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Original Research

Patient Assessment of Family Function, Glycemic Control and Quality of Life in Adult Patients With Type 2 Diabetes and Incipient Complications

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Key Messages

- Perceived family support and family barriers are associated with diabetes self-management and glycated hemoglobin levels in patients with type 2 diabetes.
- A healthy family function is correlated with a low burden of diabetes and strong mental health but was not found, in this study, to be a predictor of glycemic control.
- Family function is likely to impact family-based interventions concerning factors involved in diabetes self-management, lifestyle adherence and quality of life.

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ABSTRACT

Objectives: Family affects the perception of diabetes self-management in patients with diabetes. Family-related questionnaires have been used to assess family function, but the Brief Family Assessment Measure (Brief FAM-III) has not been used previously in a diabetes population. We aimed to determine whether the family function is associated with glycated hemoglobin levels and quality of life as potential predictors of diabetes self-management.
Methods: An exploratory study of patients with type 2 diabetes and incipient complications and their relatives using the Brief FAM-III, a self-report questionnaire comprising 3 scales assessing family function according to different perspectives: a general score, a dyadic relationship score and a self-rating score.
Results: We included 127 patients: 72.4% males, mean age 65.23 (SD=10.26) years; glycated hemoglobin levels, 6.9% (SD=0.9%); diabetes duration, 9.1 (SD=0.6) years; and body mass index, 30.8 (SD=0.5) kg/m^2. Mean FAM-III scores for the 3 scales were 41.7 (SD=1.0), 41.5 (SD=0.9) and 38.5 (SD=1.1), respectively. Correlation coefficients were –0.06 (p=0.37), –0.09 (p=0.18) and –0.12 (p=0.06), showing no significant correlation between scales and glycated hemoglobin levels levels in the 3 perspectives before and after adjustment for confounders. Family function correlated with burden of diabetes at 0.14 (p=0.02), 0.24 (p=0.0003) and 0.16 (p=0.01), respectively, and mental health at –0.21 (p=0.0007), –0.23 (p=0.0005) and –0.25 (p<0.0001), respectively.
Conclusion: The results of our study suggest that in patients with type 2 diabetes, family function does not predict the level of glycemic control. However, we found an association among healthy family function, low burden of diabetes and strong mental health, issues that are important for the patients' quality of life, compliance with lifestyle factors and diabetes self-management.

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Mots clés :
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RÉSUMÉ

Objectifs : La famille a une influence sur la perception de la prise en charge autonome du diabète chez les patients diabétiques. Des questionnaires sur la famille ont été utilisés pour évaluer le fonctionnement familial, mais le questionnaire court du FAM-III (*Brief Family Assessment Measure*) n'a jamais été utilisé auprès d'une population de personnes diabétiques. Nous avions pour objectif de déterminer si le fonctionnement familial est associé aux concentrations de l'hémoglobine glyquée et s'il constitue un prédicteur potentiel de la prise en charge autonome du diabète.
Méthodes : Il s'agissait d'une étude exploratoire auprès de patients atteints du diabète de type 2 et de complications naissantes au moyen du questionnaire court FAM-III, un questionnaire d'auto-évaluation qui consiste en 3 échelles d'évaluation du fonctionnement familial selon différentes perspectives : un score général, un score de relation dyadique et un score d'auto-évaluation.
Résultats : Les variables des 127 patients admissibles sont les suivantes : 72,4 % d'hommes, âge moyen de 65,23 ans (ÉT=10,26); concentrations de l'hémoglobine glyquée, 6,9% (ÉT=0,9 %); durée du diabète, 9,1 ans (ÉT=0,6); indice de masse corporelle, 30,8 kg/m^2 (ÉT=0,5). Les scores moyens aux 3 échelles du FAM-III étaient respectivement de 41,7 (ÉT=1,0), de 41,5 (ÉT=0,9) et de 38,5 (ÉT=1,1). Les coefficients de corrélation étaient de –0,06 (p=0,37), de –0,09 (p=0,18) et de –0,12 (p=0,06), et ne démontrent aucune corrélation significative entre les échelles et les concentrations de l'hémoglobine glyquée dans les 3 perspectives avant et après l'ajustement des variables confusionnelles. Le fonctionnement familial corrélait avec le fardeau du diabète à 0,14 (p=0,02), à 0,24 (p=0,0003) et à 0,16 (p=0,01), et ce, de façon respective, et avec la santé mentale à –0,21 (p=0,0007), à –0,23 (p=0,0005) et à –0,25 (p<0,0001), et ce, de façon respective.
Conclusion : Notre étude montre que chez les patients atteints du diabète de type 2, le fonctionnement familial n'est pas un prédicteur de la régulation de la glycémie. Toutefois, nous avons observé une association entre le fonctionnement familial sain, le faible fardeau de diabète et la bonne santé mentale, des aspects importants de la qualité de vie des patients, de l'adhésion aux facteurs liés au mode de vie et de la prise en charge autonome du diabète.

Introduction

Diabetes affects about 415 million people worldwide, most of whom are diagnosed with type 2 diabetes (1). Diabetes is diagnosed in 9.4 % of the US population and in 5.7% of the Danish population, and the prevalence is increasing (2,3). Glycemic control of type 2 diabetes is essential because it has a strong predictive value for microvascular and macrovascular complications (4). Glycated hemoglobin (A1C) levels are considered the standard for long-term evaluation of glycemic control and reflect the average glucose level during the past 12 weeks (5).

Despite advances in diagnostics and treatments, many patients still experience inadequate glycemic control. In order to improve the clinical condition of people with type 2 diabetes, knowledge of the factors that can potentially influence glycemic control is of great importance. Adherence to behavioural and pharmacologic recommendations (e.g. healthful diet, exercise, blood glucose checking and pharmacologic treatment) are important aspects of diabetes management (6,7). Moreover, interactions between adult patients and their families, perceived family support and family barriers are associated with self-management and A1C levels in patients with type 2 diabetes (8–11).

Perceived family support, dynamics and processes affecting management of diabetes have been evaluated by the use of several family-assessment instruments (12,13). Moreover, the level and quality of family functioning are associated with the perceived support for or burden on the family regarding diabetes self-management (8,13). However, research targeting the interface between the functioning of the family unit and glycemic control by adults with diabetes is scarce. In addition, studies conducted to better understand the influence of family functioning on glycemic control are inconsistent with regard to research methods, population samples, intervention strategies and measured outcomes. Furthermore, the instruments for assessing family functioning and the definitions of family functioning vary (14).

The Brief Family Assessment Measure (Brief FAM-III) (15,16) is a brief version of the original FAM-III and is a non-disease-specific instrument evaluating individual family members' perceptions of problems and strengths in their family's functioning in the areas of task accomplishment, role performance, communication, affective expression, involvement, control and values and norms. FAM-III and Brief FAM-III have not previously been used in a diabetes population but have been widely used to study the relationship of family functioning to a number of family issues, such as emotional disturbance, coping with disease, cancer, eating disorder, affective disorder, chronic heart disease and cystic fibrosis. These studies suggested an association between family function, disease management and quality of life (15,17,18). The Brief FAM-III is appropriate for preliminary screening to obtain an overall index of family functioning as well as to monitor family functioning over time. The scales take 5 minutes to complete, making the instrument useful in time-limited clinical practices (15,16).

We used the instrument to test our hypothesis: The perception of a strong family function is related to improved disease management and glycemic control in patients with type 2 diabetes. The primary aim of this study was to evaluate the association between the level of perceived family functioning and the level of glycemic control as measured by A1C levels in patients with type 2 diabetes. The secondary aims were to assess associations between the family functioning, the burden of diabetes, health-related quality of life and A1C levels and, thereby, evaluate family functioning as a unique predictor of glycemic control.

Methods

Study design

The study used an explorative, descriptive cross-sectional design. The sample comprised 140 patients with type 2 diabetes and was embedded at baseline in a randomized controlled trial comparing 2 diabetes care programs (19). Eligible patients were recruited either from the diabetes outpatient clinic at Gentofte Hospital, University of Copenhagen, Denmark, or from their general practitioners, according to where the patients received regular diabetes care. Patients agreeing to participate in the study by oral and written

informed consent were invited to a baseline screening visit in the outpatient clinic at Gentofte Hospital and randomized if they met all of the inclusion criteria and none of the exclusion criteria. All participants were asked to complete a questionnaire packet to be returned within the following 2 weeks. Baseline demographic and anthropometric variables were checked, and serum samples were taken for the measurement of A1C levels. Gentofte Hospital is situated in the Copenhagen metropolitan area and covers approximately 10,000 inhabitants diagnosed with diabetes. The diabetes outpatient clinic is responsible for the care of approximately 1,200 patients with type 2 diabetes.

Ethical considerations

The protocol of the main study was approved by the Committees on Health Research Ethics in the Capital Region of Denmark (H-4-2014-069) and registered at the Danish Data Protection agency (GEH-2015-085) and clinicaltrials.gov (NCT02586545) and was carried out according to the principles of the Declaration of Helsinki.

Inclusion criteria

The inclusion and exclusion criteria have been described in detail elsewhere (19). Briefly, patients were over the age of 18 years with type 2 diabetes and at-risk stratification characterized by either hyperglycemia (A1C 7% to 9% [53 to 75 mmol/mol]), hypertension (blood pressure 130/80 to 160/90 mmHg) and/or incipient diabetic complications (20,21). All patients were able to understand, speak and write Danish, volunteered to participate and gave their oral and written informed consent after being introduced to the study.

Exclusion criteria

Patients were excluded from the data analysis if at least 1 of the 3 FAM-III scales had not been completed, because the primary outcome of this study was the correlation between the FAM-III dimensions and A1C levels. We excluded 13 nonresponding patients, yielding 127 patients eligible for the study.

The Brief FAM-III had not been used previously in a population with diabetes, so the sample-size estimate of 140 participants was based on the power calculation according to the criteria for the randomized controlled trial in which this study is embedded (19).

Measurements

Demographic variables included age, gender, marital status, level of education and duration of diabetes.

Clinical outcome variables included A1C levels as shown by venous blood samples. A1C levels corresponded to glycemic control and were categorized according to American Diabetes Association guidelines for glycemic targets for adults with type 2 diabetes (5). Thus, participants with A1C levels lower than 7% (53 mmol/mol) were considered to have adequate glycemic control, whereas participants with A1C levels higher than or equal to 7% (53 mmol/mol) were considered to have inadequate glycemic control.

Anthropometric variables included weight and height measured using the same calibrated digital scale for all participants—weight with a precision of 0.1 kg and height with an accuracy of 1 mm. Abdominal and hip circumferences were measured by 1 of 2 study nurses. A waist-hip ratio above 0.90 for males and above 0.85 for females is defined as abdominal obesity. A body mass index score >30 kg/m^2 represents obesity according to the standards of the World Health Organization (22).

The Brief Family Assessment Measure-III

Family functioning was assessed by using the Danish validated version of the Brief FAM-III (23). The Brief FAM-III is a self-report instrument and is a short version of the original FAM-III by Skinner et al (1995) (15), consisting of 3 scales (general, dyadic relationships and self-rating). The general scale examines the family from a systems perspective and offers a general rating of the family's functioning; the dyadic relationship scale assesses how family members view their relationship with another chosen family member; and in the self-rating scale, individuals rate their own functioning within the family. Each scale has 14 items that assess the family's strengths and weaknesses in 7 dimensions of family functioning, including task accomplishment, role performance, communication, affective expression, involvement, control, values and norms. Each item is answered on a 4-point Likert scale ranging from 0 (strongly agree) to 3 (strongly disagree). Lower scores on each scale indicate stronger family functioning. A raw score of each scale is summed up and converted to a T score using a conversion table. T scores range from 16 to 110 in the general scale and from 10 to 104 in the dyadic relationships and self-rating scales. T scores lower than 50 indicate fewer than average family difficulties, whereas T scores higher than 50 indicate more than average family difficulties (15). The patients' perceptions of family functioning was the primary focus, and they were to respond to all 3 scales. The relatives' perception of the dyadic relationship to the patient was reflected in their responses to the dyadic relationship scale (16).

Diabetes Symptom Checklist-Revised

The patients' perceived symptoms and burdens of diabetes were assessed by the Diabetes Symptom Checklist-Revised (DSC-R). The DSC-R is a disease-specific, self-administered questionnaire measuring the occurrence and perceived burdens of physical and psychological symptoms related to type 2 diabetes (24). It comprises 34 items grouped into 8 domains: hyperglycemic, hypoglycemic, psychological-cognitive, psychological-fatigue, cardiovascular, neurologic-pain, neurologic-sensory and ophthalmologic (24,25). For each item, patients respond "yes" or "no" to the experience of the described symptom within the past 4 weeks. Furthermore, they specify how troublesome the symptom has been on a 5-point Likert scale if they typed "yes" initially. The total score ranges from 0 to 5 and was calculated by summing up the item scores and dividing by the number of items. Low scores indicated lower diabetes symptom distress. The DSC-R is a previously validated, reliable measurement instrument that is sensitive to changes over time (25).

Short form-36

Short form-36 (SF-36) is a generic self-administered patient questionnaire measuring health-related quality of life; it comprises 36 questions (26,27). The 36 items measure 8 domains: physical function, physical limitations, bodily pain, general health, vitality, social function, emotional limitation and mental health. The raw scores of each scale are transformed into a 0 to 100 score, with higher scores indicating less disability and greater quality of the aspects. The 8 domains can be divided into the mental component summary (MCS) and the physical component summary (PCS), respectively. The MCS cut-off score is 42, and the PCS cut-off score is 50 (26,27). SF-36 has been validated and is reliable in a range of languages, including Danish (28).

Data analyses

The Kendall tau-b correlation coefficient was used to assess the associations among the scores of the Brief FAM-III scales, DCS-R, MCS, PCS and A1C levels by assessing the associations between pairs of continuous variables and testing for independence. Independent 2-sample t tests were used to analyze differences in demographic variables and to analyze the mean differences between Brief

FAM-III scores and A1C levels in patients with adequate and inadequate glycemic control, respectively.

Multiple linear regression models examined predictive factors of A1C levels (dependent variable) for patients with type 2 diabetes, controlling for covariates, including: demographics, anthropometrics and SF-36, DCS-R and FAM-III scores. All analyses were performed using SAS v. 9.4 (Cary, North Carolina, United States) (29). A value of p≤0.05 was considered statistically significant.

Results

Sociodemographic characteristics, A1C levels, family functioning, diabetes distress and quality of life according to glycemic-control categories

A total of 140 participants attended the baseline appointment and signed the informed consent forms. Of these participants, 127 (90.7%) completed all the questionnaires, including at least 1 of the Brief FAM-III scales. There were no significant differences between the respondents and the nonrespondents in terms of A1C levels or demographic and anthropometric characteristics.

Of the 127 included, 83 (65.4%) completed all 4 Brief FAM-III scales, and 107 (84.3%) completed all 3 patient-related scales, whereas 88 (69.3%) of the relatives completed the relative-related scale, the relative dyadic relationship scale (RDRS), of whom 24 (26%) were children of the patients, and 65 (74%) were spouses of the patients. The individual responses to the patient-related scales were, respectively: patient general scale, 121 (95.3%); patient dyadic relationship scale, 109 (85.9%); and patient self-rating scale, 118 (92.9%). The mean age of participants was 65.23 years (SD=10.26); 72.4% were male. The mean A1C levels were 6.9% (SD=0.9%). The majority of the participants were well-educated on respective classified levels of education duration: 46% high (>15 years), 22.5% high-middle (13 to 14 years), 22% low-middle (10 to 12 years) and low 9.5% (≤9 years). Married or cohabiting couples accounted for 65.5% and singles or widows for 34.5%, respectively.

Table 1 shows the sociodemographic characteristics of patients with type 2 diabetes categorized into 2 groups according to adequate glycemic control of A1C levels (<7%) and inadequate glycemic control of A1C levels (≥7%). According to these categories, 56.7% of the study population had adequate glycemic control. We found a wide range of all the variables, indicating sufficient variation. Regardless of the patients' A1C levels, there were no significant differences in mean values of the following variables: Brief FAM-III, age, body mass index, waist-hip ratio, DSC-R, MCS and PCS scores. Duration of diabetes was 2.78 years longer (p=0.02) in the group with inadequate glycemic control. The mean Brief FAM-III scores could also be found well below the cut-off at 50 for all dimensions, indicating healthy family functioning in both groups. Furthermore, the majority of the patients and relatives scored lower than or equal to 50, respectively: patient general scale, 100 (82.6%); patient dyadic relationship scale, 95 (87.2%); patient self-rating scale, 99 (83.9%); relative dyadic relationship scale, 76 (86.4%). The mean body mass index was >30 kg/m^2 in both groups, indicating a population of overweight and obese patients. The mean waist-hip ratio was ≥0.98 in both groups (mean male ratio, 1.01/1.03; mean female ratio, 0.92/0.93), also indicating obesity. The mean DSC-R scores for both groups were ≤1.00, pointing out a very low burden of diabetes symptoms. The MCS scores in both groups indicated an experience of good mental health. The PCS scores in the groups showed values a little under average according to the experience of physical health. Adjustment for age, social status, education level and gender did not alter the results.

Correlation among Brief FAM-III scores, DSC-R, MCS, PCS and A1C

Table 2 outlines the association among Brief FAM-III scores, DSC-R, MCS, PCS and A1C levels in the study population. The Brief FAM-III dimensions scores, including the *Patient General Scale* (PGS), the PDRS, the *Patient Self-Rating Scale* (PSRS) and the RDRS, were all low and negatively, yet insignificantly, correlated; A1C levels indicated a slight tendency toward an association between better family functioning and poorer A1C control. The weak and insignificant correlation between Brief FAM-III dimension scores and A1C levels is illustrated in Figure 1 by fairly flat slopes. There was no significant correlation between DSC-R and A1C levels or among MCS, PCS and A1C levels, which means that the burden of diabetes, as well as the patients' experiences of their mental and physical health, do not seem to influence glycemic control as measured by A1C levels. Furthermore, all Brief FAM-III scales were significantly positively correlated (p≤0.05).

Table 1
Sociodemographic characteristics, A1C, family functioning, diabetes distress and quality of life according to glycemic-control categories

Variables	Adequate glycemic control				Inadequate glycemic control			
	A1C <53, n=72 (71% male)				A1C ≥53, n=55 (75% male)			
	Mean	SD	Min	Max	Mean	SD	Min	Max
Brief FAM-III								
PGS	41.79	9.83	26.00	76.00	41.25	11.89	20.00	74.00
PDRS	41.90	8.26	30.00	70.00	40.78	10.53	30.00	74.00
PSRS	39.16	11.13	20.00	66.00	37.29	13.56	20.00	72.00
RDRS	41.96	8.28	30.00	66.00	40.95	10.32	30.00	68.00
A1C (%)	6.2	0.4	5.4	6.9	7.8	0.6	7	8.9
Age (years)	66.19	10.21	33.00	84.00	63.96	10.29	34.00	82.00
BMI (kg/m^2)	30.43	5.27	21.01	44.87	31.33	5.79	20.37	46.40
WHR (ratio)	0.98	0.09	0.81	1.20	1.00	0.10	0.83	1.29
Duration of diabetes (years)	7.92	6.32	1.00	26.00	10.67	6.42	1.00	28.00
DSC-R	1.00	0.60	0.00	2.44	0.99	0.67	0.00	2.76
SF-36 (MCS)	54.66	7.89	21.40	65.80	55.40	8.72	30.67	70.17
SF-36 (PCS)	49.09	8.13	25.53	59.99	47.35	9.73	21.64	65.59

Notes: N=127 (male, n=92/female, n=35). The Brief FAM-III (cut-off score, 50) was measured by PGS, PDRS, PSRS and RDRS. Higher Brief FAM-III scores indicate poorer functioning. A BMI score >30 represents obesity. A WHR above 0.90 for males and above 0.85 for females is defined as abdominal obesity. A DSC-R score ranges from 0 to 5; a higher score indicates worse burden of diabetes. SF-36 MCS (part of SF-36) ranges from 0 to 100. Higher scores represent better health. An MCS cut-off score of 42 indicates risk for major depressive disorder. The PCS (part of SF-36) has a cut-off score of 50; higher scores represent better health.
A1C, glycated hemoglobin; *BMI*, body mass index; *Brief FAM-III*, Brief Family Assessment Measure; *DSC-R*, Diabetes Symptom Checklist-Revised; *MCS*, Mental Component Summary; *PCS*, Physical Component Summary; *PDRS*, Patient Dyadic Relationship Scale; *PGS*, Patient General Scale; *PSRS*, Patient Self-Rating Scale; *RDRS*, Relative Dyadic Relationship Scale; *SF-36*, Short form-36; *WHR*, waist-hip ratio.

Table 2
Correlation among Brief FAM-III scores, DSC-R, MCS and A1C levels

Variables	A1C	p
Brief FAM-III		
PGS	−0.06	0.37
PDRS	−0.09	0.18
PSRS	−0.12	0.06
RDRS	−0.08	0.29
DSC-R	−0.00	0.99
SF-36 (MCS)	0.06	0.31
SF-36 (PCS)	0.01	0.90

Notes: Brief FAM-III as measured by PGS, PDRS, PSRS, RDRS and DSC-R, SF-36 MCS and SF-36 PCS. The Kendall tau-b correlation coefficient was used.
A1C, glycated hemoglobin; *Brief FAM-III*, Brief Family Assessment Measure-III; *DSC-R*, Diabetes Symptom Checklist-Revised; *MCS*, Mental Component Summary; *PCS*, physical component summary; *PDRS*, Patient Dyadic Relationship Scale; *PGS*, Patient General Scale; *PSRS*, Patient Self-Rating Scale; *RDRS*, Relative Dyadic Relationship Scale; *SF-36*, Short form-36.

Correlation among Brief FAM-III scores, DSC-R, MCS and PCS

The Brief FAM-III patient dimension scores were all significantly positively correlated with the DSC-R scores, whereas the Brief FAM-III relative dimension showed a slight positive, insignificant correlation, indicating that a healthy perception of family function is related to a low perception of diabetes distress (Table 3). All the Brief FAM-III dimensions and the DSC-R were negatively significantly correlated with MCS, demonstrating that a healthy perception of family function and a low perception of diabetes distress are related to a good perception of mental health. The Brief FAM-III patient dimensions scores were all low and negatively, yet insignificantly, correlated with PCS, meaning a slight tendency toward an association between better family functioning and good perception of physical health. The relative dimension, RDRS, showed a vague positive and insignificant correlation with PCS, reflecting a possible association between good family functioning and bad perceptions of health. DSC-R was negatively significantly correlated with PCS, demonstrating that a low perception of diabetes distress is related to a good perception of physical health. MCS and PCS were low, positively yet insignificantly correlated, meaning a tendency toward a relationship between good mental health and good physical health.

Discussion

In this study, we found no correlation between glycemic control and family functioning in patients with type 2 diabetes. Thereby, the perceived family function was not a unique predictor of glycemic control. However, the perceived family function, burden of diabetes and health-related quality of life were correlated, suggesting that healthy family functioning is associated with a lower burden of diabetes and a stronger quality of life.

The study results showed that more than half of the participants (56.7%) had adequate glycemic control, corresponding to the defined treatment goal of A1C levels <7%. The participants were mainly older people with a mean age of 65 years. Older adults are more likely to have time for self-care (30) and to perform frequent self-monitoring of blood glucose levels (31)—behaviours that have positive impacts on glycemic control (30,31).

We found no differences due to demographic or anthropometric data, according to glycemic control levels, except the duration of disease. The participants with longer disease durations were significantly more likely to have inadequate glycemic control, which is probably due to the characteristic progressive evolution of type 2 diabetes (32). Furthermore, the majority of the participants were well educated, which is likely to strengthen diabetes management and have a preventive effect on diabetes complications, glycemic control and the perception of diabetes distress (33–35).

Regarding family function, on average, all participants had low scores on the Brief FAM-III scales, and the majority (>82%) had scores below average, indicating healthy family function. There was no difference in perceived family functioning by any of the scales, regardless of glycemic control, indicating no association between family function and A1C levels (16). Conversely, several studies outline that family functioning influences the perceived support for or burden felt by the family regarding diabetes self-management, and this perception, furthermore, affects A1C levels in patients with type 2 diabetes (8,13,36,37). Obstructive family behaviours appear to have a relatively stronger impact on self-management than supportive behaviours and are associated with patients' being less adherent to diabetes regimens and medications and, thereby, having worse glycemic control. On the other hand, studies showed only a marginal association between supportive family behaviours and glycemic control (9,38). This contributes to the explanation of the noncorrelation of A1C levels and family function in the present study because the majority of the participants are likely to perceive their family's behaviours as supportive. We did not test that assumption, so further research is required to assess the association between family function and the perceived supportive and/or obstructive family behaviours. Thus, because previous studies (37,38) have shown that family function relates to glycemic control, which is not consistent with our results, it is also important to consider the low frequency of poorly perceived family functioning in our study population, suggesting that the distribution of variation in these variables might be too small to perform correlation analyses and may justify the absence of correlation in the present study.

Moreover, it is important to note that the present study was an exploratory cross-sectional study and not a family-based intervention. In that context, several studies found improvements in glycemic control as measured by A1C levels in varied family-based interventions (educational, behavioural and psychosocial) and, conversely, no effect in the control groups. Therefore, the lack of correlation between family function and A1C levels in the present study might have occurred because of the theoretical framework; family-related improvements in glycemic control are dependent on family-based interventions' having an impact. In addition, improvements in glycemic control in other studies were detected only in the short term (fewer than 12 months postbaseline). Effects were not sustained 1 year after the intervention period, which indicates a need for stronger family-based components and longer intervention periods with a connection to the health-care system to maintain the rewarding changes in self-care and clinical outcomes (39–41). Furthermore, only a few studies have targeted adults 65 years of age and older who have type 2 diabetes and the impact of family functioning and support. Considering the burden and high prevalence of type 2 diabetes in the older populations, there is a need for family-intervention research that especially targets older persons with type 2 diabetes and their families. Finally, interventions are required to examine whether the perceptions of the family's functions are altered by the evolution of the disease to a worse stage (39).

Family function was not a predictor of A1C levels in our study, but we found that a healthy perception of family function correlated with a low sense of diabetes distress and a strong mental health-related quality of life. In line with our findings, several studies concerning chronic diseases introduced family function as 1 of the main factors affecting quality of life and disease management (42–44). Other studies have suggested that unhealthy family function is significantly more predictive of unhealthful behaviours than is healthy family function (45). Moreover, behaviours leading to poorer glycemic control were closely associated with higher diabetes distress and lower self-efficacy (46). However, studies

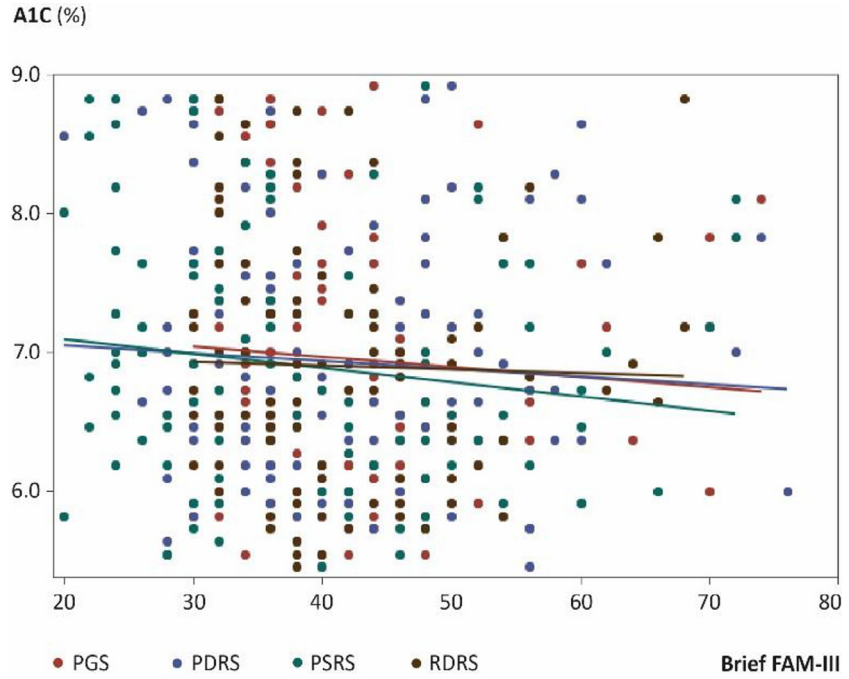

Figure 1. Associations among patient general score (PGS), patient dyadic relation score (PDRS), patient self-rating score (PSRS), relative dyadic relation score (RDRS) and A1C levels. *A1C*, glycated hemoglobin; *Brief FAM-III*, Brief Family Assessment Measure.

Table 3
Correlations among Brief FAM-III scores, DSC-R, MCS and PCS

Variables	DSC-R	p	SF-36 (MCS)	p	SF-36 (PCS)	p
Brief FAM-III						
PGS	0.14	0.02	−0.21	0.0007	−0.09	0.1352
PDRS	0.24	0.0003	−0.23	0.0005	−0.10	0.1209
PSRS	0.16	0.01	−0.25	<.0001	−0.07	0.2784
RDRS	0.07	0.34	−0.13	0.09	0.06	0.3965
DSC-R			−0.30	<.0001	−0.27	<.0001
SF-36 (MCS)					0.05	0.3861

Note: Kendall's tau-b correlation coefficient was used.
Brief FAM-III, Brief Family Assessment Measure; *DSC-R*, Diabetes Symptom Checklist-Revised; *MCS*, Mental Component Summary; *PCS*, physical component summary; *PDRS*, Patient Dyadic Relationship Scale; *PGS*, Patient General Scale; *PSRS*, Patient Self-Rating Scale; *RDRS*, Relative Dyadic Relationship Scale; *SF-36*, short form-36.

evaluating the perception of family function by individuals with diabetes are scarce. Interventions addressing family functioning could improve diabetes self-management and prognosis and prevent or delay complications and, moreover, strengthen quality of life.

Diabetes self-management and health-care factors occur almost entirely in the patients' homes, in the context of the family environment. Therefore, involving the family in diabetes interventions, education and long-term self-management improvements, with a clear description of the family members' roles and participation, might have great potential for adherence to diabetes management (47,48). However, theoretical knowledge about family theory and family-based education seems to be lacking among diabetes educators (49), emphasizing the importance for health-care providers and researchers to expand their knowledge of how to integrate assessment of family functioning and dynamics in diabetes-related clinical practice. That would have a potential impact on patients' diabetes-related outcomes, not least their A1C levels (50).

The strength of this study is the well-defined population of patients with type 2 diabetes and incipient complications and the consistency regarding setting and health professionals; all the participants were examined at the same place, primarily by the same 2 physicians and nurses. Furthermore, there was a high rate of response to all the questionnaires. However, there are limitations to our study that need to be taken into account in the interpretation of the results. First, no causal explanation is possible due to the explorative cross-sectional design. Combining the results with qualitative interviews and/or using the full version of the FAM-III questionnaire instead of the brief version would potentially provide greater insight and demonstrate the impacts of the various dimensions of family function on glycemic control and other measures of diabetes management. However, we anticipated that compliance would be too weak if we used a questionnaire more comprehensive than FAM-III in addition to the rest of the questionnaires in the packet. Moreover, there is a risk of selection bias because our sample might not be representative of the general population of people with type 2 diabetes and incipient complications; it was slightly homogeneous in the perception of family functioning and the burden of diabetes as well as education and A1C levels. Additionally, a minority of the study's participants were women and were a relatively smaller proportion than occurs in the general population with diabetes. Hence, a more differential sample would enhance the credibility of a correlation analysis. Furthermore, the majority of the study population included older people, and their perceptions of family function were related mainly to their spouses. Younger adults with type 2 diabetes might consider nuclear family, extended family and friends in their perceptions of family functioning,

potentially altering our results. Finally, we focused primarily on the patients' perspectives of family functioning. The family members' perspectives might be quite different and could potentially expand or even change the interpretation of the results.

Perspective

Glycemic control is a strong predictor of long-term microvascular complications of diabetes but does not provide a comprehensive picture of the patients' diabetes management or their perceptions of burden or well-being. Experiencing good family function does not necessarily lead to a healthful lifestyle or medication adherence and, thus, improved A1C levels. However, because good family function is associated with advantageous family support, low burden of diabetes and higher quality of life, it is likely to improve patients' potential to change and maintain a healthful lifestyle and, thus, has an indirect impact on diabetes management and prognosis. To fully understand the influence of family function, future intervention-based research focusing on the structure of the family and the dimensions of family function are essential in order to enhance diabetes management and the cohesion and well-being of entire families.

Conclusion

The results of our study suggest that in patients with type 2 diabetes, family function as measured by the Brief FAM III does not predict levels of glycemic control. However, we found an association among the perceptions of healthy family function, low burden of diabetes and strong mental health-related quality of life. Thereby, the results do not exclude associations between family functioning and the multiple factors involved in diabetes self-management, all of which are important to patients' compliance with lifestyle factors and quality of life.

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Author Disclosures

Conflicts of interest: None.

Author Contributions

BBB, DO, HK, MR and TV conceived and designed the study; BBB and LM collected the data; BBB, DO, SL, IE and HK analyzed and interpreted the data; BBB drafted the manuscript; LM, DO, IE, HK, SL, MR, FK and TV critically revised the manuscript and commented on the subsequent drafts; all authors read and approved the final manuscript for publication. An abstract of this study was accepted for oral presentation and given at the 5th Nordic Conference in Family Focused Nursing, Tampere, Finland, June 3 to 5, 2018.

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