Job strain in primary care health centres and glycaemic control among patients with type 2 diabetes

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Job strain in primary care health centres and glycaemic control among patients with type 2 diabetes

Abstract

Objectives This study investigates associations between health care personnel's perceived job strain and the outcome of care in terms of glycaemic control among patients with type 2 diabetes.

Design A cross-sectional study in 2006.

Setting Eighteen primary care health centres (HC) from five municipalities in Finland.

Participants Aggregated survey data on job strain from health care personnel (n=422) was combined with registered data from 8975 patients with type 2 diabetes.

Outcome measure Poor glycaemic control (HbA1c ≥7%).

Results Among the 8975 type 2 diabetes patients (51% men, mean age 67 years), the mean HbA1c level was 7.1 (SD 1.2, range 4.5-19.1), and 43% had poor glyacemic control (HbA1c ≥7%). Multilevel logistic regression analyses adjusted for patient's age and sex, and HC- and HC service area-level characteristics showed that patients' HbA1c-levels were less optimal in high strain HCs than in low strain HCs (OR 1.44, 95%, CI 1.12-1.86).

Conclusion Care outcome in type 2 diabetes may be affected by the level of job strain among the health care personnel.

ARTICLE SUMMARY

Article focus

- This paper focuses on the association between job strain of health care personnel and the outcome of care among patients with type 2 diabetes.

Key messages

- HbA1c-levels were less optimal in health centres where health care personnel's perceived job strain was high compared with health centres where perceived job strain was low.
- The outcome of care in type 2 diabetes may be improved by decreasing job strain of health care personnel in primary care.

Strengths and limitations of this study

- Previous studies suggest that the organization of care can affect the quality and the outcome of care in diabetes. This study showed that job strain of health care personnel may be one key factor associated with glycaemic control among patients with type 2 diabetes.
- We did not have information on patients' medication and comorbidity associated with type 2 diabetes.

INTRODUCTION

Diabetes mellitus is an important and increasing public health problem worldwide[1 2 3]. In Finland, about 10% of the population has diabetes of which a majority is of type 2[4]. Primary health care faces a serious challenge to provide high quality care in order to decrease complications, mortality and costs caused by this public health burden.

Health care organizations may differ in the quality of care[5]. However, we know only little about organizational aspects that promote good care of diabetes. One aspect may relate to the organization of care. Collins et al.[6] showed that compliance to diabetes care was better in structured general practitioner (GP) care than in traditional hospital care or in hospital/GP shared care. McLean et al.[7] found that the intermediate outcome target in cholesterol measurement of diabetic patients was achieved more often in urban practices than in very remote rural practices. Medical outcomes of care in type 2 diabetes have been shown to be better in physician-nurse practitioner teams than in care provided by a physician alone [8 9]. Linzer et al.[10] found that good organizational culture with high values alignment with leadership and work control was associated with higher-quality care for diabetic patients. In the study by Virtanen et al.[11] perception of procedural justice among staff was associated with more optimal glycaemic control among patients.

More research on the associations between organizational factors and the quality of care, especially the outcome of care, in diabetes is needed. Based on the theory of Karasek[12] and Karasek & Theorell[13] equilibrium between personnel's job demands and job control as well as social support at work might be important organizational factors associated with the quality of care. Active work with high demands and high control most likely promotes high quality care [13]. High demands give challenges, motivation and promote learning but combined with high control high demands do not cause negative psychological strain. Instead, high-strain work with high demands and low control

exhausts personnel and decreases productivity. Low-strain work with high control and low demands may not offer optimal challenges, and passive work with low demands and low control may lead to apathy and loss of learned skills and abilities. Besides an optimal balance between job demands and job control, also social support at work is likely to promote good health, learning and productivity. Social support can, for example, buffer the negative effect of psychological stressors on employee health, and co-workers and supervisors are valuable sources of information and expertise.

This study investigates associations between health care personnel's perceived job strain and the outcome of care in terms of glycaemic control among patients with type 2 diabetes. We hypothesize that glycaemic control is best in health centres where care personnel has possibility to active work and high supervisor support. The study was conducted in 18 outpatient health centres (HC) clinics in five municipalities in Finland. Municipalities differed in size (about 7500-200000 inhabitants) and the number of health centres in each municipality (1-10).

METHODS

Study context

In Finland, municipalities are responsible for organizing primary health care services and cover the costs together with the state. Primary health care services are provided by a health centre comprising inpatient and outpatient units. Health centres offer a wide range of care services including doctor and nurse services[14] and have a central role in disease management for major chronic conditions like diabetes[15].

Participants

This study was part of the Finnish Public Sector Study which was approved by the ethics committee of the Finnish Institute of Occupational Health. Local government personnel of the participating

towns responded to a voluntary-basis questionnaire in 2006. The 18 HCs provided anonymous register-data of all HbA1c-values measured in 2006 of all patients in outpatient care with type 2 diabetes (n=8975).

Measures

Job strain

Aggregated measures of job strain were derived from the responses of doctors and nurses (n=422, response rate 79%) to questions measuring job demands (5 items) and job control (9 items) derived from the Job Content Questionnaire[16] and social support from the supervisor (4 items)[17]. A 5-point Likert-type response format ranging from 1 (totally agree) to 5 (totally disagree) was used for all items. A mean score for the constructs was computed and the individual scores were then used to measure aggregated scores of job strain and supervisor support for each work unit based on the identification of each participant's work unit obtained from employers' administrative records. To create a job strain indicator for each work unit, aggregated demands and control were split on the median and combined to four categories: low strain jobs (low demands combined with high control), active jobs (high demands combined with high control), passive jobs (low demands combined with low control), and high strain jobs (high demands combined with low control)[12]. To create a supervisor support indicator for each work unit, aggregated supervisor support was split into three equal groups indicating low, medium and high support.

Glycaemic control

Glycaemic control was determined by one-year glycated haemoglobin (HbA1c) value which also was used as an outcome in the statistical analyses. In case of several control measurements the mean HbA1c-value was calculated (mean number of measurements was 2.1, range 1-15). Of the

patients, 35% had one measurement. We used a value under 7% to indicate good and a value of 7 or higher to indicate poor glycaemic control[18].

Background variables

Patient characteristics: Information on age, sex, and the postal zip code of area of residence of each patient was obtained from the HCs registers.

HC characteristics: The percentage of fixed-term HC personnel and the mean rate of sickness absence days in the work unit were drawn from employers' registers[19].

HC service area characteristics: By using the patient postal zip codes and data obtained from Statistics Finland we formulated the average educational level (percentage of adults aged >18 years whose highest education level is elementary school), the median income and the unemployment rate (unemployed persons belonging to the workforce divided by total workforce) of the residents in the HC catchment area, that is, the population-weighted means for residents in the specific areas that each HC served. The mean for each variable for each HC was calculated and linked to individual data on each patient. Educational level, income and unemployment rate are standard variables to characterize areal disadvantage and deprivation[20 21].

Statistical analysis

Descriptive statistics were estimated and the baseline associations between independent variables, covariates and glycaemic control were tested with Pearson chi²-tests or one-way analysis of variance depending on the measurement scale of the variable of interest. Because the patients were nested within the 18 HC units, we used a two-level modelling to account the data structure with job strain at the second level and the outcome – patient-level glycaemic control – at the first level. We fitted five models using the multilevel logistic regression analysis. The first model, an empty model including only the random effect variable, was used

to examine the clustering of the outcome between the 18 HCs. Then, we added job strain to examine its associations with the outcome. Next, we added patient-level confounders, after that HC characteristics and finally, variables describing socioeconomic composition of the HC service area (unadjusted model, model I, II and III). Because we used register data combined with aggregated variables describing HCs and HC catchment areas, there were only a few missing cases, and they were not included in the analyses. Statistical analyses were performed using SPSS version 19.0 and R-program, version 2.13.0.

RESULTS

Tables 1-2 show baseline associations between independent variables, covariates and glycaemic control. Of the 8975 type 2 diabetes patients, 51% were men, and the mean age was 67 years (SD 11, range 16-106 years). The mean HbA1c level of patients was 7.1 (SD 1.2, range 4.5-19.1), and 43% had poor glycaemic control (≥7%). The mean percentage of personnel with fixed term job contract in HCs was 22% and the average amount of sickness absence days was 14 days. The socioeconomic characteristics of the HC service area were as follows: residents with more than basic education in the patients' neighbourhood 73%, the median yearly income 17203 euros, and the mean unemployment rate 7%. The mean rates of job control, job demands and supervisor support at the HCs were 3.9, 3.6 and 3.6, respectively.

[Insert tables 1-2 somewhere here]

Table 3 shows that after adjustment for all covariates (model III) glycaemic control among patients was less optimal in HCs where care personnel's perceived job strain was high compared with HCs where job strain was low. Active and passive work HCs did not differ

statistically significantly from low strain HCs in the outcome of care. Also, supervisor support was not associated with patients' glycaemic control (table 4).

[Insert tables 3-4 somewhere here]

DISCUSSION

This study showed that exposure to high job strain of primary health care personnel may be associated with worse outcome of diabetes care. Glycaemic control among type 2 diabetes patients was less optimal in high strain HCs than in low strain HCs. Supervisor support was not associated with the outcome of care.

Several studies have shown the strong association between experienced work load and burnout, particularly its exhaustion dimension[22 23 24]. Emotional exhaustion is further associated with low job performance shown in job withdrawal, deterioration of productivity and effectiveness[24], and the outcome of care [5 25]. Exhausted employees are not effective, accurate or innovative at work[13]. Instead, a favourable psychosocial work environment may enhance employee well-being and motivate health care personnel to invent new working methods and strengthen patients' motivation to self-care.

However, patients' glycaemic control was not best in active work HCs as we predicted based on the job strain model[13]. It is possible that active work assumption does not fit well in the health care sector. Active jobs give more challenges than low strain jobs or passive jobs but the motivational potential of higher demands of active jobs may be lost if demands are so high that they overwhelm health care personnel´s capacities. In that case high control or other job resources may have only limited capability of buffering the undesired impact of high job demands[22 26].

Register data give reliable care results but also has limitations. It does not give information on patients' socioeconomic status, such as educational level that is known to be strongly related with health behaviour[27]. Healthy lifestyle is the key factor in management of diabetes[18]. However, we were able to use disadvantage of the patient's residential area as a proxy for individual socioeconomic position. Indeed, the effect of job strain on glycaemic control emerged after adjustment of educational level, income and unemployment rate in the HC catchment area. Another limitation was that we did not have information on patients' medication and comorbidity associated with type 2 diabetes[28].

Further, we did not have access to exact information on where the principal care responsibility of the patients was. In spite of the fact that the patients had HbA1c-values measured via the HC it is possible that some of them, at least the younger ones, had also visited separate private or specialized public occupational health care units. In these cases, the psychosocial work environment of these units is more crucial for the outcome of care. However, the majority of the patients in the data were over 64 years old with many visits to the HC during 2006. Thus, it is unlikely that their main care responsibility would have been somewhere else. Also, the municipalities now studied, did not systematically differ in availability of care from occupational health care units.

This and previous studies suggest that the organization of care affects the quality and the outcome of care[5] [11]. However, research evidence is still limited. Follow-up studies investigating the effect of changes in the psychosocial work environment of health care personnel on change in glycaemic control of patients with type 2 diabetes, are needed as well as interventions aiming at improving psychosocial work environment in health care. Monitoring HbA1c-values might be a useful tool in strategic leaderships of HCs because

maintaining good control is essential in order to prevent micro- and macrovascular complications of diabetes and costs caused by these chronic diseases related to type 2 diabetes[1].

Funding statement

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Competing Interest

None to declare

Contributorship statement

Anne Koponen, the guarantor, formulated the initial hypotheses, designed the study, analyzed and interpreted data, and wrote the manuscript. Jussi Vahtera, Sakari Suominen, Marianna Virtanen and Mika Kivimäki formulated the initial hypotheses, designed the study, contributed to interpretation of the data, and reviewed/edited the manuscript. Nina Simonsen-Rehn designed the study, contributed to interpretation of the data, and reviewed/edited the manuscript. Jaana Pentti designed the study, analyzed data, contributed to interpretation of the data, and reviewed/edited the manuscript. Janne Pitkäniemi analyzed data, contributed to interpretation of the data, and reviewed/edited the manuscript.

Data Sharing

We have no additional unpublished data from the study.

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Table 1. Patient, health centre, and health centre service area characteristics in primary care health centre (HCs) varying in job strain (n=8975).

	Job strain in primary care health centre					
	All HCs (n=18)	Low strain HCs	Passive job HCs	Active job HCs	High strain job HCs	p-value
Patient characteristics						
Percentage of men[1]	51	50	48	54	52	<.001
Mean age[2]	67	67	68	66	65	<.001
Patients with poor glycaemic control (%)[1]	43	45	42	42	46	<.05
HC characteristics						
Personnel with fixed term job contract (%)[1]	22	28	12	30	16	<.001
Staff sickness absence days (mean)[2]	14	9	17	12	16	<.001
Socioeconomic composition of HC service area						
Percentage of the lowest educational level [1]	27	29	26	25	27	<.001
Median income level in the HC service area[2]	17203	15660	16097	18951	18280	<.001
Unemployment rate (mean)[2]	7	7	10	4	6	<.001

1) x^2-test
2) 1-way ANOVA

Table 2. Patient, health centre, and health centre service area characteristics in primary care health centres (HCs) varying in supervisor support (n=8975).

	Supervisor support in primary care health centre				
	All HCs (n=18)	Low support HCs	Moderate support HCs	High support HCs	p-value
Patient characteristics					
Percentage of men[1]	51	48	54	52	<.001
Mean age[2]	67	67	66	65	<.001
Patients with poor glycaemic control (%)[1]	43	44	44	41	ns.
HC characteristics					
Personnel with fixed term job contract (%)[1]	22	12	31	26	<.001
Staff sickness absence days (mean)[2]	14	15	14	10	<.001
Socioeconomic composition of HC service area					
Percentage of the lowest educational level [1]	27	28	26	25	<.001
Median income level, euros[2]	17203	15173	18971	18429	<.001
Unemployment rate (mean)[2]	7	10	5	5	<.01

1) x^2-test
2) 1-way ANOVA

Table 3. Level of perceived job strain among the health care personnel (doctors and nurses) as a predictor of poor glycaemic control indicator (HbA1c≥7%) in patients with type 2 diabetes (n=8975) in primary care health centres (HCs).

Job strain in the HCs	**Unadjusted model**		**Model I***		**Model II****		**Model III*****	
	OR (95% CI)	p-value	OR (95% CI)	p-value	OR (95% CI)	p-value	OR (95% CI)	p-value
Fixed effects								
Low strain job	1.00		1.00		1.00		1.00	
Passive job	0.96 (0.72-1.27)	ns.	0.96 (0.72-1.27)	ns.	0.97 (0.70-1.36)	ns.	1.08 (0.86-1.36)	ns.
Active job	0.89 (0.68-1.18)	ns.	0.89 (0.67-1.19)	ns.	0.91 (0.69-1.20)	ns.	1.17 (0.96-1.43)	ns.
High strain job	1.08 (0.80-1.47)	ns.	1.09 (0.80-1.48)	ns.	1.10 (0.78-1.56)	ns.	1.44 (1.12-1.86)	<.01
Random effects								
HC variance (SE)	0.04 0.05		0.04 0.05		0.04 0.04		0.01 0.02	

Multilevel regression analysis
*Adjusted for patient characteristics (sex and age)
**Adjusted as model I + HC characteristics (the percentage of fixed-term HC personnel and the mean rate of sickness absence days in the HC)
*** Adjusted as model II + HC service area characteristics (educational level of the residents, median income and unemployment rate)

Table 4. Level of perceived supervisor support among the health care personnel (doctors and nurses) as a predictor of poor glycaemic control indicator (HbA1c≥7%) in patients with type 2 diabetes (n=8975) in primary care health centres (HCs).

Supervisor support in the HCs	**Unadjusted model**		**Model I***		**Model II****		**Model III*****	
	OR (95% CI)	p-value	OR (95% CI)	p-value	OR (95% CI)	p-value	OR (95% CI)	p-value
Fixed effects								
High support	1.00		1.00		1.00		1.00	
Medium support	1.11 (0.86-1.43)	ns.	1.11 (0.86-1.43)	ns.	1.17 (0.90-1.53)	ns.	1.14 (0.95-1.36)	ns.
Low support	1.13 (0.88-1.45)	ns.	1.13 (0.88-1.45)	ns.	1.10 (0.84-1.44)	ns.	0.87 (0.65-1.16)	ns.
Random effects								
HC variance (SE)	0.04 0.05		0.04 0.05		0.03 0.04		0.01 0.02	

Multilevel regression analysis
*Adjusted for patient characteristics (sex and age)
**Adjusted as model I + HC characteristics (the percentage of fixed-term HC personnel and the mean rate of sickness absence days in the HC)
*** Adjusted as model II + HC service area characteristics (educational level of the residents, median income and unemployment rate)

STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cross-sectional studies*

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4-5
Objectives	3	State specific objectives, including any prespecified hypotheses	5
Methods			
Study design	4	Present key elements of study design early in the paper	5-6
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5-6
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	5-6
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	6-7
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	6-7
Bias	9	Describe any efforts to address potential sources of bias	*6 (all patients with type 2 diabetes were included)*
Study size	10	Explain how the study size was arrived at	5-6
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	6-7
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	7-8
		(*b*) Describe any methods used to examine subgroups and interactions	
		(*c*) Explain how missing data were addressed	8
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	

		(*e*) Describe any sensitivity analyses	
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	5-7, 15-18
		(b) Give reasons for non-participation at each stage	
		(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	8, 15-16
		(b) Indicate number of participants with missing data for each variable of interest	
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	8, 10, 15-18
		(*b*) Report category boundaries when continuous variables were categorized	6, 17-18
		(*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	8-9
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	10
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	10
Generalisability	21	Discuss the generalisability (external validity) of the study results	10-11
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	11

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

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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Job strain and supervisor support in primary care health centres and glycaemic control among patients with type 2 diabetes – a cross-sectional study

Abstract

Objectives This study investigates associations between health care personnel's perceived job strain, supervisor support and the outcome of care in terms of glycaemic control among patients with type 2 diabetes.

Design A cross-sectional study in 2006.

Setting Eighteen primary care health centres (HCs) from five municipalities in Finland.

Participants Aggregated survey data on perceived job strain and supervisor support from health care personnel (doctors, n=122, mean age 45.5 years, nurses, n=300, mean age 47.1 years) was combined with registered data from 8975 patients (51% men, mean age 67 years) with type 2 diabetes.

Outcome measure Poor glycaemic control (HbA1c ≥7%).

Results The mean HbA1c-level among the patients with type 2 diabetes was 7.1 (SD 1.2, range 4.5-19.1), and 43% had poor glyacemic control (HbA1c ≥7%). Multilevel logistic regression analyses adjusted for patient's age and sex, and HC- and HC service area-level characteristics showed that patients' HbA1c-levels were less optimal in high strain HCs than in low strain HCs (OR 1.44, 95%, CI 1.12-1.86). Supervisor support in HCs was not associated with the outcome of care.

Conclusion The level of job strain among the health care personnel may play a role in achieving good glycaemic control among patients with type 2 diabetes.

ARTICLE SUMMARY

Article focus

- This paper focuses on the association between job strain and supervisor support of health care personnel and the outcome of care among patients with type 2 diabetes.

Key messages

- HbA1c-levels were less optimal in health centres where health care personnel's perceived job strain was high compared with health centres where perceived job strain was low.
- Perceived job strain of health care personnel and health centres' success in achieving glycaemic control of patients with diabetes might be good quality indicators of patient care.

Strengths and limitations of this study

- Previous studies suggest that the organization of care can affect the quality and the outcome of care in diabetes. This study showed that job strain of health care personnel may be one key factor associated with glycaemic control among patients with type 2 diabetes.
- We did not have information on patients' medication and comorbidity associated with type 2 diabetes.

INTRODUCTION

Diabetes mellitus is an important and increasing public health problem worldwide[1 2 3]. In Finland, about 10% of the population has diabetes of which a majority is of type 2[4]. Primary health care faces a serious challenge to provide high quality care in order to decrease complications, mortality and costs caused by this public health burden.

Health care organizations may differ in the quality of care[5]. However, we know only little about organizational aspects that promote good care of diabetes. One aspect may relate to the organization of care. Collins et al.[6] showed that compliance to diabetes care was better in structured general practitioner (GP) care than in traditional hospital care or in hospital/GP shared care. McLean et al.[7] found that the intermediate outcome target in cholesterol measurement of diabetic patients was achieved more often in urban practices than in very remote rural practices. Medical outcomes of care in type 2 diabetes have been shown to be better in physician-nurse practitioner teams than in care provided by a physician alone[8 9]. Linzer et al.[10] found that good organizational culture with high values alignment with leadership and work control was associated with higher-quality care for diabetic patients. In the study by Virtanen et al.[11] perception of procedural justice among staff was associated with more optimal glycaemic control among patients.

More research on the associations between organizational factors and the quality of care, especially the outcome of care, in diabetes is needed. Based on the theory of Karasek[12] and Karasek & Theorell[13] equilibrium between personnel's job demands and job control as well as social support at work might be important organizational factors associated with the quality of care. Active work with high demands and high control most likely promotes high quality care[13]. High demands give challenges, motivation and promote learning but combined with high control high demands do not cause negative psychological strain. Instead, high-strain work with high demands and low control

exhausts personnel and decreases productivity. Low-strain work with high control and low demands may not offer optimal challenges, and passive work with low demands and low control may lead to apathy and loss of learned skills and abilities. Besides an optimal balance between job demands and job control, also social support at work is likely to promote good health, learning and productivity[13]. Social support can, for example, buffer the negative effect of psychological stressors on employee health, and co-workers and supervisors are valuable sources of information and expertise.

AIM AND HYPOTHESES OF THE STUDY

The aim of this study was to investigate associations between health care personnel's perceived job strain, supervisor support and the outcome of care in terms of glycaemic control among patients with type 2 diabetes. We hypothesize that glycaemic control is best achieved in health centres where health care personnel has possibility to active work and high supervisor support.

METHODS

Study context

The study was conducted in 18 outpatient health centres (HC) clinics in five municipalities in Finland. Municipalities differed in size (about 7500-200000 inhabitants) and the number of health centres in each municipality (1-10). In Finland, municipalities are responsible for organizing primary health care services and cover the costs together with the state. Primary health care services are provided by a health centre comprising inpatient and outpatient units. Health centres offer a wide range of care services including doctor and nurse services[14] and have a central role in disease management for major chronic conditions like diabetes[15]. Three of the five research municipalities had a family doctor system in their HCs and all HCs had a diabetes nurse. One city had also a clinic specialized for prevention and care of chronic conditions. Patients from HCs could be referred there for additional advice and care.

Data collection and participants

The data to this cross-sectional study were gathered in 2006. Information on job strain and supervisor support in 18 HCs is based on responses of doctors (n=122, mean age 45.5 years) and nurses (n=300, mean age 47.1 years), who took part in the Finnish Public Sector Study[16], a voluntary-basis survey addressed to local government personnel of the participating towns (response rate 79%). Information on glycaemic control (HbA1c-values) of patients with the diagnosis of type 2 diabetes (N=8975, 51% men, mean age 67 years, SD 11, range 16-106 years) was collected from HC registers by the contact persons who worked in HCs. They delivered anonymous data to researchers. Aggregated variables indicating the levels of job strain and social support (based on survey responses of doctors and nurses) were created for each HC and linked to patient data. Thus, each patient has information in her/his individual data on job strain and supervisor support in the HC that had responsibility of her/his diabetes care.

The Finnish Public Sector Study was approved by the ethics committee of the Finnish Institute of Occupational Health. In one city, the anonymous collection of HbA1c-values of type 2 diabetes patients combined with data on their sex, age and the postal zip code of area of residence was accomplished as a part of this study. In four other cities, the collection of the aforementioned patient data was based on a written application approved by the chief physician of primary care or the Board of Health and Social Affairs/Board of Social Security in the respective municipality.

Measures

Job strain and supervisor support

Aggregated measure of job strain was derived from the responses of doctors and nurses (n=422) to questions measuring job demands (5 items) and job control (9 items) derived from the Job Content Questionnaire[17]. Aggregated measure of social support from the supervisor[18 19] (4 items) was

derived from a standard survey instrument of Statistics Finland[20]. A 5-point Likert-type response format ranging from 1 (totally agree) to 5 (totally disagree) was used for all items. A mean score for the constructs was computed and the individual scores were then used to measure aggregated scores of job strain and supervisor support for each work unit (HC) based on the identification of each participant's work unit obtained from employers' administrative records.

To create a job strain indicator for each HC, aggregated demands and control were split on the median and combined to four categories: low strain jobs (low demands combined with high control, 4 HCs), active jobs (high demands combined with high control, 5 HCs), passive jobs (low demands combined with low control, 5 HCs), and high strain jobs (high demands combined with low control, 4 HCs)[12]. To create a supervisor support indicator for each HC, aggregated supervisor support was split into three equal groups indicating low, medium and high support (6 HCs in each group).

Job strain and supervisor support indicators for each HC were created based on the responses of doctors and nurses because doctors and nurses work independently in HCs and equally affect the quality of care. Aggregated job demands of doctors were higher (mean 3.9, range 3.0-4.4) than job demands of nurses (mean 3.5, range 2.8-4.3). Aggregated job control of doctors was also somewhat higher (mean 3.9, range 3.7-4.3) than job control of nurses (mean 3.8, range 3.6-4.2). In aggregated supervisor support there was no difference between doctors (mean 3.6, range 2.5-5.0) and nurses (3.6, range 2.9-4.5).

Glycaemic control

Glycaemic control was determined by 1 year's measurements of glycated haemoglobin (HbA1c) value. In case of several control measurements the mean HbA1c-value was calculated (mean number of measurements was 2.1, range 1-15). Of the patients, 35% had one measurement. Based

on the standards of medical care in diabetes[21] we used a value under 7% to indicate good and a value of 7 or higher to indicate poor glycaemic control.

Background variables

Patient characteristics: Information on age, sex, and the postal zip code of area of residence of each patient was obtained from the HC's registers.

HC characteristics: The proportion of temporary employees and the mean rate of sickness absence days in the work unit in 2006 were drawn from employers' registers[22].

HC service area characteristics: By using the patient postal zip codes and data obtained from Statistics Finland we formulated the average educational level (percentage of adults aged >18 years whose highest education level is elementary school), the median income and the unemployment rate (unemployed persons belonging to the workforce divided by total workforce) of the residents in the HC catchment area, that is, the population-weighted means for residents in the specific areas that each HC served. The mean for each variable for each HC was calculated and linked to individual data on each patient. Educational level, income and unemployment rate are standard variables to characterize areal disadvantage and deprivation[23 24].

Statistical analysis

The statistical data analysis was carried out within individual patient data (N=8975) with HC characteristics on an aggregated level. Descriptive statistics were estimated and the baseline associations between independent variables, covariates and glycaemic control were tested with Pearson chi²-tests or one-way analysis of variance depending on the measurement scale of the variable of interest. Because the patients were nested within the 18 HC units, we used a two-level modelling to account the data structure with job strain (or supervisor support) at the second level and the outcome – patient-level glycaemic control – at the first level. We fitted five models using

the multilevel logistic regression analysis. The first model, an empty model including only the random effect variable, was used to examine the clustering of the outcome between the 18 HCs. Then, we added job strain (or supervisor support) to examine its associations with the outcome. Next, we added patient-level confounders, after that HC characteristics and finally, variables describing socioeconomic composition of the HC service area (unadjusted model, model I, II and III). Because we used register data combined with aggregated variables describing HCs and HC catchment areas, there were only a few missing cases, and they were not included in the analyses. Statistical analyses were performed using SPSS version 19.0 and R-program, version 2.13.0.

RESULTS

The baseline associations between independent variables, covariates and glycaemic control are presented in tables 1-2. The mean HbA1c level of patients was 7.1 (SD 1.2, range 4.5-19.1, Q1=6.3, median 6.8, Q3=7.6), and 43% had poor glycaemic control (≥7%). HCs did not differ in the mean HbA1c-levels but the percentage of poor glycaemic control was highest in high strain HCs. The mean rates of job control, job demands and supervisor support in the HCs were 3.9, 3.6 and 3.6, respectively.

The socioeconomic characteristics of the HC service areas were as follows: residents with more than basic education in the patients' neighbourhood 73%, the median yearly income 17203 euros, and the mean unemployment rate 7%. (Table 1)

Table 1 shows that the percentage of temporary employees in HCs was 22% being lowest in passive job HCs (12%) and highest in active job HCs (30%). The average number of sickness absence days was 14 days. It was lowest in low strain job HCs (9 days) and highest in passive

job HCs (17 days). The socioeconomic composition of residents was most favourable in active job HC service areas. (Table 1)

Table 2 shows that the percentage of temporary employees was highest in the moderate supervisor support HCs (31%). The average number of sickness absence days was lowest in high supervisor support HCs (10 days). Also the socioeconomic composition of residents was more favourable than the average in the high support HC service areas as well as in the moderate supervisor support HC areas.

[Insert tables 1-2 somewhere here]

Table 3 shows that after adjustment for all covariates (model III) glycaemic control among patients was less optimal in HCs where care personnel's perceived job strain was high compared with HCs where job strain was low. Active and passive work HCs did not differ statistically significantly from low strain HCs in the outcome of care. Also, supervisor support was not associated with patients' glycaemic control (table 4).

[Insert tables 3-4 somewhere here]

DISCUSSION

This study showed that exposure to high job strain of primary health care personnel may be associated with worse outcome of diabetes care. Glycaemic control among type 2 diabetes patients was less optimal in high strain HCs than in low strain HCs. Supervisor support was not associated with the outcome of care.

Several studies have found the strong association between experienced work load and burnout, particularly its exhaustion dimension[25 26 27]. Emotional exhaustion is further

associated with low job performance shown in job withdrawal, deterioration of productivity and effectiveness[27], and the outcome of care[5 28]. Recent studies on physicians show that their experienced job strain, stress and burnout are associated with increased risk of suboptimal patient care and likelihood of making errors[29-32]. Exhausted employees are not effective, accurate or innovative at work[13]. Instead, a favourable psychosocial work environment may enhance employee well-being and motivate health care personnel to invent new working methods and strengthen patients' motivation to self-care.

However, patients' glycaemic control was not best in active jobs HCs as we predicted based on the job strain model[13]. This result is in line with the results of the study on clinicians in surgery by Klein et al.[30] They found that clinicians with active job reported suboptimal quality of care more often than clinicians with low-strain job. It is possible that active work assumption does not fit well in the health care sector. Active jobs give more challenges than low strain jobs or passive jobs but the motivational potential of higher demands of active jobs may be lost if demands are so high that they overwhelm health care personnel´s capacities. In that case high control or other job resources may have only limited capability of buffering the undesired impact of high job demands[25 33]. Contrary to our prediction, social support from supervisor was not associated with the outcome of care. The fact that doctors and nurses in the Finnish HCs work quite independently is a potential explanation for this.

Register data give reliable care results but also has limitations. It does not give information on patients' socioeconomic status, such as educational level that is known to be strongly related with health behaviour, many unhealthy behaviours like smoking, poor dietary habits and physical inactivity being more prevalent in lower socioeconomic groups[34]. Healthy lifestyle again is the key factor in management of diabetes[21]. However, we were able to use

disadvantage of the patient's residential area as a proxy for individual socioeconomic position. Indeed, the effect of job strain on glycaemic control emerged after adjustment of educational level, income and unemployment rate in the HC catchment area. This result points to suppression, a situation in which the magnitude of the relationship between an independent variable and a dependent variable becomes larger when a third variable (or multiple variables) is included to the analysis[35]

This was a cross-sectional study and no causal inferences of the associations between independent and dependent variables can be made. Another limitation was that we did not have information on patients' medication and comorbidity associated with type 2 diabetes[36]. Neither did we have information on other aspects of the quality of care, such as numbers of doctors or nurses per inhabitants in the HC service area indicating the sufficiency of staff. This is an important question to be further studied. However, job strain can be seen as one indicator of sufficiency of staff.

Further, we did not have access to exact information on where the principal care responsibility of the patients was. In spite of the fact that the patients had HbA1c-values measured via the HC it is possible that some of them, at least the younger ones, had also visited separate private or specialized public occupational health care units. In these cases, the psychosocial work environment of these units is more crucial for the outcome of care. However, the majority of the patients in the data were over 64 years old with many visits to the HC during 2006. Thus, it is unlikely that their main care responsibility would have been somewhere else. Also, the municipalities now studied, did not systematically differ in availability of care from occupational health care units.

This and previous studies suggest that the organization of care affects the quality and the outcome of care[5 11 30]. However, research evidence is still limited. Follow-up studies investigating the effect of changes in the psychosocial work environment of health care personnel on change in glycaemic control of patients with type 2 diabetes, are needed as well as interventions aiming at improving psychosocial work environment in health care. The studies of Bourbonnais et al.[37 38] showed that such interventions may have positive effect on the psychosocial work environment and mental health of health care personnel. Monitoring HbA1c-values might be a useful tool in strategic leaderships of HCs because maintaining good control is essential in order to prevent micro- and macrovascular complications of diabetes and costs caused by these chronic diseases related to type 2 diabetes[1].

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Competing Interest

None to declare

Contributorship statement

Anne Koponen, the guarantor, formulated the initial hypotheses, designed the study, analyzed and interpreted data, and wrote the manuscript. Jussi Vahtera, Sakari Suominen, Marianna Virtanen and Mika Kivimäki formulated the initial hypotheses, designed the study, contributed to interpretation of the data, and reviewed/edited the manuscript. Nina Simonsen-Rehn designed the study, contributed to interpretation of the data, and reviewed/edited the manuscript. Jaana Pentti designed the study, analyzed data, contributed to interpretation of the data, and reviewed/edited the

manuscript. Janne Pitkäniemi analyzed data, contributed to interpretation of the data, and reviewed/edited the manuscript.

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Table 1. Patient, health centre, and health centre service area characteristics in primary care health centres (HCs) varying in job strain.

	Job strain in primary care health centre					
	All HCs (N=18)	Low strain job HCs [3] (n=4)	Passive job HCs[4] (n=5)	Active job HCs[5] (n=5)	High strain job HCs[6] (n=4)	p-value
Patient characteristics						
Percentage of men[1]	51	50	48	54	52	<.001
Age (mean/SD) [2]	67 (11.6)	67 (10.9)	68 (11.2)	66 (11.2)	65 (11.2)	<.001
HbA1c (mean/SD) [2]	7.1 (1.2)	7.1 (1.2)	7.1 (1.1)	7.1 (1.1)	7.1 (1.1)	ns.
Patients with poor glycaemic control (HbA1c≥7%) (%)[1]	43	45	42	42	46	<.05
N	8975	1999	2862	2707	1407	
HC characteristics						
Temporary employees (%)[1]	22	28	12	30	16	<.001
Staff sickness absence days (mean/SD)[2]	14 (5.3)	9 (4.3)	17 (2.3)	12 (5.4)	16 (5.5)	<.001
Socioeconomic composition of HC service area						
Percentage of the lowest educational level [1]	27	29	26	25	27	<.001
Median income level in the HC service area, euros (mean, SD)[2]	17203 (2556)	15660 (3057)	16097 (756)	18951 (2166)	18280 (2301)	<.001
Unemployment rate (mean, SD)[2]	7 (2.9)	7 (3.3)	10 (1.6)	4 (0.8)	6 (1.2)	<.001

1) x^2-test
2) 1-way ANOVA
3) Low demands and high control
4) Low demands and low control
5) High demands and high control
6) High demands and low control

Table 2. Patient, health centre, and health centre service area characteristics in primary care health centres (HCs) varying in supervisor support.

	Supervisor support in primary care health centre				
	All HCs (N=18)	Low support HCs (n=6)	Moderate support HCs (n=6)	High support HCs (n=6)	p-value
Patient characteristics					
Percentage of men[1]	51	48	54	52	<.001
Age (mean/SD)[2]	67 (11.2)	67 (11.3)	66 (11.0)	65 (11.6)	<.001
HbA1c-value (mean/SD) [2]	7.1 (1.2)	7.1 (1.3)	7.1 (1.1)	7.0 (1.1)	ns.
Patients with poor glycaemic control (HbA1c≥7%) (%)[1]	43	44	44	41	ns.
N	8975	3911	3194	1870	
HC characteristics					
Temporary employees (%)[1]	22	12	31	26	<.001
Staff sickness absence days (mean/SD)[2]	14 (5.3)	15 (4.4)	14 (4.5)	10 (6.6)	<.001
Socioeconomic composition of HC service area					
Percentage of the lowest educational level [1]	27	28	26	25	<.001
Median income level, euros (mean, SD)[2]	17203 (2556)	15173 (1510)	18971 (2009)	18429 (2055)	<.001
Unemployment rate (mean/SD)[2]	7 (2.9)	10 (1.4)	5 (1.4)	5 (0.6)	<.01

1) x^2-test
2) 1-way ANOVA

Table 3. Level of perceived job strain among the health care personnel (doctors and nurses) as a predictor of poor glycaemic control indicator (HbA1c≥7%) in patients with type 2 diabetes (N=8975) in primary care health centres (HCs, N=18).

Job strain in the HCs	**Unadjusted model**		**Model I***		**Model II****		**Model III*****	
	OR (95% CI)	p-value	OR (95% CI)	p-value	OR (95% CI)	p-value	OR (95% CI)	p-value
Fixed effects								
Low strain job	1.00		1.00		1.00		1.00	
Passive job	0.96 (0.72-1.27)	ns.	0.96 (0.72-1.27)	ns.	0.97 (0.70-1.36)	ns.	1.08 (0.86-1.36)	ns.
Active job	0.89 (0.68-1.18)	ns.	0.89 (0.67-1.19)	ns.	0.91 (0.69-1.20)	ns.	1.17 (0.96-1.43)	ns.
High strain job	1.08 (0.80-1.47)	ns.	1.09 (0.80-1.48)	ns.	1.10 (0.78-1.56)	ns.	1.44 (1.12-1.86)	<.01
Random effects								
HC variance (SE)	0.04 0.05		0.04 0.05		0.04 0.04		0.01 0.02	

Multilevel regression analysis
*Adjusted for patient characteristics (sex and age)
**Adjusted as model I + HC characteristics (the percentage of temporary employees and the mean rate of sickness absence days in the HC)
*** Adjusted as model II + HC service area characteristics (educational level of the residents, median income and unemployment rate)

Table 4. Level of perceived supervisor support among the health care personnel (doctors and nurses) as a predictor of poor glycaemic control indicator (HbA1c≥7%) in patients with type 2 diabetes (N=8975) in primary care health centres (HCs, N=18).

Supervisor support in the HCs	**Unadjusted model**		**Model I***		**Model II****		**Model III*****	
	OR (95% CI)	p-value	OR (95% CI)	p-value	OR (95% CI)	p-value	OR (95% CI)	p-value
Fixed effects								
High support	1.00		1.00		1.00		1.00	
Medium support	1.11 (0.86-1.43)	ns.	1.11 (0.86-1.43)	ns.	1.17 (0.90-1.53)	ns.	1.14 (0.95-1.36)	ns.
Low support	1.13 (0.88-1.45)	ns.	1.13 (0.88-1.45)	ns.	1.10 (0.84-1.44)	ns.	0.87 (0.65-1.16)	ns.
Random effects								
HC variance (SE)	0.04 0.05		0.04 0.05		0.03 0.04		0.01 0.02	

Multilevel regression analysis
*Adjusted for patient characteristics (sex and age)
**Adjusted as model I + HC characteristics (the percentage of temporary employees and the mean rate of sickness absence days in the HC)
*** Adjusted as model II + HC service area characteristics (educational level of the residents, median income and unemployment rate)

Job strain and supervisor support in primary care health centres and glycaemic control among patients with type 2 diabetes – a cross-sectional study

Abstract

Objectives This study investigates associations between health care personnel's perceived job strain, supervisor support and the outcome of care in terms of glycaemic control among patients with type 2 diabetes.

Design A cross-sectional study in 2006.

Setting Eighteen primary care health centres (HCs) from five municipalities in Finland.

Participants Aggregated survey data on perceived job strain and supervisor support from health care personnel (doctors, n=122, mean age 45.5 years, nurses, n=300, mean age 47.1 years) was combined with registered data from 8975 patients (51% men, mean age 67 years) with type 2 diabetes.

Outcome measure Poor glycaemic control (HbA1c ≥7%).

Results The mean HbA1c-level among the patients with type 2 diabetes was 7.1 (SD 1.2, range 4.5-19.1), and 43% had poor glyacemic control (HbA1c ≥7%). Multilevel logistic regression analyses adjusted for patient's age and sex, and HC- and HC service area-level characteristics showed that patients' HbA1c-levels were less optimal in high strain HCs than in low strain HCs (OR 1.44, 95%, CI 1.12-1.86). Supervisor support in HCs was not associated with the outcome of care.

Conclusion The level of job strain among the health care personnel may play a role in achieving good glycaemic control among patients with type 2 diabetes.

ARTICLE SUMMARY

Article focus

- This paper focuses on the association between job strain and supervisor support of health care personnel and the outcome of care among patients with type 2 diabetes.

Key messages

- HbA1c-levels were less optimal in health centres where health care personnel's perceived job strain was high compared with health centres where perceived job strain was low.
- Perceived job strain of health care personnel and health centres' success in achieving glycaemic control of patients with diabetes might be good quality indicators of patient care.

Strengths and limitations of this study

- Previous studies suggest that the organization of care can affect the quality and the outcome of care in diabetes. This study showed that job strain of health care personnel may be one key factor associated with glycaemic control among patients with type 2 diabetes.
- We did not have information on patients' medication and comorbidity associated with type 2 diabetes.

INTRODUCTION

Diabetes mellitus is an important and increasing public health problem worldwide[1 2 3]. In Finland, about 10% of the population has diabetes of which a majority is of type 2[4]. Primary health care faces a serious challenge to provide high quality care in order to decrease complications, mortality and costs caused by this public health burden.

Health care organizations may differ in the quality of care[5]. However, we know only little about organizational aspects that promote good care of diabetes. One aspect may relate to the organization of care. Collins et al.[6] showed that compliance to diabetes care was better in structured general practitioner (GP) care than in traditional hospital care or in hospital/GP shared care. McLean et al.[7] found that the intermediate outcome target in cholesterol measurement of diabetic patients was achieved more often in urban practices than in very remote rural practices. Medical outcomes of care in type 2 diabetes have been shown to be better in physician-nurse practitioner teams than in care provided by a physician alone[8 9]. Linzer et al.[10] found that good organizational culture with high values alignment with leadership and work control was associated with higher-quality care for diabetic patients. In the study by Virtanen et al.[11] perception of procedural justice among staff was associated with more optimal glycaemic control among patients.

More research on the associations between organizational factors and the quality of care, especially the outcome of care, in diabetes is needed. Based on the theory of Karasek[12] and Karasek & Theorell[13] equilibrium between personnel's job demands and job control as well as social support at work might be important organizational factors associated with the quality of care. Active work with high demands and high control most likely promotes high quality care[13]. High demands give challenges, motivation and promote learning but combined with high control high demands do not cause negative psychological strain. Instead, high-strain work with high demands and low control

exhausts personnel and decreases productivity. Low-strain work with high control and low demands may not offer optimal challenges, and passive work with low demands and low control may lead to apathy and loss of learned skills and abilities. Besides an optimal balance between job demands and job control, also social support at work is likely to promote good health, learning and productivity[13]. Social support can, for example, buffer the negative effect of psychological stressors on employee health, and co-workers and supervisors are valuable sources of information and expertise.

AIM AND HYPOTHESES OF THE STUDY

The aim of this study was to investigate associations between health care personnel's perceived job strain, supervisor support and the outcome of care in terms of glycaemic control among patients with type 2 diabetes. We hypothesize that glycaemic control is best achieved in health centres where health care personnel has possibility to active work and high supervisor support.

METHODS

Study context

The study was conducted in 18 outpatient health centres (HC) clinics in five municipalities in Finland. Municipalities differed in size (about 7500-200000 inhabitants) and the number of health centres in each municipality (1-10). In Finland, municipalities are responsible for organizing primary health care services and cover the costs together with the state. Primary health care services are provided by a health centre comprising inpatient and outpatient units. Health centres offer a wide range of care services including doctor and nurse services[14] and have a central role in disease management for major chronic conditions like diabetes[15]. Three of the five research municipalities had a family doctor system in their HCs and all HCs had a diabetes nurse. One city had also a clinic specialized for prevention and care of chronic conditions. Patients from HCs could be referred there for additional advice and care.

Data collection and participants

The data to this cross-sectional study were gathered in 2006. Information on job strain and supervisor support in 18 HCs is based on responses of doctors (n=122, mean age 45.5 years) and nurses (n=300, mean age 47.1 years), who took part in the Finnish Public Sector Study[16], a voluntary-basis survey addressed to local government personnel of the participating towns (response rate 79%). Information on glycaemic control (HbA1c-values) of patients with the diagnosis of type 2 diabetes (N=8975, 51% men, mean age 67 years, SD 11, range 16-106 years) was collected from HC registers by the contact persons who worked in HCs. They delivered anonymous data to researchers. Aggregated variables indicating the levels of job strain and social support (based on survey responses of doctors and nurses) were created for each HC and linked to patient data. Thus, each patient has information in her/his individual data on job strain and supervisor support in the HC that had responsibility of her/his diabetes care.

The Finnish Public Sector Study was approved by the ethics committee of the Finnish Institute of Occupational Health. In one city, the anonymous collection of HbA1c-values of type 2 diabetes patients combined with data on their sex, age and the postal zip code of area of residence was accomplished as a part of this study. In four other cities, the collection of the aforementioned patient data was based on a written application approved by the chief physician of primary care or the Board of Health and Social Affairs/Board of Social Security in the respective municipality.

Measures

Job strain and supervisor support

Aggregated measure of job strain was derived from the responses of doctors and nurses (n=422) to questions measuring job demands (5 items) and job control (9 items) derived from the Job Content Questionnaire[17]. Aggregated measure of social support from the supervisor[18 19] (4 items) was

derived from a standard survey instrument of Statistics Finland[20]. A 5-point Likert-type response format ranging from 1 (totally agree) to 5 (totally disagree) was used for all items. A mean score for the constructs was computed and the individual scores were then used to measure aggregated scores of job strain and supervisor support for each work unit (HC) based on the identification of each participant's work unit obtained from employers' administrative records.

To create a job strain indicator for each HC, aggregated demands and control were split on the median and combined to four categories: low strain jobs (low demands combined with high control, 4 HCs), active jobs (high demands combined with high control, 5 HCs), passive jobs (low demands combined with low control, 5 HCs), and high strain jobs (high demands combined with low control, 4 HCs)[12]. To create a supervisor support indicator for each HC, aggregated supervisor support was split into three equal groups indicating low, medium and high support (6 HCs in each group).

Job strain and supervisor support indicators for each HC were created based on the responses of doctors and nurses because doctors and nurses work independently in HCs and equally affect the quality of care. Aggregated job demands of doctors were higher (mean 3.9, range 3.0-4.4) than job demands of nurses (mean 3.5, range 2.8-4.3). Aggregated job control of doctors was also somewhat higher (mean 3.9, range 3.7-4.3) than job control of nurses (mean 3.8, range 3.6-4.2). In aggregated supervisor support there was no difference between doctors (mean 3.6, range 2.5-5.0) and nurses (3.6, range 2.9-4.5).

Glycaemic control

Glycaemic control was determined by 1 year's measurements of glycated haemoglobin (HbA1c) value. In case of several control measurements the mean HbA1c-value was calculated (mean number of measurements was 2.1, range 1-15). Of the patients, 35% had one measurement. Based

on the standards of medical care in diabetes[21] we used a value under 7% to indicate good and a value of 7 or higher to indicate poor glycaemic control.

Background variables

Patient characteristics: Information on age, sex, and the postal zip code of area of residence of each patient was obtained from the HC's registers.

HC characteristics: The proportion of temporary employees and the mean rate of sickness absence days in the work unit in 2006 were drawn from employers' registers[22].

HC service area characteristics: By using the patient postal zip codes and data obtained from Statistics Finland we formulated the average educational level (percentage of adults aged >18 years whose highest education level is elementary school), the median income and the unemployment rate (unemployed persons belonging to the workforce divided by total workforce) of the residents in the HC catchment area, that is, the population-weighted means for residents in the specific areas that each HC served. The mean for each variable for each HC was calculated and linked to individual data on each patient. Educational level, income and unemployment rate are standard variables to characterize areal disadvantage and deprivation[23 24].

Statistical analysis

The statistical data analysis was carried out within individual patient data (N=8975) with HC characteristics on an aggregated level. Descriptive statistics were estimated and the baseline associations between independent variables, covariates and glycaemic control were tested with Pearson chi²-tests or one-way analysis of variance depending on the measurement scale of the variable of interest. Because the patients were nested within the 18 HC units, we used a two-level modelling to account the data structure with job strain (or supervisor support) at the second level and the outcome – patient-level glycaemic control – at the first level. We fitted five models using

the multilevel logistic regression analysis. The first model, an empty model including only the random effect variable, was used to examine the clustering of the outcome between the 18 HCs. Then, we added job strain (or supervisor support) to examine its associations with the outcome. Next, we added patient-level confounders, after that HC characteristics and finally, variables describing socioeconomic composition of the HC service area (unadjusted model, model I, II and III). Because we used register data combined with aggregated variables describing HCs and HC catchment areas, there were only a few missing cases, and they were not included in the analyses. Statistical analyses were performed using SPSS version 19.0 and R-program, version 2.13.0.

RESULTS

The baseline associations between independent variables, covariates and glycaemic control are presented in tables 1-2. The mean HbA1c level of patients was 7.1 (SD 1.2, range 4.5-19.1, Q1=6.3, median 6.8, Q3=7.6), and 43% had poor glycaemic control (≥7%). HCs did not differ in the mean HbA1c-levels but the percentage of poor glycaemic control was highest in high strain HCs. The mean rates of job control, job demands and supervisor support in the HCs were 3.9, 3.6 and 3.6, respectively.

The socioeconomic characteristics of the HC service areas were as follows: residents with more than basic education in the patients' neighbourhood 73%, the median yearly income 17203 euros, and the mean unemployment rate 7%. (Table 1)

Table 1 shows that the percentage of temporary employees in HCs was 22% being lowest in passive job HCs (12%) and highest in active job HCs (30%). The average number of sickness absence days was 14 days. It was lowest in low strain job HCs (9 days) and highest in passive

job HCs (17 days). The socioeconomic composition of residents was most favourable in active job HC service areas. (Table 1)

Table 2 shows that the percentage of temporary employees was highest in the moderate supervisor support HCs (31%). The average number of sickness absence days was lowest in high supervisor support HCs (10 days). Also the socioeconomic composition of residents was more favourable than the average in the high support HC service areas as well as in the moderate supervisor support HC areas.

[Insert tables 1-2 somewhere here]

Table 3 shows that after adjustment for all covariates (model III) glycaemic control among patients was less optimal in HCs where care personnel's perceived job strain was high compared with HCs where job strain was low. Active and passive work HCs did not differ statistically significantly from low strain HCs in the outcome of care. Also, supervisor support was not associated with patients' glycaemic control (table 4).

[Insert tables 3-4 somewhere here]

DISCUSSION

This study showed that exposure to high job strain of primary health care personnel may be associated with worse outcome of diabetes care. Glycaemic control among type 2 diabetes patients was less optimal in high strain HCs than in low strain HCs. Supervisor support was not associated with the outcome of care.

Several studies have found the strong association between experienced work load and burnout, particularly its exhaustion dimension[25 26 27]. Emotional exhaustion is further

associated with low job performance shown in job withdrawal, deterioration of productivity and effectiveness[27], and the outcome of care[5 28]. Recent studies on physicians show that their experienced job strain, stress and burnout are associated with increased risk of suboptimal patient care and likelihood of making errors[29-32]. Exhausted employees are not effective, accurate or innovative at work[13]. Instead, a favourable psychosocial work environment may enhance employee well-being and motivate health care personnel to invent new working methods and strengthen patients' motivation to self-care.

However, patients' glycaemic control was not best in active jobs HCs as we predicted based on the job strain model[13]. This result is in line with the results of the study on clinicians in surgery by Klein et al.[30] They found that clinicians with active job reported suboptimal quality of care more often than clinicians with low-strain job. It is possible that active work assumption does not fit well in the health care sector. Active jobs give more challenges than low strain jobs or passive jobs but the motivational potential of higher demands of active jobs may be lost if demands are so high that they overwhelm health care personnel´s capacities. In that case high control or other job resources may have only limited capability of buffering the undesired impact of high job demands[25 33]. Contrary to our prediction, social support from supervisor was not associated with the outcome of care. The fact that doctors and nurses in the Finnish HCs work quite independently is a potential explanation for this.

Register data give reliable care results but also has limitations. It does not give information on patients' socioeconomic status, such as educational level that is known to be strongly related with health behaviour, many unhealthy behaviours like smoking, poor dietary habits and physical inactivity being more prevalent in lower socioeconomic groups[34]. Healthy lifestyle again is the key factor in management of diabetes[21]. However, we were able to use

disadvantage of the patient's residential area as a proxy for individual socioeconomic position. Indeed, the effect of job strain on glycaemic control emerged after adjustment of educational level, income and unemployment rate in the HC catchment area. This result points to suppression, a situation in which the magnitude of the relationship between an independent variable and a dependent variable becomes larger when a third variable (or multiple variables) is included to the analysis[35]

This was a cross-sectional study and no causal inferences of the associations between independent and dependent variables can be made. Another limitation was that we did not have information on patients' medication and comorbidity associated with type 2 diabetes[36]. Neither did we have information on other aspects of the quality of care, such as numbers of doctors or nurses per inhabitants in the HC service area indicating the sufficiency of staff. This is an important question to be further studied. However, job strain can be seen as one indicator of sufficiency of staff.

Further, we did not have access to exact information on where the principal care responsibility of the patients was. In spite of the fact that the patients had HbA1c-values measured via the HC it is possible that some of them, at least the younger ones, had also visited separate private or specialized public occupational health care units. In these cases, the psychosocial work environment of these units is more crucial for the outcome of care. However, the majority of the patients in the data were over 64 years old with many visits to the HC during 2006. Thus, it is unlikely that their main care responsibility would have been somewhere else. Also, the municipalities now studied, did not systematically differ in availability of care from occupational health care units.

This and previous studies suggest that the organization of care affects the quality and the outcome of care[5 11 30]. However, research evidence is still limited. Follow-up studies investigating the effect of changes in the psychosocial work environment of health care personnel on change in glycaemic control of patients with type 2 diabetes, are needed as well as interventions aiming at improving psychosocial work environment in health care. The studies of Bourbonnais et al.[37 38] showed that such interventions may have positive effect on the psychosocial work environment and mental health of health care personnel. Monitoring HbA1c-values might be a useful tool in strategic leaderships of HCs because maintaining good control is essential in order to prevent micro- and macrovascular complications of diabetes and costs caused by these chronic diseases related to type 2 diabetes[1].

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Competing Interest

None to declare

Contributorship statement

Anne Koponen, the guarantor, formulated the initial hypotheses, designed the study, analyzed and interpreted data, and wrote the manuscript. Jussi Vahtera, Sakari Suominen, Marianna Virtanen and Mika Kivimäki formulated the initial hypotheses, designed the study, contributed to interpretation of the data, and reviewed/edited the manuscript. Nina Simonsen-Rehn designed the study, contributed to interpretation of the data, and reviewed/edited the manuscript. Jaana Pentti designed the study, analyzed data, contributed to interpretation of the data, and reviewed/edited the

manuscript. Janne Pitkäniemi analyzed data, contributed to interpretation of the data, and reviewed/edited the manuscript.

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Table 1. Patient, health centre, and health centre service area characteristics in primary care health centres (HCs) varying in job strain.

	Job strain in primary care health centre					
	All HCs (N=18)	Low strain job HCs [3] (n=4)	Passive job HCs[4] (n=5)	Active job HCs[5] (n=5)	High strain job HCs[6] (n=4)	p-value
Patient characteristics						
Percentage of men[1]	51	50	48	54	52	<.001
Age (mean/SD) [2]	67 (11.6)	67 (10.9)	68 (11.2)	66 (11.2)	65 (11.2)	<.001
HbA1c (mean/SD) [2]	7.1 (1.2)	7.1 (1.2)	7.1 (1.1)	7.1 (1.1)	7.1 (1.1)	ns.
Patients with poor glycaemic control (HbA1c≥7%) (%)[1]	43	45	42	42	46	<.05
N	8975	1999	2862	2707	1407	
HC characteristics						
Temporary employees (%)[1]	22	28	12	30	16	<.001
Staff sickness absence days (mean/SD)[2]	14 (5.3)	9 (4.3)	17 (2.3)	12 (5.4)	16 (5.5)	<.001
Socioeconomic composition of HC service area						
Percentage of the lowest educational level [1]	27	29	26	25	27	<.001
Median income level in the HC service area, euros (mean, SD)[2]	17203 (2556)	15660 (3057)	16097 (756)	18951 (2166)	18280 (2301)	<.001
Unemployment rate (mean, SD)[2]	7 (2.9)	7 (3.3)	10 (1.6)	4 (0.8)	6 (1.2)	<.001

1) x^2-test
2) 1-way ANOVA
3) Low demands and high control
4) Low demands and low control
5) High demands and high control
6) High demands and low control

Table 2. Patient, health centre, and health centre service area characteristics in primary care health centres (HCs) varying in supervisor support.

	Supervisor support in primary care health centre				
	All HCs (N=18)	Low support HCs (n=6)	Moderate support HCs (n=6)	High support HCs (n=6)	p-value
Patient characteristics					
Percentage of men[1]	51	48	54	52	<.001
Age (mean/SD)[2]	67 (11.2)	67 (11.3)	66 (11.0)	65 (11.6)	<.001
HbA1c-value (mean/SD) [2]	7.1 (1.2)	7.1 (1.3)	7.1 (1.1)	7.0 (1.1)	ns.
Patients with poor glycaemic control (HbA1c≥7%) (%)[1]	43	44	44	41	ns.
N	8975	3911	3194	1870	
HC characteristics					
Temporary employees (%)[1]	22	12	31	26	<.001
Staff sickness absence days (mean/SD)[2]	14 (5.3)	15 (4.4)	14 (4.5)	10 (6.6)	<.001
Socioeconomic composition of HC service area					
Percentage of the lowest educational level [1]	27	28	26	25	<.001
Median income level, euros (mean, SD)[2]	17203 (2556)	15173 (1510)	18971 (2009)	18429 (2055)	<.001
Unemployment rate (mean/SD)[2]	7 (2.9)	10 (1.4)	5 (1.4)	5 (0.6)	<.01

1) x^2-test
2) 1-way ANOVA

Table 3. Level of perceived job strain among the health care personnel (doctors and nurses) as a predictor of poor glycaemic control indicator (HbA1c≥7%) in patients with type 2 diabetes (N=8975) in primary care health centres (HCs, N=18).

Job strain in the HCs	**Unadjusted model**		**Model I***		**Model II****		**Model III*****	
	OR (95% CI)	p-value	OR (95% CI)	p-value	OR (95% CI)	p-value	OR (95% CI)	p-value
Fixed effects								
Low strain job	1.00		1.00		1.00		1.00	
Passive job	0.96 (0.72-1.27)	ns.	0.96 (0.72-1.27)	ns.	0.97 (0.70-1.36)	ns.	1.08 (0.86-1.36)	ns.
Active job	0.89 (0.68-1.18)	ns.	0.89 (0.67-1.19)	ns.	0.91 (0.69-1.20)	ns.	1.17 (0.96-1.43)	ns.
High strain job	1.08 (0.80-1.47)	ns.	1.09 (0.80-1.48)	ns.	1.10 (0.78-1.56)	ns.	1.44 (1.12-1.86)	<.01
Random effects								
HC variance (SE)	0.04 0.05		0.04 0.05		0.04 0.04		0.01 0.02	

Multilevel regression analysis
*Adjusted for patient characteristics (sex and age)
**Adjusted as model I + HC characteristics (the percentage of temporary employees and the mean rate of sickness absence days in the HC)
*** Adjusted as model II + HC service area characteristics (educational level of the residents, median income and unemployment rate)

Table 4. Level of perceived supervisor support among the health care personnel (doctors and nurses) as a predictor of poor glycaemic control indicator (HbA1c≥7%) in patients with type 2 diabetes (N=8975) in primary care health centres (HCs, N=18).

Supervisor support in the HCs	**Unadjusted model**		**Model I***		**Model II****		**Model III*****	
	OR (95% CI)	p-value	OR (95% CI)	p-value	OR (95% CI)	p-value	OR (95% CI)	p-value
Fixed effects								
High support	1.00		1.00		1.00		1.00	
Medium support	1.11 (0.86-1.43)	ns.	1.11 (0.86-1.43)	ns.	1.17 (0.90-1.53)	ns.	1.14 (0.95-1.36)	ns.
Low support	1.13 (0.88-1.45)	ns.	1.13 (0.88-1.45)	ns.	1.10 (0.84-1.44)	ns.	0.87 (0.65-1.16)	ns.
Random effects								
HC variance (SE)	0.04 0.05		0.04 0.05		0.03 0.04		0.01 0.02	

Multilevel regression analysis
*Adjusted for patient characteristics (sex and age)
**Adjusted as model I + HC characteristics (the percentage of temporary employees and the mean rate of sickness absence days in the HC)
*** Adjusted as model II + HC service area characteristics (educational level of the residents, median income and unemployment rate)

STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cross-sectional studies*

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4-5
Objectives	3	State specific objectives, including any prespecified hypotheses	5
Methods			
Study design	4	Present key elements of study design early in the paper	5-6
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5-6
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	5-6
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	6-7
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	6-7
Bias	9	Describe any efforts to address potential sources of bias	*6 (all patients with type 2 diabetes were included)*
Study size	10	Explain how the study size was arrived at	5-6
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	6-7
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	7-8
		(*b*) Describe any methods used to examine subgroups and interactions	
		(*c*) Explain how missing data were addressed	8
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	

		(*e*) Describe any sensitivity analyses	
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	5-7, 15-18
		(b) Give reasons for non-participation at each stage	
		(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	8, 15-16
		(b) Indicate number of participants with missing data for each variable of interest	
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	8, 10, 15-18
		(*b*) Report category boundaries when continuous variables were categorized	6, 17-18
		(*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	8-9
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	10
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	10
Generalisability	21	Discuss the generalisability (external validity) of the study results	10-11
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	11

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

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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Job strain and supervisor support in primary care health centres and glycaemic control among patients with type 2 diabetes – a cross-sectional study

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Job strain and supervisor support in primary care health centres and glycaemic control among patients with type 2 diabetes – a cross-sectional study

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Word Count: 2756

Abstract

Objectives This study investigates associations between health care personnel's perceived job strain, supervisor support and the outcome of care in terms of glycaemic control among patients with type 2 diabetes.

Design A cross-sectional study from 2006.

Setting Eighteen primary care health centres (HCs) from five municipalities in Finland.

Participants Aggregated survey data on perceived job strain and supervisor support from health care personnel (doctors, n=122, mean age 45.5 years, nurses, n=300, mean age 47.1 years) were combined with registered data (Electronic Medical Records) from 8975 patients (51% men, mean age 67 years) with type 2 diabetes.

Outcome measure Poor glycaemic control (HbA1c ≥7%).

Results The mean HbA1c-level among the patients with type 2 diabetes was 7.1 (SD 1.2, range 4.5-19.1), and 43% had poor glyacemic control (HbA1c ≥7%). Multilevel logistic regression analyses adjusted for patient's age and sex, and HC- and HC service area-level characteristics showed that patients' HbA1c-levels were less optimal in high strain HCs than in low strain HCs (OR 1.44, 95%, CI 1.12-1.86). Supervisor support in HCs was not associated with the outcome of care.

Conclusion The level of job strain among the health care personnel may play a role in achieving good glycaemic control among patients with type 2 diabetes.

ARTICLE SUMMARY

Article focus

- This paper focuses on the association between job strain and supervisor support of health care personnel and the outcome of care among patients with type 2 diabetes.

Key message

- HbA1c-levels were less optimal in primary care health centres where health care personnel's perceived job strain was high compared with primary care health centres where perceived job strain was low.

Strengths and limitations of this study

- Previous studies suggest that the organization of care can affect the quality and the outcome of care in diabetes. This study showed that job strain of health care personnel may be one key factor associated with glycaemic control among patients with type 2 diabetes.
- We did not have information on patients' health behaviour, medication and comorbidity associated with type 2 diabetes.

INTRODUCTION

Diabetes mellitus is an important and increasing public health problem worldwide[1 2 3]. In Finland, about 10% of the population has diabetes of which a majority is of type 2[4]. Primary health care faces a serious challenge to provide high quality care in order to decrease complications, mortality and costs caused by this public health burden.

Health care organizations may differ in the quality of care[5]. However, we know only little about organizational aspects that promote good care of diabetes. One aspect may relate to the organization of care. Collins et al.[6] showed that compliance to diabetes care was better in structured general practitioner (GP) care than in traditional hospital care or in hospital/GP shared care. McLean et al.[7] found that the intermediate outcome target in cholesterol measurement of diabetic patients was achieved more often in urban practices than in very remote rural practices. Medical outcomes of care in type 2 diabetes have been shown to be better in physician-nurse practitioner teams than in care provided by a physician alone[8 9]. Linzer et al.[10] found that good organizational culture with high values alignment with leadership and work control was associated with higher-quality care for diabetic patients. In the study by Virtanen et al.[11] perception of procedural justice among staff was associated with more optimal glycaemic control among patients.

More research on the associations between organizational factors and the quality of care, especially the outcome of care, in diabetes is needed. Based on the theory of Karasek[12] and Karasek & Theorell[13] equilibrium between personnel's job demands and job control as well as social support at work might be important organizational factors associated with the quality of care. Active work with high demands and high control most likely promotes high quality care[13]. High demands give challenges, motivation and promote learning but combined with high control high demands do not cause negative psychological strain. Instead, high-strain work with high demands and low control

exhausts personnel and decreases productivity. Low-strain work with high control and low demands may not offer optimal challenges, and passive work with low demands and low control may lead to apathy and loss of learned skills and abilities. Besides an optimal balance between job demands and job control, also social support at work is likely to promote good health, learning and productivity[13]. Social support can, for example, buffer the negative effect of psychological stressors on employee health, and co-workers and supervisors are valuable sources of information and expertise.

AIM AND HYPOTHESES OF THE STUDY

The aim of this study was to investigate associations between health care personnel's perceived job strain, supervisor support and the outcome of care in terms of glycaemic control among patients with type 2 diabetes. We hypothesize that glycaemic control is best achieved in primary care health centres where health care personnel have possibility to active work and high supervisor support.

METHODS

Study context

The study was conducted in 18 primary care health centres (HCs) in five municipalities in Finland. Municipalities differed in size (about 7500-200000 inhabitants) and the number of HCs in each municipality (1-10). In Finland, municipalities are responsible for organizing primary health care services and cover the costs together with the state. Primary health care services are provided by HCs that offer a wide range of care services including doctor and nurse services[14] and have a central role in disease management for major chronic conditions like diabetes[15]. Three of the five municipalities had a family doctor system in their HCs. The two other municipalities had the traditional model in which appointments can be made with any doctor in the HC. All HCs had a diabetes nurse. One city had also a clinic specialized for prevention and care of chronic conditions. Patients from HCs could be referred there for additional advice and care.

Data collection and participants

The data to this cross-sectional study were gathered in 2006. Information on job strain and supervisor support in 18 HCs is based on responses of doctors (n=122, mean age 45.5 years) and nurses (n=300, mean age 47.1 years), who took part in the Finnish Public Sector Study[16], a voluntary-basis survey addressed to local government personnel of the participating towns (response rate 79%). Information on sex, age, the postal zip code of area of residence and glycaemic control (HbA1c-values) of patients with the diagnosis of type 2 diabetes (N=8975, 51% men, mean age 67 years, SD 11, range 16-106 years) was collected from HC registers (Electronic Medical Records) by the contact persons who worked in HCs. They delivered anonymous data to researchers. Aggregated variables indicating the levels of job strain and social support (based on survey responses of doctors and nurses) were created for each HC and linked to patient data. Thus, each patient has information in her/his individual data on job strain and supervisor support in the HC that had responsibility of her/his diabetes care.

Because all patient data included only a very limited set of variables without any identification code it was totally anonymous. Thus, no informed consent was needed. Instead, a written approval based on a brief description of the study was applied for and granted by all chief physicians responsible for the organization and administration of primary care in the involved municipalities.

Measures

Job strain and supervisor support

Aggregated measure of job strain was derived from the responses of doctors and nurses (n=422) to questions measuring job demands (5 items) and job control (9 items) derived from the Job Content Questionnaire[17]. Aggregated measure of social support from the supervisor[18 19] (4 items) was

derived from a standard survey instrument of Statistics Finland[20]. A 5-point Likert-type response format ranging from 1 (totally agree) to 5 (totally disagree) was used for all items. A mean score for the constructs was computed and the individual scores were then used to measure aggregated scores of job strain and supervisor support for each work unit (HC) based on the identification of each participant's work unit obtained from employers' administrative records.

To create a job strain indicator for each HC, aggregated demands and control were split on the median and combined to four categories: low strain jobs (low demands combined with high control, 4 HCs), active jobs (high demands combined with high control, 5 HCs), passive jobs (low demands combined with low control, 5 HCs), and high strain jobs (high demands combined with low control, 4 HCs)[12]. To create a supervisor support indicator for each HC, aggregated supervisor support was split into three equal groups indicating low, medium and high support (6 HCs in each group).

Job strain and supervisor support indicators for each HC were created based on the responses of doctors and nurses because doctors and nurses work quite independently in HCs and these two professional groups both affect the quality of care. Aggregated job demands of doctors were higher (mean 3.9, range 3.0-4.4) than job demands of nurses (mean 3.5, range 2.8-4.3). Aggregated job control of doctors was also somewhat higher (mean 3.9, range 3.7-4.3) than job control of nurses (mean 3.8, range 3.6-4.2). In aggregated supervisor support there was no difference between doctors (mean 3.6, range 2.5-5.0) and nurses (3.6, range 2.9-4.5).

Glycaemic control

Glycaemic control was determined by 1 year's measurements of glycated haemoglobin (HbA1c) value. In case of several control measurements the mean HbA1c-value was calculated (mean number of measurements was 2.1, range 1-15). Of the patients, 35% had one measurement. Based

on the standards of medical care in diabetes[21 22] we used a value under 7% to indicate good and a value of 7 or higher to indicate poor glycaemic control. For an additional secondary analysis we used HbA1c-value of 8% as a cut point.

Background variables

Patient characteristics: Information on age, sex, and the postal zip code of area of residence of each patient was obtained from the HC's registers.

HC characteristics: The proportion of temporary employees and the mean rate of sickness absence days in the work unit in 2006 were drawn from employers' registers[23].

HC service area characteristics: By using the patient postal zip codes and data obtained from Statistics Finland we formulated the average educational level (percentage of adults aged >18 years whose highest education level is elementary school), the median income and the unemployment rate (unemployed persons belonging to the workforce divided by total workforce) of the residents in the HC catchment area, that is, the population-weighted means for residents in the specific areas that each HC served. The mean for each variable for each HC was calculated and linked to individual data on each patient. Educational level, income and unemployment rate are standard variables to characterize areal disadvantage and deprivation[24 25].

Statistical analysis

The statistical data analysis was carried out within individual patient data (N=8975) with HC characteristics on an aggregated level. Descriptive statistics were estimated and the baseline associations between independent variables, covariates and glycaemic control were tested with Pearson chi²-tests or one-way analysis of variance depending on the measurement scale of the variable of interest. Because the patients were nested within the 18 HC units, we used a two-level modelling to account the data structure with job strain (or supervisor support) at the second level

and the outcome – patient-level glycaemic control – at the first level. We fitted five models using the multilevel logistic regression analysis. The first model, an empty model including only the random effect variable, was used to examine the clustering of the outcome between the 18 HCs. Then, we added job strain (or supervisor support) to examine its associations with the outcome. Next, we added patient-level confounders, after that HC characteristics and finally, variables describing socioeconomic composition of the HC service area (unadjusted model, model I, II and III). Because we used register data combined with aggregated variables describing HCs and HC catchment areas, there were only a few missing cases, and they were not included in the analyses. Statistical analyses were performed using SPSS version 19.0 and R-program, version 2.13.0.

RESULTS

Tables 1-2 show baseline associations between independent variables, covariates and glycaemic control. The mean HbA1c level of patients was 7.1 (SD 1.2, range 4.5-19.1, Q1=6.3, median 6.8, Q3=7.6), and 43% had poor glycaemic control (≥7%). HCs did not differ in the mean HbA1c-levels but the percentage of poor glycaemic control was highest in high strain HCs.

The mean percentage of temporary employees in HCs was 22% and the average amount of sickness absence days was 14 days. The socioeconomic characteristics of the HC service areas were as follows: the mean proportion of residents in the patients' neighbourhood with only basic education was 27%, the median yearly income was 17203 euros, and the mean unemployment rate was 7%. (Table 1). The mean rates of job control, job demands and supervisor support in the HCs were 3.9, 3.6 and 3.6, respectively.

[Insert tables 1-2 somewhere here]

Tables 3-4 show that after adjustment for all covariates (model III) glycaemic control among patients was less optimal in HCs where care personnel's perceived job strain was high compared with HCs where job strain was low. Active and passive work HCs did not differ statistically significantly from low strain HCs in the outcome of care. Also, supervisor support was not associated with patients' glycaemic control (table 5).

[Insert tables 3-5 somewhere here]

DISCUSSION

This study showed that perceived job strain of health care personnel may be associated with the outcome of diabetes care. Glycaemic control among type 2 diabetes patients was less optimal in high strain HCs than in low strain HCs. Supervisor support was not associated with the outcome of care.

Several studies have found strong associations between experienced work load and burnout, particularly its exhaustion dimension[26 27 28]. Emotional exhaustion is further associated with low job performance shown in job withdrawal, deterioration of productivity and effectiveness[28], and the outcome of care[5 29]. Recent studies on physicians show that their experienced job strain, stress and burnout are associated with increased risk of suboptimal patient care and likelihood of making errors[30-33]. Exhausted employees are not effective, accurate or innovative at work[13]. Instead, a favourable psychosocial work environment may enhance employee well-being and motivate health care personnel to invent new working methods and strengthen patients' motivation to self-care.

However, patients' glycaemic control was not best in active jobs HCs as we predicted based on the job strain model[13]. This result is in line with the results of the study on clinicians in surgery by Klein et al.[31] They found that clinicians with active job reported suboptimal quality of care more often than clinicians with low-strain job. It is possible that active work assumption does not fit well in the health care sector. Active jobs give more challenges than low strain jobs or passive jobs but the motivational potential of higher demands of active jobs may be lost if demands are so high that they overwhelm health care personnel´s capacities. In that case high control or other job resources may have only limited capability of buffering the undesired impact of high job demands[26 34]. Contrary to our prediction, social support from supervisor was not associated with the outcome of care. The fact that doctors and nurses in the Finnish HCs work quite independently is a potential explanation for this. Doctors and nurses consult patients alone in separate appointments. Therefore, supervisor support may not play a great role in daily appointments with patients and the outcome of care.

Register data give reliable care results but also has limitations. It does not give information on patients' socioeconomic status, such as educational level that is known to be strongly related with health behaviour, many unhealthy behaviours like smoking, poor dietary habits and physical inactivity being more prevalent in lower socioeconomic groups[35]. Healthy lifestyle again is the key factor in management of diabetes[21]. However, we were able to use disadvantage of the patient's residential area as a proxy for individual socioeconomic position. Indeed, the effect of job strain on glycaemic control emerged after adjustment of educational level, income and unemployment rate in the HC catchment area. This result points to suppression, a situation in which the magnitude of the relationship between an independent variable and a dependent variable becomes larger when a third variable (or multiple variables) is included to the analysis[36]

This was a cross-sectional study and no causal inferences of the associations between independent and dependent variables can be made. Another limitation was that we did not have information on patients' medication and comorbidity associated with type 2 diabetes[37]. Neither did we have information on other aspects of the quality of care, such as numbers of doctors or nurses per inhabitants in the HC service area indicating the sufficiency of staff. This is an important question to be further studied. However, job strain can be seen as one indicator of sufficiency of staff.

Further, we did not have access to exact information on where the principal care responsibility of the patients was. In spite of the fact that the patients had HbA1c-values measured via the HC it is possible that some of them, at least the younger ones, had also visited separate private or specialized public occupational health care units. In these cases, the psychosocial work environment of these units is more crucial for the outcome of care. However, the majority of the patients in the data were over 64 years old with many visits to the HC during 2006. Thus, it is unlikely that their main care responsibility would have been somewhere else. Also, the municipalities now studied, did not systematically differ in availability of care from occupational health care units.

This and previous studies suggest that the organization of care is associated with the quality and the outcome of care[5 11 31]. However, research evidence is still limited. Further studies including all relevant confounding factors are needed. Some of those factors may be equally or more strongly associated with patients' glycaemic control than the organization of care. In addition, follow-up studies investigating the effect of changes in the psychosocial work environment, for example in job strain, of health care personnel on change in glycaemic control of patients with type 2 diabetes, are

needed as well as interventions aiming at improving psychosocial work environment in health care. The studies of Bourbonnais et al.[38 39] showed that such interventions may have positive effect on the psychosocial work environment and mental health of health care personnel. Monitoring HbA1c-values might be a useful tool in strategic leaderships of HCs because maintaining good glycaemic control is essential in order to prevent micro- and macrovascular complications of diabetes and costs caused by these chronic diseases related to type 2 diabetes[1].

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Competing Interest

None to declare

Contributorship statement

Anne Koponen, the guarantor, formulated the initial hypotheses, designed the study, analyzed and interpreted data, and wrote the manuscript. Jussi Vahtera, Sakari Suominen, Marianna Virtanen and Mika Kivimäki formulated the initial hypotheses, designed the study, contributed to interpretation of the data, and reviewed/edited the manuscript. Nina Simonsen-Rehn designed the study, contributed to interpretation of the data, and reviewed/edited the manuscript. Jaana Pentti designed the study, analyzed data, contributed to interpretation of the data, and reviewed/edited the manuscript. Janne Pitkäniemi analyzed data, contributed to interpretation of the data, and reviewed/edited the manuscript.

Data sharing

We have no additional unpublished data from the study.

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Table 1. Patient, organization and service area characteristics in primary care health centres (HCs) varying in job strain.

	Job strain in primary care health centre (HC)					
	All HCs (N=18)	Low strain job HCs [3] (n=4)	Passive job HCs[4] (n=5)	Active job HCs[5] (n=5)	High strain job HCs[6] (n=4)	p-value
Patient characteristics						
Percentage of men[1]	51	50	48	54	52	<.001
Age (mean/SD) [2]	67 (11.6)	67 (10.9)	68 (11.2)	66 (11.2)	65 (11.2)	<.001
HbA1c (mean/SD) [2]	7.1 (1.2)	7.1 (1.2)	7.1 (1.1)	7.1 (1.1)	7.1 (1.1)	.349
Patients with poor glycaemic control (HbA1c≥7%) (%)[1]	43	45	42	42	46	.021
N	8975	1999	2862	2707	1407	
Organization characteristics						
Temporary employees (%)[1]	22	28	12	30	16	<.001
Staff sickness absence days (mean/SD)[2]	14 (5.3)	9 (4.3)	17 (2.3)	12 (5.4)	16 (5.5)	<.001
Socioeconomic composition of HC service area						
Percentage of the lowest educational level [1]	27	29	26	25	27	<.001
Median income level in the HC service area, euros (mean, SD)[2]	17203 (2556)	15660 (3057)	16097 (756)	18951 (2166)	18280 (2301)	<.001
Unemployment rate (mean, SD)[2]	7 (2.9)	7 (3.3)	10 (1.6)	4 (0.8)	6 (1.2)	<.001

1) x^2-test
2) 1-way ANOVA
3) Low demands and high control
4) Low demands and low control
5) High demands and high control
6) High demands and low control

Table 2. Patient, organization and service area characteristics in primary care health centres (HCs) varying in supervisor support.

	Supervisor support in primary care health centre (HC)				
	All HCs (N=18)	Low support HCs (n=6)	Moderate support HCs (n=6)	High support HCs (n=6)	p-value
Patient characteristics					
Percentage of men[1]	51	48	54	52	<.001
Age (mean/SD)[2]	67 (11.2)	67 (11.3)	66 (11.0)	65 (11.6)	<.001
HbA1c-value (mean/SD) [2]	7.1 (1.2)	7.1 (1.3)	7.1 (1.1)	7.0 (1.1)	.082
Patients with poor glycaemic control (HbA1c≥7%) (%)[1]	43	44	44	41	.076
N	8975	3911	3194	1870	
Organization characteristics					
Temporary employees (%)[1]	22	12	31	26	<.001
Staff sickness absence days (mean/SD)[2]	14 (5.3)	15 (4.4)	14 (4.5)	10 (6.6)	<.001
Socioeconomic composition of HC service area					
Percentage of the lowest educational level [1]	27	28	26	25	<.001
Median income level, euros (mean, SD)[2]	17203 (2556)	15173 (1510)	18971 (2009)	18429 (2055)	<.001
Unemployment rate (mean/SD)[2]	7 (2.9)	10 (1.4)	5 (1.4)	5 (0.6)	<.001

1) x^2-test
2) 1-way ANOVA

Table 3. Level of perceived job strain among the health care personnel (doctors and nurses) as a predictor of poor glycaemic control indicator (HbA1c≥7%) in patients with type 2 diabetes (N=8975) in primary care health centres (HCs, N=18).

Job strain in the HCs	**Unadjusted model**		**Model I***		**Model II****		**Model III*****	
	OR (95% CI)	p-value	OR (95% CI)	p-value	OR (95% CI)	p-value	OR (95% CI)	p-value
Fixed effects								
Low strain job	1.00		1.00		1.00		1.00	
Passive job	0.96 (0.72-1.27)	0.752	0.96 (0.72-1.27)	0.760	0.97 (0.70-1.36)	0.871	1.08 (0.86-1.36)	0.497
Active job	0.89 (0.68-1.18)	0.430	0.89 (0.67-1.19)	0.438	0.91 (0.69-1.20)	0.484	1.17 (0.96-1.43)	0.114
High strain job	1.08 (0.80-1.47)	0.603	1.09 (0.80-1.48)	0.586	1.10 (0.78-1.56)	0.572	1.44 (1.12-1.86)	0.004
Random effects								
HC variance (SE)	0.04 0.05		0.04 0.05		0.04 0.04		0.01 0.02	

Multilevel regression analysis
*Adjusted for patient characteristics (sex and age)
**Adjusted as model I + organization characteristics (the percentage of temporary employees and the mean rate of sickness absence days in the HC)
*** Adjusted as model II + HC service area characteristics (educational level of the residents, median income and unemployment rate)

Table 4. Level of perceived job strain among the health care personnel (doctors and nurses) as a predictor of poor glycaemic control indicator (HbA1c≥8%) in patients with type 2 diabetes (N=8975) in primary care health centres (HCs, N=18).

Job strain in the HCs	**Unadjusted model**		**Model I***		**Model II****		**Model III*****	
	OR (95% CI)	p-value	OR (95% CI)	p-value	OR (95% CI)	p-value	OR (95% CI)	p-value
Fixed effects								
Low strain job	1.00		1.00		1.00		1.00	
Passive job	1.06 (0.72-1.58)	0.764	1.07 (0.73-1.57)	0.742	1.08 (0.71-1.64)	0.725	1.16 (0.89-1.51)	0.287
Active job	0.84 (0.57-1.25)	0.394	0.83 (0.57-1.22)	0.341	0.86 (0.60-1.23)	0.408	1.23 (0.96-1.56)	0.101
High strain job	1.12 (0.73-1.71)	0.609	1.09 (0.72-1.65)	0.679	1.09 (0.71-1.69)	0.684	1.57 (1.17-2.12)	0.003
Random effects								
HC variance (SE)	0.07 0.06		0.07 0.06		0.06 0.06		0.01 0.02	

Multilevel regression analysis
*Adjusted for patient characteristics (sex and age)
**Adjusted as model I + organization characteristics (the percentage of temporary employees and the mean rate of sickness absence days in the HC)
*** Adjusted as model II + HC service area characteristics (educational level of the residents, median income and unemployment rate)

Table 5. Level of perceived supervisor support among the health care personnel (doctors and nurses) as a predictor of poor glycaemic control indicator (HbA1c≥7%) in patients with type 2 diabetes (N=8975) in primary care health centres (HCs, N=18).

Supervisor support in the HCs	**Unadjusted model**		**Model I***		**Model II****		**Model III*****	
	OR (95% CI)	p-value	OR (95% CI)	p-value	OR (95% CI)	p-value	OR (95% CI)	p-value
Fixed effects								
High support	1.00		1.00		1.00		1.00	
Medium support	1.11 (0.86-1.43)	.415	1.11 (0.86-1.43)	.441	1.17 (0.90-1.53)	.249	1.14 (0.95-1.36)	.157
Low support	1.13 (0.88-1.45)	.334	1.13 (0.88-1.45)	.353	1.10 (0.84-1.44)	.507	0.87 (0.65-1.16)	.344
Random effects								
HC variance (SE)	0.04 0.05		0.04 0.05		0.03 0.04		0.01 0.02	

Multilevel regression analysis
*Adjusted for patient characteristics (sex and age)
**Adjusted as model I + organization characteristics (the percentage of temporary employees and the mean rate of sickness absence days in the HC)
*** Adjusted as model II + HC service area characteristics (educational level of the residents, median income and unemployment rate)

Job strain and supervisor support in primary care health centres and glycaemic control among patients with type 2 diabetes – a cross-sectional study

Abstract

Objectives This study investigates associations between health care personnel's perceived job strain, supervisor support and the outcome of care in terms of glycaemic control among patients with type 2 diabetes.

Design A cross-sectional study from 2006.

Setting Eighteen primary care health centres (HCs) from five municipalities in Finland.

Participants Aggregated survey data on perceived job strain and supervisor support from health care personnel (doctors, n=122, mean age 45.5 years, nurses, n=300, mean age 47.1 years) were combined with registered data (Electronic Medical Records) from 8975 patients (51% men, mean age 67 years) with type 2 diabetes.

Outcome measure Poor glycaemic control (HbA1c ≥7%).

Results The mean HbA1c-level among the patients with type 2 diabetes was 7.1 (SD 1.2, range 4.5-19.1), and 43% had poor glyacemic control (HbA1c ≥7%). Multilevel logistic regression analyses adjusted for patient's age and sex, and HC- and HC service area-level characteristics showed that patients' HbA1c-levels were less optimal in high strain HCs than in low strain HCs (OR 1.44, 95%, CI 1.12-1.86). Supervisor support in HCs was not associated with the outcome of care.

Conclusion The level of job strain among the health care personnel may play a role in achieving good glycaemic control among patients with type 2 diabetes.

ARTICLE SUMMARY

Article focus

- This paper focuses on the association between job strain and supervisor support of health care personnel and the outcome of care among patients with type 2 diabetes.

Key message

- HbA1c-levels were less optimal in primary care health centres where health care personnel's perceived job strain was high compared with primary care health centres where perceived job strain was low.

Strengths and limitations of this study

- Previous studies suggest that the organization of care can affect the quality and the outcome of care in diabetes. This study showed that job strain of health care personnel may be one key factor associated with glycaemic control among patients with type 2 diabetes.
- We did not have information on patients' health behaviour, medication and comorbidity associated with type 2 diabetes.

INTRODUCTION

Diabetes mellitus is an important and increasing public health problem worldwide[1 2 3]. In Finland, about 10% of the population has diabetes of which a majority is of type 2[4]. Primary health care faces a serious challenge to provide high quality care in order to decrease complications, mortality and costs caused by this public health burden.

Health care organizations may differ in the quality of care[5]. However, we know only little about organizational aspects that promote good care of diabetes. One aspect may relate to the organization of care. Collins et al.[6] showed that compliance to diabetes care was better in structured general practitioner (GP) care than in traditional hospital care or in hospital/GP shared care. McLean et al.[7] found that the intermediate outcome target in cholesterol measurement of diabetic patients was achieved more often in urban practices than in very remote rural practices. Medical outcomes of care in type 2 diabetes have been shown to be better in physician-nurse practitioner teams than in care provided by a physician alone[8 9]. Linzer et al.[10] found that good organizational culture with high values alignment with leadership and work control was associated with higher-quality care for diabetic patients. In the study by Virtanen et al.[11] perception of procedural justice among staff was associated with more optimal glycaemic control among patients.

More research on the associations between organizational factors and the quality of care, especially the outcome of care, in diabetes is needed. Based on the theory of Karasek[12] and Karasek & Theorell[13] equilibrium between personnel's job demands and job control as well as social support at work might be important organizational factors associated with the quality of care. Active work with high demands and high control most likely promotes high quality care[13]. High demands give challenges, motivation and promote learning but combined with high control high demands do not cause negative psychological strain. Instead, high-strain work with high demands and low control

exhausts personnel and decreases productivity. Low-strain work with high control and low demands may not offer optimal challenges, and passive work with low demands and low control may lead to apathy and loss of learned skills and abilities. Besides an optimal balance between job demands and job control, also social support at work is likely to promote good health, learning and productivity[13]. Social support can, for example, buffer the negative effect of psychological stressors on employee health, and co-workers and supervisors are valuable sources of information and expertise.

AIM AND HYPOTHESES OF THE STUDY

The aim of this study was to investigate associations between health care personnel's perceived job strain, supervisor support and the outcome of care in terms of glycaemic control among patients with type 2 diabetes. We hypothesize that glycaemic control is best achieved in primary care health centres where health care personnel have possibility to active work and high supervisor support.

METHODS

Study context

The study was conducted in 18 primary care health centres (HCs) in five municipalities in Finland. Municipalities differed in size (about 7500-200000 inhabitants) and the number of HCs in each municipality (1-10). In Finland, municipalities are responsible for organizing primary health care services and cover the costs together with the state. Primary health care services are provided by HCs that offer a wide range of care services including doctor and nurse services[14] and have a central role in disease management for major chronic conditions like diabetes[15]. Three of the five municipalities had a family doctor system in their HCs. The two other municipalities had the traditional model in which appointments can be made with any doctor in the HC. All HCs had a diabetes nurse. One city had also a clinic specialized for prevention and care of chronic conditions. Patients from HCs could be referred there for additional advice and care.

Data collection and participants

The data to this cross-sectional study were gathered in 2006. Information on job strain and supervisor support in 18 HCs is based on responses of doctors (n=122, mean age 45.5 years) and nurses (n=300, mean age 47.1 years), who took part in the Finnish Public Sector Study[16], a voluntary-basis survey addressed to local government personnel of the participating towns (response rate 79%). Information on sex, age, the postal zip code of area of residence and glycaemic control (HbA1c-values) of patients with the diagnosis of type 2 diabetes (N=8975, 51% men, mean age 67 years, SD 11, range 16-106 years) was collected from HC registers (Electronic Medical Records) by the contact persons who worked in HCs. They delivered anonymous data to researchers. Aggregated variables indicating the levels of job strain and social support (based on survey responses of doctors and nurses) were created for each HC and linked to patient data. Thus, each patient has information in her/his individual data on job strain and supervisor support in the HC that had responsibility of her/his diabetes care.

Because all patient data included only a very limited set of variables without any identification code it was totally anonymous. Thus, no informed consent was needed. Instead, a written approval based on a brief description of the study was applied for and granted by all chief physicians responsible for the organization and administration of primary care in the involved municipalities.

Measures

Job strain and supervisor support

Aggregated measure of job strain was derived from the responses of doctors and nurses (n=422) to questions measuring job demands (5 items) and job control (9 items) derived from the Job Content Questionnaire[17]. Aggregated measure of social support from the supervisor[18 19] (4 items) was

derived from a standard survey instrument of Statistics Finland[20]. A 5-point Likert-type response format ranging from 1 (totally agree) to 5 (totally disagree) was used for all items. A mean score for the constructs was computed and the individual scores were then used to measure aggregated scores of job strain and supervisor support for each work unit (HC) based on the identification of each participant's work unit obtained from employers' administrative records.

To create a job strain indicator for each HC, aggregated demands and control were split on the median and combined to four categories: low strain jobs (low demands combined with high control, 4 HCs), active jobs (high demands combined with high control, 5 HCs), passive jobs (low demands combined with low control, 5 HCs), and high strain jobs (high demands combined with low control, 4 HCs)[12]. To create a supervisor support indicator for each HC, aggregated supervisor support was split into three equal groups indicating low, medium and high support (6 HCs in each group).

Job strain and supervisor support indicators for each HC were created based on the responses of doctors and nurses because doctors and nurses work quite independently in HCs and these two professional groups both affect the quality of care. Aggregated job demands of doctors were higher (mean 3.9, range 3.0-4.4) than job demands of nurses (mean 3.5, range 2.8-4.3). Aggregated job control of doctors was also somewhat higher (mean 3.9, range 3.7-4.3) than job control of nurses (mean 3.8, range 3.6-4.2). In aggregated supervisor support there was no difference between doctors (mean 3.6, range 2.5-5.0) and nurses (3.6, range 2.9-4.5).

Glycaemic control

Glycaemic control was determined by 1 year's measurements of glycated haemoglobin (HbA1c) value. In case of several control measurements the mean HbA1c-value was calculated (mean number of measurements was 2.1, range 1-15). Of the patients, 35% had one measurement. Based

on the standards of medical care in diabetes[21 22] we used a value under 7% to indicate good and a value of 7 or higher to indicate poor glycaemic control. For an additional secondary analysis we used HbA1c-value of 8% as a cut point.

Background variables

Patient characteristics: Information on age, sex, and the postal zip code of area of residence of each patient was obtained from the HC's registers.

HC characteristics: The proportion of temporary employees and the mean rate of sickness absence days in the work unit in 2006 were drawn from employers' registers[23].

HC service area characteristics: By using the patient postal zip codes and data obtained from Statistics Finland we formulated the average educational level (percentage of adults aged >18 years whose highest education level is elementary school), the median income and the unemployment rate (unemployed persons belonging to the workforce divided by total workforce) of the residents in the HC catchment area, that is, the population-weighted means for residents in the specific areas that each HC served. The mean for each variable for each HC was calculated and linked to individual data on each patient. Educational level, income and unemployment rate are standard variables to characterize areal disadvantage and deprivation[24 25].

Statistical analysis

The statistical data analysis was carried out within individual patient data (N=8975) with HC characteristics on an aggregated level. Descriptive statistics were estimated and the baseline associations between independent variables, covariates and glycaemic control were tested with Pearson chi²-tests or one-way analysis of variance depending on the measurement scale of the variable of interest. Because the patients were nested within the 18 HC units, we used a two-level modelling to account the data structure with job strain (or supervisor support) at the second level

and the outcome – patient-level glycaemic control – at the first level. We fitted five models using the multilevel logistic regression analysis. The first model, an empty model including only the random effect variable, was used to examine the clustering of the outcome between the 18 HCs. Then, we added job strain (or supervisor support) to examine its associations with the outcome. Next, we added patient-level confounders, after that HC characteristics and finally, variables describing socioeconomic composition of the HC service area (unadjusted model, model I, II and III). Because we used register data combined with aggregated variables describing HCs and HC catchment areas, there were only a few missing cases, and they were not included in the analyses. Statistical analyses were performed using SPSS version 19.0 and R-program, version 2.13.0.

RESULTS

Tables 1-2 show baseline associations between independent variables, covariates and glycaemic control. The mean HbA1c level of patients was 7.1 (SD 1.2, range 4.5-19.1, Q1=6.3, median 6.8, Q3=7.6), and 43% had poor glycaemic control (≥7%). HCs did not differ in the mean HbA1c-levels but the percentage of poor glycaemic control was highest in high strain HCs.

The mean percentage of temporary employees in HCs was 22% and the average amount of sickness absence days was 14 days. The socioeconomic characteristics of the HC service areas were as follows: the mean proportion of residents in the patients' neighbourhood with only basic education was 27%, the median yearly income was 17203 euros, and the mean unemployment rate was 7%. (Table 1). The mean rates of job control, job demands and supervisor support in the HCs were 3.9, 3.6 and 3.6, respectively.

[Insert tables 1-2 somewhere here]

Tables 3-4 show that after adjustment for all covariates (model III) glycaemic control among patients was less optimal in HCs where care personnel's perceived job strain was high compared with HCs where job strain was low. Active and passive work HCs did not differ statistically significantly from low strain HCs in the outcome of care. Also, supervisor support was not associated with patients' glycaemic control (table 5).

[Insert tables 3-5 somewhere here]

DISCUSSION

This study showed that perceived job strain of health care personnel may be associated with the outcome of diabetes care. Glycaemic control among type 2 diabetes patients was less optimal in high strain HCs than in low strain HCs. Supervisor support was not associated with the outcome of care.

Several studies have found strong associations between experienced work load and burnout, particularly its exhaustion dimension[26 27 28]. Emotional exhaustion is further associated with low job performance shown in job withdrawal, deterioration of productivity and effectiveness[28], and the outcome of care[5 29]. Recent studies on physicians show that their experienced job strain, stress and burnout are associated with increased risk of suboptimal patient care and likelihood of making errors[30-33]. Exhausted employees are not effective, accurate or innovative at work[13]. Instead, a favourable psychosocial work environment may enhance employee well-being and motivate health care personnel to invent new working methods and strengthen patients' motivation to self-care.

However, patients' glycaemic control was not best in active jobs HCs as we predicted based on the job strain model[13]. This result is in line with the results of the study on clinicians in surgery by Klein et al.[31] They found that clinicians with active job reported suboptimal quality of care more often than clinicians with low-strain job. It is possible that active work assumption does not fit well in the health care sector. Active jobs give more challenges than low strain jobs or passive jobs but the motivational potential of higher demands of active jobs may be lost if demands are so high that they overwhelm health care personnel´s capacities. In that case high control or other job resources may have only limited capability of buffering the undesired impact of high job demands[26 34]. Contrary to our prediction, social support from supervisor was not associated with the outcome of care. The fact that doctors and nurses in the Finnish HCs work quite independently is a potential explanation for this. Doctors and nurses consult patients alone in separate appointments. Therefore, supervisor support may not play a great role in daily appointments with patients and the outcome of care.

Register data give reliable care results but also has limitations. It does not give information on patients' socioeconomic status, such as educational level that is known to be strongly related with health behaviour, many unhealthy behaviours like smoking, poor dietary habits and physical inactivity being more prevalent in lower socioeconomic groups[35]. Healthy lifestyle again is the key factor in management of diabetes[21]. However, we were able to use disadvantage of the patient's residential area as a proxy for individual socioeconomic position. Indeed, the effect of job strain on glycaemic control emerged after adjustment of educational level, income and unemployment rate in the HC catchment area. This result points to suppression, a situation in which the magnitude of the relationship between an independent variable and a dependent variable becomes larger when a third variable (or multiple variables) is included to the analysis[36]

This was a cross-sectional study and no causal inferences of the associations between independent and dependent variables can be made. Another limitation was that we did not have information on patients' medication and comorbidity associated with type 2 diabetes[37]. Neither did we have information on other aspects of the quality of care, such as numbers of doctors or nurses per inhabitants in the HC service area indicating the sufficiency of staff. This is an important question to be further studied. However, job strain can be seen as one indicator of sufficiency of staff.

Further, we did not have access to exact information on where the principal care responsibility of the patients was. In spite of the fact that the patients had HbA1c-values measured via the HC it is possible that some of them, at least the younger ones, had also visited separate private or specialized public occupational health care units. In these cases, the psychosocial work environment of these units is more crucial for the outcome of care. However, the majority of the patients in the data were over 64 years old with many visits to the HC during 2006. Thus, it is unlikely that their main care responsibility would have been somewhere else. Also, the municipalities now studied, did not systematically differ in availability of care from occupational health care units.

This and previous studies suggest that the organization of care is associated with the quality and the outcome of care[5 11 31]. However, research evidence is still limited. Further studies including all relevant confounding factors are needed. Some of those factors may be equally or more strongly associated with patients' glycaemic control than the organization of care. In addition, follow-up studies investigating the effect of changes in the psychosocial work environment, for example in job strain, of health care personnel on change in glycaemic control of patients with type 2 diabetes, are

needed as well as interventions aiming at improving psychosocial work environment in health care. The studies of Bourbonnais et al.[38 39] showed that such interventions may have positive effect on the psychosocial work environment and mental health of health care personnel. Monitoring HbA1c-values might be a useful tool in strategic leaderships of HCs because maintaining good glycaemic control is essential in order to prevent micro- and macrovascular complications of diabetes and costs caused by these chronic diseases related to type 2 diabetes[1].

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Competing Interest

None to declare

Contributorship statement

Anne Koponen, the guarantor, formulated the initial hypotheses, designed the study, analyzed and interpreted data, and wrote the manuscript. Jussi Vahtera, Sakari Suominen, Marianna Virtanen and Mika Kivimäki formulated the initial hypotheses, designed the study, contributed to interpretation of the data, and reviewed/edited the manuscript. Nina Simonsen-Rehn designed the study, contributed to interpretation of the data, and reviewed/edited the manuscript. Jaana Pentti designed the study, analyzed data, contributed to interpretation of the data, and reviewed/edited the manuscript. Janne Pitkäniemi analyzed data, contributed to interpretation of the data, and reviewed/edited the manuscript.

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Table 1. Patient, organization and service area characteristics in primary care health centres (HCs) varying in job strain.

	Job strain in primary care health centre (HC)					
	All HCs (N=18)	Low strain job HCs [3] (n=4)	Passive job HCs[4] (n=5)	Active job HCs[5] (n=5)	High strain job HCs[6] (n=4)	p-value
Patient characteristics						
Percentage of men[1]	51	50	48	54	52	<.001
Age (mean/SD) [2]	67 (11.6)	67 (10.9)	68 (11.2)	66 (11.2)	65 (11.2)	<.001
HbA1c (mean/SD) [2]	7.1 (1.2)	7.1 (1.2)	7.1 (1.1)	7.1 (1.1)	7.1 (1.1)	.349
Patients with poor glycaemic control (HbA1c≥7%) (%)[1]	43	45	42	42	46	.021
N	8975	1999	2862	2707	1407	
Organization characteristics						
Temporary employees (%)[1]	22	28	12	30	16	<.001
Staff sickness absence days (mean/SD)[2]	14 (5.3)	9 (4.3)	17 (2.3)	12 (5.4)	16 (5.5)	<.001
Socioeconomic composition of HC service area						
Percentage of the lowest educational level [1]	27	29	26	25	27	<.001
Median income level in the HC service area, euros (mean, SD)[2]	17203 (2556)	15660 (3057)	16097 (756)	18951 (2166)	18280 (2301)	<.001
Unemployment rate (mean, SD)[2]	7 (2.9)	7 (3.3)	10 (1.6)	4 (0.8)	6 (1.2)	<.001

1) x^2-test
2) 1-way ANOVA
3) Low demands and high control
4) Low demands and low control
5) High demands and high control
6) High demands and low control

Table 2. Patient, organization and service area characteristics in primary care health centres (HCs) varying in supervisor support.

	Supervisor support in primary care health centre (HC)				
	All HCs (N=18)	Low support HCs (n=6)	Moderate support HCs (n=6)	High support HCs (n=6)	p-value
Patient characteristics					
Percentage of men[1]	51	48	54	52	<.001
Age (mean/SD)[2]	67 (11.2)	67 (11.3)	66 (11.0)	65 (11.6)	<.001
HbA1c-value (mean/SD) [2]	7.1 (1.2)	7.1 (1.3)	7.1 (1.1)	7.0 (1.1)	.082
Patients with poor glycaemic control (HbA1c≥7%) (%)[1]	43	44	44	41	.076
N	8975	3911	3194	1870	
Organization characteristics					
Temporary employees (%)[1]	22	12	31	26	<.001
Staff sickness absence days (mean/SD)[2]	14 (5.3)	15 (4.4)	14 (4.5)	10 (6.6)	<.001
Socioeconomic composition of HC service area					
Percentage of the lowest educational level [1]	27	28	26	25	<.001
Median income level, euros (mean, SD)[2]	17203 (2556)	15173 (1510)	18971 (2009)	18429 (2055)	<.001
Unemployment rate (mean/SD)[2]	7 (2.9)	10 (1.4)	5 (1.4)	5 (0.6)	<.001

1) x^2-test
2) 1-way ANOVA

Table 3. Level of perceived job strain among the health care personnel (doctors and nurses) as a predictor of poor glycaemic control indicator (HbA1c≥7%) in patients with type 2 diabetes (N=8975) in primary care health centres (HCs, N=18).

Job strain in the HCs	**Unadjusted model**		**Model I***		**Model II****		**Model III*****	
	OR (95% CI)	p-value	OR (95% CI)	p-value	OR (95% CI)	p-value	OR (95% CI)	p-value
Fixed effects								
Low strain job	1.00		1.00		1.00		1.00	
Passive job	0.96 (0.72-1.27)	0.752	0.96 (0.72-1.27)	0.760	0.97 (0.70-1.36)	0.871	1.08 (0.86-1.36)	0.497
Active job	0.89 (0.68-1.18)	0.430	0.89 (0.67-1.19)	0.438	0.91 (0.69-1.20)	0.484	1.17 (0.96-1.43)	0.114
High strain job	1.08 (0.80-1.47)	0.603	1.09 (0.80-1.48)	0.586	1.10 (0.78-1.56)	0.572	1.44 (1.12-1.86)	0.004
Random effects								
HC variance (SE)	0.04 0.05		0.04 0.05		0.04 0.04		0.01 0.02	

Multilevel regression analysis
*Adjusted for patient characteristics (sex and age)
**Adjusted as model I + organization characteristics (the percentage of temporary employees and the mean rate of sickness absence days in the HC)
*** Adjusted as model II + HC service area characteristics (educational level of the residents, median income and unemployment rate)

Table 4. Level of perceived job strain among the health care personnel (doctors and nurses) as a predictor of poor glycaemic control indicator (HbA1c≥8%) in patients with type 2 diabetes (N=8975) in primary care health centres (HCs, N=18).

Job strain in the HCs	Unadjusted model		Model I*		Model II**		Model III***	
	OR (95% CI)	p-value	OR (95% CI)	p-value	OR (95% CI)	p-value	OR (95% CI)	p-value
Fixed effects								
Low strain job	1.00		1.00		1.00		1.00	
Passive job	1.06 (0.72-1.58)	0.764	1.07 (0.73-1.57)	0.742	1.08 (0.71-1.64)	0.725	1.16 (0.89-1.51)	0.287
Active job	0.84 (0.57-1.25)	0.394	0.83 (0.57-1.22)	0.341	0.86 (0.60-1.23)	0.408	1.23 (0.96-1.56)	0.101
High strain job	1.12 (0.73-1.71)	0.609	1.09 (0.72-1.65)	0.679	1.09 (0.71-1.69)	0.684	1.57 (1.17-2.12)	0.003
Random effects								
HC variance (SE)	0.07 0.06		0.07 0.06		0.06 0.06		0.01 0.02	

Multilevel regression analysis
*Adjusted for patient characteristics (sex and age)
**Adjusted as model I + organization characteristics (the percentage of temporary employees and the mean rate of sickness absence days in the HC)
*** Adjusted as model II + HC service area characteristics (educational level of the residents, median income and unemployment rate)

Table 5. Level of perceived supervisor support among the health care personnel (doctors and nurses) as a predictor of poor glycaemic control indicator (HbA1c≥7%) in patients with type 2 diabetes (N=8975) in primary care health centres (HCs, N=18).

Supervisor support in the HCs	**Unadjusted model**		**Model I***		**Model II****		**Model III*****	
	OR (95% CI)	p-value	OR (95% CI)	p-value	OR (95% CI)	p-value	OR (95% CI)	p-value
Fixed effects								
High support	1.00		1.00		1.00		1.00	
Medium support	1.11 (0.86-1.43)	.415	1.11 (0.86-1.43)	.441	1.17 (0.90-1.53)	.249	1.14 (0.95-1.36)	.157
Low support	1.13 (0.88-1.45)	.334	1.13 (0.88-1.45)	.353	1.10 (0.84-1.44)	.507	0.87 (0.65-1.16)	.344
Random effects								
HC variance (SE)	0.04 0.05		0.04 0.05		0.03 0.04		0.01 0.02	

Multilevel regression analysis
*Adjusted for patient characteristics (sex and age)
**Adjusted as model I + organization characteristics (the percentage of temporary employees and the mean rate of sickness absence days in the HC)
*** Adjusted as model II + HC service area characteristics (educational level of the residents, median income and unemployment rate)

STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cross-sectional studies*

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4-5
Objectives	3	State specific objectives, including any prespecified hypotheses	5
Methods			
Study design	4	Present key elements of study design early in the paper	5-6
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5-6
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	5-6
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	6-7
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	6-7
Bias	9	Describe any efforts to address potential sources of bias	*6 (all patients with type 2 diabetes were included)*
Study size	10	Explain how the study size was arrived at	5-6
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	6-7
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	7-8
		(*b*) Describe any methods used to examine subgroups and interactions	
		(*c*) Explain how missing data were addressed	8
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	

		(*e*) Describe any sensitivity analyses	
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	5-7, 15-18
		(b) Give reasons for non-participation at each stage	
		(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	8, 15-16
		(b) Indicate number of participants with missing data for each variable of interest	
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	8, 10, 15-18
		(*b*) Report category boundaries when continuous variables were categorized	6, 17-18
		(*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	8-9
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	10
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	10
Generalisability	21	Discuss the generalisability (external validity) of the study results	10-11
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	11

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

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.