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Original Article

No evidence for increased self-reported cognitive failure in Type 1 and Type 2 diabetes: a cross-sectional study

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Abstract

Aims Mild cognitive deficits have been determined in both types of diabetes using neurocognitive tests. Little is known about the degree to which patients complain about their cognitive functioning. This study set out to investigate the magnitude and correlates of self-reported cognitive failure in adult out-patients with Type 1 and Type 2 diabetes.

Methods Subjective cognitive functioning was measured in 187 diabetic patients using the Cognitive Failures Questionnaire (CFQ). Demographic and clinical characteristics were retrieved from the medical records. The Patient Health Questionnaire 9 items (PHQ-9) was self-administered along with the CFQ to correct for the confounding effect of depression.

Results Analyses were based on 55 patients with Type 1 diabetes and 100 patients with Type 2 diabetes. No difference in mean CFQ score was observed between Type 1 and Type 2 diabetic patients or between Type 1 diabetic patients and healthy control subjects. Female patients with Type 2 diabetes reported significantly fewer cognitive complaints compared with female healthy control subjects. None of the demographic variables and diabetes-related complications was associated with subjective cognitive complaints. A strong positive association was found between depression symptomatology and frequency of self-reported cognitive failure.

Conclusions Our study could not confirm elevated subjective cognitive complaints in a group of Type 1 and Type 2 diabetes patients, as might be expected given the observed elevated rates of mild cognitive dysfunction in patients with diabetes. Self-reported cognitive failure appears largely determined by depressive symptomatology. Therefore, affective status should be included in any cognitive assessment procedure.

Diabet. Med. 24, 735–740 (2007)

Keywords depression, self-reported cognitive failure, Type 1 diabetes, Type 2 diabetes

Abbreviations CFQ, Cognitive Failures Questionnaire; PHQ-9, Patient Health Questionnaire 9 items

Introduction

Diabetes mellitus is associated with the occurrence of well-described microvascular and macrovascular complications, including retinopathy, nephropathy, peripheral neuropathy and cardiovascular disease. Evidence is increasing that diabetes is also associated with mild performance deficits on a range of neuropsychological tests [1,2].

Little is known, however, about the subjective experience of cognitive dysfunctioning in persons with diabetes. Subjective cognitive complaints may include decreased attention and concentration, forgetfulness, difficulty completing more than one task simultaneously, and slowed thinking [3,4]. It is important to note that from a quality of life perspective, the subjective experience of cognitive dysfunction is an important outcome in itself [5–7]. Moreover, reported cognitive complaints may have prognostic value, as they could be early signs of cognitive decline in the future, as has been shown in dementia [8–11].

To the best of our knowledge, the question of whether middle-aged adult patients with Type 1 and Type 2 diabetes have subjective complaints has not yet been studied. Subjective cognitive complaints in diabetes may be influenced by age, education and diabetes-related factors, including duration of the disease, frequency of severe hypoglycaemia and presence of

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complications. Also, depressed mood can influence subjective cognitive functioning and should therefore be taken into account [6,12–16].

The aim of this study was to investigate (i) the magnitude of cognitive complaints in adult patients with Type 1 and Type 2 diabetes relative to published norms for healthy control subjects, and (ii) the associations between these complaints and demographic and clinical patient characteristics, including current symptoms of depression.

Patients and methods

Subjects

Data were collected within the framework of a multicentre depression screening research project in the Netherlands. For the present study, baseline data from one of the participating hospitals, Haaglanden Medical Centre (Westeinde, The Hague, the Netherlands) were used. A random sample of 555 out-patients with diabetes was drawn from the patient register of Westeinde Hospital. A demographic questionnaire (including a question regarding total number of severe hypoglycaemic episodes), a second questionnaire (depression and cognitive failures; see Measures) and, in case of non-response, a reminder letter (which was sent after the first letter and questionnaires) were sent to these out-patients. Clinical information was extracted from the medical records of each patient. Patients were excluded on the grounds of epilepsy, stroke or if taking psychiatric medication at that time.

Written consent was obtained from all participants and the study was approved by the local medical ethics advisory committee. The investigations were carried out in accordance with the principles of the Declaration of Helsinki as revised in 2000.

Measures

Participants completed the following questionnaires at home and returned the completed questionnaires in stamped addressed envelopes:

1. A short questionnaire was developed with questions pertaining to history of head trauma, Parkinson's disease, epilepsy, blood pressure, stroke, psychotropic medication and history of severe hypoglycaemia since disease onset (defined as hypoglycaemia with unconsciousness and external assistance for recovery since diabetes onset).
2. The Dutch version of the Cognitive Failures Questionnaire (CFQ) [17,18]. The CFQ consists of 25 items measuring the frequency of everyday cognitive failures or lapses in the general population. These concern failures of memory, attention, motor function and perception. Evidence suggests the CFQ is unifactorial, measuring a general factor of cognitive failure [17–20]. Each item is rated for frequency in the past 6 months, from 4 ('very often') to 0 ('never'). The maximum score is 100. Higher total CFQ scores reflect a higher frequency of self-reported cognitive failures. The psychometric qualities of the Dutch translation of the CFQ are satisfactory: test–retest reliability, 0.83; Cronbach's α, 0.79 [18]. The mean score and SD of a Dutch reference group (3021 adults, mean age 46.8 years) was 32.2 ± 9.9 [21].
3. We used the nine-item depression module of the Patient Health Questionnaire, the PHQ-9, to chart the frequency of depression symptoms occurring during the previous 2 weeks [22]. A PHQ diagnosis of major depression has been found to have high agreement with the diagnosis of major depression based on a structured interview [22,23]. Scores of ≥ 4 indicate no depression. Scores of 5–14 indicate a need for clinical judgement about treatment, based on the patient's duration of symptoms and functional impairment, and scores of ≥ 15 represent likely major depression.

From the medical records of the patients, the following data were extracted: age, gender, ethnicity (White or non-White), highest level of completed educational level [this variable was assessed by a Dutch scoring system that consists of an eight-point scale, ranging from unfinished primary education (level 1) to university education (level 8)], type of diabetes, duration of diabetes, microvascular complications (retinopathy: background or proliferative, nephropathy and neuropathy), cardiovascular disease, haemoglobin A_{1c} (HbA_{1c}) and blood pressure.

Statistical analysis

Statistical analysis was performed using SPSS version 11.0 (SPSS Inc., Chicago, IL, USA). Continuous demographic data of the participants were analysed using independent means *t*-tests and χ^2 tests were used for categorical variables [for expected frequencies (i.e. cell counts < 5) we used Fisher's exact test]. A *P*-value < 0.05 was considered to be statistically significant. Stepwise linear multiple regression analysis (both groups of diabetes in one regression model) was used to study whether subjective cognitive complaints could be predicted by means of three subsequent blocks, that contained the following independent variables (coded as 1 for the regression analysis): (i) female gender, age, being married/partner, having low education [which is defined as equal to or less than vocational training (level 3 according to the Dutch scoring system)], non-White; (ii) diabetes duration, retinopathy (background and proliferative retinopathy combined), nephropathy, neuropathy, cardiovascular disease(s) and severe hypoglycaemic episodes (defined as hypoglycaemia with unconsciousness and external assistance for recovery since diabetes onset); and (iii) depression score.

First, we investigated the contribution of the demographic variables on CFQ scores (Model 1). Those variables which were not significantly predictive of CFQ scores were removed from the second step (Model 2): the contribution of the clinical variables on CFQ score. In the last step (Model 3, prediction of depression scores on CFQ scores) only those variables significantly predicting CFQ scores in any of the earlier models were included. Age and gender were included in all of the models. Analyses were based on all participants for whom data were complete. All the data met the requirements of parametric analysis.

Results

Subjects

In total, 272 (of 555) questionnaires were returned (49%); 54 (16%) questionnaires were returned after the reminding letter.

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Of these, 236 participants (43%) gave informed consent and returned a completed first screening questionnaire (demographic variables); 18 (3%) had died; 12 (2%) responded that they refused to participate because of lack of time or interest; three (1%) responded that they were too ill or incapacitated to participate and another three (1%) had moved. The remaining 283 (51%) did not respond. Due to non-response to the second questionnaires containing the depression measure and the CFQ, a further 49 participants were lost, leaving a study sample of 187 participants.

Type of diabetes was known for 166 of the 187 patients. There were 57 (34%) patients with Type 1 diabetes and 109 (66%) with Type 2 diabetes. Two participants reported having epilepsy, five had a history of stroke, one patient had both a history of stroke and epilepsy and three patients used medication to treat psychiatric comorbidity/disease. These patients were excluded from analysis. Therefore, analyses were based on 55 patients with Type 1 diabetes and 100 with Type 2 diabetes (Table 1). Patients with Type 2 diabetes were significantly older (59.0 vs. 42.8 years), had lower education (41.1% vs. 17.3% were educated to vocational training or less: level 3), had a shorter diabetes duration (15.4 vs. 23.8 years), had more disease-related complications, experienced fewer hypoglycaemic episodes since diabetes onset (1.2 vs. 4.2 episodes), were less often married/or with a partner and were more often non-White (36.3% vs. 8.0%).

Cognitive complaints

There was no significant difference in mean CFQ score between patients with Type 1 diabetes (31.8 ± 13.7) and patients with Type 2 diabetes (27.9 ± 18.7) ($P = 0.14$). However, in the Type 1 diabetes patient group, females reported significantly more cognitive failures than men (34.6 ± 13.5 vs. 26.9 ± 12.8, $P = 0.04$) (Fig. 1).

There was no significant difference in total number of self-reported cognitive failures between patients with Type 1 diabetes and healthy control subjects ($t[54] = -0.20$ and $P = 0.84$). Patients with Type 2 diabetes reported significantly fewer cognitive complaints, compared with the healthy reference group ($t[99] = -2.26$ and $P = 0.03$).

No differences in self-reported cognitive failures were found between men and women with Type 1 diabetes compared with healthy men ($N = 1418$; mean 30.9 ± 10.0) and healthy women ($N = 1603$; mean 33.4 ± 9.8) ($t[19] = -1.42$, $P = 0.17$ for men and $t[34] = 0.54$, $P = 0.60$ for women). We did not find a difference in self-reported cognitive failures in male Type 2 diabetic patients compared with male healthy control subjects ($t[45] = -0.90$ and $P = 0.37$). However, female patients with Type 2 diabetes reported significantly fewer cognitive failures compared with female healthy control subjects ($t[53] = -2.29$ and $P = 0.03$).

Table 1 Clinical characteristics of the study population

	Type 1 diabetes			Type 2 diabetes		
	Male	Female	Total	Male	Female	Total
N	20	35	55	46	54	100
Age (years)	39.5 ± 10.2	44.4 ± 13.5	42.8 ± 12.6	57.5 ± 11.5	60.3 ± 12.8	59.0 ± 12.2***
Married/partner	80.0% (16/20)	81.3% (26/32)	80.8% (42/52)	78.3% (36/46)	50.0% (25/50)†	63.5% (61/96)*
Non-White	5.3% (1/19)	9.7% (3/31)	8.0% (4/50)	37.2% (16/43)	35.4% (17/48)	36.3% (33/91)***
Low education	15% (3/20)	18.8% (6/32)	17.3% (9/52)	34.1% (15/44)	47.1% (24/51)	41.1% (39/95)**
HbA_{1c} (%)	7.7 ± 1.0 (*n* = 17)	7.9 ± 1.2 (*n* = 29)	7.9 ± 1.1 (*n* = 46)	8.0 ± 1.5 (*n* = 40)	8.3 ± 1.7 (*n* = 43)	8.2 ± 1.6 (*n* = 83)
Diabetes duration (years)	21.0 ± 9.6	25.2 ± 12.7	23.8 ± 11.8	16.5 ± 8.3	14.4 ± 8.9	15.4 ± 8.6***
No retinopathy	76.5% (13/17)	75.0% (24/32)	75.5% (37/49)	68.3% (28/41)	70.8% (34/48)	69.7% (62/89)
Background retinopathy	17.6% (3/17)	9.4% (3/32)	12.2% (6/49)	24.4% (10/41)	20.8% (10/48)	22.5% (20/89)
Proliferative retinopathy	5.9% (1/17)	15.6% (5/32)	12.2% (6/49)	7.3% (3/41)	8.3% (4/48)	7.0% (7/89)
Neuropathy	17.6% (3/17)	3.1% (1/32)	8.2% (4/49)	25.0% (10/40)	24.5% (12/49)	24.7% (22/89)*
Nephropathy	16.7% (3/18)	6.3% (2/32)	10.0% (5/50)	27.9% (12/43)	14.0% (7/50)	20.4% (19/93)
Cardiovascular disease	5.9% (1/17)	20.0% (6/30)	14.7% (7/47)	50.0% (20/40)	24.4% (11/45)†	36.5% (31/85)**
Severe hypoglycaemic episodes	3.68 ± 6.25 (*n* = 19)	4.52 ± 6.78 (*n* = 31)	4.20 ± 6.53 (*n* = 50)	1.83 ± 5.41 (*n* = 36)	0.69 ± 2.46 (*n* = 42)	1.22 ± 4.11 (*n* = 78)**
Blood pressure (mmHg)						
Systolic	126.0 ± 10.8 (*n* = 5)	128.5 ± 12.0 (*n* = 17)	128.0 ± 11.5 (*n* = 22)	141.3 ± 17.5 (*n* = 27)	135.8 ± 14.9 (*n* = 26)	138.6 ± 16.4 (*n* = 53)**
Diastolic	75.0 ± 5.0	74.1 ± 8.0	74.3 ± 7.3	80.0 ± 9.9	77.8 ± 8.0	78.9 ± 9.0*
Use antihypertensive agents	7.1% (1/14)	16.0% (4/25)	12.8% (5/39)	71.1% (27/38)	48.8% (21/43)†	59.3% (48/81)***

*$P < 0.05$; **$P < 0.01$; ***$P < 0.001$ comparing all Type 1 diabetic patients with all Type 2 diabetic patients.
†$P < 0.05$ comparing men and women within the Type 2 diabetes group.
Low education is defined as vocational training or less (level 3 according to the Dutch scoring system). Severe hypoglycaemic episodes is defined as total number of hypoglycaemic episodes with unconsciousness and external assistance for recovery required since diabetes onset. Missing data are the result of missing data in the medical records.

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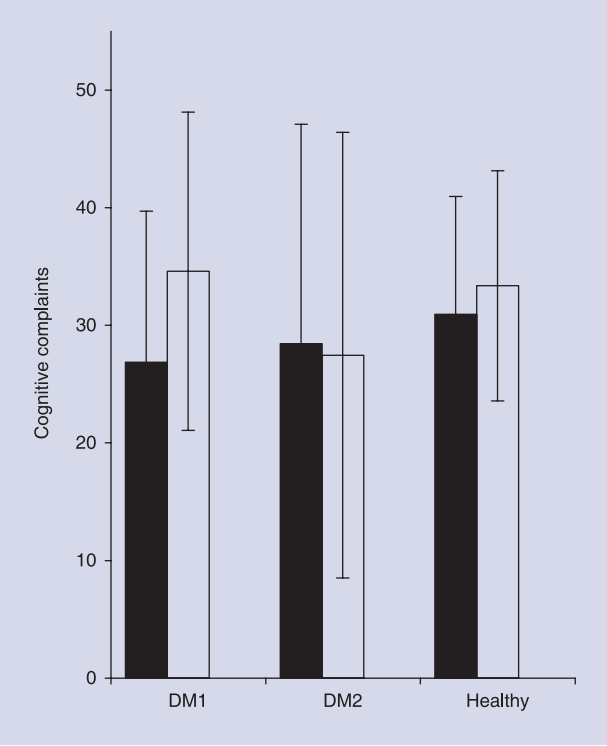

FIGURE 1 Mean CFQ scores for patients and healthy control subjects [Dutch reference group (3021 healthy adults)]. CFQ, Cognitive Failures Questionnaire. ■, Male; □, female.

Depression

The mean PHQ-9 score was not significantly different between the Type 1 diabetes group (4.9 ± 4.4) and the Type 2 diabetes group (5.9 ± 6.0, $P = 0.33$). In both types of diabetes, females scored significantly higher on the PHQ-9 compared with men (6.5 ± 5.7 vs. 4.2 ± 4.9, $P = 0.01$).

Four Type 1 diabetic patients (7.5%; one male, three female) had a PHQ-9 score of > 15 (15.5 ± 0.6), indicating major depression, whereas 11 patients (11.1%; three male, eight female) with Type 2 diabetes reported a PHQ-9 score of > 15 (18.5 ± 3.4). There was no significant association between PHQ-9 score > 15 or ≤ 15 and type of diabetes ($\chi^2(1) = 0.49$, $P = 0.48$).

Correlates of subjective cognitive complaints

In view of the small sample sizes, we performed stepwise multiple regression analyses in the total patient group (Table 2). From Model 1 ($N = 135$), it appeared that none of the demographic variables was significantly associated with the frequency of subjective cognitive complaints. Furthermore [Model 2 ($N = 108$), also adjusted for age and gender], none of the diabetes-related complications (diabetes duration, retinopathy, nephropathy, neuropathy, severe hypoglycaemic episodes and cardiovascular disease) was associated with subjective cognitive complaints. In Model 3 ($N = 152$, also adjusted for age and female gender), total PHQ-9 score accounted for 33% of the explained variance and all predictors in Model 3 explained 35% of the variance in CFQ scores. If the effects of age and gender were held constant, there was a strong positive association between total PHQ-9 scores and cognitive failures. Exclusion of participants with a PHQ-9 score of > 15 (severe depression) did not affect the results.

The finding that female patients had significantly higher scores on the PHQ-9 prompted us to explore an interaction effect of gender and PHQ-9 scores on cognitive failures. We entered the factor gender × PHQ-9 score into Model 3 of the regression analysis. There was no significant interaction effect ($B = -0.24$; SE $B = 0.44$, standardized $\beta = -0.08$ and $P = 0.58$), indicating that the positive association between depression and cognitive failures, as was shown from the regression analysis, was similar for men and women.

Furthermore, it also appeared that there was no significant interaction effect of type of diabetes and PHQ-9 scores (type of diabetes × PHQ-9 scores in Model 3; $B = -0.40$; SE $B = 0.37$, standardized $\beta = -0.13$ and $P = 0.28$), indicating that the positive association between depression and cognitive failures was similar for both types of diabetes.

Discussion

The central finding of this study is that patients with Type 1 and Type 2 diabetes appear not to complain more about their cognitive functioning than a healthy reference group. Furthermore, no differences in number of self-reported cognitive failures were found between Type 1 and Type 2 diabetic patients. Interestingly, diabetes-related factors, including complication status and frequency of severe hypoglycaemia, did not predict subjective cognitive functioning. However, a strong positive association was found between depression symptomatology and frequency of self-reported cognitive failures. Overall, our study could not confirm more subjective cognitive complaints in a group of Type 1 and Type 2 diabetic patients as might be expected given the observed elevated rates of mild cognitive dysfunction in patients with diabetes [1,2].

The participants' subjective cognitive complaints, although important in their own right, probably do not provide a reliable measure of their objective cognitive performance. Indeed, the clinical utility of subjective cognitive complaints as indicators of cerebral dysfunction has not been clearly established. Some studies have found a relationship between subjective and objective measures of cognitive impairment [24–26], whereas others, which studied patients with cancer, temporal lobe epilepsy, multiple sclerosis and older persons, failed to find such a relationship [5,6,12,13,27–29]. The question therefore arises whether complaints about memory and attention in patients with diabetes have a prospective value, as is the case in, for example, dementia. A longitudinal study that included a substantial number of participants with borderline cognitive impairment, as well as participants without memory complaints, has found that baseline memory complaints have significant

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Table 2 Stepwise multiple regression analysis predicting cognitive failures (CFQ) by demographic variables, complications of diabetes and depression

	Model 1 (*N* = 135) DM1 = 49, DM2 = 86				Model 2 (*N* = 108) DM1 = 43, DM2 = 65				Model 3 (*N* = 152) DM1 = 53, DM2 = 99			
	Demographic variables only				Clinical characteristics controlling for demographic variables				Depression controlling for demographics			
	B	SE B	β	*P*	B	SE B	β	*P*	B	SE B	β	*P*
A. Demographic variables												
Age	−0.12	0.11	−0.10	0.30	−0.15	0.12	−0.14	0.22	−0.12	0.08	−0.10	0.14
Female gender	1.90	3.01	0.06	0.53	2.00	3.05	0.06	0.51	−1.82	2.35	−0.05	0.44
Married/partner	2.95	3.38	0.08	0.38								
Low education	−1.58	3.37	−0.04	0.64								
Non-White	1.35	3.41	0.04	0.69								
B. Clinical characteristics												
Diabetes duration					0.16	0.15	0.11	0.31				
Cardiovascular disease					−1.47	4.02	−0.04	0.72				
Retinopathy (background and proliferative combined)					2.63	3.57	−0.08	0.46				
Nephropathy					−6.60	4.61	−1.14	0.16				
Neuropathy					−2.10	4.29	−0.05	0.63				
Severe hypoglycaemic episodes					0.40	0.30	0.14	0.18				
C. Depression												
PHQ-9									1.84	0.21	0.59	< 0.001
R^2				0.03				0.12				0.35
R^2 change				0.03				0.07				0.33
F change				0.71				1.27				75.33
P				0.62				0.14				< 0.001

Retinopathy is defined as background retinopathy and proliferative retinopathy combined. Low education is defined as vocational training or less (level 3).

predictive value for dementia at 3 years [8]. Memory complaints were associated with future cognitive decline in participants with baseline cognitive impairment and in participants whose cognition was in the normal range at baseline [9,10]. Finally, a review article [11] concluded that there is an established association between memory complaints and decline in memory (or dementia) in older participants. Clearly, prospective studies into the relationship between objective cognitive performance and subjective cognitive complaints in larger populations of patients with Type 1 and Type 2 diabetes are warranted. Meanwhile, self-reported complaints of cognitive function appear to be of limited clinical use and should therefore be interpreted with caution.

The finding that subjective cognitive functioning was closely related to depressive affect is not unexpected. Others have also found such a relationship [6,12–16]. Maor *et al*. [13], for example, found a high correlation between perceived cognitive deficits and depressive symptoms in multiple sclerosis patients. Cull and colleagues [6] studied a group of adult patients after treatment for lymphoma and found that there was no difference between 'complainers' and 'non-complainers' in their performance on standard neuropsychometric tests of concentration and memory. Again, those reporting concentration and memory difficulties had significantly higher scores on measures of anxiety, depression and fatigue. The importance of addressing depression in diabetes is underscored by the fact that diabetes has been reported to at least double the risk of comorbid depression, with the point prevalence approximating 11% in the diabetic population [30–32]. Depression should therefore be part of any comprehensive neuropsychological examination.

There are some limitations to this study. First, the relatively high rate of non-responders (51%) limits the generalizability. Second, we may wonder if the CFQ is suitable to detect the mild cognitive impairment observed in persons with diabetes. The CFQ provides a reliable general measure of perceived cognitive failure that includes perception, memory and motor function, but does not possess any additional factors [17–20]. It would be of interest to elucidate separate cognitive domains, known to be affected by diabetes, and to study whether diabetic patients have cognitive complaints related to these specific domains. As far as we know, such a measure does not yet exist.

We conclude that mean CFQ scores of patients with Type 1 and Type 2 diabetes are similar to those found in the general population. Whether the failure to demonstrate higher rates of subjective cognitive failure in this group is due to a lack of sensitivity of the measure used to detect cognitive impairment

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remains to be seen. Self-reported cognitive failures appear largely determined by depression. Future research should include measures of objective neuropsychological performance to be able to distinguish subjective from objective cognitive dysfunction. Furthermore, little is known about the subjective experience of cognitive dysfunction in persons with diabetes and how this affects their daily functioning and diabetes self-management. This is also an interesting future research topic. Finally, our findings stress the importance of including affective status in any cognitive assessment procedure. Neuropsychological examination is the gold standard, but assessing individuals' perceived cognitive performance is an important source of information in its own right. Future research will show if subjective cognitive complaints have prognostic value in diabetes.

Competing interests

None to declare.

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