DOES HYPERGLYCAEMIA CAUSE SYMPTOMS IN ELDERLY PEOPLE?

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SUMMARY

The aim of the present study was to describe the associations between glucose tolerance and symptoms in an unselected non-institutionalised elderly population aged 73 years or over (n= 259, of whom 93 were men). Diabetes was assessed on the basis of self-reports and 2-h oral glucose tolerance tests (1985 WHO criteria). Symptoms were measured with a modified diabetes symptom checklist (DSC-Type 2).

The previously diagnosed diabetic patients reported to have more symptoms in all the six dimensions of the symptom checklist than the other study groups. According to the responses to twenty out of 34 items, more of the previously diagnosed diabetic women had symptoms than the other female study groups; the corresponding figure for the previously diagnosed diabetic men being 16/34. The following hyperglycaemic symptoms: "dry mouth", "increasing fatigue in the course of the day", "numbness in the hands", were either weakly or significantly associated with undiagnosed diabetes. Men with IGT reported to have "dry mouth" and "tingling or pricking in the legs or feet" more often than men with NGT. Symptoms of "moodiness" increased along with the deterioration of glucose tolerance, and it seems that depression is associated with type 2 diabetes in elderly people, too.

Although the study covered a wide range of symptoms, it did not clearly reveal such symptoms that could be used as potential indicators of undiagnosed diabetes or especially IGT among elderly patients.

Key words: elderly, epidemiological study, OGTT, symptoms, type 2 diabetes

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INTRODUCTION

Symptoms related to diabetes are mainly due to hyperglycaemia or complications of the disease. Even the presence of mild diabetic complications may have a remarkable effect on the patient's quality of life (1, 2), which makes early diagnosis and treatment essential. Especially elderly people often lack diabetic symptoms or have symptoms that are atypical (failure to thrive, confusion, urinary incontinence) or mistakenly ignored or confounded with other conditions and diseases (3, 4). The clinical features may also be manifested in a variety of ways. For example, symptoms of macroangiopathic complications may be similar to those observed in non-diabetic patients, but the ischaemia may also be silent more often than among non-diabetic persons (5, 6).

The few previous studies on elderly diabetic patients' symptoms and symptom-related quality of life have shown that diabetic patients rate their quality of life as inferior to that of non-diabetic people (7-10).

Epidemiologic data suggest that diabetic patients are more often depressive than non-diabetic patients (10-12). A recently published follow-up study suggested also that depressive symptoms are associated with a modest increase in the risk of type 2 diabetes (13).

The older the diabetic person is, the more important it is to treat hyperglycaemic symptoms instead of primarily aiming at ideal blood glucose or glycohaemoglobin values and also to retain the patient's every-day functional ability and quality of life as far as possible (14).

The aim of this study was to describe elderly persons' somatic, psychosomatic and depressive symptoms in view of their glucose tolerance status by using a standardised symptom checklist questionnaire and to explore whether undiagnosed diabetes or impaired glucose tolerance can be recognised based on certain specific symptoms.

METHODS

The study population consisted of community-living persons born in 1920 or earlier and resident on 1 September 1991 in three small municipalities (Kempele, Oulunsalo, Hailuoto) in northern Finland, who additionally participated, in 1994-1995, in the follow-up of a baseline study on diabetes conducted in 1991-1992 (15). The study subjects were examined between 1 October 1994 and 4 May 1995, which examination included a 2-hour oral glucose tolerance test (OGTT) and measurement of symptoms with a questionnaire.

The presence of diabetes mellitus was assessed by questions on the participants' previously diagnosed diabetes and by an OGTT. All participants except the diabetic patients on oral hypoglycaemic drug or insulin treatment underwent an oral glucose tolerance test, which was performed and classified according to the 1985 WHO criteria (16).

Altogether 79 % (n=259, of whom 92 were men) out of the eligible 327 (112 men) subjects took part in the study in 1994-1995. The median age of the participating men was 77 years (range 75-94) and that of the women 79 years (range 73-96).

OGTT: Capillary blood samples were obtained before and 2 hours after a 75 g glucose load (75 g glucose in 300 ml water, or Glucodyn, Leiras) in the morning (between 7.30 and 9.30). The maximum deviation allowed for the 2-hour blood sample was 5 minutes. The blood glucose measurements were determined daily from capillary whole blood using a glucosedehydrogenase (anhydrous glucose) enzymatic method (Merck Glucose System 250, FRG, Darmstadt). The coefficients of variation (CVs) for within-run studies were 0.4-1.6 % when the corresponding blood glucose values were 3.3 mmol/l and 18.0 mmol/l. For day-to-day studies, CV was 1.6 % at the upper end of the reference range. A person was classified as having previously diagnosed diabetes if he/she was on oral drug or insulin treatment or if he/she was on dietary treatment and, in addition, had an OGTT 2-h value ≥11.1 mmol/l. A person without previously diagnosed diabetes was classified as having previously undiagnosed diabetes if his/her 2-h OGTT was ≥11.1 mmol/l and impaired glucose tolerance (IGT) if his/her 2-h value was 7.8 to 11.0 mmol/l. Those with 2-h OGTT values <7.8 mmol/l were classified as having normal glucose tolerance (NGT).

15% (n=14) of the men were diagnosed as having previously diagnosed diabetes, 8% (n=7) as having previously undiagnosed diabetes, 36% (n=33) as having IGT and the remaining 41% (n= 38) as having normal glucose tolerance. The corresponding figures for the women were: 22 % (n = 37), 8% (n = 13), 37% (n= 61) and 34% (n = 56), respectively.

The symptoms were recorded with a modified diabetes symptom checklist (DSC Type 2) (17). The original DSC-Type 2 scale measures the occurrence and perceived burden of physical and psychological symptoms associated with type 2 diabetes and its possible complications during the past four weeks. It includes 34 items on the following symptom dimensions: hyperglycaemic (4 items), hypoglycaemic (3), psychological (8), cardiovascular (4), neuropathic (pain-sensory) (10), and ophthalmological (5). The DSC-Type 2 instrument also includes symptom severity scales, which were not used in our study.

Statistical methods: Descriptive comparisons of groups defined by glucose tolerance status are presented as percentages. The χ^2 test or the Fischer's exact test were used to test the significance of difference in the frequency of the symptoms between the study groups; p-values less or equal to 0.05 were considered to be statistically significant. SPSS for Windows version 7.5.1 was used in the statistical calculations.

RESULTS

Overall, a greater proportion of the previously diagnosed diabetic patients reported having individual symptoms than the other study groups (Table 1, 2 and 3). As to gender, in twenty out of 34 items, more of the previously diagnosed diabetic women had symptoms than the other female study groups. For the men, the corresponding figure was 16 out of 34 items

There were no persons without any of the 34 symptoms during the last four weeks in the previously diagnosed and in the undiagnosed diabetic group, but, still, one person in the undiagnosed group had only one symptom out of the 34 symptoms. Three persons in the IGT group and two persons in the NGT group had none of the 34 symptoms.

The hyperglycaemic symptom "very thirsty" was not clearly associated with undiagnosed diabetes (p= 0.4). Among the women, a weak, but not statistically significant association was found with previously diagnosed diabetes (p= 0.2). "Dry mouth" was from 1,5 to 2 times more common among the male groups with abnormal glucose tolerance than among the men with NGT, though again, only a tendency, but no significant statistical difference was found due to relatively small numbers of subjects in each study group (p = 0.23 for previously diagnosed diabetes, p = 0.14 for undiagnosed diabetes and p= 0.09 for IGT).

Most psychological symptoms, i.e. "lack of energy" (p= 0.08), "fatigue in the morning when getting up" (p= 0.2), "sleepiness or drowsiness" (p = 0.1, for the women p= 0.06), "difficulty concentrating (p = 0.09) and staying attentive" (p= 0.07) tended to be more common among the previously diagnosed diabetic patients, but despite a slightly increased tendency of "increased sleepiness and drowsiness" (p = 0.15) in the IGT group, no other clear differences were seen between the undiagnosed diabetic, IGT and NGT groups. There was a trend for "moodiness" to become more common along with worsening glucose tolerance, though a statistical difference was found only among the female study groups (p = 0.02 for undiagnosed diabetes and p < 0.01 for IGT). Overall, moodiness was more common among the women than among the men (p = 0.04) (Table 2).

The men and women with previously diagnosed diabetes (p= 0.09) and women with undiagnosed diabetes (p= 0.01) had more "increasing fatigue in the course of the day" than those with NGT (Table 1). As to cardiovascular symptoms, both "pains in the chest or heart region", and, among the men, "shortness of breath during exercise" were 1.5 times as common among the previously diagnosed diabetic patients compared with the other study groups, though it did not reach statistical significance (p = 0.5) (Table 2). On the neuropathy dimension, more of the previously diagnosed diabetic patients tended to have "burning pain in the legs during the day" (p = 0.08) and had "numbness in the hands (p < 0.01)" and "numbness in the feet" (p= 0.03).

"Tingling or prickling in the legs or feet" was 1.5 times as common, though not quite statistically significantly (p= 0.1), among the previously diagnosed diabetic men and it was more common among the men with IGT (p < 0.01) compared to the men with NGT (Table 3). As to undiagnosed diabetes, "numbness in the hands" was twice as common among the women with undiagnosed diabetes than among those with NGT (p = 0.03). "Persistently blurred vision" (p= 0.02) and "deteriorating vision" (p = 0.02) were also more common among the previously diagnosed diabetic patients than among the other study groups (Table 2).

DISCUSSION

There are surprisingly few research reports on diabetic patients' symptoms, and especially the elderly have rarely been in focus in this respect (3, 4, 18, 19). Our own previous study on persons aged 70 or older included a questionnaire with only 14 questions on diabetic symptoms (4). In that study, our conclusion was

that undiagnosed diabetes or impaired glucose tolerance among the elderly could not be recognised based on symptoms, but undiagnosed diabetes should, however, be kept in mind if an elderly patient complains of pollacisuria or urinary incontinence (4). Though it is well known that type 2 diabetes often remains undiagnosed for many years, no a simple symptom checklist for screening undiagnosed diabetes or IGT in clinical practice has been developed so far.

The DSC-Type-2 instrument was developed by Grootenhuis et al. for use in clinical practice and epidemiological research to measure the occurrence and perceived burden of symptoms related to type 2 diabetes and its complications (17). The final version of the questionnaire includes 34 items on hyperglycaemic, hypoglycaemic, psychological, cardiovascular, neuropathic (pain-sensory) and ophtahalmological symptoms. Thus, the questionnaire used in the present study covered a wider range of symptoms than the questionnaire used in our previous study in 1991.

Diabetic symptoms are due either to hyperglycaemia itself or to diabetic complications. A large proportion of diabetic patients

Table 1. *Percentages of subjects (numbers in parentheses) with hyperglycaemic, psychological and fatigue symptoms according to glucose tolerance status and gender*

Symptom		Prev. DM (n= 51; W 35-37, M 14)	Undg. DM (n=20; W 12-13, M 6-7)	IGT (n=94; W 60-61, M 32-33)	NGT (n=94; W 56, M 36-38)	Total (n=263)
Very thirsty	Hyper					
Men		0 (0)	17 (1)	12 (4)	11 (4)	10 (9)
Women		16 (6)	15 (2)	8 (5)	9 (5)	11 (18)
Dry mouth	Hyper					
Men		50 (7)	67 (4)	52 (17)	34 (13)	45 (41)
Women		62 (23)	62 (8)	54 (33)	59 (33)	58 (97)
Drink a lot (all sorts of drinks)	Hyper					
Men		7 (1)	17 (1)	16 (5)	19 (7)	16 (14)
Women		37 (13)	17 (2)	26 (16)	30 (17)	29 (48)
Frequent voiding	Hyper					
Men		57 (8)	50 (3)	56 (18)	65 (24)	60 (53)
Women		54 (19)	50 (6)	57 (35)	61 (34)	57 (94)
Lack of energy	Psycho-fatigue					
Men		64 (9)	33 (2)	44 (14)	39 (14)	44 (39)
Women		74 (26)	50 (6)	61 (37)	52 (29)	60 (98)
Overall sense of fatigue	Psycho-fatigue					
Men		36 (5)	17 (1)	34 (11)	38 (14)	35 (31)
Women		54 (19)	50 (6)	54 (33)	45 (25)	51 (83)
Fatigue in the morning when getting up	Psycho-fatigue					
Men		36 (5)	0 (0)	9 (3)	24 (9)	19 (17)
Women		40 (14)	33 (4)	25 (15)	25 (14)	29 (47)
Increasing fatigue in the course of the day	Psycho-fatigue					
Men		71 (10)	33 (2)	63 (20)	65 (24)	63 (56)
Women		71 (25)	83 (10)	74 (45)	64 (36)	71 (116)
Sleepiness or drowsiness	Psycho-cogn					
Men		43 (6)	17 (1)	9 (3)	22 (8)	20 (18)
Women		46 (16)	17 (2)	34 (21)	23 (13)	32 (52)
Difficulty concentrating	Psycho-cogn					
Men		50 (7)	17 (1)	19 (6)	27 (10)	27 (24)
Women		46 (16)	17 (2)	20 (12)	38 (21)	31 (51)
Difficulty staying attentive	Psycho-cogn					
Men		50 (7)	0 (0)	16 (5)	27 (10)	25 (22)
Women		43 (15)	17 (2)	20 (12)	34 (19)	29 (48)

Prev. DM = previously diagnosed diabetes, Undg. DM = undiagnosed diabetes, IGT = impaired glucose tolerance, NGT = normal glucose tolerance, W = women, M = men, Hyper = hyperglycaemic symptoms, Psycho-cogn =psychological-cognitive symptoms, Psycho-fatigue = psychological-fatigue symptoms

already have complications at the time of the diagnosis, and the symptoms usually increase with the duration of the disease (18). Therefore, it is possible that the complications, either diagnosed or not, such as neuropathic and atherosclerotic complications, play an integral role in the symptoms of diabetic patients with increasing duration of the disease.

Table 2. *Percentages of subjects (numbers in parentheses) with hypoglycaemic, cardiac and ophthalmological symptoms according to glucose tolerance status and gender*

Symptom		Prev. DM (n= 51; W 35-37, M 14)	Undg. DM (n=20; W 12-13, M 6-7)	IGT (n=94; W 60-61, M 32-33)	NGT (n=94; W 56, M 36-38)	Total (n=263)
Easily irritated or annoyed	Hypo					
Men		7 (1)	0 (0)	9 (3)	8 (3)	8 (7)
Women		9 (3)	17 (2)	18 (11)	11 (6)	13 (22)
Irritability just before meal	Hypo					
Dull head	Hypo					
Men		29 (4)	33 (2)	28 (9)	35 (13)	32 (28)
Women		46 (16)	42 (5)	38 (23)	48 (27)	43 (71)
Moodiness	Hypo					
Men		29 (4)	33 (2)	34 (11)	22 (8)	28 (25)
Women		63 (22)	50 (6)	51 (31)	43 (24)	51 (83)
Shortness of breath during exercise	Cardiac					
Men		57 (8)	67 (4)	47 (15)	41 (15)	47 (42)
Women		40 (14)	42 (5)	48 (29)	45 (25)	46 (73)
Shortness of breath at night	Cardiac					
Men		14 (2)	0 (0)	9 (3)	14 (5)	11 (10)
Women		11 (4)	17 (2)	10 (6)	9 (5)	10 (17)
Palpitations	Cardiac					
Men		21 (3)	0 (0)	19 (6)	32 (12)	24 (21)
Women		37 (13)	25 (3)	33 (20)	30 (17)	32 (53)
Pains in the breast or heart region	Cardiac					
Men		50 (7)	17 (1)	31 (10)	30 (11)	33 (29)
Women		34 (12)	17 (2)	31 (19)	21 (12)	27 (45)
Persistently blurred vision (also with glasses)	Vision					
Men		29 (4)	0 (0)	6 (2)	16 (6)	14 (12)
Women		46 (16)	8 (1)	18 (11)	21 (12)	24 (40)
Deteriorating vision	Vision					
Men		36 (5)	0 (0)	33 (11)	21 (8)	26 (24)
Women		62 (23)	8 (1)	26 (16)	41 (23)	38 (63)
Flashes or black spots in the field of vision	Vision					
Men		36 (5)	33 (2)	28 (9)	43 (16)	36 (32)
Women		29 (10)	33 (4)	41 (25)	27 (15)	33 (54)
Fluctuating clear and blurred vision	Vision					
Men		29 (4)	0 (0)	6 (2)	18 (7)	14 (13)
Women		24 (9)	8 (1)	13 (8)	16 (9)	16 (27)
Sudden deterioration in vision	Vision					
Men		0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Women		0 (0)	0 (0)	2 (1)	0 (0)	0,6 (1)

Prev. DM = previously diagnosed diabetes, Undg. DM = undiagnosed diabetes, IGT = impaired glucose tolerance, NGT = normal glucose tolerance, W = women, M = men

In the present study, the previously diagnosed diabetic patients reported more symptoms than the NGT subjects. Our results support the idea that the DSC-Type 2 symptom checklist discriminates well between previously diagnosed diabetic patients and NGT subjects and can be used at least to detect symptoms. The sex difference that emerged in some of the symptoms of the previously diagnosed diabetic patients might be due to the participating women's higher age or to the fact that women overall report more easily perceived symptoms than elderly men do. The possible role of medications in the previously diagnosed diabetic patients' symptoms, such as diuretic use, remains unresolved, because we did not gather data on the patients' medications. On the basis of the baseline data collected in 1990-1991, however, it can be assumed that the previously diagnosed diabetic patients used more medications than the other participants and that their medications may have partly contributed to the occurrence of their symptoms (4).

Though some of the symptoms discovered with the DSC-Type 2 instrument were more common among the participants with undiagnosed abnormal GT than among the NGT subjects, our results suggest that undiagnosed diabetes or IGT cannot be easily identified even with a comprehensive symptom checklist among elderly subjects. Moodiness and fatigue as well as some neuropathic symptoms should, however, be considered as possible signs of glucose tolerance abnormality in an elderly subject, and when they are present, the patient's blood glucose level should be checked. In addition to preventing long-term complications, the above-mentioned symptoms may, without attention and treatment, impair elderly persons' overall functional ability and possibly lead to increased and repeated use of health care services and even unnecessary institutionalisation.

The frequent occurrence of ophthalmological symptoms among the previously diagnosed diabetic patients deserves to be noticed and could be due to several reasons, e.g. diabetic retinopathy or

Table 3. *Percentages of subjects (numbers in parentheses) with neuropathic symptoms according to glucose tolerance status and gender*

Symptom		**Prev. DM (n= 51; W 35-37, M 14)**	**Undg. DM (n=20, W 12-13, M 6-7)**	**IGT (n=94; W 60-61, M 32-33)**	**NGT (n=94; W 56, M 36-38)**	**Total (n=263)**
Aching calves when walking	N-pain					
Men		21 (3)	17 (1)	38 (12)	32 (12)	32 (28)
Women		46 (16)	25 (3)	34 (21)	32 (18)	35 (58)
Burning pain in the calves at night	N-pain					
Men		7 (1)	0 (0)	16 (5)	3 (1)	8 (7)
Women		14 (5)	8 (1)	15 (9)	9 (5)	12 (20)
Burning pain in the legs during the day	N-pain					
Men		14 (2)	17 (1)	0 (0)	8 (3)	7 (6)
Women		14 (5)	8 (1)	3 (2)	5 (3)	7 (11)
Shooting pains in the legs	N-pain					
Men		29 (4)	0 (0)	31 (10)	30 (11)	28 (25)
Women		23 (8)	33 (4)	25 (15)	32 (18)	27 (45)
Numbness (loss of sensation) in the hands	N-sens					
Men		43 (6)	0 (0)	16 (5)	11 (4)	17 (15)
Women		34 (12)	50 (6)	20 (12)	18 (10)	24 (40)
Numbness (loss of sensation) in the feet	N-sens					
Men		36 (5)	0 (0)	19 (6)	30 (11)	25 (22)
Women		37 (13)	25 (3)	25 (15)	20 (11)	26 (42)
Tingling or prickling in the hands or fingers	N-sens					
Men		29 (4)	33 (2)	16 (5)	24 (9)	23 (20)
Women		17 (6)	0 (0)	15 (9)	21 (12)	17 (27)
Tingling or prickling in the legs or feet	N-sens					
Men		36 (5)	0 (0)	25 (8)	16 (6)	21 (19)
Women		20 (7)	0 (0)	13 (8)	23 (13)	17 (28)
Tingling in the limbs at night	N-sens					
Men		14 (2)	0 (0)	9 (3)	11 (4)	10 (9)
Women		9 (3)	0 (0)	10 (6)	13 (7)	10 (16)
Queer feeling in the legs or feet when touching	N-sens					
Men		7 (1)	0 (0)	9 (3)	17 (6)	11 (10)
Women		31 (11)	8 (1)	15 (9)	18 (10)	19 (31)

N-sens = polyneuropathic sensory symptoms, N-pain = polyneuropathic pain symptoms

cataract, which are known to be more common among diabetic compared to non-diabetic subjects (20, 21). Uncontrolled major changes in the blood glucose level may also cause contemporary oedema of the ocular lens, leading to these annoying symptom. Regular blood glucose control and avoidance of peaks and valleys in the blood sugar level may prevent these symptoms.

To sum up, we checked a wide range of symptoms, but did not find any easily and clearly distinguishable symptoms that would suggest the presence of undiagnosed diabetes or IGT in elderly patients. Still, if an elderly patient complains of increased thirst, dry mouth, increasing fatigue in the course of the day, burning pain in the legs during the day or numbness in the hands, the possibility of undiagnosed diabetes should be taken into account. In line with many earlier studies, depressive symptoms were more common among the elderly diabetic than the non-diabetic persons in our study, too (10-13). Thus, depression should also be taken into account in elderly diabetic patients' treatment.

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