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Age differences in the associations between sick leave and aspects of health, psychosocial workload and family life: a cross-sectional study

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ARTICLE SUMMARY

Article Focus

- Since dissimilarities between workers from different age groups are present, it is expected that factors associated with sick leave vary between different age groups.
- This article focuses on the differences in work-related characteristics, family-related characteristics, work-family interference, health-related characteristics and frequent and prolonged sick leave between four age groups (<36 years, 36-45 years, 46-55 years and 55^{+} years). Moreover, differences in the associations between various characteristics and the two sick leave outcomes between the age groups are investigated.

Key messages

- Older workers report more often prolonged sick leave and presence of chronic disease but less frequent sick leave than younger workers. However, they have equally high scores on fatigue, emotional exhaustion and perceived health complaints and several psychosocial work characteristics.
- There are age differences in associations between psychosocial workload, family-related characteristics and frequent and prolonged sick leave.
- Perceived health complaints and life events in private life are indicators for sick leave in all age groups.

Strengths and limitations of this study

- Knowledge on age differences in the relationship between psychosocial workload, family, health and sick leave is scarce. Our results may help managers and occupational physicians in supporting employees.
- Our population involved mainly knowledge workers, a rapidly growing occupational group in many modern economies.

- Cross-sectional studies are sufficient to obtain a rough notion of the relationship between psychosocial workload and diminished health and sick leave in different age groups. However, this design prevents establishing causality.

ABSTRACT

Objectives: To investigate associations between sick leave and aspects of health, psychosocial workload, family life and work-family interference in four age groups (<36; 36–45; 46–55 and 55^{+} years).

Design: A cross-sectional study; a questionnaire was sent to the home addresses of all employees of a university.

Setting: A Dutch university.

Participants: 1843 employees returned the questionnaire (net response: 49.1%). The age distribution was as follows: <36: 32%; 36–45:26%; 46–55:27% and 55+:12%

Primary outcomes: Frequent sick leave (FSL, ≥3 times in last 12 months) and prolonged sick leave (PSL, >2 weeks in total in last 12 months). Logistic regression analysis was used to calculate associations between the variables and the sick leave outcomes. Interaction terms were included to detect differences between the age groups.

Results: Age differences were found for many work- and family-related characteristics, but not in the mean scores for health-related aspects. Presence of chronic disease was reported more frequently with increasing age. The 55^{+} had almost 2 times less chance of FSL, but 1.6 times more chance of PSL than the <36. Age moderates several associations of work- and family-related characteristics, and FSL and PSL. However, life events in private lives and perceived health complaints are important in all age groups. FSL and PSL have some determinants in common, but there are differences between the outcomes as well.

Conclusions: Age should be treated as a variable of interest instead of a control variable. Employers and occupational physicians need to be aware that each phase in life has specific difficulties that can lead to frequent and prolonged sick leave.

Key words: sick leave, older workers, psychosocial workload, chronic disease, life events

INTRODUCTION

Sick leave is a substantial economic burden in societies where employees receive sick leave benefits.[1,2] In the light of the upcoming shortage of work force due to demographic changes,[3-5] it has become increasingly important to reduce sickness absence. Sick leave is associated with many factors. Psychosocial workload like increased job demands, low job control and low support has shown to be associated with diminished health and absence.[6-8] Family-related factors like marital status and children at home are either controlled for (and associations aren't made visible), or inconsistent results are found.[9,10] In addition, having difficulties with combining the demands at work and in family life, possibly resulting in work-family conflict, is related to ill health and sick leave.[10,11] To understand the factors affecting sick leave, it is important to take all these domains simultaneously into account.

Although some studies included factors from various domains to explain sick leave,[2] knowledge on age differences in the relationship between psychosocial workload, family, health and sick leave is scarce. It is quite possible that factors associated with sick leave vary between different age groups since dissimilarities between workers from different age groups are present. For example, the presence of chronic disease is associated with increased sick leave[1] and is more prevalent in older people.[2] Also, the balance between work and family is experienced differently between age groups,[3] and is found to be associated with sick leave.[10] Understanding age differences in determinants of sick leave provides insight into the desirability of age-related support and measures to reduce sick leave.

Most research on sick leave is focused on either frequent (i.e. the number of sick leave spells during one year) or prolonged sick leave (i.e. sick leave with a duration longer than e.g. two weeks in total in one year). This paper focuses on both frequent and prolonged sick leave for several reasons. First, both forms of sick leave are a burden for employers: productivity is reduced and both sudden and long-term replacements of employees are expensive and difficult to achieve. Second, determinants of the two sick leave measures may differ. Sick leave frequency is associated with personal well-being (i.e. health status), individual factors (including life style and individual circumstances) and atmosphere at

work (e.g. work contents, working relations).[4] Prolonged sick leave is associated with 'history of sickness absence' and 'older age'.[5] Finally, age differences are seen in both frequent and prolonged sick leave.[17,18]

The aim of the present study was to investigate associations between sick leave and aspects of health, work, family life and work-family interference in four age groups. Our research questions are (1) what are the differences in work-related characteristics, family-related characteristics, work-family interference and health-related characteristics between age groups? (2) Do frequent and prolonged sick leave differ between age groups? (3) Are there differences between the age groups in the associations between various characteristics and the two sick leave outcomes?

METHODS

Population

A questionnaire was mailed to the home addresses of 3881 employees at a Dutch university. Both the University Board and Works Council approved this study. No ethical approval was required. By means of an accompanying booklet, the employees were informed about the objectives of the study and the confidential handling of their responses. A reminder was sent after three weeks. A total of 1843 returned questionnaires proved usable, which means a (net) response of 49.1%.

Questionnaire

The aim of the questionnaire was to obtain information about psychosocial workload, family-related characteristics and difficulties with combining work and family life in order to explain sick leave. The construction was based on existing questionnaires previously used in scientific research, as well as on practice-based information from professionals.[6]

Demographic characteristics

Age was divided into four categories: <36 years, 36-45 years, 46-55 years and 55+ years. Employment category was categorized as: lower-educated non-scientific personnel (low NSP), higher-educated non-scientific personnel (level of education is college or university degree; high NSP) or scientific personnel (SP).[7] Employment category and sex were chiefly used as control variables (Table 1).

Health characteristics

Fatigue was assessed with the Shortened Fatigue Questionnaire.[8] *Emotional exhaustion* was measured with the Dutch version of the Maslach Burnout Inventory.[22] *Perceived health complaints* were measured with the VOEG-13.[23,24] The *presence of chronic disease* was coded as no (0) or yes (1).[1]

Work-related characteristics

Validated Dutch questionnaires using 4-point or 5-point Likert-type scales were used to assess negative and positive work-related characteristics, i.e. job demands and job resources (see Table 2).[9] Item responses were averaged for each scale. The internal consistency of the scales was moderate to good: Cronbach's alpha of less than 0.70 was only found for unpleasant treatment, job security and pay, work variety, and career opportunities.

A *work-related life event,* coded as no (0) or yes (1), meant that the respondent reported the experience of an emotional event within the work situation (e.g. conflicts with colleagues or superior, reorganization, changing of jobs). *Hours worked weekly* was included as control variable. It represents the total number of hours worked, including overtime and hours worked in other jobs.

Family-related characteristics

The following family-related characteristics were assessed, classified in five areas:[9] Family composition (*being married/cohabiting*, *children living at home*), partner's work characteristics (*partner has a job*, *partner working overtime and/or in shifts*, *being the breadwinner*), quality of relation with family members (*relationship with the partner*, *frequency of conflict/disagreement with the partner*, *relationship with children*, *frequency of conflict/disagreement with children*, *support from*

the partner, *support from children*), help in domestic and child rearing tasks (*partner's contribution to domestic tasks*, *partner's contribution to child rearing*, *childcare arrangements*, *need for more childcare*, *having a domestic help*), and characteristics representing more burden (*family care inside one's own home*, *family care outside one's own home*, *taking work home*, *burden of commuting*, *time pressure outside work*, *a life event in private life*).

Many family related characteristics were not associated with either FSL or PSL and are not further described (data available on request). Details about family composition and the significantly associated characteristics are presented in Table 1.

Work-family interference

Work-family interference (WFI) was assessed with the 18 item scale developed by Carlson *et al*.[10] Each of the three forms of conflict (*time*-based, *strain*-based and *behaviour*-based) has two directions: work interfering with family (W→FI) and family interfering with work (F→WI). Responses could range from strongly disagree (1) to strongly agree (5). Item responses are averaged for each subscale, with higher scores indicating more WFI. The Cronbach's alphas indicated good internal consistency.

Sick leave

Sick leave was based on the question 'Have you ever taken sick leave because of health problems in the past 12 months?' (yes or no). Open questions were posed with regard to the frequency and duration (in weeks) during the past 12 months. *Frequent sick leave* (FSL) was defined as three or more episodes of sick leave during the past 12 months, regardless of duration. *Prolonged sick leave* (PSL) was defined as more than two weeks of sick leave during the past 12 months (sum of the duration of all episodes of sick leave).

Analyses

All analyses were done using SPSS 16.0. Differences between the age groups in the independent variables were investigated using χ^2-tests or GLM (with correction for sex, employment category, working hours/week and presence of chronic disease), followed by post-hoc tests using Tukey.

Significance level for these tests was set at 0.001 to detect the most relevant differences. After this, work-related characteristics, health-related characteristics and the WFI scales were dichotomised at the 50th percentile into low and high scores.

Age differences in FSL and PSL were investigated using logistic regression analysis with <36 years as reference category. The analyses were controlled for sex, employment category and hours worked weekly.[1] To gain more insight into the impact of chronic disease on sick leave, the analyses were additionally controlled for this factor.

Logistic regression analyses were applied to calculate the associations between the independent variables and FSL and PSL. Independent variables were divided over several blocks: 1) health characteristics; 2) job demands; 3) job resources; 4) family composition; 5) partner's work characteristics; 6) quality of relation with family members; 7) help in domestic and child rearing tasks; 8) characteristics representing more burden; 9) work-family interference. In the first step, for each of these nine blocks, a hierarchical backward elimination procedure was applied.[11] To investigate the moderating role of age, product terms of the variables with age were included: a significant interaction term indicates that age-related differences in the relation between that independent variable and the outcome exist. Non-significant interaction terms were eliminated one at a time ($p>0.10$). Next, non-significant variables were eliminated. However, when the variable was non-significant but the product term was, the variable remained in the model.[11] Sex, employment category and hours worked weekly were kept in the model regardless the significance as we considered them as potential confounders.[11]

In the second step, the remaining job demands and job resources were combined into one block, again using hierarchical backward elimination. The same was applied to the family-related characteristics.

In the third step, the remaining variables of the blocks 'health', 'work characteristics', 'family-related characteristics' and 'WFI' were simultaneously entered in a final logistic regression model ($p<0.05$). When age differences occurred (indicated by a significant interaction term), age-specific analyses were done.

RESULTS

Age differences in independent variables

Significant age differences were found in the demographic and family-related characteristics (Table 1). More women and temporary contracts were found in the youngest group. The two youngest groups showed the lowest percentages regarding low NSP. With increasing age, more presence of chronic disease occurred. Working >40 hours/week most commonly occurred in the oldest group. In the 36-45 group, the highest percentages of <25 hours/week was found. A work-related life event did not show age differences, as opposite to the family-related characteristics.

Many age-related differences were found regarding work-related characteristics (Table 2). The groups differed from each other regarding job security and pay, job involvement and decision latitude: the mean scores were higher with increasing age. The <36 reported less work pressure and more use of professional expertise than the other groups. The 55^{+} reported less role ambiguity than the other groups. No differences were found in the health-related characteristics. The 36-45 reported more $F \rightarrow WI_{time}$ than the other groups.

Age differences in frequent sick leave and prolonged sick leave.

Table 3 presents the odds ratios (and 95% confidence intervals [95% CI]) for FSL and PSL in four age groups. Unadjusted figures showed no significant association between age and FSL. Statistically significant results were found for PSL: 55^{+} employees had 1.6 times more chance of PSL than the <36. Adjustment for sex, employment category and hours worked weekly had minimal effect on FSL. For PSL, the OR remained significant among the 55^{+} and became significant among the 46-55. Additional adjustment for presence of chronic disease resulted in a decrease of more than 10% in the ORs for FSL and PSL among the 46-55 (although no statistically significant results) and the 55^{+}: this group shows almost half as much chance of FSL, but 1.6 times more chance of PSL than the <36.

Determinants of frequent sick leave

Table 4 shows ORs and 95% CIs for significantly associated characteristics with frequent sick leave (FSL). The upper part presents characteristics that are significantly differently associated with FSL between the age groups. The middle part shows the characteristics associated with more FSL; characteristics in the lower part are associated with less FSL.

Differences between the age groups are found for career opportunities, partner's contribution to domestic tasks and sex. In the <36, more career opportunities are associated with more FSL, whereas in the 36-45 group, more career opportunities are associated with less FSL. When the partner is doing more in domestic tasks, this is associated with more FSL in the <36 group. In the 55^{+} group, this is associated with less FSL. Sex (i.e. being female) is associated with more FSL in the <36 group. In the 46-55 and 55^{+} groups, being female is associated with less FSL.

Table 4 also shows the other characteristics relevant for explaining FSL common for all age groups (first column). More perceived health complaints, conflicts with colleagues, more communication, a life event in private life and more $W \rightarrow FI_{strain}$ are associated with more FSL. More decision latitude and more hours worked weekly are associated with less FSL.

Determinants of prolonged sick leave

The characteristics associated with prolonged sick leave (PSL) are presented in Table 5, which is designed in the same way as Table 4. Higher scores with job security and pay are associated with less PSL in the younger groups, whereas it is associated with more PSL in the two oldest groups. Support from superiors is associated with less PSL in the < 36 group while in the two older groups, the value of the OR indicates that more support from superiors is associated with more PSL. Having challenging work is associated with less PSL in the 55^{+} group. The three other groups don't show a statistically significant association, but the values of ORs indicate that with increasing age, the association gets stronger. Being the breadwinner is associated with less PSL in the youngest group. Earning about the same as the partner is associated with more PSL in the 46-55 group. The OR (although not statistically significant) in the 55^{+} indicates that being the breadwinner is associated with more PSL.

Other factors associated with more PSL are more perceived health complaints, more fatigue, the presence of chronic disease, more physical workload, conflict with superiors, a work-related life event and a life event in private life. More job satisfaction and more hours worked weekly are associated with less PSL.

DISCUSSION

This study was conducted to explore determinants of sick leave at different ages. To our knowledge, this was the first study that simultaneously investigated the associations between characteristics from various domains (work, family life, health) and two sick leave measures, taking age differences into consideration. We expected that especially characteristics pertaining to domestic tasks and childcare as well as work-family interference would be more strongly associated with the sick leave outcomes in the two younger groups. Our regression analyses showed differences in associations between the age groups, indicating that age-specific measures to reduce sick leave seem worthwhile. However, the expected differences in associations regarding family-related characteristics and work-family interference were not confirmed.

Differences in independent variables

Presence of chronic disease is found more often by older employees which is reported elsewhere.[13,28] Differences between the age groups occurred among the work and family-related aspects which may be explained by variations in career stage, personal circumstances and stage of life. Table 2 also shows that older employees report equal scores on career opportunities, opportunities for learning, challenging work and job satisfaction and higher scores on job security and pay, professional expertise, decision latitude and job involvement compared to younger employees ($p<0.001$). Many managers fear that older employees are less motivated and involved in their work.[12] Such stereotypical thinking is however not confirmed in our study.

Despite age differences in family-related aspects, very few differences in WFI were seen. The only difference concerns more $F \rightarrow WI_{time}$ among the 36-45 year olds. These employees find it difficult to

spend enough time on work-related tasks due to family demands. The presence of younger children (which is more time consuming than older children) may explain this result.[14,25]

Surprisingly, no age differences were found for fatigue, emotional exhaustion and perceived health complaints after correction for sex, employment category and hours worked weekly (Table 2). This may partly be explained by the healthy survivor effect:[13] employees with deteriorated health may have already left the organization. However, several other studies did not find an association with age after correction for sex in subjective health complaints[14] or emotional exhaustion in men.[32] This indicates that controlling for sex seems important to obtain a good understanding about age differences.

Differences in frequent and prolonged sick leave between age groups

Older workers reported more PSL than the <36 group after correction for sex, employment category and hours worked weekly. For FSL, lower ORs were found with increasing age, though no statistical differences were found (Table 3). Additional adjustment for the presence of a chronic disease resulted in an over 10% lower chance of both FSL and PSL in the two oldest age groups. This means that sick leave in these age groups can partly be attributed to the presence of chronic diseases, supporting reports made elsewhere that chronic diseases are a major cause of long-term sickness absence and job loss.[33] Compared to the <36, the 55^{+} had almost 2 times less chance of FSL, but 1.6 times more chance of PSL. These results are expected from earlier studies: older people are absent less frequently,[15] but their absence is often more prolonged compared to younger workers.[16] Younger workers seem to stay out of work due to minor health complaints more often.[1] The health problems that older workers are confronted with (not necessarily chronic conditions) often take more time to recover from, therefore older workers report more PSL.

Age differences in determinants of frequent sick leave

This study showed that age-specific measures to reduce FSL are recommendable since some determinants were significantly differently associated with FSL for the age groups. More career opportunities was associated with more FSL in the <36 group whereas it was associated with less FSL in the 36-45 group. Within a university, only those employees who proved to have sufficient capacities

are offered permanent jobs. For younger employees more career opportunities might go with an increased effort to pursue an (academic) career which may be difficult to achieve as there are not that many higher positions available.[17]

The association between higher contribution of partner to domestic tasks with more FSL in the youngest group may be explained by the cross-sectional design of the study. FSL may indicate a decreased overall health, and because of that a lower participation in such tasks, implying that the partners have to do more to keep the household running.

Many studies have shown that women report more sick leave.[15] We found that women in the <36 group reported more FSL, whereas women in the 46-55 group reported less FSL. Apparently, the age of women is important to consider.

Other determinants did not show statistically significant differences between the age groups, although the separate analyses sometimes presented different ORs, e.g. communication is differently associated with FSL in the 36-45 and 46-55 group compared to the other two groups. The lack of statistical difference may be explained by variance within age groups and different group sizes.

Generally, our results indicate that is it important to take the domains of work, family and health into consideration when investigating the determinants of FSL. Managers and occupational physicians may benefit from this knowledge in supporting employees: Life events in work and in private life and perceived health complaints are indicators for higher chance of FSL, whereas more decision latitude seems protective to FSL. Regarding work-family interference, we found only an association between strain-based interference from work to family ($W \rightarrow FI_{strain}$) and FSL. Some studies found an association between family interference with work ($F \rightarrow WI$) and sick leave.[10] As the younger employees reported more $F \rightarrow WI_{time}$ (Table 2), we had expected an association for this factor, but it was not remained in our model. Time-based WFI seems better manageable, e.g. by managing work hours better, or to reduce working overtime.[35] Among university employees, the high level of autonomy and flexibility probably facilitates resolving (time-concerning) family-related difficulties.[9] Moreover, several Dutch measures (e.g. parental leave or leave to take care of ill family members) are

currently available to facilitate combing paid work with family-related tasks. It is questionable whether these (time-related) measures are sufficient to reduce the mental strain that university employees have to cope with.

Age differences in determinants of prolonged sick leave

The analyses on PSL also indicate that age-specific measures to reduce sick leave are advisable. The ORs indicate that younger persons with higher scores on job security and pay have less chance of PSL, while in older employees there is more chance of PSL. An explanation may be that older employees have such secure positions in the organization that they do not fear dismissal despite their sick leave. Support from superiors seems particularly important for younger employees. These employees lack some work experience and help of superiors makes them function better. A remarkable finding in the light of the stereotypical image of older employees is the association of more challenging work with less PSL in the oldest workers. Older workers are often associated with a lack of adaptability and a resistance to innovation.[12] Age differences were also found in the association between being the breadwinner and PSL. Being breadwinner was associated with less sick leave in the younger workers, which is in line with research into return to work after back complaints.[36] However, we found an opposite association for older employees: older employees with deteriorated health may see themselves forced to continue working for financial reasons.

As with FSL, characteristics from various areas were relevant for PSL in all age groups although some ORs diverge between the age groups, e.g. presence of chronic disease and conflict with superiors seem even more relevant in the 55^{+} group than in the other groups. Perceived health complaints, presence of chronic disease and life events in both work and private lives were strongly associated with more PSL in all groups. More job satisfaction was associated with less PSL which is in line with results reported elsewhere.[36] Paying attention to signals of deteriorated health and decreased job satisfaction by superiors and act upon those signals (discuss work- and/or family problems with the employee) may prevent sick leave.

Similarities and differences between frequent and prolonged sick leave

Our findings illustrate that determinants of both FSL and PSL are important to consider when managers intend to increase the productivity among employees and reduce the financial burden. Both FSL and PSL are associated with hours worked weekly, perceived health complaints and life events in private life. More hours worked weekly is associated with less sick leave, which may indicate a healthy survivor effect: employees in good health are able to work that amount of hours, while persons with deteriorated health may opt for smaller contracts. Managers should be aware of requests for changing the contract and of signals of diminished health and discuss possibilities to maintain or improve employee's well-being and productivity.

Several differences are also found: Conflict with colleagues is associated with more FSL, but conflict with superiors is associated with more PSL. Conflicts with superiors might be more serious than with colleagues and therefore leads to longer sick leave. Work-related life events were associated with more PSL but not with FSL: It might be that the threshold to return to work is high in such cases. Being a breadwinner is associated with less PSL but not associated with FSL. Previous research has revealed the importance of an economic incentive to return-to-work: employees with a higher financial need return to work more often.[36]

Methodological considerations

Our population involved mainly knowledge workers, a rapidly growing occupational group in many modern economies. However, our results may not apply to other occupational groups, as blue collar workers employees may report more sick leave than white collar workers.[18] Future studies should include various occupations.

The response of 49.1% was comparable with other questionnaire studies.[19] Due to the anonymous design, in-depth non-response analyses were not feasible. We found that somewhat less employees of <36 years and somewhat more 55^{+} employees returned the questionnaire. Nevertheless, the number of employees of 55^{+} years that reported FSL was rather small. This weakens the power of the study and possible significant effects may be missed. Results regarding FSL in the 55^{+} group should be interpreted with care.

Owing to the cross-sectional design of our study, we could not establish causality. Cross-sectional studies are sufficient to obtain a rough notion of the relationship between psychosocial workload and diminished health and sick leave in different age groups.[20] Obviously, longitudinal designs are desired to strengthen our results.

It is possible that the employees who were on long-term sick leave (e.g. because of problems at work or at home) did not return the questionnaire even though we send it to the home addresses to reduce such selective non-response.

Sick leave registers are considered to be a reliable source to obtain the number of days of sick leave.[19] However, due to our anonymous design, we were unable to link up with the university's sick leave register. The assessment of sick leave was therefore based on self-reported data. This may have introduced some recall bias in the frequency or duration of sick leave. Ferrie *et al*[19] reported that more than two thirds of their respondents had a discrepancy of two days or less. However, as we dichotomised our outcome measures with cut-off points that were rather high compared to that study, we expect that the influence of misclassification regarding sick leave was rather limited.

People with deteriorated health may already have left the labour force and therefore limitedly included in our study. In the near future more persons with decreased health will still be working. Several changes have already been made in Dutch social legislation to reduce the number of people who take early retirement or depend on disability pensions, as solutions to deal with the scanty labour force. Moreover, the pension date will be extended to the age of 67. Repeating this study in a few years may lead to other results.

Despite these limitations, our results provide more knowledge of (age-related) factors associated with frequent and prolonged sick leave, which may help managers and occupational physicians in supporting employees. Necessary adjustments can be made in earlier stages so diminished health and sick leave is reduced or even prevented.

CONCLUSIONS

Our study showed that several differences between age groups exist in the work- and family-related characteristics, but not in the health characteristics. Compared to <36 employees, the 55^{+} have a decreased risk of FLS and an elevated risk of PSL. Presence of chronic disease partly explains sick leave in the two older groups.

Our multivariate analyses revealed differences in associations between the age groups. Research implications are that age should be treated as a variable of interest instead of as a control variable. Differences will be missed by simply controlling for age. Practical implications are that supervisors, managers and occupation physicians should be aware of specific interventions for employees of different ages. Interventions aimed at preventing or reducing sick leave should keep the differences between age groups into account e.g. career opportunities, job security and pay, and challenging work. Next to differences, similarities were found. Both frequent and prolonged sick leave may partially be prevented by increasing job resources like decision latitude. For managers and superiors, it is important to be alert to (health) symptoms and life events and discuss possible causes and solutions with the employees. Finally, FLS and PSL differ in the found associations indicating that it is important to pay attention to determinants of both outcomes to improve employees' health and productivity.

Contributorship

NCGMD contributed in the study design and data collection, conducted the data analysis and took a leading part in writing this article.

JB contributed substantially to the interpretation of the results and revision of the manuscript.

KvdV has critically commented on and edited drafts of the manuscript.

JvdG contributed in the study design and has critically commented on and edited drafts of the manuscript. All authors have approved the final version of the manuscript.

Data Sharing

The data set has been used for other publications and contains various characteristics regarding work, family life and health of Dutch university employees. Any research interested in those topics can contact the author for correspondence to see if the data can be used for other studies.

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Competing Interests

All authors declare that they have no conflict of interest.

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Table 1: Distribution of demographic and family-related characteristics (numbers and percentages) over the four age groups with results from chi-square tests[#]

		<36 (n=584)		**36-45** (n=487)		**46-55** (n=492)		**55+** (n=216)		χ^2	df	p-value
Sex	Male*	237	39.8	257	52.0	288	57.8	170	77.6	99.5	3	<0.001
	Female	358	60.2	237	48.0	210	42.2	49	22.4			
Presence of chronic disease	No*	478	82.1	372	77.7	340	70.5	137	63.4	38.4	3	<0.001
	Yes	104	17.9	107	22.3	142	29.5	73	36.6			
Employment category	Lower educated non-scientific personnel (low NSP)*	118	19.9	128	25.9	164	32.9	72	32.9	57.7	6	<0.001
	Higher-educated non-scientific personnel (high NSP)	138	23.3	156	31.6	155	31.1	57	25.8			
	Scientific personnel (SP)	336	56.8	210	42.5	179	35.8	92	41.6			
Hours worked weekly	<25 hours*	79	13.3	99	20.2	62	12.6	27	12.2	22.2	6	0.001
	25-40 hours	326	55.0	245	50.0	257	52.0	104	47.1			
	>40 hours	188	31.7	146	29.8	175	35.4	90	41.6			
Type of contract	Permanent	206	34.7	366	74.2	440	88.2	214	96.0	482.3	3	<0.001
	Temporary	387	65.3	127	25.8	59	11.8	9	4.0			
Married/cohabiting	No	261	43.9	101	20.4	85	17.0	27	12.1	149.2	3	<0.001
	Yes	334	56.1	393	79.6	414	83.0	196	87.9			
Having children at home	No	480	80.7	171	34.6	254	50.9	180	80.7	295.5	3	<0.001
	Yes	115	19.3	323	65.4	245	49.1	43	19.3			
Partner's contribution to domestic tasks	No partner or partner is doing (much) less or the same*	518	87.1	338	68.4	292	58.5	90	40.4	199.4	3	<0.001
	Partner is doing more	77	12.9	156	31.6	207	41.5	135	59.6			
Breadwinning	Partner is breadwinner*	149	25.1	148	30.0	119	24.0	15	6.8	99.3	6	<0.001
	About the same	100	16.9	54	10.9	42	8.5	6	2.7			
	Respondent is breadwinner	344	58.0	292	59.1	335	67.5	200	90.5			
Life event in private life	No*	308	53.5	304	63.6	316	67.2	154	70.3	30.2	3	<0.001
	Yes	268	46.5	174	36.4	154	32.8	65	29.7			
Work-related life event	No*	514	89.2	440	92.1	433	92.1	204	93.2	4.8	3	0.19
	Yes	62	10.8	38	7.9	37	7.9	15	6.8			

[#]: due to missing data the number of respondents differs per characteristic.
*: reference group for that variable in the logistic regression analysis

Table 2: Mean scores and standard error (se) of work-related characteristics, health and work-family interference (number of items per scale and range between brackets), corrected for sex, employment category, hours worked weekly and presence of chronic disease.

	<36 n=577		**36-45** n=475		**46-55** n=475		**55+** n=211			
Job demands[#]	mean	se	mean	Se	mean	se	mean	se	F	p
Unpleasant treatment (6, 1-4)	1.08	.01	1.06	.01	1.06	.01	1.08	.02	.45	.714
Role conflict (5, 1-4)	1.68	.03	1.70	.02	1.70	.02	1.58	.04	2.60	.051
Work pressure (8, 1-5)	2.85	.04	3.18	.04	3.16	.04	3.13	.06	13.11	<.001
Role ambiguity (5; 1-4)	2.11	.04	2.06	.03	1.96	.03	1.90	.05	5.38	.001
Physical workload (3)	1.71	.03	1.58	.03	1.60	.03	1.55	.05	3.57	.014
Conflicts with superiors (1; 1-5)	.37	.03	.44	.03	.43	.03	.34	.05	1.78	.148
Conflicts with colleagues (1; 1-5)	.33	.03	.47	.03	.43	.03	.43	.05	3.81	.009
Job resources[‡]										
Job security and pay (2; 1-5)	2.90	.06	3.20	.05	3.38	.05	3.71	.09	23.70	<.001
Decision authority on working hours (3; 1-5)	3.60	.05	3.57	.05	3.59	.05	3.76	.08	1.46	.224
Work variety (3, 1-5)	3.09	.04	3.23	.04	3.22	.04	3.29	.06	3.36	.018
Information on work (3; 1-4)	3.00	.04	2.86	.04	2.99	.04	3.01	.06	3.11	.026
Career opportunities (3; 1-4)	2.64	.06	2.68	.05	2.52	.05	2.47	.08	2.63	.049
Communication (4; 1-4)	2.56	.04	2.64	.04	2.70	.04	2.78	.06	3.78	.010
Professional expertise (2; 1-5)	3.85	.05	4.03	.04	4.11	.04	4.15	.07	6.69	<.001
Opportunities for learning (4; 1-4)	2.85	.04	2.78	.04	2.77	.04	2.83	.06	1.12	.341
Decision latitude (9; 1-4)	2.47	.04	2.61	.03	2.68	.03	2.81	.05	11.06	.000
Autonomy (1; 1-5)	3.40	.04	3.46	.04	3.46	.04	3.57	.06	1.71	.162
Social support superiors (4; 1-4)	3.18	.05	3.05	.04	3.10	.04	3.19	.07	1.76	.152
Social support colleagues (4; 1-4)	3.14	.04	3.12	.03	3.11	.03	3.21	.06	.90	.440
Job involvement (1; 1-5)	3.84	.05	4.12	.05	4.27	.05	4.40	.07	18.82	<.001
Challenging work (1; 1-5)	3.43	.06	3.61	.05	3.60	.05	3.67	.08	2.87	.035
Job satisfaction (1; 1-5)	3.69	.06	3.80	.05	3.77	.05	4.07	.09	4.57	.003
Health-related characteristics[#]										
Fatigue (4; 4-28)	13.36	.40	13.26	.37	13.18	.37	11.85	.60	1.68	.170
Emotional exhaustion (4; 1-5)	2.50	.06	2.54	.05	2.54	.05	2.45	.09	.34	.798
Health complaints (13; 0-13)	3.09	.15	3.02	.14	3.29	.14	2.95	.23	.84	.472
Work-family interference[#]										
W→FI $_{time}$ (3; 1-5)	2.49	.06	2.69	.05	2.57	.05	2.61	.08	2.35	.071
F→WI $_{time}$ (3; 1-5)	1.72	.05	2.07	.05	1.82	.05	1.64	.08	11.84	<.001
W→FI $_{strain}$ (3; 1-5)	2.37	.06	2.45	.05	2.42	.05	2.26	.09	1.31	.271
F→WI $_{strain}$ (3; 1-5)	1.64	.05	1.73	.04	1.66	.04	1.55	.07	1.95	.120
W→FI $_{behaviour}$ (3; 1-5)	2.32	.06	2.51	.06	2.52	.05	2.43	.09	2.46	.061
F→WI $_{behaviour}$ (3; 1-5)	2.37	.06	2.57	.06	2.58	.06	2.48	.09	2.48	.059

[#]: On these scales, a higher score is unfavourable
[‡]: On these scales, a higher score is favourable

Table 3: Odds ratios (and 95% confidence intervals – 95% CI) for frequent sick leave and prolonged sick leave.

	<36*	36-45		46-55		55+	
		OR	95%CI	OR	95%CI	OR	95%CI
Frequent sick leave (not corrected)	1	0.88	(0.59-1.31)	0.82	(0.55-1.22)	0.58	(0.32-1.04)
corrected for sex, employment category and hours worked weekly	1	0.82	(0.55-1.23)	0.75	(0.49-1.14)	0.60	(0.33-1.10)
corrected for sex, employment category, hours worked weekly and chronic disease	1	0.79	(0.53-1.19)	0.67	(0.44-1.02)	**0.51**	(0.27-0.94)
Prolonged sick leave (not corrected)	1	1.19	(0.84-1.70)	1.35	(0.96-1.91)	**1.58**	(1.04-2.43)
corrected for sex, employment category and hours worked weekly	1	1.24	(0.86-1.79)	**1.46**	(1.02-2.10)	**2.01**	(1.27-3.19)
corrected for sex, employment category. hours worked weekly and chronic disease	1	1.22	(0.84-1.77)	1.29	(0.88-1.87)	**1.64**	(1.02-2.63)

* The group of <36 years old was used as reference.
Bolt indicates significant association at p ≤. 05

Table 4: Final logistic regression models for *frequent sick leave* (FSL, ≥ 3 episodes in the last 12 months)

	Total population		< 36 years		36-45 years		46-55 years		55+ years	
	OR	95%CI	OR	95%CI	OR	95%CI	OR	95%CI	OR	95%CI
Career opportunities	2.29	0.99 5.28	**1.91**	1.01 3.63	**0.39**	0.18 0.86	0.70	0.33 1.48	0.24	0.04 1.33
Partner is doing more in domestic tasks	**7.34**	2.66 20.24	**3.95**	1.80 8.65	1.29	0.51 3.23	1.07	0.44 2.60	0.25	0.06 1.01
Sex (being female)	**3.79**	1.52 9.47	**2.19**	1.08 4.41	0.86	0.36 2.05	**0.34**	0.12 0.98	0.19	0.03 1.18
Perceived health complaints	**2.64**	1.79 3.90	**3.06**	1.61 5.80	**2.99**	1.37 6.55	1.79	0.81 3.94	3.37	0.80 14.24
Conflict with colleagues	**1.48**	1.04 2.11	1.34	0.73 2.45	1.66	0.83 3.29	1.36	0.68 2.73	3.41	0.89 13.12
Communication	**1.71**	1.17 2.50	0.91	0.49 1.69	**3.06**	1.43 6.55	**2.89**	1.26 6.61	1.30	0.28 6.03
Life event in private life	**2.11**	1.49 2.99	**1.98**	1.09 3.59	**2.40**	1.20 4.81	**2.29**	1.15 4.54	2.99	0.86 10.45
W→FI strain	**1.70**	1.15 2.51	1.42	0.75 2.65	1.65	0.75 3.62	**3.66**	1.57 8.52	0.91	0.23 3.66
Employment category										
- high NSP vs low NSP	1.34	0.87 2.08	1.48	0.68 3.22	1.28	0.54 3.01	1.07	0.45 2.54	2.34	0.53 10.31
- SP vs low NSP	0.66	0.41 1.07	0.46	0.21 1.01	0.53	0.19 1.45	1.08	0.40 2.93	1.94	0.32 11.69
Decision latitude	**0.52**	0.35 0.78	**0.50**	0.25 1.00	**0.21**	0.09 0.51	0.92	0.41 2.10	0.52	0.11 2.50
Hours worked weekly										
- 24-40 hours vs < 24 hours	0.72	0.44 1.19	1.31	0.53 3.25	0.69	0.28 1.68	**0.27**	0.09 0.84	0.79	0.12 5.31
- >40 hours vs < 24 hours	**0.49**	0.26 0.92	1.09	0.37 3.18	0.54	0.17 1.79	**0.13**	0.03 0.54	0.09	0.01 1.04
Age	**1.76**	1.23 2.53								
interaction term career opportunities * age	p=.008									
interaction term partner's contribution * age	p<.001									
interaction term sex * age	p=.001									
Nagelkerke R^2	.184		.203		.263		.205		.335	

Bold figures indicate significant associations at p<0.05; underlined figures indicate significant associations at p<0.10.

Table 5: Final logistic regression models for *prolonged sick leave* (PSL, > 2 weeks in total in the last 12 months).

	Total population			**< 36 years***			**36-45 years**			**46-55 years**			**55^{+} years***		
	OR	95%CI		OR	95%CI		OR	95%CI		OR	95%CI		OR	95%CI	
Job security and pay	0.54	0.25	1.21	0.76	0.39	1.47	0.92	0.48	1.77	1.61	0.89	2.92	2.80	0.80	9.81
Support from superiors	**0.40**	0.19	0.85	0.59	0.32	1.09	0.56	0.27	1.18	1.25	0.64	2.42	1.19	0.36	3.87
Challenging work	1.82	0.83	3.98	1.12	0.55	2.29	0.82	0.41	1.62	0.59	0.31	1.15	**0.27**	0.09	0.82
Breadwinner															
- about equal vs partner is breadwinner	**0.18**	0.05	0.69	0.43	0.18	1.05	0.70	0.22	2.17	2.61	0.87	7.80	1.51	0.03	66.52
- being breadwinner vs partner is breadwinner	**0.29**	0.12	0.67	0.52	0.27	1.01	1.12	0.48	2.61	1.54	0.69	3.45	4.30	0.34	53.57
Perceived health complaints	**2.25**	1.55	3.27	1.85	0.90	3.77	**2.51**	1.25	5.02	**2.54**	1.21	5.31	2.16	0.66	7.07
Fatigue	**1.55**	1.07	2.24	1.83	0.88	3.81	1.42	0.69	2.91	1.29	0.63	2.66	2.83	0.92	8.65
Presence of chronic disease	**1.96**	1.42	2.71	1.15	0.59	2.27	**2.52**	1.34	4.75	**2.03**	1.11	3.71	**5.64**	2.00	15.90
Physical workload	**1.40**	1.03	1.92	1.72	0.92	3.18	1.23	0.68	2.22	1.35	0.75	2.44	1.28	0.47	3.51
Conflict with superiors	**1.54**	1.09	2.16	1.81	0.98	3.35	1.13	0.58	2.20	1.33	0.70	2.53	**4.83**	1.34	17.50
Work-related life event	**2.42**	1.55	3.79	1.80	0.84	3.85	**2.93**	1.29	6.64	2.82	0.97	8.21	**6.96**	1.40	34.57
Life event in private life	**1.76**	1.29	2.40	1.36	0.76	2.43	**2.54**	1.39	4.63	**2.22**	1.23	4.01	0.92	0.32	2.67
Job satisfaction	**0.69**	0.48	0.98	0.59	0.30	1.14	0.98	0.49	1.97	**0.46**	0.24	0.87	1.30	0.36	4.68
Hours worked weekly															
- 24-40 hours vs < 24 hours	0.94	0.61	1.46	0.96	0.42	2.18	0.96	0.42	2.19	0.87	0.34	2.21	1.43	0.31	6.49
- > 40 hours vs < 24 hours	**0.44**	0.25	0.77	0.34	0.12	0.97	0.53	0.17	1.65	0.61	0.19	1.92	**0.18***	0.03	1.09
Employment category															
- high NSP vs low NSP	0.89	0.60	1.34	1.32	0.55	3.14	1.36	0.63	2.92	**0.35**	0.16	0.75	2.16	0.60	7.82
- SP vs low NSP	0.85	0.55	1.32	1.48	0.63	3.48	0.85	0.35	2.04	**0.38**	0.16	0.90	2.25	0.50	10.19
Sex (being female)	1.44	1.00	2.07	1.87	0.92	3.78	1.59	0.76	3.29	1.29	0.65	2.55	1.26	0.34	4.65
Age	1.11	0.64	1.93												
interaction term job security and pay * age	p=.048														
interaction term support superiors* age	p=.040														
interaction term challenging work* age	p=.010														
interaction term breadwinner * age	p=.006														
Nagelkerke R^2	.246			.256			.269			.250			.427		

Bold figures indicate significant associations at p<0.05; underlined figures indicate significant associations at p<0.10.

STROBE Statement—Checklist of items that should be included in reports of ***cross-sectional studies***

In red the items that we did not fulfil, with an explanation why.
In green the items we did fulfil.
In black the items that are not applicable to this study.

	Item No	Recommendation
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found
Introduction		
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported
Objectives	3	State specific objectives, including any prespecified hypotheses
Methods		
Study design	4	Present key elements of study design early in the paper
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group We did not meet this aspect: a detailed description of the variables in the questionnaire was omitted but can be found in the included references.
Bias	9	Describe any efforts to address potential sources of bias
Study size	10	Explain how the study size was arrived at
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding
		(*b*) Describe any methods used to examine subgroups and interactions
		(*c*) Explain how missing data were addressed: We omitted such explanations to fulfil the criteria of a maximum of 4500 words. This information can be added if the editors allow us to use more words.
		(*d*) If applicable, describe analytical methods taking account of sampling strategy (not applicable)
		(*e*) Describe any sensitivity analyses (not applicable)
Results		
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed
		(b) Give reasons for non-participation at each stage We omitted this due to the maximum of 4500 words. This information can be added if the editors allow us to use more words.
		(c) Consider use of a flow diagram
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and

		information on exposures and potential confounders
		(b) Indicate number of participants with missing data for each variable of interest. We omitted this due to the maximum of 4500 words. This information can be added if the editors allow us to use more words.
Outcome data	15*	Report numbers of outcome events or summary measures:
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included
		(*b*) Report category boundaries when continuous variables were categorized
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses
Discussion		
Key results	18	Summarise key results with reference to study objectives
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence
Generalisability	21	Discuss the generalisability (external validity) of the study results
Other information		
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based There was no external funding, therefore this item is not recorded in the manuscript.

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

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Age differences in the associations between sick leave and aspects of health, psychosocial workload and family life: a cross-sectional study

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ARTICLE SUMMARY

Article Focus

- ~~Since dissimilarities between workers from different age groups are present, it is expected that factors associated with sick leave vary between different age groups.~~
- This article focuses on both the differences in work-related characteristics, family-related characteristics, work-family interference, health-related characteristics and frequent and prolonged sick leave between four age groups and ~~(<36 years, 36-45 years, 46-55 years and 55+ years). Moreover, differences in~~ their associations ~~between various characteristics and the~~ with two sick leave outcomes ~~between the age groups are investigated~~.

Key messages

- Older workers report more often prolonged sick leave and presence of chronic disease but less frequent sick leave than younger workers. However, they have equally high scores on fatigue, emotional exhaustion and perceived health complaints and several psychosocial work characteristics.
- ~~There are~~ Age is important to take into consideration when investigating the ~~age differences in~~ associations between psychosocial workload, family-related characteristics and frequent and prolonged sick leave.
- ~~Perceived health complaints and life events in private life are indicators for sick leave in all age groups.~~

Strengths and limitations of this study

- Knowledge on age differences in the relationship between psychosocial workload, family, health and sick leave is scarce. ~~Our~~ The results from our cross-sectional study may help managers and occupational physicians in supporting employees.

- Our population involved mainly knowledge workers, a rapidly growing occupational group in many modern economies.
- ~~Cross-sectional studies are sufficient to obtain a rough notion of the relationship between psychosocial workload and diminished health and sick leave in different age groups. However, this design prevents establishing causality.~~

ABSTRACT

Objectives: To investigate differences in associations between sick leave and aspects of health, psychosocial workload, family life and work-family interference ~~in~~ between four age groups (<36; 36–45; 46–55 and 55^{+} years).

Design: A cross-sectional study; a questionnaire was sent to the home addresses of all employees of a university.

Setting: A Dutch university.

Participants: 1843 employees returned the questionnaire (net response: 49.1%). The age distribution was as follows: <36: 32%; 36–45:26%; 46–55:27% and 55+:12%

Primary outcomes: Frequent sick leave (FSL, ≥3 times in last 12 months) and prolonged sick leave (PSL, >2 weeks in total in last 12 months). Differences between the age groups in independent variables and outcomes were investigated. Logistic regression analysis was used to calculate associations between ~~the~~ various variables and the sick leave outcomes. Interaction terms were included to detect differences between the age groups.

Results: Age differences were found for many work- and family-related characteristics, but not in the mean scores for health-related aspects. Presence of chronic disease was reported more frequently with increasing age. The 55^{+} had almost 2 times less chance of FSL, but 1.6 times more chance of PSL than the <36. Age moderates ~~several~~ the associations between career opportunities, partner's contribution in domestic tasks and gender, ~~work- and family-related characteristics,~~ and FSL. Job security and pay, support from supervisor, challenging work and being breadwinner have different associations with ~~and~~ PSL. However, life events in private lives and perceived health complaints are important in all age groups. FSL and PSL have some determinants in common, but there are differences between the outcomes as well.

Conclusions: Age should be treated as a variable of interest instead of a control variable. Employers and occupational physicians need to be aware that each phase in life has specific difficulties that can lead to frequent and prolonged sick leave.

INTRODUCTION

Sick leave is a substantial economic burden in societies where employees receive sick leave benefits.[1 2] In the light of the upcoming shortage of work force due to demographic changes,[3-5] it has become increasingly important to reduce sickness absence. Sick leave is associated with many factors. Psychosocial workload like increased job demands, low job control and low support has shown to be associated with diminished health and absence.[6-8] Family-related factors like marital status and children at home are either controlled for (and associations aren't made visible), or inconsistent results are found.[9 10] In addition, having difficulties with combining the demands at work and in family life, possibly resulting in work-family conflict, is related to ill health and sick leave.[11 12] To understand the factors affecting sick leave, it is important to take all these domains simultaneously into account.

Due to the tight labour market, it is important to keep employees of all ages well-motivated and healthy on the job. Although some studies included factors from various domains to explain sick leave,[1] to date, it is unclear whether there are differences between age groups in the relationships between psychosocial workload, family-related factors, and health and sick leave. ~~knowledge on age differences in the relationship between psychosocial workload, family, health and sick leave is scarce. It is quite possible that factors associated with sick leave vary between different age groups s~~Since dissimilarities between workers from different age groups are present, it is quite possible that determinants of sick leave vary between different age groups. For example, the presence of chronic disease is associated with increased sick leave[2] and is more prevalent in older people.[13] Perhaps the presence of a chronic disease is an important determinant for sick leave only in older employees~~Also,~~. Work-family ~~the~~ balance ~~between work and family~~ is experienced differently between age groups,[14] and is found to be associated with sick leave.[10] Therefore, work-family interference or characteristics pertaining to domestic tasks and childcare might be more strongly associated with sick leave in younger employees.

The aim of this study is to explore ~~Understanding~~ age differences in determinants of sick leave as this provides insight into the desirability of age-related support and ~~measures~~ interventions to reduce sick leave. Although most research on sick leave is focused on either frequent (i.e. the number of sick leave spells during one year) or prolonged sick leave (i.e. sick leave with a duration longer than e.g. two weeks in total in one year), this paper focuses on both frequent and prolonged sick leavefor several reasons. First, ~~both forms of sick leave are a burden for employers: productivity is reduced and~~ both sudden and long-term replacements of employees are expensive and difficult to achieve. Second, determinants of the two sick leave measures may differ. ~~Sick leave frequency is associated with personal well-being (i.e. health status), individual factors (including life style and individual circumstances) and atmosphere at work (e.g. work contents, working relations).~~[15 16] Moreover, frequent sick leave may have to do with motivational aspects or unwillingness to work, whereas sick leave duration can be considered as an indicator of involuntary absenteeism (inability to work).[17] ~~Prolonged sick leave is associated with 'history of sickness absence' and 'older age'~~ Finally, age differences are seen in both frequent and prolonged sick leave.[18 19]

The research questions addressed in this article are (1) what are the differences in work-related characteristics, family-related characteristics, work-family interference and health-related characteristics between age groups? (2) Do frequent and prolonged sick leave differ between age groups? (3) Does age moderate the associations between various characteristics and the two sick leave outcomes?

METHODS

Population

A questionnaire was mailed to the home addresses of 3881 employees at a Dutch university. Both the University Board and Works Council approved this study. No ethical approval was required. By means of an accompanying booklet, the employees were informed about the objectives of the study

and the confidential handling of their responses. A reminder was sent after three weeks. A total of 1843 returned questionnaires proved usable, which means a (net) response of 49.1%.

Questionnaire

The aim of the questionnaire was to obtain information about psychosocial workload, family-related characteristics and work-family interference in order to explain sick leave. The construction was based on existing questionnaires previously used in scientific research,[20] as well as on practice-based information from professionals.[21]

Demographic characteristics

Age was divided into four categories: <36 years, 36-45 years, 46-55 years and 55^{+} years. Employment category was categorized as: lower-educated non-scientific personnel (low NSP), higher-educated non-scientific personnel (level of education is college or university degree; high NSP) or scientific personnel (SP).[22] Employment category and sex were chiefly used as control variables (Table 1).

Health characteristics

Fatigue was assessed with the Shortened Fatigue Questionnaire.[23] Emotional exhaustion was measured with the Dutch version of the Maslach Burnout Inventory.[24] Perceived health complaints were measured with the VOEG-13.[25 26] The presence of chronic disease was coded as no (0) or yes (1).[12]

Work-related characteristics

Validated Dutch questionnaires using 4-point or 5-point Likert-type scales were used to assess negative and positive work-related characteristics, i.e. job demands and job resources (see Table 2).[20] Item responses were averaged for each scale. The internal consistency of the scales was moderate to good: Cronbach's alpha of less than 0.70 was only found for unpleasant treatment, job security and pay, work variety, and career opportunities.

A *work-related life event,* coded as no (0) or yes (1), meant that the respondent reported the experience of an emotional event within the work situation (e.g. conflicts with colleagues or superior,

reorganization, changing of jobs).[20] *Hours worked weekly* was included as control variable. It represents the total number of hours worked, including overtime and hours worked in other jobs.[20]

Family-related characteristics

The following family-related characteristics were assessed,[20] classified in five areas: Family composition (*being married/cohabiting*, *children living at home*), partner's work characteristics (*partner has a job*, *partner working overtime and/or in shifts*, *being the breadwinner*), quality of relation with family members (*relationship with the partner*, *frequency of conflict/disagreement with the partner*, *relationship with children*, *frequency of conflict/disagreement with children*, *support from the partner*, *support from children*), help in domestic and child rearing tasks (*partner's contribution to domestic tasks*, *partner's contribution to child rearing*, *childcare arrangements*, *need for more childcare*, *having a domestic help*), and characteristics representing more burden (*family care inside one's own home*, *family care outside one's own home*, *taking work home*, *burden of commuting*, *time pressure outside work*, *a life event in private life*).

Many family related characteristics were not associated with either FSL or PSL and are not further described (data available on request). Details about family composition and the significantly associated characteristics are presented in Table 1.

Work-family interference

Work-family interference (WFI) was assessed with the 18 item scale developed by Carlson *et al*.[27] Each of the three forms of conflict (*time*-based, *strain*-based and *behaviour*-based) has two directions: work interfering with family (W→FI) and family interfering with work (F→WI). Responses could range from strongly disagree (1) to strongly agree (5). Item responses are averaged for each subscale, with higher scores indicating more WFI. The Cronbach's alphas indicated good internal consistency.

Sick leave

Sick leave was based on the question 'Have you ever taken sick leave because of health problems in the past 12 months?' (yes or no).[12] Open questions were posed with regard to the frequency and

duration (in weeks) during the past 12 months. Frequent sick leave (FSL) was defined as three or more episodes of sick leave during the past 12 months, regardless of duration. Prolonged sick leave (PSL) was defined as more than two weeks of sick leave during the past 12 months (sum of the duration of all episodes of sick leave).

Analyses

All analyses were done using SPSS 16.0. Differences between the age groups in the independent variables were investigated using χ^2-tests or GLM (with correction for sex, employment category, working hours/week and presence of chronic disease), followed by post-hoc tests using Tukey. Significance level for these tests was set at 0.001 to detect the most relevant differences. After this, work-related characteristics, health-related characteristics and the WFI scales were dichotomised at the 50th percentile into low and high scores.

Age differences in FSL and PSL were investigated using logistic regression analysis with <36 years as reference category. The analyses were controlled for sex, employment category and hours worked weekly.[12 19] To gain more insight into the impact of chronic disease on sick leave, the analyses were additionally controlled for this factor.

Logistic regression analyses were applied to calculate the associations between the independent variables and FSL and PSL. Independent variables were divided over several blocks: 1) health characteristics; 2) job demands; 3) job resources; 4) family composition; 5) partner's work characteristics; 6) quality of relation with family members; 7) help in domestic and child rearing tasks; 8) characteristics representing more burden; 9) work-family interference. In the first step, for each of these nine blocks, a hierarchical backward elimination procedure was applied.[28] To ~~investigate~~ explore the moderating role of age, interaction terms were included: a significant interaction term indicates that age-related differences in the relation between that independent variable and the outcome exist. Non-significant interaction terms were eliminated one at a time (p>0.10). Next, non-significant variables were eliminated. However, when the variable was non-significant but the product term was, the variable remained in the model.[28] Sex, employment category and hours worked weekly were kept in the model regardless the significance as we considered them as potential confounders.

In the second step, the remaining job demands and job resources were combined into one block, again using hierarchical backward elimination. The same was applied to the family-related characteristics. In the third step, the remaining variables of the blocks 'health', 'work characteristics', 'family-related characteristics' and 'WFI' were simultaneously entered in a final logistic regression model ($p<0.05$). When age differences occurred (indicated by a significant interaction term), age-specific analyses were done.

RESULTS

Age differences in independent variables

~~Significant age differences were found in the demographic and family-related characteristics (Table 1).~~ More women and temporary contracts were found in the youngest group (Table 1). The two youngest groups showed the lowest percentages regarding low NSP. With increasing age, more presence of chronic disease occurred. Working >40 hours/week most commonly occurred in the oldest group. In the 36-45 group, the highest percentages of <25 hours/week was found. A work-related life event did not show age differences, as opposite to the family-related characteristics.

~~Many age-related differences were found regarding work-related characteristics (Table 2).~~ The groups differed from each other regarding job security and pay, job involvement and decision latitude: the mean scores were higher with increasing age (Table 2). The <36 reported less work pressure and more use of professional expertise than the other groups. The 55^{+} reported less role ambiguity than the other groups. No differences were found in the health-related characteristics. The 36-45 reported more $F \rightarrow WI_{time}$ than the other groups.

Age differences in frequent sick leave and prolonged sick leave.

Table 3 presents the odds ratios (and 95% confidence intervals [95% CI]) for FSL and PSL in four age groups. Unadjusted figures showed no significant association between age and FSL. Statistically significant results were found for PSL: 55^{+} employees had 1.6 times more chance of PSL than the <36.

Adjustment for sex, employment category and hours worked weekly had minimal effect on FSL. For PSL, the OR remained significant among the 55^{+} and became significant among the 46-55. Additional adjustment for presence of chronic disease resulted in a decrease of more than 10% in the ORs for FSL and PSL among the 46-55 (although no statistically significant results) and the 55^{+}: this group shows almost half as much chance of FSL, but 1.6 times more chance of PSL than the <36.

Determinants of frequent sick leave

Table 4 shows ORs and 95% CIs for significantly associated characteristics with frequent sick leave (FSL). The upper part presents characteristics that are significantly differently associated with FSL between the age groups (the p-value for the interaction terms is placed at the bottom).The middle part shows the characteristics associated with more FSL; characteristics in the lower part are associated with less FSL.

Differences between the age groups are found for career opportunities, partner's contribution to domestic tasks and sex. In the <36, more career opportunities are associated with more FSL, whereas in the 36-45 group, more career opportunities are associated with less FSL. When the partner is doing more in domestic tasks, this is associated with more FSL in the <36 group. In the 55^{+} group, this is associated with less FSL. Sex (i.e. being female) is associated with more FSL in the <36 group. In the 46-55 and 55^{+} groups, being female is associated with less FSL.

Table 4 also shows the other characteristics relevant for explaining FSL common for all age groups (first column). More perceived health complaints, conflicts with colleagues, more communication, a life event in private life and more $W \rightarrow FI_{strain}$ are associated with more FSL. More decision latitude and more hours worked weekly are associated with less FSL.

Determinants of prolonged sick leave

The characteristics associated with prolonged sick leave (PSL) are presented in Table 5, which is designed in the same way as Table 4. Higher scores with job security and pay are associated with less PSL in the younger groups, whereas it is associated with more PSL in the two oldest groups. Support from superiors is associated with less PSL in the < 36 group while in the two older groups, the value

of the OR indicates that more support from superiors is associated with more PSL. Having challenging work is associated with less PSL in the 55^+ group. The three other groups don't show a statistically significant association, but the values of ORs indicate that with increasing age, the association gets stronger. Being the breadwinner is associated with less PSL in the youngest group. Earning about the same as the partner is associated with more PSL in the 46-55 group. The OR (although not statistically significant) in the 55^+ indicates that being the breadwinner is associated with more PSL.

Other factors associated with more PSL are more perceived health complaints, more fatigue, the presence of chronic disease, more physical workload, conflict with superiors, a work-related life event and a life event in private life. More job satisfaction and more hours worked weekly are associated with less PSL.

DISCUSSION

This study was conducted to explore determinants of sick leave at different ages. To our knowledge, this was the first study that simultaneously investigated the associations between characteristics from various domains (work, family life, health) and two sick leave measures, taking age differences into consideration. ~~We expected that especially characteristics pertaining to domestic tasks and childcare as well as work-family interference would be more strongly associated with the sick leave outcomes in the two younger groups.~~ Our regression analyses showed differences in associations between the age groups, indicating that age-specific measures to reduce sick leave seem worthwhile. However, the expected differences in associations regarding family-related characteristics and work-family interference were not confirmed.

Differences in independent variables

Presence of chronic disease is found more often by older employees which is reported elsewhere.[13 29] Age ~~D~~differences ~~between the age groups~~ occurred in ~~among~~ the work and family-related aspects which may be explained by variations in career stage, personal circumstances and stage of life. Our results ~~Table 2 also~~ show~~s~~ that older employees report equal scores on career opportunities,

opportunities for learning, challenging work and job satisfaction and higher scores on job security and pay, professional expertise, decision latitude and job involvement compared to younger employees ~~(p<0.001)~~. Many managers fear that older employees are less motivated and involved in their work.[30] Such stereotypical thinking is however not confirmed in our study.

Despite age differences in family-related aspects, very few differences in WFI were seen. The only difference concerns more $F \rightarrow WI_{time}$ among the 36-45 year olds. These employees find it difficult to spend enough time on work-related tasks due to family demands. The presence of younger children (which is more time consuming than older children) may explain this result.[14 20]

Surprisingly, no age differences were found for fatigue, emotional exhaustion and perceived health complaints after correction for sex, employment category and hours worked weekly ~~(Table 2)~~. This may partly be explained by the healthy survivor effect:[2 31] employees with deteriorated health may have already left the organization. However, several other studies did not find an association with age after correction for sex in subjective health complaints[32] or emotional exhaustion in men[33]. This indicates that it is important to do separate analyses for men and women ~~controlling for sex seems important~~ to obtain a good understanding about age differences. However, the power of our study was not sufficient to perform this.

Differences in frequent and prolonged sick leave between age groups

Older workers reported more PSL than the <36 group after correction for sex, employment category and hours worked weekly. For FSL, lower ORs were found with increasing age, though no statistical differences were found ~~(Table 3)~~. Additional adjustment for the presence of a chronic disease resulted in an over 10% lower chance of both FSL and PSL in the two oldest age groups. This means that sick leave in these age groups can partly be attributed to the presence of chronic diseases, supporting other reports that chronic diseases are a major cause of long-term sickness absence and job loss.[34] Compared to the <36, the 55^{+} had almost 2 times less chance of FSL, but 1.6 times more chance of PSL. These results are expected from earlier studies: older people are absent less frequently,[15] but their absence is often more prolonged compared to younger workers.[16 18] Younger workers seem to stay out of work due to minor health complaints more often.[2] The health problems that older workers are confronted

with (not necessarily chronic conditions) often take more time to recover from, therefore older workers report more PSL.

Age differences in determinants of frequent sick leave

This study showed that age-specific measures to reduce FSL are recommendable since some determinants were significantly differently associated with FSL for the age groups. More career opportunities was associated with more FSL in the <36 group whereas it was associated with less FSL in the 36-45 group. Within a university, only those employees who proved to have sufficient capacities are offered permanent jobs. For younger employees more career opportunities might go with an increased effort to pursue an (academic) career which may be difficult to achieve as there are not that many higher positions available.[35]

The association between more contribution of partner to domestic tasks with more FSL in the youngest group may be explained by the cross-sectional design of the study. FSL may indicate a decreased overall health, and because of that a lower participation in such tasks, implying that the partners have to do more to keep the household running.

Many studies have shown that women report more sick leave.[9] We found that women in the <36 group reported more FSL, whereas women in the 46-55 group reported less FSL. Apparently, the age of women is important to consider.

Other determinants did not show statistically significant differences between the age groups, although the separate analyses sometimes presented different ORs, e.g. communication is differently associated with FSL in the 36-45 and 46-55 group compared to the other two groups. The lack of statistical difference may be explained by variance within age groups and different group sizes.

Generally, our results indicate that is it important to take the domains of work, family and health into consideration when investigating the determinants of FSL. Managers and occupational physicians may benefit from this knowledge in supporting employees: Life events in work and in private life and perceived health complaints are indicators for higher chance of FSL, whereas more decision latitude seems protective to FSL. Regarding work-family interference, we found only an association between

strain-based interference from work to family (W→FI_{strain}) and FSL. Some studies found an association between family interference with work (F→WI) and sick leave.[10] As the younger employees reported more F→WI_{time} ~~(Table 2)~~, we had expected an association for this factor, but it was not remained in our model. Time-based WFI seems better manageable, e.g. by managing work hours better, or to reduce working overtime.[36] Among university employees, the high level of autonomy and flexibility probably facilitates resolving (time-concerning) family-related difficulties.[20] Moreover, several Dutch measures (e.g. parental leave or leave to take care of ill family members) are currently available to facilitate combing paid work with family-related tasks. It is questionable whether these (time-related) measures are sufficient to reduce the mental strain that university employees have to cope with.

Age differences in determinants of prolonged sick leave

The analyses on PSL also indicate that age-specific measures to reduce sick leave are advisable. Younger persons with higher scores on job security and pay showed less chance of PSL, while in older employees there is more chance of PSL. An explanation may be that older employees have such secure positions in the organization that they do not fear dismissal despite their sick leave. Support from superiors seems particularly important for younger employees. These employees lack some work experience and help of superiors makes them function better. A remarkable finding in the light of the stereotypical image of older employees is the association of more challenging work with less PSL in the oldest workers. Older workers are often associated with a lack of adaptability and a resistance to innovation.[30] ~~Age differences were also found in the association between being the breadwinner and PSL.~~ Being breadwinner was associated with less sick leave in the younger workers, which is in line with research into return to work after back complaints.[37] However, we found an opposite association for older employees: older employees with deteriorated health may see themselves forced to continue working for financial reasons.

As with FSL, characteristics from various areas were relevant for PSL in all age groups although some ORs diverge between the age groups, e.g. presence of chronic disease and conflict with superiors seem even more relevant in the 55^{+} group than in the other groups. Perceived health complaints, presence of chronic disease and life events in both work and private lives were strongly associated with more PSL in all groups. More job satisfaction was associated with less PSL which is in line with results reported elsewhere.[37] Paying attention to signals of deteriorated health and decreased job satisfaction by superiors and act upon those signals (discuss work- and/or family problems with the employee) may prevent sick leave.

Similarities and differences between frequent and prolonged sick leave

Our findings illustrate that determinants of both FSL and PSL are important to consider when managers intend to increase the productivity among employees and reduce the financial burden. Both FSL and PSL are associated with hours worked weekly, perceived health complaints and life events in private life. More hours worked weekly is associated with less sick leave, which may indicate a healthy survivor effect: employees in good health are able to work that amount of hours, while persons with deteriorated health may opt for smaller contracts. Managers should be aware of requests for changing the contract and of signals of diminished health and discuss possibilities to maintain or improve employee's well-being and productivity.

Several differences are also found: Conflict with colleagues is associated with more FSL, but conflict with superiors is associated with more PSL. Conflicts with superiors might be more serious than with colleagues and therefore leads to longer sick leave. Work-related life events were associated with more PSL but not with FSL: It might be that the threshold to return to work is high in such cases. Being a breadwinner is associated with less PSL but not associated with FSL. Previous research has revealed the importance of an economic incentive to return-to-work: employees with a higher financial need return to work more often.[37]

Methodological considerations

Our response of 49.1% was comparable with other questionnaire studies.[2 17 38] The cross sectional design impedes to establish causality. However, it provides a rough notion of the relationship between psychosocial workload and diminished health and sick leave in different age groups.[39] The results provide managers and occupational physicians indications for adjustments in earlier stages, so diminished health and sick leave is reduced or even prevented.

Our population involved university employees. Although a quarter of the population had only low or middle level education, most of the respondents were knowledge workers. Knowledge workers cover a rapidly growing occupational group in many modern economies. Our results might be relevant for e.g. other research institutes or financial organizations but may be less applicable to blue collar occupational groups, as they may report more sick leave.[2] Future studies should include various occupations.

The anonymous design of the study prevented an in-depth non-response analysis. We found that somewhat less employees of <36 years and somewhat more 55^{+} employees returned the questionnaire. The number of 55^{+} employees that reported FSL was rather small. This weakens the power of the study and possible significant effects may be missed. Also due to the anonymous design, it was impossible to link up with the university's sick leave register, which is considered to be a reliable source to obtain sick leave data.[40] Ferrie *et al.*[40] reported that more than two thirds of their respondents had a discrepancy of two days or less. We expect that the influence of misclassification regarding sick leave was rather limited, as we dichotomised our outcome measures due to the skewness of the data,[41] and because our cut-off points were rather high.[40]

It is possible that employees who were on long-term sick leave were underrepresented, even though we send the questionnaire to the home addresses to reduce such selective non-response. Moreover, people with deteriorated health may already have left the labour force and therefore limitedly included in our study. In the near future more persons with decreased health will still be working. Several changes have already been made in Dutch social legislation to reduce the number of people who take early retirement or depend on disability pensions, as solutions to deal with the scanty labour force.

Moreover, the pension date will be extended to the age of 67. Repeating this study in a few years may lead to other results.

CONCLUSIONS

Our study showed that several differences between age groups exist in the work- and family-related characteristics, but not in the health characteristics. Compared to <36 employees, the 55^{+} have a decreased risk of FLS and an elevated risk of PSL. Presence of chronic disease partly explains sick leave in the two older groups.

Our multivariate analyses revealed differences in associations between the age groups. Research implications are that age should be treated as a variable of interest instead of as a control variable. Differences will be missed by simply controlling for age. Practical implications are that supervisors, managers and occupation physicians should be aware of specific interventions for employees of different ages. Measures and interventions aimed at preventing or reducing sick leave should keep the differences between age groups into account e.g. career opportunities, job security and pay, and challenging work. Moreover, adjustments in tasks or in working hours, different discussion topics during annual progress interviews, taking the private situation of employees into consideration or simply offer a genuine listening ear every now and then may be efficacious to maintain or improve the workability of employees.

Both frequent and prolonged sick leave may partially be prevented by increasing job resources like decision latitude. For managers and superiors, it is important to be alert to (health) symptoms and life events and discuss possible causes and solutions with the employees. Finally, FLS and PSL differ in the found associations indicating that it is important to pay attention to determinants of both outcomes to improve employees' health and productivity.

CONTRIBUTORSHIP STATEMENT

NCGMD contributed in the study design and data collection, conducted the data analysis and took a leading part in writing this article.

JB contributed substantially to the interpretation of the results and revision of the manuscript.

KvdV has critically commented on and edited drafts of the manuscript.

JvdG contributed in the study design and has critically commented on and edited drafts of the manuscript. All authors have approved the final version of the manuscript.

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Table 1: Distribution of nominal variables (demographic, family-related characteristics and work-related characteristics; numbers and percentages) over the four age groups with results from chi-square tests[#]

		<36 (n=584)		36-45 (n=487)		46-55 (n=492)		55+ (n=216)		χ^2	df	p-value
Sex	Male*	237	39.8	257	52.0	288	57.8	170	77.6	99.5	3	<0.001
	Female	358	60.2	237	48.0	210	42.2	49	22.4			
Presence of chronic disease	No*	478	82.1	372	77.7	340	70.5	137	63.4	38.4	3	<0.001
	Yes	104	17.9	107	22.3	142	29.5	73	36.6			
Employment category	Lower educated non-scientific personnel (low NSP e.g. secretary, lower technician, catering)*	118	19.9	128	25.9	164	32.9	72	32.9	57.7	6	<0.001
	Higher-educated non-scientific personnel (high NSP, e.g. librarians, policy, HRM, managers)	138	23.3	156	31.6	155	31.1	57	25.8			
	Scientific personnel (SP, e.g. PhD students, lectures, researchers)	336	56.8	210	42.5	179	35.8	92	41.6			
Hours worked weekly	<25 hours*	79	13.3	99	20.2	62	12.6	27	12.2	22.2	6	0.001
	25-40 hours	326	55.0	245	50.0	257	52.0	104	47.1			
	>40 hours	188	31.7	146	29.8	175	35.4	90	41.6			
Type of contract	Permanent	206	34.7	366	74.2	440	88.2	214	96.0	482.3	3	<0.001
	Temporary	387	65.3	127	25.8	59	11.8	9	4.0			
Married/cohabiting	No	261	43.9	101	20.4	85	17.0	27	12.1	149.2	3	<0.001
	Yes	334	56.1	393	79.6	414	83.0	196	87.9			
Having children at home	No	480	80.7	171	34.6	254	50.9	180	80.7	295.5	3	<0.001
	Yes	115	19.3	323	65.4	245	49.1	43	19.3			
Partner's contribution to domestic tasks	No partner or partner is doing (much) less or the same*	518	87.1	338	68.4	292	58.5	90	40.4	199.4	3	<0.001
	Partner is doing more	77	12.9	156	31.6	207	41.5	135	59.6			
Breadwinning	Partner is breadwinner*	149	25.1	148	30.0	119	24.0	15	6.8	99.3	6	<0.001
	About the same	100	16.9	54	10.9	42	8.5	6	2.7			
	Respondent is breadwinner	344	58.0	292	59.1	335	67.5	200	90.5			
Life event in private life	No*	308	53.5	304	63.6	316	67.2	154	70.3	30.2	3	<0.001
	Yes	268	46.5	174	36.4	154	32.8	65	29.7			
Work-related life event	No*	514	89.2	440	92.1	433	92.1	204	93.2	4.8	3	0.19
	Yes	62	10.8	38	7.9	37	7.9	15	6.8			
Conflict with superiors	No*	392	65.9	278	56.3	274	54.9	143	64.1	18.4	3	<0.001
	Yes	203	34.1	216	43.7	225	45.1	80	35.9			
Conflict with colleagues	No*	404	37.9	269	54.5	269	53.9	133	59.6	29.1	3	<0.001
	Yes	191	32.1	225	45.5	230	46.1	90	40.4			

[#]: due to missing data the number of respondents differs per characteristic.

*: reference group for that variable in the logistic regression analysis

Table 2: Mean scores and standard error (se) of work-related characteristics, health and work-family interference (number of items per scale and range between brackets), corrected for sex, employment category, hours worked weekly and presence of chronic disease.

	<36 n=577		**36-45** n=475		**46-55** n=475		**55+** n=211			
Job demands[#]	mean	se	mean	Se	mean	se	mean	se	F	p
Unpleasant treatment (6, 1-4)	1.08	.01	1.06	.01	1.06	.01	1.08	.02	.45	.714
Role conflict (5, 1-4)	1.68	.03	1.70	.02	1.70	.02	1.58	.04	2.60	.051
Work pressure (8, 1-5)	2.85	.04	3.18	.04	3.16	.04	3.13	.06	13.11	<.001
Role ambiguity (5; 1-4)	2.11	.04	2.06	.03	1.96	.03	1.90	.05	5.38	.001
Physical workload (3; 1-4)	1.71	.03	1.58	.03	1.60	.03	1.55	.05	3.57	.014
Job resources[‡]										
Job security and pay (2; 1-5)	2.90	.06	3.20	.05	3.38	.05	3.71	.09	23.70	<.001
Decision authority on working hours (3; 1-5)	3.60	.05	3.57	.05	3.59	.05	3.76	.08	1.46	.224
Work variety (3, 1-5)	3.09	.04	3.23	.04	3.22	.04	3.29	.06	3.36	.018
Information on work (3; 1-4)	3.00	.04	2.86	.04	2.99	.04	3.01	.06	3.11	.026
Career opportunities (3; 1-4)	2.64	.06	2.68	.05	2.52	.05	2.47	.08	2.63	.049
Communication (4; 1-4)	2.56	.04	2.64	.04	2.70	.04	2.78	.06	3.78	.010
Professional expertise (2; 1-5)	3.85	.05	4.03	.04	4.11	.04	4.15	.07	6.69	<.001
Opportunities for learning (4; 1-4)	2.85	.04	2.78	.04	2.77	.04	2.83	.06	1.12	.341
Decision latitude (9; 1-4)	2.47	.04	2.61	.03	2.68	.03	2.81	.05	11.06	.000
Autonomy (1; 1-5)	3.40	.04	3.46	.04	3.46	.04	3.57	.06	1.71	.162
Social support superiors (4; 1-4)	3.18	.05	3.05	.04	3.10	.04	3.19	.07	1.76	.152
Social support colleagues (4; 1-4)	3.14	.04	3.12	.03	3.11	.03	3.21	.06	.90	.440
Job involvement (1; 1-5)	3.84	.05	4.12	.05	4.27	.05	4.40	.07	18.82	<.001
Challenging work (1; 1-5)	3.43	.06	3.61	.05	3.60	.05	3.67	.08	2.87	.035
Job satisfaction (1; 1-5)	3.69	.06	3.80	.05	3.77	.05	4.07	.09	4.57	.003
Health-related characteristics[#]										
Fatigue (4; 4-28)	13.36	.40	13.26	.37	13.18	.37	11.85	.60	1.68	.170
Emotional exhaustion (4; 1-5)	2.50	.06	2.54	.05	2.54	.05	2.45	.09	.34	.798
Health complaints (13; 0-13)	3.09	.15	3.02	.14	3.29	.14	2.95	.23	.84	.472
Work-family interference[#]										
W→FI $_{time}$ (3; 1-5)	2.49	.06	2.69	.05	2.57	.05	2.61	.08	2.35	.071
F→WI $_{time}$ (3; 1-5)	1.72	.05	2.07	.05	1.82	.05	1.64	.08	11.84	<.001
W→FI $_{strain}$ (3; 1-5)	2.37	.06	2.45	.05	2.42	.05	2.26	.09	1.31	.271
F→WI $_{strain}$ (3; 1-5)	1.64	.05	1.73	.04	1.66	.04	1.55	.07	1.95	.120
W→FI $_{behaviour}$ (3; 1-5)	2.32	.06	2.51	.06	2.52	.05	2.43	.09	2.46	.061
F→WI $_{behaviour}$ (3; 1-5)	2.37	.06	2.57	.06	2.58	.06	2.48	.09	2.48	.059

[#]: On these scales, a higher score is unfavourable
[‡]: On these scales, a higher score is favourable

Table 3: Odds ratios (and 95% confidence intervals – 95% CI) for frequent sick leave and prolonged sick leave.

	<36*	**36-45**		**46-55**		**55+**	
		OR	95%CI	OR	95%CI	OR	95%CI
Frequent sick leave (not corrected)	1	0.88	(0.59-1.31)	0.82	(0.55-1.22)	0.58	(0.32-1.04)
corrected for sex, employment category and hours worked weekly	1	0.82	(0.55-1.23)	0.75	(0.49-1.14)	0.60	(0.33-1.10)
corrected for sex, employment category, hours worked weekly and chronic disease	1	0.79	(0.53-1.19)	0.67	(0.44-1.02)	**0.51**	(0.27-0.94)
Prolonged sick leave (not corrected)	1	1.19	(0.84-1.70)	1.35	(0.96-1.91)	**1.58**	(1.04-2.43)
corrected for sex, employment category and hours worked weekly	1	1.24	(0.86-1.79)	**1.46**	(1.02-2.10)	**2.01**	(1.27-3.19)
corrected for sex, employment category. hours worked weekly and chronic disease	1	1.22	(0.84-1.77)	1.29	(0.88-1.87)	**1.64**	(1.02-2.63)

* The group of <36 years old was used as reference.
Bolt indicates significant association at p ≤. 05

Table 4: Final logistic regression models for *frequent sick leave* (FSL, ≥ 3 episodes in the last 12 months)

	Total population			< 36 years			36-45 years			46-55 years			55+ years		
	OR	95%CI		OR	95%CI		OR	95%CI		OR	95%CI		OR	95%CI	
Career opportunities	2.29	0.99	5.28	**1.91**	1.01	3.63	**0.39**	0.18	0.86	0.70	0.33	1.48	0.24	0.04	1.33
Partner is doing more in domestic tasks	**7.34**	2.66	20.24	**3.95**	1.80	8.65	1.29	0.51	3.23	1.07	0.44	2.60	0.25	0.06	1.01
Sex (being female)	**3.79**	1.52	9.47	**2.19**	1.08	4.41	0.86	0.36	2.05	**0.34**	0.12	0.98	0.19	0.03	1.18
Perceived health complaints	**2.64**	1.79	3.90	**3.06**	1.61	5.80	**2.99**	1.37	6.55	1.79	0.81	3.94	3.37	0.80	14.24
Conflict with colleagues	**1.48**	1.04	2.11	1.34	0.73	2.45	1.66	0.83	3.29	1.36	0.68	2.73	3.41	0.89	13.12
Communication	**1.71**	1.17	2.50	0.91	0.49	1.69	**3.06**	1.43	6.55	**2.89**	1.26	6.61	1.30	0.28	6.03
Life event in private life	**2.11**	1.49	2.99	**1.98**	1.09	3.59	**2.40**	1.20	4.81	**2.29**	1.15	4.54	2.99	0.86	10.45
W→FI strain	**1.70**	1.15	2.51	1.42	0.75	2.65	1.65	0.75	3.62	**3.66**	1.57	8.52	0.91	0.23	3.66
Employment category															
- high NSP vs low NSP	1.34	0.87	2.08	1.48	0.68	3.22	1.28	0.54	3.01	1.07	0.45	2.54	2.34	0.53	10.31
- SP vs low NSP	0.66	0.41	1.07	0.46	0.21	1.01	0.53	0.19	1.45	1.08	0.40	2.93	1.94	0.32	11.69
Decision latitude	**0.52**	0.35	0.78	**0.50**	0.25	1.00	**0.21**	0.09	0.51	0.92	0.41	2.10	0.52	0.11	2.50
Hours worked weekly															
- 24-40 hours vs < 24 hours	0.72	0.44	1.19	1.31	0.53	3.25	0.69	0.28	1.68	**0.27**	0.09	0.84	0.79	0.12	5.31
- >40 hours vs < 24 hours	**0.49**	0.26	0.92	1.09	0.37	3.18	0.54	0.17	1.79	**0.13**	0.03	0.54	0.09	0.01	1.04
Age	**1.76**	1.23	2.53												
interaction term career opportunities * age	p=.008														
interaction term partner's contribution * age	p<.001														
interaction term sex * age	p=.001														
Nagelkerke R^2	.184			.203			.263			.205			.335		

Bold figures indicate significant associations at p<0.05; underlined figures indicate significant associations at p<0.10.

Table 5: Final logistic regression models for *prolonged sick leave* (PSL, > 2 weeks in total in the last 12 months).

	Total population			**< 36 years**			**36-45 years**			**46-55 years**			**55^{+} years**		
	OR	95%CI		OR	95%CI		OR	95%CI		OR	95%CI		OR	95%CI	
Job security and pay	0.54	0.25	1.21	0.76	0.39	1.47	0.92	0.48	1.77	1.61	0.89	2.92	2.80	0.80	9.81
Support from superiors	**0.40**	0.19	0.85	0.59	0.32	1.09	0.56	0.27	1.18	1.25	0.64	2.42	1.19	0.36	3.87
Challenging work	1.82	0.83	3.98	1.12	0.55	2.29	0.82	0.41	1.62	0.59	0.31	1.15	**0.27**	0.09	0.82
Breadwinner															
- about equal vs partner is breadwinner	**0.18**	0.05	0.69	0.43	0.18	1.05	0.70	0.22	2.17	2.61	0.87	7.80	1.51	0.03	66.52
- being breadwinner vs partner is breadwinner	**0.29**	0.12	0.67	0.52	0.27	1.01	1.12	0.48	2.61	1.54	0.69	3.45	4.30	0.34	53.57
Perceived health complaints	**2.25**	1.55	3.27	1.85	0.90	3.77	**2.51**	1.25	5.02	**2.54**	1.21	5.31	2.16	0.66	7.07
Fatigue	**1.55**	1.07	2.24	1.83	0.88	3.81	1.42	0.69	2.91	1.29	0.63	2.66	2.83	0.92	8.65
Presence of chronic disease	**1.96**	1.42	2.71	1.15	0.59	2.27	**2.52**	1.34	4.75	**2.03**	1.11	3.71	**5.64**	2.00	15.90
Physical workload	**1.40**	1.03	1.92	1.72	0.92	3.18	1.23	0.68	2.22	1.35	0.75	2.44	1.28	0.47	3.51
Conflict with superiors	**1.54**	1.09	2.16	1.81	0.98	3.35	1.13	0.58	2.20	1.33	0.70	2.53	**4.83**	1.34	17.50
Work-related life event	**2.42**	1.55	3.79	1.80	0.84	3.85	**2.93**	1.29	6.64	2.82	0.97	8.21	**6.96**	1.40	34.57
Life event in private life	**1.76**	1.29	2.40	1.36	0.76	2.43	**2.54**	1.39	4.63	**2.22**	1.23	4.01	0.92	0.32	2.67
Job satisfaction	**0.69**	0.48	0.98	0.59	0.30	1.14	0.98	0.49	1.97	**0.46**	0.24	0.87	1.30	0.36	4.68
Hours worked weekly															
- 24-40 hours vs < 24 hours	0.94	0.61	1.46	0.96	0.42	2.18	0.96	0.42	2.19	0.87	0.34	2.21	1.43	0.31	6.49
- > 40 hours vs < 24 hours	**0.44**	0.25	0.77	0.34	0.12	0.97	0.53	0.17	1.65	0.61	0.19	1.92	**0.18***	0.03	1.09
Employment category															
- high NSP vs low NSP	0.89	0.60	1.34	1.32	0.55	3.14	1.36	0.63	2.92	**0.35**	0.16	0.75	2.16	0.60	7.82
- SP vs low NSP	0.85	0.55	1.32	1.48	0.63	3.48	0.85	0.35	2.04	**0.38**	0.16	0.90	2.25	0.50	10.19
Sex (being female)	1.44	1.00	2.07	1.87	0.92	3.78	1.59	0.76	3.29	1.29	0.65	2.55	1.26	0.34	4.65
Age	1.11	0.64	1.93												
interaction term job security and pay * age	p=.048														
interaction term support superiors* age	p=.040														
interaction term challenging work* age	p=.010														
interaction term breadwinner * age	p=.006														
Nagelkerke R^2	.246			.256			.269			.250			.427		

Bold figures indicate significant associations at p<0.05; underlined figures indicate significant associations at p<0.10

STROBE Statement—Checklist of items that should be included in reports of ***cross-sectional studies***

In red the items that we did not fulfil, with an explanation why.
In green the items we did fulfil.
In black the items that are not applicable to this study.

	Item No	Recommendation
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found
Introduction		
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported
Objectives	3	State specific objectives, including any prespecified hypotheses
Methods		
Study design	4	Present key elements of study design early in the paper
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group We did not meet this aspect: a detailed description of the variables in the questionnaire was omitted but can be found in the included references.
Bias	9	Describe any efforts to address potential sources of bias
Study size	10	Explain how the study size was arrived at
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding
		(*b*) Describe any methods used to examine subgroups and interactions
		(*c*) Explain how missing data were addressed: We omitted such explanations to fulfil the criteria of a maximum of 4500 words. This information can be added if the editors allow us to use more words.
		(*d*) If applicable, describe analytical methods taking account of sampling strategy (not applicable)
		(*e*) Describe any sensitivity analyses (not applicable)
Results		
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed
		(b) Give reasons for non-participation at each stage We omitted this due to the maximum of 4500 words. This information can be added if the editors allow us to use more words.
		(c) Consider use of a flow diagram
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and

		information on exposures and potential confounders
		(b) Indicate number of participants with missing data for each variable of interest. We omitted this due to the maximum of 4500 words. This information can be added if the editors allow us to use more words.
Outcome data	15*	Report numbers of outcome events or summary measures:
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included
		(*b*) Report category boundaries when continuous variables were categorized
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses
Discussion		
Key results	18	Summarise key results with reference to study objectives
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence
Generalisability	21	Discuss the generalisability (external validity) of the study results
Other information		
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based There was no external funding, therefore this item is not recorded in the manuscript.

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.