡	1.58 (1.17 to 2.13)	2.03 (1.43 to 2.88)
Baseline and participation‡	1.51 (1.12 to 2.05)	1.95 (1.37 to 2.77)
Baseline and job insecurity‡	1.66 (1.23 to 2.24)	2.08 (1.47 to 2.95)

*Sickness absence before downsizing, age, and sex.

†Before and after downsizing.

‡After downsizing.

Results

Downsizing was associated with changes in work characteristics, social relationships, and health behaviours (table 1). Major downsizing was associated with increased levels of physical work demands and job insecurity and decreased levels of skill discretion and participation. Downsizing was also associated with lower levels of spouse support and increased prevalence of regular smoking. There were only two differences between the sexes or income groups in these linear trends. The effect of downsizing on participation was stronger among women ($F_{1,567}=5.48$, $P<0.05$) than among men ($F_{1,185}=4.36$, $P<0.05$) and its effect on physical demands was stronger in employees with low income ($F_{1,431}=55.9$, $P<0.001$) than in those with high income ($F_{1,322}=9.6$, $P<0.01$).

Sickness absence was more than two times greater after major downsizing than after minor downsizing (table 2). We found a considerable attenuation in this rate ratio when changes in work characteristics were taken into account, indicating their considerable role in the downsizing-sickness absence relation. After adjustment for work characteristics in multilevel models, the ratio of the rate of sickness absence after major downsizing compared with that after minor downsizing decreased by 49% in the entire sample. The results were similar in men and women and employees with high and low income (table 3).

Of the separate work characteristics, adjustments for increased physical demands, decreased participation in decision making, reduction in skill discretion, and heightened job insecurity attenuated the ratio of absence rates related to major versus minor downsizing by 28%, 19%, 12%, and 8%, respectively (table 4).

Adjustment for changes in social support and health behaviours did not significantly affect the associations between downsizing and sickness absence (tables 2 and 3).

Discussion

The most powerful method for examining causal relations is to carry out a randomised experiment. Such an experiment is, however, from the ethical and practical point of view, impossible to perform when the effect of organisational downsizing on health is studied. In such cases the strongest evidence derives from natural experiments in which causal inferences are made on the basis of the time ordering of the variables and explicating the potential linking mechanisms. Our longitudinal design, which allowed the same individuals to be followed from before any rumour of downsizing and during and after it, provided a natural experiment that has rarely been feasible. Although temporal succession is no evidence of causal relations, alternative explanations for the present results cannot be supported by the evidence available.

Another methodological advance of the study was the measurement of downsizing from records of actual days worked in each job category of the organisation. Such a measure has been shown to be sensitive to variations across organisations as well as within organisations across types of worker. Both these variations have relevance in predicting health.³

During the study period municipal employees received full pay for the first 60 days of sick leave and two thirds for the next 180 days from the employer. For longer sick leaves, they received benefits from the Social Insurance Institution. The institution also provided compensation to employers for salaries paid to employees on sick leave after the first eight days. We used medically certified sickness absences of more than three days as an indicator of health. On the basis of the extensive Whitehall II studies, spells of sickness absences accurately reflect the health of employees.²²

Linkages between downsizing and health

Much of the effect of major downsizing on sickness absence was attributable to adverse changes in work characteristics. Increases in physical demands and job insecurity and reductions in job control, particularly in skill discretion and opportunities to participate in decision making, were the most important ones. The largest proportion of the association between downsizing and health was explained by the combination of these changes in work characteristics. Thus, the findings show that multiple mechanisms rather than a single change in work may underlie the adverse effect on health in employees after major downsizing. In previous research work demands, job insecurity, and job control have been shown to be associated with sickness absence, morbidity, and mortality.^{4 9 10 16 23 24}

The manner in which major downsizing was undertaken in Raisio was typical of the public sector in Finland and other countries. The workforce had to be reduced in response to national economic decline to contain costs. Staff numbers were reduced partly through retirement and partly through not filling vacancies. Savings were also gained by not hiring cover for those absent from work. Only employees without permanent contracts of employment lost jobs. Reactive implementation of downsizing is common in public organisations,⁶ and the effects on health of such a downsizing are probably less than would occur when downsizing also affects those with permanent contracts. This potential underestimate of effects, particularly in relation to job insecurity, needs to be borne in mind when the implications of these findings are considered.²

Conclusions

The present data on health, characteristics of work, social relationships, and health behaviours before and after downsizing extend existing knowledge on the potential pathways through which downsizing may affect health.

It is likely that downsizing and other threats to job security will continue to be an important trend within industrialised countries for the foreseeable future.¹ We show that records of contracted days worked allow identification of the degree of downsizing in each job category and thus indicate employees at greatest risk of health impairments. The threat of job loss generated by downsizing resulted in increased morbidity. This increase was not only mediated through job insecurity, which is the expected correlate of threatened job loss, but also through changes in other psychosocial work characteristics.

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What is already known on this topic

There is an association between organisational downsizing and the health of employees

Until now evidence about the mechanisms through which downsizing affects health has been lacking

What this study adds

The threat of job loss generated by downsizing results in increased morbidity

This increase seems to be mediated not only through job insecurity but also through increased job demands and lowered job control

Contributors: MK was the principal investigator and together with JV designed and conducted the study and wrote the paper. JP developed the downsizing measure and helped in data analysis. JEF contributed to the analyses and interpretation of data and writing of the paper.

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- Hurrell JJ. Editorial. *Am J Pub Health* 1998;88:1012-3.
- Beale N, Nethercott S. Certificated sickness absence in industrial employees threatened with redundancy. *BMJ* 1988;296:1508-10.
- Vahtera J, Kivimäki M, Pentti J. Effect of organisational downsizing on health of employees. *Lancet* 1997;350:1124-8.
- Ferrie JE, Shipley MJ, Marmot MG, Stansfeld SA, Smith GD. An uncertain future: the health effects of threats to employment security in white-collar men and women. *Am J Pub Health* 1998;88:1030-6.
- Cobb S, Kasl SV. *Termination: the consequences of job loss*. Cincinnati: National Institute for Occupational Safety and Health, 1977.
- Parker SK, Chmiel N, Wall TD. Work characteristics and employee well-being within a context of strategic downsizing. *J Occup Health Psychol* 1997;2:289-303.
- Marmot M, North F, Feeney A, Head J. Alcohol consumption and sickness absence: from the Whitehall II study. *Addiction* 1993;88:369-82.
- Rael EGS, Stansfeld SA, Shipley M, Head J, Feeney A, Marmot M. Sickness absence in the Whitehall II study, London: the role of social support and material problems. *J Epidemiol Community Health* 1995;49:474-81.
- North F, Syme SL, Feeney A, Head J, Shipley MJ, Marmot MG. Psychosocial work environment and sickness absence among British civil servants: the Whitehall II study. *Am J Public Health* 1996;86:332-40.
- Kivimäki M, Vahtera J, Thomson J, Griffiths A, Cox T, Pentti J. Psychosocial factors predicting employee sickness absence during economic decline. *J Appl Psychol* 1997;82:858-72.
- Statistics Finland. *Statistical yearbook of Finland*. Helsinki: Statistics Finland, 1998.
- Vahtera J, Pentti J. *Employees in the storm of economy: development of psychosocial work environment between 1990-97*. Helsinki: Finnish Institute of Occupational Health, 1999.
- Vahtera J, Uutela A, Pentti J. The effects of objective job demands on registered sickness absence spells: do personal, social and job-related resources act as moderators? *Work Stress* 1996;19:286-308.
- Kaprio J, Koskenvuo M, Langinvainio H, Romanov K, Sarna S, Rose RJ. Genetic influences on use and abuse of alcohol: a study of 5638 adult Finnish twin brothers. *Alcohol Clin Exp Res* 1987;11:349-56.
- Kujala UM, Kaprio J, Sarna S, Koskenvuo M. Relationship of leisure-time physical activity and mortality. *JAMA* 1998;279:440-4.
- Bosma H, Marmot MG, Hemingway H, Nicholson AC, Brunner E, Stansfeld SA. Low control and risk of coronary heart disease in Whitehall II (prospective cohort) study. *BMJ* 1997;314:558-64.
- Cohen J, Cohen P. *Applied multiple regression/correlation analysis for the behavioral sciences*. 2nd ed. Hillsdale, NJ: Erlbaum.
- McCullagh P, Nelder JA. *Generalized linear models*. London: Chapman Hall, 1989.
- Diez-Roux AV. Bringing context back into epidemiology: variables and fallacies in multilevel analysis. *Am J Public Health* 1998;88:216-22.
- SAS Institute. *SAS technical report P-243, SAS/STAT software: the GENMOD procedure, release 6.09*. Cary, NC: SAS Institute, 1993.
- Littell RC, Milliken GA, Stroup WW, Wolfinger RD. *SAS system for mixed models*. Cary, NC: SAS Institute, 1998.
- Marmot MG, Feeney A, Shipley M, North F, Syme SL. Sickness absence as a measure of health status and functioning: from the UK Whitehall II study. *J Epidemiol Community Health* 1995;49:124-30.
- Schnall PL, Landsbergis PA, Baker D. Job strain and cardiovascular disease. *Ann Rev Public Health* 1994;15:381-411.
- Johnson JV, Steward W, Hall EM, Fredlund P, Theorell T. Long-term psychosocial work environment and cardiovascular mortality among Swedish men. *Am J Public Health* 1996;86:324-31.

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