Original article

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Job strain and informal caregiving as predictors of long-term sickness absence: A longitudinal multi-cohort study

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Objectives The aim of this study was to investigate the individual, joint and interactive effects of job strain and informal caregiving on long-term sickness absence with special attention to gender differences.

Methods The study comprised a prospective cohort study of 6798 working adults from France, 14 727 from Finland, and 5275 from the UK. A total of 26 800 participants, age 52 (interquartile range 47–56) years participated in the study. Job strain was assessed using the demand–control model. Informal caregiving was defined as care for a sick, disabled, or elderly person. Long-term sickness absence spells defined as absence >14 consecutive days were registered during two years follow-up. We used recurrent-events Cox regression in random-effects meta-analyses.

Results A total of 12% men and 21% women had ≥1 long-term sickness absence spell. Among women, both high job strain [hazard ratio (HR) 1.08, 95% confidence interval (95% CI) 1.00–1.17] and informal caregiving (HR 1.13, 95% CI 1.04–1.23) were associated with a modestly higher risk of sickness absence. Women doubly exposed to high job strain and informal caregiving also showed a moderately higher risk of sickness absence (HR 1.20, 95% CI 1.03–1.41), but the excess risk was not more than expected from joint exposure to caregiving and job strain. Neither job strain nor informal caregiving predicted sickness absence for men.

Conclusions High job strain and informal caregiving predicted long-term sickness absence among women. However there was no noticeable interaction in the presence of both exposures.

Key terms gender difference; interaction; sick leave; unpaid care; women.

Informal caregiving, defined as unpaid assistance with activities of daily living for sick, disabled, or elderly relatives, contributes invaluably to the well-being of populations in western countries and is becoming a key issue in many countries due to rapid population aging (1). Informal caregiving may entail benefits such as satisfaction and meaning for the caregiver (2). However, the combination of prolonged distress, physiological demands, financial strain and social isolation that sometimes accompanies informal caregiving may eventually compromise the caregivers' own health (3–6).

According to the role accumulation theory, having multiple roles from paid work and informal caregiving may carry positive effects for the caregiver (7) as one role may buffer stressors related to other roles (8). In contrast, the role strain theory hypothesizes that individuals who provide informal caregiving may be particularly vulnerable to its potential health consequences if they are simultaneously exposed to other stressors such as a high-strain job (9). This double exposure may lead to work–family conflicts introduced by the experience of role conflict (ie, being subject to conflicting

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demands) or role overload (ie, having too much to do) (10) and eventually render the caregiver more vulnerable to negative health consequences.

Sickness absence has a large impact on employees, work sites, and society and provides a measure of work incapacity as a social consequence of morbidity (11). In two recent longitudinal studies from Australia and Belgium and a case–control study from Brazil, it has been shown that high job strain predicts long-term sickness absence (12–14). In contrast, one study only found an association for men in adjusted models (15), and another study found no association for either men or women in adjusted models (16). A few studies have also investigated the association between work–family conflicts and sickness absence (17–19). A large study including workers from 31 European countries found that work–life imbalance predict sickness absence (19), and a Finnish study showed that spillover from work into family life predicted a heightened rate of sickness absence spells (17). However, research on work–family conflicts has so far primarily focused on perceived imbalances between work and family life without distinguishing between different sources to this imbalance (20). Only few studies have investigated the combined effect of work and family factors on sickness absence (21–24). Two studies, based on the same occupational cohort, showed that the combination of high work and family demands predicted all-cause sickness absence and sickness absence due to mental health disorders (21, 22). In those studies, family demands were defined by the number of individuals the participant supported economically. Informal caregiving, however, involves both physically and mentally straining elements and is thus different from providing economic support. Looking specifically at informal caregiving, a study from Austria has shown that a time-based conflict between informal eldercare and paid work was related to the intended job change of female workers and that the intensity of caregiving provided was related to male workers' anticipated labor market exit (25). However, to our knowledge no studies have investigated the association between informal caregiving and sickness absence due to paid work.

Quantifying the separate and joint effects of job strain and informal caregiving on sickness absence will help in the identification of high-risk workers. Such information is important for policy-makers and employers to develop special need support and efficient preventive strategies (26).

Women are traditionally more engaged in informal caregiving than men, and it has been suggested that women may be especially vulnerable to the joint health effects of demanding work and life circumstances (27, 28). Furthermore, women in general still carry the largest household workload, and it has been shown that women have higher evening cortisol levels than men (29), indicating that they may have difficulties relaxing and unwinding after work.

In this multi-cohort study, the objective was to investigate the joint effects of job strain and informal caregiving on long-term sickness absence with special attention to gender differences, using data from three large European occupational cohorts. Based on the role strain theory (9), we hypothesized that the joint effects of high job strain and informal caregiving on long-term sickness absence exceed the combination of their individual associations. We additionally hypothesized that women were at greater risk of sickness absence compared to men when exposed to both high job strain and informal caregiving.

Methods

Study participants

We used longitudinal data from the GAZEL cohort from France (30), the Finnish Public Sector Study (FPS) from Finland (31), and the Whitehall II study from the UK (32). These cohorts were chosen as they have detailed data on job strain, informal caregiving, and longitudinal register-based data on sickness absence.

The GAZEL cohort was established in 1989 and includes 20 625 employees of the French national gas and electricity company (response rate, approximately 75% annually).

FPS was established in 1997 and comprises all 151 901 public employees in ten towns and five hospital districts in Finland. A nested open cohort with 16 948 responders at baseline (baseline response rate, 70%), FPS includes data on psychosocial work and domestic factors, along with health outcomes.

Whitehall II was established in 1985 and includes 10 308 British civil servants from 20 London-based departments (baseline response rate, 73%).

Further information about each cohort can be found in the cohort profiles (30–32). We used data from year 2000 as baseline in GAZEL, year 2012 in FPS, and years 1991–1994 in Whitehall II, due to the availability of data on informal caregiving in the present years. We included individuals in paid work and excluded individuals on sick leave at the day of the baseline questionnaires. The present study comprised 6798 individuals from GAZEL, 14 727 individuals from FPS, and 5275 individuals from Whitehall II, a total of 26 800 individuals in paid work. Participants gave written consent to participate in the cohort studies, and all three cohorts have been approved by the respective human ethics committees. The data selection procedure is presented in a flow chart in the appendix (www.sjweh.fi/index.php?page=data-repository).

Measures

Informal caregiving. Informal caregiving was treated as a binary (yes/no) variable based on slightly different questions in each cohort. In GAZEL, individuals were asked if they provide regular care for an aged person (>65 years); in FPS individuals were asked if they provide care for a sick, disabled, or aged relative; and in Whitehall II individuals were asked if they provide care for an aged or disabled relative. To investigate the effect of weekly hours of informal caregiving, we applied a cut-off at >4 weekly hours, indicating caregiving of ≥1 hour (average) on each weekday. Information on weekly hours of caregiving was only available in FPS and Whitehall II.

Job strain. Job strain (33) was assessed using the Job Content Questionnaire in GAZEL and FPS and the Demand–Control Questionnaire in Whitehall II (34). High job strain was in accordance with the job strain model (33) defined as the combination of high job demands and low job control; all other combinations of job demands and job control was defined as no high strain (34). Job demands were assessed with five items in GAZEL and four items in Whitehall II and FPS, and encompass statements such as "My job requires working very fast". High job demands were defined as a score above the median score of the specific study population. Job control (decision latitude) is comprised of two subscales: skill discretion and decision authority. Skill discretion was assessed with four items in all cohorts, and encompasses statements such as "My job requires a high level of skill". Decision authority was assessed with two items in all cohorts, and encompasses statements such as "I have a lot of say about what happens on my job". The two items in decision authority are weighted the same as the four items in skill discretion, in calculation of job control scores. Low job control was defined as a job control score below the median score of the specific study population (34). In GAZEL, job strain in 1999 was used as a proxy for information in 2000.

Long-term sickness absence. We used all-cause long-term sickness absence from paid work as the outcome, defined as spells of >14 consecutive days. Long-term sickness absence has shown to be a useful global measure of health differentials between employees (11, 35, 36), as opposed to shorter sickness absence spells, which may in some cases represent healthy coping behaviors to avoid serious morbidity (11, 35, 36). Furthermore, long-term spells were used as opposed to number of days absent, as spells ≤14 days are sometimes based on self-report in the three cohorts, and we wanted to prevent any reporting bias. Sickness absence information was from national registers in FPS and Whitehall II, and company register in GAZEL (17, 22, 37). Recorded sickness absence was due to own morbidity and not absence due to, eg, maternity leave or care for a sick child. We used a follow-up period of two years in registration of long-term sickness absence. This period was chosen as longer follow-up might entail a weaker causal path between baseline exposures and later sickness absence.

Confounders

We identified confounders for analyses using directed acyclic graphs (DAG) (38) (see appendix, www.sjweh.fi/index.php?page=data-repository). Included variables were: age of children (0, 1–3, >3 years), occupational grade in three groups (low included low wage and manual laborers, intermediate included lower non-manual and midlevel managers, and high included upper non-manual workers and administrative staff), married/cohabiting, death of a close relative and/or divorce within the past 12 months, ≥1 spell of long-term sickness absence in the two years preceding baseline, ≥1 longstanding illness at baseline (diabetes, cardiovascular disease, cancer or respiratory disease).

Statistical analysis

We used individual participant data in Cox proportional hazards random effects meta-analyses (39). This approach can be thought of as a type of multilevel model (with cohorts as cluster units) on the proportional hazard scale. Heterogeneity among cohort specific estimates were assessed with I^2 statistics (40). A random effects model was chosen to allow for the true effect to vary between the included cohorts; eg, the effect size of informal caregiving on sickness absence could be greater when questions on caregiving encompass sick, disabled, or aged relatives in FPS and Whitehall II compared to only aged relatives in GAZEL.

Person-years at risk encompassed time until the occurrence of a long-term sickness absence spell or until censoring due to retirement, disability pension/incapacity benefit, death, or leaving the workplace. Sickness absence for spells ≤14 days were included in time-at-risk of long-term sickness absence based on the argument that one would still be at risk of long-term sickness absence during shorter spells of sickness absence.

To account for recurrent events of long-term sickness absence we used the Prentice, Williams and Peterson Total Time (PWP-TT) model (41), which is appropriate if the occurrence of the first event increases the likelihood of a recurrence. In PWP-TT, multiple events are ordered by stratification based on the prior number of events, such that all participants are at risk of an event in the first stratum, but only those with a prior event are at risk for a successive event (41). We truncated analy-

ses at two spells of long-term sickness absence during follow-up, due to small number of individuals with a greater number of spells.

We estimated hazard ratios (HR) and 95% confidence intervals (CI) with long-term sickness absence as the event of interest, for the individual associations with job strain and informal caregiving and the joint associations compared to those with no high strain and no informal caregiving as reference group (42). We then carried out similar analyses adjusted for the mentioned confounders. Confounders are presented in table 1 along with possible mediating lifestyle factors including smoking, alcohol, and overweight. We assessed additive interaction with the synergy index (SI) (43), which can be interpreted as the excess risk from double exposures when there is interaction relative to the risk from exposure without interaction, and further tested for multiplicative interaction. Analyses were conducted separately for men and women to address gender differences. It was not feasible to test formally for 3-way interaction with job strain, caregiving and gender due to lack of statistical power.

We carried out several sensitivity analyses to test the robustness of our results. In the first sensitivity analysis we used multiple imputation on the 14% of individuals with missing data, assuming that data were missing at random (44). We imputed missing data with a chained equation model and applied Rubin's rules at the study level prior to meta-analysis (45). Results from the imputed analyses were compared to results from the complete case analyses to investigate selection bias introduced by excluding participants with missing data. Secondly, retirement may be a competing risk to long-term sickness absence and therefore we carried out a sensitivity analysis in which we excluded individuals >58 years at baseline to account for retirement from the workforce due to the statutory pension age. Thirdly, by only looking at number of spells >14 days, individuals with very long spells may not have contributed with risk time following the first spell, as the first spell may have lasted the whole follow-up period. This may potentially underestimate the consequences of job strain and caregiving exposure on the risk of sickness absence. Therefore, we also made a sensitivity analysis where we only looked at time to the first event of long-term sickness absence. In a fourth analysis, we included weekly work hours as a confounding variable (<36 hours, 36-40 hours, >40 hours). This information was only available in Whitehall II. We also looked whether job strain and caregiving predicted the length of long-term sickness absence spells in the subpopulation of individuals with long-term spells. Lastly, we did a sensitivity analysis were we looked at job demands and job control separately to see if they were better predictors of sickness absence than the combined job strain measure. We used the ipdmetan statistical software package in STATA v13/IC for analyses. Ipdmetan performs two-stage individual participant-data meta-analysis using the inverse-variance method. The syntax used is "ipdmetan, study(studyID) : stcox…", which fits the model command once within each level of study ID.

Results

In this population of 26 800 employees, there were 5946 spells of long-term sickness absence during 46 794 person-years. A total of 12% of male and 21% of female participants experienced ≥1 spell of long-term sickness absence within a 2-year period. When truncating at two

Table 1. Baseline characteristics according to cohort and gender. [FPS=Finnish Public Sector Study; M=median; IQR=interquartile range.]

	GAZEL: France (Baseline, year 2000)						FPS: Finland (Baseline, year 2012)						Whitehall II: UK (Baseline, year 1994)					
	Men (N=4546)			Women (N=2252)			Men (N=2999)			Women (N=11 728)			Men (N=3786)			Women (N=1489)		
	%	M	IQR	%	M	IQR	%	M	IQR	%	M	IQR	%	M	IQR	%	M	IQR
Age (years)		53	52–54		50	48–53		52	46–57		53	47–57		48	44–53		50	45–55
Married/cohabiting	92			71			82			74			82			63		
Children [a]	95			87			84			86			58			30		
Death of relative/divorce [b]	17			18			6			6			31			38		
Low occupational grade	12			25			30			33			7			38		
High alcohol intake	23			9			9			10			18			10		
Smoking	16			16			17			12			13			17		
Overweight	63			30			66			51			47			48		
Previous long-term sickness absence	14			23			22			27			9			21		
Longstanding illness (≥1)	11			9			25			26			11			12		
High job strain	13			24			11			20			17			22		
Informal caregiving	27			30			10			15			10			13		

[a] Children in household in Whitehall II.

[b] In FPS, death of relative or divorce for the preceding part 2012 only (not one year previous to baseline).

years, the median length of the first event of long-term sickness absence spells was 29 days (15–436), 28 days (15–370), and 28 days (15–724) in Whitehall II, FPS and GAZEL, respectively. Clear gender differences were evident for marital status, with more men being married/cohabiting than women (table 1). Longstanding illness was most prevalent in FPS compared to GAZEL and Whitehall II. Both high job strain and informal caregiving were more prevalent for women (table 1), and informal caregiving was more prevalent in GAZEL with 27% of men and 30% of women providing care, compared to 10% and 15% in FPS and 10% and 13% in Whitehall II.

For men, neither informal caregiving nor high job strain were associated with a higher risk of long-term sickness absence in the unadjusted analyses and the multiple adjusted analyses, as seen in table 2. Among women, high job strain and informal caregiving were associated with long-term sickness absence in the unadjusted model, which was slightly attenuated in the multiple adjusted model, as seen in table 2.

Stratifying by hours of caregiving in a sub-analysis, caregiving >4 weekly hours was a risk factor for sickness absence among women in the unadjusted and multiple adjusted models (table 2). No associations were found between weekly hours of caregiving and long-term sickness absence for men in neither the unadjusted nor the multiple adjusted models.

Looking at the joint exposure, high job strain and no informal caregiving predicted long-term sickness absence for men in the unadjusted model with (HR 1.30, 95% CI 1.01–1.67). However, this was considerably attenuated in the multiple adjusted model with (HR 1.14, 95% CI 0.97–1.35), as seen in figure 1. For women, no high job strain and informal caregiving (HR 1.15, 95% CI 1.01–1.29) was a predictor of long-term sickness absence in the multiple adjusted model, but the excess risk from exposure to both high job strain and informal caregiving was not more than expected (HR 1.20, 95% CI 1.03–1.41), (P=0.766, SI=0.95), as seen in figure 1. All estimates in the joint exposure analyses for both men and women were attenuated in the multiple adjusted models compared to the unadjusted models.

Sensitivity analyses using multiple imputations did not change results substantially (appendix), indicating that the partial missing data have not introduced any noteworthy selection bias. Furthermore, there was no noteworthy change in results from the sensitivity analysis using only first event of long-term sickness absence or the analysis with exclusion of individuals >58 years of age. Also, no noteworthy change in estimates was found in analyses on Whitehall II including weekly work hours. In the sensitivity analyses looking separately at job demands and job control, double exposure to both high demands or low control and informal caregiving were predictors of sickness absence, with fairly similar estimates as with the main analyses using the combined job strain model. Furthermore, for men, joint exposure from low control and informal caregiving was less than expected given the size of their individual effects (P=0.02, SI=0.05). Detailed results are not shown but can be obtained from the first author upon request.

Discussion

We investigated the joint exposure of job strain and informal caregiving as predictors of long-term sickness

Table 2. Individuals associations between job strain, informal caregiving and long-term sickness absence (SA). [HR=hazard ratio; HR_{adj}=adjusted for age, married/cohabiting, children, occupational grade, death of relative and/or divorce, previous long-term sickness absence (SA), and longstanding illness; 95% CI=95% confidence interval.]

	Men							Women						
	Individuals with ≥1 long-term SA spell	HR	95% CI	I^2 (%)	HR_{adj}	95% CI	I^2 (%)	Individuals with ≥1 long-term SA spell	HR	95% CI	I^2 (%)	HR_{adj}	95% CI	I^2 (%)
High job strain														
No	1114	1.00			1.00			2350	1.00			1.00		
Yes	211	1.24	0.99–1.54	57	1.09	0.93–1.28	20	734	1.19	1.04–1.36	44	1.08	1.00–1.17	0
Informal caregiving														
No	1101	1.00	–		1.00			2572	1.00			1.00		
Yes	260	1.05	0.92–1.20	0	1.01	0.88–1.16	0	654	1.15	1.02–1.30	34	1.13	1.04–1.23	0
Weekly hours caregiving														
0	768	1.00			1.00			2283	1.00			1.00		
1–4	53	1.10	0.84–1.43	0	1.09	0.83–1.43	0	207	0.78	0.29–2.08	68	0.88	0.42–1.86	52
>4	25	0.89	0.55–1.45	36	0.80	0.42–1.53	64	205	1.25	1.09–1.44	0	1.19	1.04–1.36	0

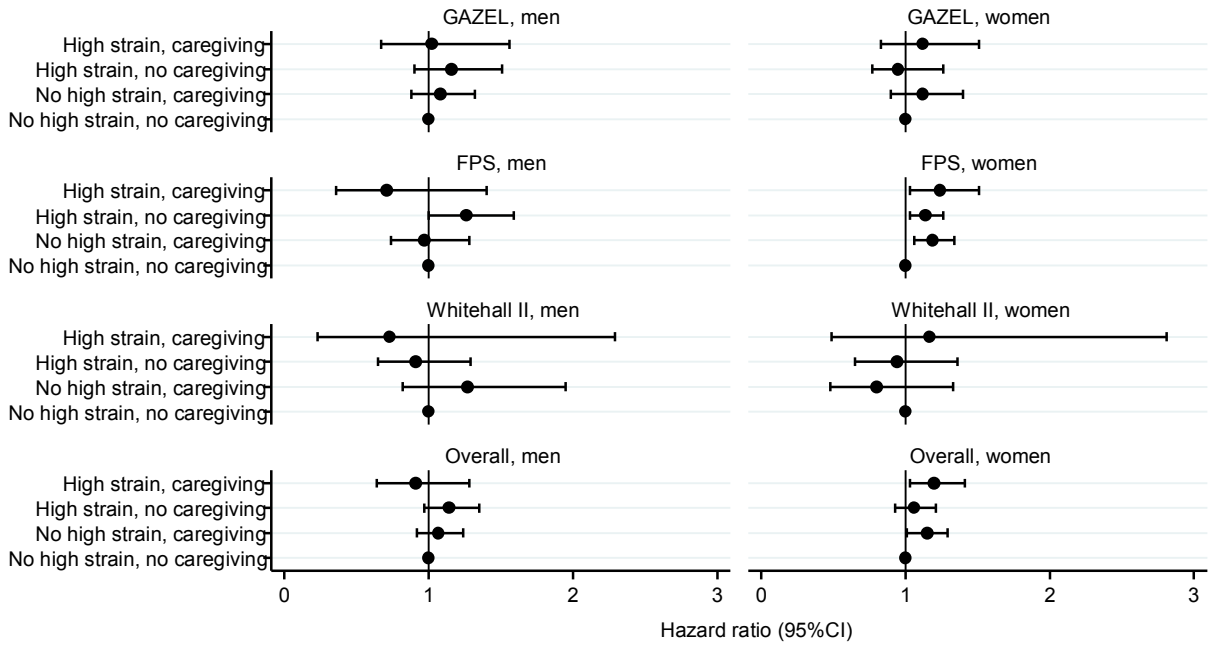

Figure 1. Job strain and informal caregiving as predictors of recurrent events of long-term sickness absence during two years follow-up. Adjusted for age, married/cohabiting, children, occupational grade, death of relative and/or divorce, previous long-term sickness absence, and longstanding illness. Interaction between job strain and informal caregiving in meta-analysis: Multiplicative: Men (P=0.112), women (P=0.766). Additive: Men (synergy index=-0.43), women (synergy index=0.95).

absence. Informal caregiving responsibilities were common with prevalence's ranging between 10–30% across cohorts. With regards to sickness absence, 12% of men and 21% of women experienced ≥1 spell of long-term sickness absence during a 2-year period. We found that high job strain and informal caregiving were predictors of long-term sickness absence among women, and women jointly exposed to high job strain and informal caregiving had a 34% increased risk of sickness absence compared to women with no high strain and no informal caregiving. However, contrary to our hypothesis, being doubly exposed to informal caregiving and job strain was not associated with an excess risk of sickness absence compared to the expected risk from their individual effects. We found no associations between informal caregiving and job strain on sickness absence among men.

Informal caregiving as a predictor of long-term sickness absence among women may be a consequence of role overload ascribed to additional responsibilities in daily living (10). Women have been increasingly engaged in full-time employment, but still carry the largest household workload (23, 46), and might therefore be more likely than men to experience any health consequences due to the joint effects of paid work, household chores, and informal caregiving (47, 48). In line with this, previous studies have shown that women are more likely to take the role as primary caregiver (49–51), and more often assist with basic and instrumental activities of daily living (49, 52). Thus, the additional role as informal caregiver may be more burdensome for women compared to men. A previous study using the GAZEL cohort (22), found no gender difference for individuals exposed to high work-family demands in risk of sickness absence. However, in that study family demands were defined as number of economically dependent family members, and informal caregiving may encompass a much greater emotional burden than having economically dependents. In line with our findings, a previous study from the GAZEL cohort also found tendencies for gender differences, but here, sickness absence was restricted to psychiatric disorders and family demands were also defined as number of economically dependents (21).

Job strain as a predictor of sickness absence in women is in line with findings from longitudinal studies in nurses (13, 53); and another longitudinal study covering a broader range of workers found that the strongest mediator in the association between gender and sickness absence was job strain (54). Also, a recent longitudinal population-based study on both men and women found support for the association between job strain and long-term sickness absence (12). In the latter study, long-term sickness absence was defined as absence >16 days, which is somewhat similar to our study. However, job strain was categorized in a variable with three groups: high, active or passive, and low strain. Thus, the reference category is different from our study. Other studies

have found high job demands (19) and low control (55) as predictors of sickness absence. One of the reasons why we chose to look at the combined job strain measure instead of demands and control separately was that it has been shown that job strain (even without positive interaction between job demands and control) predicts outcomes such as coronary heart disease better than low job control, when analyses are adjusted for socioeconomic status (56). Furthermore, sensitivity analyses on job demands and control did not change conclusions.

Even though we found a moderately higher risk of sickness absence among women who were exposed to both informal caregiving and job strain, this excess risk was not more than expected from their individual effects. These results are in line with recent findings showing no interactive effect of job strain and informal caregiving in relation to allostatic load (57), which is a biological measure of stress associated with poor health (58, 59). According to the role enhancement theory (7), a possible explanation for no interaction between high job strain and informal caregiving is that work may have acted as a buffer against stress from caregiving and vice versa (8). However, another possibility is a healthy caregiver effect, ie, those who undertake informal caregiving tasks may have more personal resources to begin with and are therefore also less likely to suffer any negative health consequences from informal caregiving. Based on this, we may have underestimated the effect of caregiving on sickness absence. It is also important to consider that individuals may have diverse experience with caregiving responsibilities. A Canadian study for example showed that >70% of caregivers were positive about the caregiving role (60); another study found that, despite difficulties, caregivers in general expressed great satisfaction with providing caregiving (61). However, other studies have shown that informal caregiving may compromise the caregivers' own health and interfere with working life (3–6). Unfortunately, we had no information on whether caregiving was perceived as burdensome in the present study. Hours of caregiving may be used as a proxy measure of workload, but our data on this variable was limited to Whitehall II, and we only found tendencies indicating that more hours of caregiving is associated with higher risk of sickness absence among women. Differentiating between those who experienced high and low caregiver burden in future studies may broaden our understanding of the relationship.

Informal caregiving was more prevalent in GAZEL compared to Whitehall II and FPS. This may seem counterintuitive as the question on informal caregiving in GAZEL only encompasses care for elderly relatives, whereas caregiving in the other cohorts also include care for sick and disabled relatives. However, a possible explanation for this discrepancy in prevalences is that France has a welfare system in which both family and state have legal obligations regarding caregiving of disabled and elderly family members; whereas in Finland the state has clear obligations but families do not. In the UK, the rules of legal obligations for sick/disabled family members were somewhat unclear in the 1990s (ie, the baseline of this study) (62) compared to today. Still, the wording of the question in Whitehall and FPS might also have lead the participants to understand that only care of people with severe disabilities was included. Despite the differences in the prevalence of caregiving and the questions applied, we found low heterogeneity in the association between caregiving and sickness absence in the three cohorts. This association would most likely have been stronger if the question in the GAZEL study had also encompassed care for disabled/handicapped children and spouses. A limitation of this study is the different time periods used for baseline. Based on this, it cannot be ruled out that there have been changes/developments in work- and family-related policies or culture between the time periods that could have affected the outcome. We found some heterogeneity in the job strain and sickness absence association, showing a tendency for a time trend; with no association in Whitehall (1994–1996), a tendency for an increased risk in GAZEL (2000–2002), and a stronger tendency in FPS (2012–2014). This, it may be a time-trend where sickness absence has become easier and more socially acceptable. However, the discrepancy in cohort estimates may also be due to cultural differences.

Variables such as alcohol intake, smoking status, body mass index, and depression have been included as potential confounders in similar studies (21, 22, 63). We have chosen not to include these variables in our analysis as they may be mediators on the causal pathway between job strain and sickness absence rather than confounding factors. Thus, a meta-analysis has shown that work–family interference and family–work interference have been associated with depression and substance use/abuse as outcomes (64); and depression, which may be partly a consequence of exposure to work stressors, has been shown to be a highly contributory cause of sickness absence (65). A limitation in our analyses is that other potentially important covariates shown in the directed acyclic graph (DAG) (www.sjweh.fi/index.php?page=data-repository) were not available, such as personality, spouse work status, household income and organizational changes at the workplace, which may be associated with informal caregiving, job strain and sickness absence (66, 67). However, household income is highly associated with being married and occupational grade (for which we adjusted), and the association between spouse work status and long-term sickness absence is likely to go through household income.

Sensitivity analyses on Whitehall II, including weekly work hours as a potential confounder, did not

change estimates. In line with this, there are some inconsistencies in findings from previous studies on the association between long work hours and sickness absence. A systematic review found that long work hours predict sickness absence and ill health (68), while another study found no association (69). A meta-analysis actually found that long working hours was a protective factor against sickness absence (19). The authors suggested the healthy worker effect as a plausible explanation and that some individuals with long working hours have highly demanding jobs and may feel pressure to be working even though they are sick (19).

To our knowledge, this is the first study to prospectively investigate the joint effects of job strain and informal caregiving on long-term sickness absence. Based on this large population of European workers, we have shown that informal caregiving is common among European workers and women with high job strain and/or informal caregiving responsibilities are at higher risk of long-term sickness absence compared to women with no high strain and no informal caregiving responsibilities. Presently, there may be unmeasured confounding from factors such as personality traits and organizational changes at workplaces.

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