Fatigue in employees with diabetes: its relation with work characteristics and diabetes related burden

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Aims: To examine the relations between work characteristics as defined by the Job Demand-Control-Support model (JDCS) (that is, job demands, decision latitude, and social support), diabetes related burden (symptoms, seriousness of disease, self care activities, and disease duration), and fatigue in employees with diabetes mellitus.

Methods: Employees (n = 292) aged 30–60 years, with insulin treated diabetes, filled in self administered questionnaires that assess the above mentioned components of the JDCS model and diabetes related burdens.

Results: Both work and diabetes related factors are related to fatigue in employees with diabetes. Regression analyses revealed that work characteristics explain 19.1% of the variance in fatigue; lack of support, and the interaction of job demands and job control contribute significantly. Diabetes related factors explain another 29.0% of the variance, with the focus on diabetes related symptoms and the burden of adjusting insulin dosage to circumstances. Fatigue is more severe in case of lack of social support at work, high job demands in combination with a lack of decision latitude, more burden of adjusting insulin dosage to circumstances, and more diabetic symptoms. Furthermore, regression analysis revealed that diabetic symptoms and the burden of adjusting the insulin dosage to circumstances are especially relevant in combination with high job demands.

Conclusions: Both diabetes and work should be taken into consideration—by (occupational) physicians as well as supervisors—in the communication with people with diabetes.

Many people consider fatigue to be a problem; hence it is a common problem in the community.[1] A diversity of data is presented about the prevalence of fatigue, which varies between 7% and 45%,[1–6] due to various operationalisations of the concept and to differences in study populations. Fatigue has frequently been related to the working situation; it is a complaint employees often report.[7] Work can be a source of stress for everyone, which may lead to health complaints such as fatigue. Fatigue is also a main issue for people with diabetes; they report it twice as often as non-diabetics.[8] Although literature is available about fatigue in the general diabetes population, thus far no studies focus on the level of fatigue in the working diabetes population. Because employees with diabetes have to manage the stress related to work, as well as the burden of their disease, it is expected that—compared to employees without a chronic condition—their risk of fatigue will be higher. If employees suffer from fatigue, their performance may drop. This may also have consequences for their sickness absence rate and work disability.[9] The frequency and duration of sickness absence is higher in diabetics than non-diabetics. However, it seems that only a small proportion of the employees with diabetes is responsible for the high sickness rates.[10] Other studies found that people with diabetes work as many hours as people without diabetes, but they report more work-loss days,[11] more days of total disability, and more days of poor physical and poor mental health than control subjects without diabetes.[12] Furthermore, fatigue is a strong predictor of future work disability and the risk for receiving a disability pension is even higher in people with a chronic condition.[13] In this respect, it is important to explore the role of work and diabetes related variables in explaining fatigue, with the objective of promoting the performance of employees with diabetes with as few symptoms of fatigue as possible. Both aspects will be discussed in this contribution.

Work stress theories try to explain how stress in the workplace develops. The Job Demand-Control-Support (JDCS) model,[14 15] for instance, assumes that high job demands, lack of decision latitude, and lack of support (from colleagues and superiors) each have a negative effect on health. In addition to these so-called main effects, the JDCS model also predicts significant two way interaction effects (that is, high demands and lack of decision latitude), as well as three way interaction

Main messages

- Fatigue in employees with diabetes can to a large degree be explained by the components of the JDCS model: lack of social support and a combination of high demands with a lack of decision latitude. These findings can be expected for all employees.
- In addition to these work related factors, other important factors that explain fatigue in employees with diabetes are mainly the diabetic symptoms and, to a much lesser extent, the experienced burden of adjusting insulin dosage to circumstances.

Policy implications

- When fatigue is reported in employees with diabetes, interventions in the workplace should focus on improving co-worker and supervisor social support and preventing high job demands in combination with a lack of decision latitude. This particularly refers to people with diabetes who experience diabetes related symptoms. Supervisors of people with diabetes should be aware of the impact of these issues and discuss them with the employee.
- Medical professionals working with people with diabetes should, in addition to medical points of interest, also take the working conditions of these people into account when examining their health.

Abbreviations: CIS, Checklist Individual Strength; DSC-R, Diabetes Symptom Checklist–Revised; JDCS model, Job Demand-Control-Support model; VBBA, Questionnaire on the Experience and Assessment of Work effects (that is, high demands, lack of decision latitude, and lack of social support). Nevertheless, the interaction hypotheses are not often supported.[16 17] In contrast, the main effects are generally found—that is, high job demands, low decision latitude, and lack of support are related to poor workers health and wellbeing.[16]

In addition to the fact that fatigue is a work related complaint, it is also one of the most frequently reported complaints of individuals with chronic disorders and many of them experience it as the most demanding aspect of their disease.[18 19] In the case of people with diabetes, fatigue may directly result from physiological processes; it is a symptom of hypoglycaemia as well as hyperglycaemia.[20] Furthermore, fatigue can result from the burden associated with treatment and from long term diabetes related complications: retinopathy, nephropathy, neuropathy, and risk of cardiovascular diseases.[8] Diabetic treatment aims at controlling the blood glucose levels to near normal. To achieve this, type 1 diabetics and about 20% of type 2 diabetics have to inject insulin one or more times a day. In addition, they have to test their blood glucose level, plan their meals, and exercise. All these activities have to be geared to one another.

As indicated above, we can assume that both work and diabetes contribute to fatigue separately. Both aspects will probably also interact: in the workplace, people with diabetes who need to inject insulin and control their blood glucose levels are confronted with all the work related tasks on top of the burden of diabetes. In this study, the role of job characteristics and the role of diabetes related variables—in relation to fatigue—are explored. We consider people with diabetes as "normal" employees, who—in addition to the usual job stressors that are experienced by every employee—have to cope with their specific disease related demands. It is therefore hypothesised that diabetes related variables explain a significant proportion of the variance of experienced fatigue in addition to the proportion explained by the usual job stressors.

SUBJECTS AND METHODS

Study sample

A total of 874 subjects with insulin treated diabetes mellitus (type 1 and type 2), from three outpatient diabetes clinics in the Netherlands, were invited by letter (from their physician) to take part in the study. Information about the study was attached to the letter. They also received a form on which they could indicate whether they were willing to participate and whether they met the inclusion criteria. People with diabetes who were treated with insulin, were employed, and were 30–60 years of age were invited to take part. A total of 248 subjects did not meet the inclusion criteria. From the remaining 626 subjects, 347 were willing to participate (response rate 55.4%), 201 did not return the consent form, and 78 returned the form but indicated that they were not willing to participate. After returning the consent form, participants received a set of questionnaires, which they filled in at home. If they did not return the questionnaire within three weeks, they received a reminder. Altogether, 317 people with diabetes (166 type 1 and 151 type 2) filled in and returned the set of questionnaires (return rate 91.4%). Among them, 25 persons were unemployed ($n = 10$), not treated with insulin ($n = 4$), pregnant ($n = 1$), had not worked for more than six weeks due to illness ($n = 8$), or did not fill in the questionnaire properly ($n = 2$). Consequently, data from 292 employees with diabetes (159 type 1 and 133 type 2) could be analysed.

Assessment of diabetes related factors

Seriousness of disease, disease duration, diabetes related symptoms, and burden of self care activities have been used as indicators of the total diabetes related burden. Based on the self reported long term complications of diabetes, an index of disease severity has been established: no complications (0), micro- or macro-vascular complications (1), and micro- as well as macro-vascular complications (2). Disease duration has been defined as the time from the diagnosis up to the date when participants fill in the questionnaire. The score on the Diabetes Symptom Checklist–Revised (DSC-R) was used as a measure of symptom severity.[21] A score of total symptom severity has been established, based on eight underlying dimensions: hyperglycaemic, hypoglycaemic, psychosocial-cognitive, psychosocial-fatigue related, cardiovascular, neurological-pain related, neurological-sensory, and ophthalmological complaints. A coefficient α of 0.93 was found for the total scale. Scores range from 0 to 170. The burden of self care activities has been assessed with a scale (composed by the authors), which measures the burden of nutritional self care, injecting insulin, blood glucose testing, and adjusting the insulin dosage to the circumstances. The total scale consists of questions on the burden of the specific self care activity at home, at work, and during special occasions (for example, a party, a day out, or vacation) (for example, "Is it difficult for you to regularly check your blood glucose at home/at work/during special occasions?"). For the injection of insulin a score has been established on the basis of six items: three that focus on the frequency and three that focus on the amount of insulin injections. The subscale on nutritional self care also consists of six items: three that focus on nutritional guidelines and three that focus on the regularity of meals. The other two subscales consist of three items. Acceptable coefficients α were found for the four scales, ranging from 0.75 to 0.90. The correlations between the four self care variables were low (from 0.04 to 0.22) and, therefore, it is not possible to establish a homogeneous index for the general burden of self care activities. The four scales have therefore been used separately in the analyses. Finally, diabetes type (1 or 2) is taken into account in relation to fatigue.

Assessment of work characteristics

Job characteristics have been assessed by using five scales of the VBBA (Questionnaire on the Experience and Assessment of Work), a validated and frequently used instrument for measuring job stress.[22] Based on the JDCS model,[14 15] psychological demands of work have been measured with the "work pace and amount of work" scale (11 items; for example, "Do you have to work under time pressure?"), decision latitude with the "job autonomy" scale (11 items; for example, "Are you allowed to decide the order in which you perform your tasks?") and the "participation in work" scale (eight items; for example, "Do you have a say in what is and what isn't part of your task?"), and social support with the "support from colleagues" scale (nine items; for example, "Do you have a good relationship with your colleagues?") and the "support from the direct superior" scale (nine items; for example, "Can you rely on your supervisor when you experience problems in your work?"). The coefficient α for the job demands scale in this study is 0.89. Following the suggestion of Karasek, Schwartz, and Theorell, who combined the skill discretion and decision authority scales (measure of decision latitude) and the supervisor and co-worker support scales (measure of social support),[14 23] in this study one score (mean score of the two separate scales) has been established for decision latitude, with a coefficient α of 0.81, and for social support with a coefficient α of 0.73. Scores for all VBBA scales range from 0 to 100. High scores indicate many problems within the specific dimension.

Assessment of fatigue

The Checklist Individual Strength (CIS)[24] assesses general fatigue. The CIS is composed of four components: lack of motivation (four items; for example, "I feel no desire to do

Table 1 Study population (n=292): baseline characteristics

Gender (% male)	66.8%
Age (y)	44.6
Level of education	
Lower	34.3%
Middle	31.1%
Higher	31.9%
Unknown	2.7%
Occupational groups	
Education, culture, healthcare, and government	23.2%
Agrarian (manufacturing/construction), industry and transport	27.0%
Economic, administrative, and commercial	43.9%
Other	5.9%
Variables under study	
Disease duration (y)	16.1 (10.7)
Diabetic symptoms (0–170)	18.6 (14.1)
Seriousness of disease (0–2)	0.5 (0.6)
Burden nutritional self care (0–100)	31.9 (22.2)
Burden blood sugar control (0–100)	32.5 (30.2)
Burden injecting insulin (0–100)	7.3 (13.1)
Burden adjusting insulin dosage (0–100)	18.9 (28.9)
Job demands (0–100)	45.2 (16.6)
Lack of decision latitude (0–100)*	37.5 (21.1)
Lack of support (0–100)	21.9 (13.7)
Fatigue (0–140)	62.0 (26.5)

Results expressed as percentages and means (SD).
*n=269.

Table 2 Results of stepwise multiple regression analysis, fatigue predicted by work characteristics

Predictors	β	p value of *t* test	R^2
Variables entered in model			0.163
Lack of social support	0.207	0.002	
Lack of decision latitude	0.194	0.002	
Job demands	0.148	0.013	

Estimated standardised regression coefficients (β) and variance explained (R^2) are presented.

Table 3 Results of stepwise multiple regression analysis, fatigue predicted by diabetes related variables

Predictors	β	p value of *t* test	R^2
Variables entered in model			0.435
Diabetic symptoms	0.640	0.000	
Burden adjusting insulin dosage	0.099	0.033	
Variables removed from model			
Disease duration	0.090	0.053	
Burden nutritional self care	0.081	0.109	
Diabetes type	−0.077	0.104	
Burden blood glucose control	0.041	0.397	
Burden injecting insulin	−0.005	0.924	
Seriousness of disease	0.080	0.103	

Estimated standardised regression coefficients (β) and variance explained (R^2) are presented.

anything"), subjective fatigue (eight items; for example, "I feel tired"), lack of concentration (five items; for example, "I have trouble concentrating"), and physical activity (three items; for example, "I don't do much during the day"). For the analyses, a composite total score was used, because we wanted to gain more insight into general fatigue in the working diabetes population. A coefficient α of 0.95 was found in this study. Scores range from 0 to 140. High scores indicate many reported fatigue symptoms. The CIS was also used in other studies with diverse samples, for instance healthy employees and fatigued employees. Based on these data, a cut off point of 76 was determined, indicating an "at risk" situation for subsequent sick leave or work disability.[25]

Statistical analysis

SPSS 10.0.5 for Windows was used to analyse the data. Regression analyses were conducted to explore the relations between work characteristics, diabetes related variables, and fatigue as the dependent variable. Initial step by step univariate regression analyses were used to examine the relation of work and diabetes related variables with fatigue separately. Variables were entered into the model when the significance level of their F value was less than 0.05 and variables were removed when their level was greater than 0.10. After this exploration the variables that were entered into the two models were selected for the final integrated model. The selected work related variables were entered into the regression analyses as a whole, followed by the two way and three way interaction terms of demands, control, and support. Furthermore, the selected diabetes related variables were entered as a whole and the two way interaction terms of these variables. Finally, the interactions between the diabetes and work related variables were added.

RESULTS

Table 1 shows characteristics of the population. About 30% of the study population (n = 86) had a CIS score above the cut off score of 76. The mean score in this population is 62.01.

Correlation coefficients between the independent variables under study were calculated, in particular to look for conceptual overlap. It turned out that the correlations between the diabetes related variables were rather low (ranging from 0.00 to 0.40), with the exception of the correlation between diabetes type and disease duration ($r = 0.52$). The correlations between the work related variables range from 0.12 to 0.41. Based on these findings, we decided that all variables could be included in the regression analyses.

Work characteristics explain 16.3% of the variance in fatigue (table 2). Job demands (β = 0.15; p = 0.01), lack of decision latitude (β = 0.19; p = 0.00), and lack of support (β = 0.21; p = 0.00) were all entered into the model, each having a significant effect on fatigue.

Diabetes related variables explain 43.5% of the variance in fatigue, mostly because of diabetes related symptoms (β = 0.64; p = 0.00), which by themselves already explain 42.5% of the variance. The burden of adjusting the insulin dosage (β = 0.10; p = 0.03) is also significantly related to fatigue and explains an additional 1.0% of the remaining variance. Diabetes type (β = −0.08; p = 0.10), disease duration (β = 0.09; p = 0.05), burden of the nutritional self care activities (β = 0.08; p = 0.11), burden of glucose control (β = 0.04; p = 0.40), burden of injecting insulin (β = −0.01; p = 0.92), and seriousness of disease (β = 0.08: p = 0.10) do not contribute significantly to fatigue (table 3).

Table 4 presents the results of the final analysis with the selected diabetes and work related variables, and their interaction terms. Work characteristics explain 19.1% of the variance in fatigue: lack of support (β = 0.10; p = 0.05) and the interaction of job demands and decision latitude (β = 0.42; p = 0.02) contribute significantly. When the interaction term between demands and decision latitude was added in the regression model, no main effect was left over for job demands (β = −0.08; p = 0.49) and decision latitude (β = −0.13; p = 0.35). Figure 1 shows the interaction. When much decision latitude is reported, there is no difference in fatigue between the groups with high and low job demands. When decision latitude is more restricted, fatigue is more severe in the group with high job demands compared to the group with low job demands. No interactions between support

Table 4 Results of multiple regression analysis, fatigue predicted by diabetes related variables and work characteristics, including the interaction effects

Predictors	β final model	p value of *t* test	R^2	R^2 change	Sig. R^2 change
Block 1 (enter)			0.165	0.165	0.000
Job demands	−0.078	0.489			
Lack of decision latitude	−0.129	0.347			
Lack of support	0.104	0.047			
Block 2 (stepwise)			0.191	0.026	0.004
Job demands × lack of decision latitude	0.416	0.016			
Block 3 (enter)			0.480	0.290	0.000
Diabetic symptoms	0.863	0.000			
Burden adjusting insulin dosage	−0.204	0.120			
Block 4 (stepwise)					
Job demands × diabetic symptoms	−0.418	0.012	0.493	0.013	0.012
Job demands × burden adjusting insulin dosage	0.306	0.024	0.503	0.010	0.024

Estimated standardised regression coefficients (β) and variance explained at the specific step (R^2) are presented.

and demands (β = 0.05; p = 0.75), between support and decision latitude (β = 0.03; p = 0.84), and no three way interaction for demands, control, and support (β = 0.03; p = 0.84) were found.

Diabetes related factors explain another 29.0% of the variance, with the focus on diabetes related symptoms (β = 0.86; p = 0.00). No main effect was left over for the burden of adjusting insulin dosage to circumstances (β = −0.20; p = 0.12) after addition of the interactions between work and diabetes related variables. The interaction between the two diabetes related variables, diabetic symptoms, and burden of adjusting insulin, does not contribute significantly to the explanation of fatigue (β = 0.03; p = 0.80) and was therefore not added into the regression model when we used the stepwise method for regression analysis. In the last block, interaction terms between work and diabetes related variables were added. This resulted in a significant effect of the interaction between demands and diabetic symptoms (β = −0.42; p = 0.01), and between demands and the burden of adjusting the insulin dosage (β = 0.31; p = 0.02) on fatigue. No interaction effects were found for decision latitude and diabetic symptoms (β = 0.18; p = 0.18), for decision latitude and the burden of adjusting insulin dosage to circumstances (β = −0.01; p = 0.97), for support and diabetic symptoms (β = −0.16; p = 0.19), and for support and the burden of adjusting insulin dosage to circumstances (β = 0.08; p = 0.44).

Figures 2 and 3 present graphically the significant interaction effects. Groups have been established on the basis of the mean score on job demands: higher or lower than the mean score. The other variables have also been divided in two groups: people who have scores lower (when no or few problems are reported) or higher than the value corresponding to the 25th centile. When people report a low level of diabetic symptoms, there is no difference in fatigue between the groups with high and low demands. But when diabetic symptoms increase, more fatigue is reported in the group with high job demands compared to the group with low job demands (fig 2). Figure 3 illustrates that when people do not perceive adjusting their insulin dosage to circumstances as a difficulty, there is no difference in the level of fatigue between high and low job demands groups. When they do perceive adjusting insulin as a burden, more fatigue is reported in the group with high job demands compared to the group with low job demands. This is in agreement with the other interaction effects that were found (see figs 1 and 2).

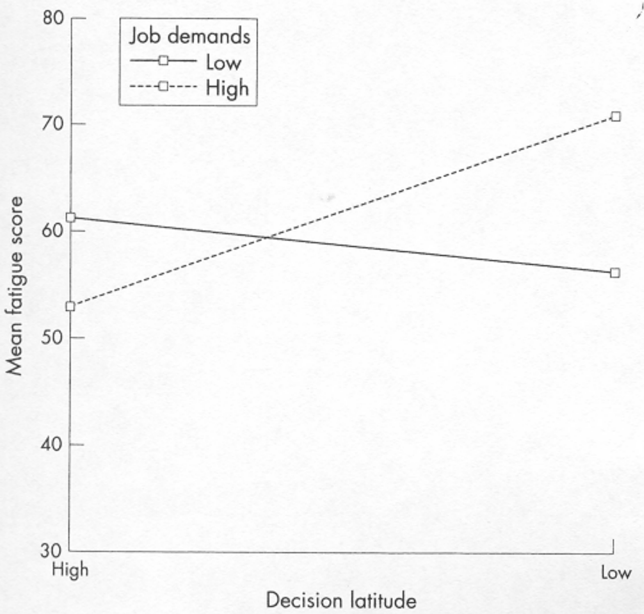

Figure 1 Interaction between job demands and decision latitude on fatigue.

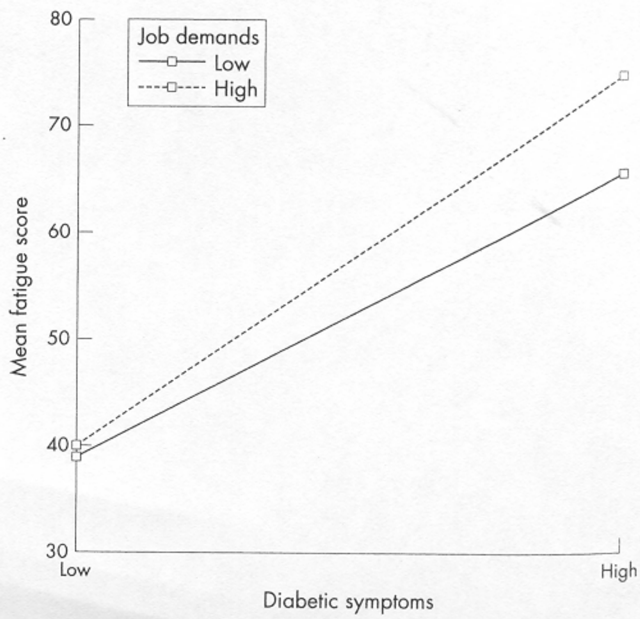

Figure 2 Interaction between job demands and diabetic symptoms on fatigue.

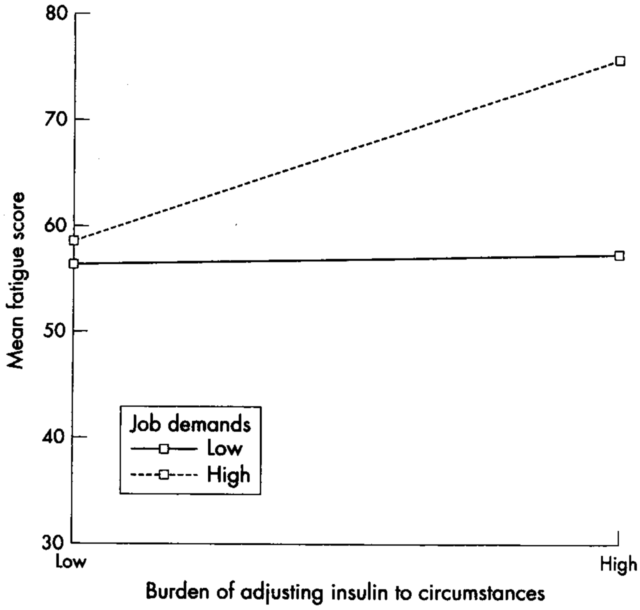

Figure 3 Interaction between job demands and burden of adjusting insulin dosage on fatigue.

CONCLUSIONS AND DISCUSSION

Half of the reported fatigue symptoms of employees with diabetes relates to their work situation and their disease: 20% can be explained by factors in the workplace and 30% by diabetes related factors.

Fatigue is more likely to be present when colleagues and direct superiors show little support, when job demands are high, and decision latitude is lacking. These results are as expected from the JDCS model.[14 15] However, there seems to be no interaction between support and the other two work characteristics. De Jonge and Kompier[16] concluded that the interaction hypothesis of the JDCS model is not often supported. Of interest in our study is that an interaction between job demands and decision latitude was actually found. It may be that people with diabetes are able to use the decision latitude to decrease the adverse effects of work demands, from what they have learned from coping with their disease. Employees with diabetes may be more inclined to cope actively with high demands.

Additionally, diabetes related symptoms have a major impact on fatigue. This is in line with Moos and Schaeffer, who mention that dealing with symptoms is the first task with which people with a chronic disease are confronted, besides the special stressors of treatment procedures.[26] Regarding self care activities, in our study, only the burden of adjusting the insulin dosage to circumstances proved to be important in relation to fatigue. This may be due to the fact that injecting insulin is a necessary activity for people with insulin dependent diabetes; it is a skill that has to be mastered and will become a routine. The same reasoning may apply for blood glucose control. Nutritional self care may be seen as less necessary and an experienced burden will therefore not affect health to a great extent. Adjusting the insulin dosage is not a routine action, because it requires flexibility and responsibility from the person, who must decide how and when to carry out these activities. Waclawski and Gill point to the positive aspects of flexible regimens with multiple injection treatment, which allows for greater variation in the timing of meals, and a better quality of life. Furthermore, careful regulation of insulin dosage together with blood glucose monitoring reduces the risk of hypoglycaemia and enables individuals to cope more easily with variations in daily work patterns.[27] When adjusting the insulin dosage is perceived as a difficult task, the positive effects of it could be counterbalanced. Surprisingly, seriousness of disease was not related to fatigue in our study, while studies show that as chronic conditions increase, the risk of developing fatigue also increases.[6 28] This finding might be explained by the fact that 56% of the people with diabetes in our study had no major diabetes related complications. Seriousness of disease was also moderately related to the diabetic symptom levels. This explains the fact that seriousness of disease does not add much to the variance in fatigue in addition to diabetic symptoms.

It was also found that high job demands by themselves are not relevant, but are a problem when employees also experience little control at work, report many diabetic symptoms, and have difficulty adjusting the insulin dosage to specific circumstances. Significant interactions between diabetes related variables and work are in accordance with the literature. Because of a chronic condition, problems in the work situation may exacerbate the general burden of stress.[26] Moreover, stressors—for example, in the workplace—may affect the blood glucose levels,[29] and therefore the health perception of people with diabetes.

In addition to diabetes related variables and work characteristics, other factors outside the workplace also influence people's health status. Coping, social support in the private setting, and self efficacy fulfil a mediating role in explaining health[16 30 31] and can influence the risk of chronic fatigue states. A multifactorial approach is probably best in relation to fatigue states.[1] Van der Doef and Maes, for example, concluded that gender differences are evident in relation to the JDCS model. They also suggest that subpopulations should be studied, because not all occupational groups benefit from the same work situation.[17] Furthermore, data were based on self reports of participants. Medical data on diabetes related complications were not available. This may result in a less objective index for seriousness of disease. Another concern is that fatigue is not only an outcome of the diabetic burden, but it is also a symptom of the disease: of hypoglycaemia and hyperglycaemia as well.[20] In this study these symptoms were part of the total diabetic symptom index, which is one of the independent variables. Therefore, and because of the cross sectional design, at this stage it is difficult to draw conclusions on causality. Results will also be limited due to the non-response, but the response rate here is comparable to those found in other studies on fatigue in employees[32] and in diabetes samples.[33] Therefore, we assume that generalisability of results will not be more problematic here than in other studies.

In general, it can be concluded that fatigue is more severe when support at work is low and more disease symptoms are present. Furthermore, fatigue is also more severe when decision latitude is lacking and adjusting insulin is seen as a burden, in combination with high job demands. Physicians, in examining the health status of people with diabetes, should be aware of the role and impact of work in relation to experienced fatigue symptoms in employees with diabetes. At the same time, supervisors and occupational physicians should examine the work situation of employees with diabetes within the context of diabetes. It is important to focus on lowering job demands, increasing control, and improving support, especially when diabetic symptoms are reported. These topics should also be raised—by both professions—in the communication with people with diabetes. When fatigue can be detected at an early stage, it is still possible to look for the determinants and to intervene in the workplace. By changing the work situation, the risk of fatigue and consequently the risk of sickness absence and work disability can be reduced.[9 13] Furthermore, the findings of this study are relevant to the vocational rehabilitation of people with diabetes who reintegrate into work. When their (future) jobs are characterised by high social support and much decision latitude without high workload, reintegration may be more successful, leading to lower levels of fatigue.

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