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Original Research

Fear of hypoglycaemia and self-management in type 1 diabetes

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ABSTRACT

Aims: We studied the association between fear of hypoglycaemia (FoH) and various diabetes self-management practices.
Methods: Data from 798 individuals with type 1 diabetes participating in the FinnDiane Study were included. Self-reported questionnaires were used to assess FoH and self-management practices (e.g. dietary intake, insulin administration, physical activity). For glycaemic control, we used both the latest HbA_{1c} measurements and the serial HbA_{1c} measurements from the medical files. Factor analysis was used to reveal underlying constructs within the food frequency section of the diet questionnaire.
Results: In all, 44% and 63% of men and women reported FoH, respectively. In men, FoH was associated with higher mean serial HbA_{1c} levels, higher number of reported self-monitoring of blood glucose (SMBG), higher carbohydrate intake, and lower scores in the “high-fat” factor. In women, FoH was associated with a higher number of reported SMBGs and higher energy intake. No difference was observed in physical activity and insulin administration.
Conclusions: FoH has various implications for the self-management of diabetes. More studies are however needed to assess on one hand the association between FoH and diabetes self-management, and on the other hand, FoH and its long term consequences, such as the emergence of diabetic complications and mortality.

Introduction

Good glycaemic control is a prerequisite for reducing the risk of late complications in type 1 diabetes. Normalising blood glucose is, however, challenging due to the potential risk of hypoglycaemia. Hypoglycaemia is, indeed, a common adverse event associated with insulin treatment [1], and a three-fold increase in the occurrence of hypoglycaemic episodes, with intensifying insulin management, was observed in the Diabetes Control and Complications Trial [2].

Hypoglycaemias are categorised as “mild” and “severe” based on the individual’s ability to self-treat oneself. During severe episodes, external assistance is required for recovery. Estimates of the frequencies of hypoglycaemias vary depending on the level of hypoglycaemia and the population in question. Roughly, two episodes of mild hypoglycaemias per week, have been reported in type 1 diabetes [3], and in a population-based study, 82% of individuals with type 1 diabetes reported having experienced at least one hypoglycaemic event over the course of one month [1]. With regards to the severe hypoglycaemias, an overall rate of 1.3 episodes per patient-year was observed in an unselected population of individuals with type 1 diabetes [4]. However, with increasing disease duration, the frequency of episodes seems to increase, as over 3 episodes per patient-year were observed among individuals with diabetes duration over 15 years [5].

The symptoms of hypoglycaemia, such as shaking, impaired vision, anxiousness and sweating may be inconvenient and unpleasant. It is, however, the life threatening nature of the severe hypoglycaemias, which are particularly worrisome to many individuals with insulin-treated diabetes. Fear of hypoglycaemia (FoH) appears to be common [6]. Amongst others, factors such as trait anxiety and frequency of experienced severe hypoglycaemic episodes have been associated with FoH [7,8].

There are various self-management strategies that individuals with FoH use to cope with their fear. One may, for example, administer less insulin than required [9] or restrain from physical activity [10]. Alternatively, one could increase the amount of food

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eaten or eat more carbohydrate-rich food stuffs in order to avoid hypoglycaemia [11]. Despite these actions that all aim at keeping the blood glucose concentrations at higher levels, there does not seem to be a clear association between FoH and HbA_{1c} [8,12–14].

The aim of the current study was to evaluate the association between self-reported FoH and various diabetes self-management practices, including self-monitoring of blood glucose (SMBG), food intake, and leisure-time physical activity (LTPA), in a large and well characterised population of patients with type 1 diabetes. Moreover, the association between FoH and HbA_{1c} was studied.

Methods

Study subjects

Study subjects were participants in the Finnish Diabetic Nephropathy (FinnDiane) Study. From this study of people with type 1 diabetes, we included all who had filled in both the diabetes questionnaire and the diet questionnaire. Thus, for the current cross-sectional analyses, we included data from a total of 798 individuals. The Ethics Committee of the Hospital District of Helsinki and Uusimaa approved the study protocol. Signed informed consent was obtained from all participants prior to study inclusion.

Clinical methods

During the study visits, participants' height and weight were measured in light clothing. Based on these measurements, body mass index was calculated. Following a 10-minute rest, blood pressure was measured in the sitting position. The measurement was repeated with a minimum of 2 minutes' interval, and the mean of the two measurements were used in the analyses. Blood samples were collected and HbA_{1c} was determined locally by standardised assays. In addition, data on all HbA_{1c} measurements conducted at the participating centres were collected from the patients' medical files. The serial HbA_{1c} data collected from these medical files and from the measurements conducted at the study visits (on average 26.6 ± 16.9 measurements per patient) were used to calculate the mean serial HbA_{1c} and the coefficient of variation for these HbA_{1c} values. The coefficient of variation was considered a measure of HbA_{1c} variability. Only those participants with a minimum of three HbA_{1c} measurements were included in the analyses of HbA_{1c} variability (n = 733). Serum lipid and lipoprotein concentrations were measured as previously described [15]. The daily insulin dose was self-reported. Based on these reports and the measured weight, insulin dose per body weight (IU/kg) was calculated.

Urinary albumin excretion rate (AER) in at least two out of three timed 24-hour or overnight urine collections was used to assess participants' renal status. The following classifications were made: normal albumin excretion rate (AER <20 µg/min or <30 mg/24 h), microalbuminuria (AER ≥20 and <200 µg/min or ≥30 and <300 mg/24 h), macroalbuminuria (AER ≥200 µg/min or ≥300 mg/24 h), and end-stage renal disease (ESRD) (in dialysis or with kidney transplant). Diabetic nephropathy was defined as macroalbuminuria or ESRD. Retinal laser-treatment (data obtained from the medical records) was used as an indication of severe retinopathy. Data on smoking and social class (grouped as unskilled/skilled blue-collar, lower/upper white-collar, farmers, and others) were self-reported. Unskilled blue-collar workers were classified as having a low socioeconomic status (SES).

Questionnaires

The diabetes questionnaire was used to collect data on various diabetes specific issues of clinical importance. The diabetes questionnaire is a self-reported structured form, designed to collect data on patients' perceptions of their disease. The questionnaire was designed by a panel of experienced diabetes specialists. Based on years of clinical work, these specialists aimed at formulating a questionnaire that would shed light on the patients' subjective view of their disease. Thus, by design, the questionnaire is subjective in nature. Two questions from this questionnaire were used to approximate FoH: 1. Are you afraid of hypoglycaemia? 2. Has fear of hypoglycaemia led you to eat just in case. FoH was assumed if a positive reply was given to both of these questions.

Dietary intake was measured by two separate methods, as previously described [16]. In short, participants (n = 798) filled in a diet questionnaire that was designed to capture information on their habitual dietary intake. As part of this diet questionnaire, a 19-item food frequency questionnaire (FFQ) was also completed. In this FFQ, the frequency of consuming the most common food items in Finland were queried. Thus, participants reported the frequency of consuming fish dishes, meat dishes, poultry, sausages and cold cuts, eggs, legumes, fresh vegetables, cooked vegetables, potatoes, pasta and rice, fruits and berries, high-fat cheese, low-fat cheese, yoghurt, ice cream, soft drinks, pastries, sweets, and fried and grilled foods using a seven scale responses. Upon returning the diet questionnaire, patients were allocated a 3-day exercise and food record (two weekdays and one weekend day). In this record, data on food consumption, physical activity, insulin use, and SMBG were reported. In order to capture some seasonal variation in the dietary intake, the 3-day recording was repeated in 2–3 months. In the current analyses, individuals who filled in the record for a minimum of three days (n = 615) were included. AivoDiet software (version 2.0.0.1, AIVO, Turku, Finland), based on the Finnish National Food Composition Database (Fineli) [17], was used to calculate the mean daily energy and nutrient intakes reported in the records.

From the same record, the number of reported blood glucose measurements per journal day, the mean value of the reported blood glucose measurements, and the number of days with reported blood glucose values <3.5 mmol/l (cut off level previously used by Leese et al. [18]) per journal day were calculated. Additionally, the mean reported insulin dose divided by body weight was calculated. Finally, we calculated the daily metabolic equivalent of task hour (METh), which reflects the energy cost of LTPA. The METh was calculated by multiplying the duration of the activity, reported in the record, by the activity- and intensity-specific metabolic equivalent.

Statistical analyses

Descriptive statistics are reported as percentages for categorical data, median (interquartile range) for non-normally distributed continuous data, and mean ± standard deviation (SD) for normally distributed continuous data. The respective group comparisons were performed with chi-squared test, Mann–Whitney U-test, and independent-sample t-test. Exploratory factor analysis (maximal likelihood and varimax rotation) was conducted to reveal underlying constructs within the FFQ of the diet questionnaire. In the analysis, the number of factors identified was based on eigenvalues >1.0, and items with factor loading | ≥ 0.20| with a particular factor, were included. The factor score was the sum of the scores for all items associated with that particular factor multiplied by its corresponding factor loading. The obtained scores were used as dependent variables in the analyses. Forward stepwise logistic regression analyses were used to assess factors independently associated with FoH. For the model, all items that were statistically significant ($p < 0.05$) or borderline significant ($p < 0.08$) in the bivariate analyses were included. All data were analysed using IBM SPSS Statistics for Windows, Version 22.0 (IBM Corp, Armonk, NY, USA).