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Highlights

- The Danish diet is high in saturated fat and low in fibre, vegetable, fruit and fish
- Dietary adherence is higher in diabetes patients compared with the general population
- Patients with diabetes consume less sugar and alcohol, and more fibre and vegetables

Dietary habits and adherence to dietary recommendations in patients with type 1 and type 2 diabetes compared with the general population in Denmark

Running head: **Dietary habits and adherence in patients with diabetes**

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INTRODUCTION

Diet is a cornerstone in the management of type 1 diabetes (T1D) and type 2 diabetes (T2D) and dietary guidance aim to maintain and improve healthy eating habits in order to achieve optimal metabolic control. According to The Diabetes and Nutrition Study Group (DNSG) of the European Association for the Study of Diabetes(1) dietary guidelines for patients with T1D and T2D are very similar to the Nordic Nutrition Recommendations (NNR)(2) including the National Food-based Dietary Guidelines(3) targeted the general population. Dietary guidelines for management of T1D mainly focus on improving glycaemic control through matching of carbohydrate intake with insulin

and to a limited degree on healthy eating habits(1, 4). In contrast, guidelines for T2D focus on weight reduction or maintenance through energy restriction and healthy eating habits to improve glycaemic control and reduce cardiovascular disease (CVD)(1, 4). In Denmark patients with diabetes are offered free-of-charge access to dietary counselling with a dietician. However, it is unknown whether this individualised approach in diabetes is reflected by a higher dietary adherence to the recommendations. The latest national survey of dietary habits in Denmark (2011-13) concluded that the Danish diet was too high in fat and carbohydrates (added sugar) and too low in dietary fibre compared to the dietary guidelines(5). Only a few studies have investigated dietary intake and adherence to the recommendations in patients with diabetes(6-11), in general reporting poor adherence for most macronutrients. Dietary studies comparing patients with diabetes with the general population have not previously been reported. Thus, the aim of this study was to investigate dietary habits and adherence to dietary recommendations in patients with T1D and T2D as compared to the general population in Denmark.

SUBJECTS AND METHODS

Design and participants

The dietary survey among patients with T1D and T2D was a cross-sectional design based on a web-based questionnaire with information concerning the patients' habitual diet, physical activity, and socio-economic status. Data were collected July 2014 - January 2015. A random sample of 3,000 adult patients (>18 years) with diabetes (1,500 with T1D and 1,500 with T2D) followed in the out-patient clinic at Steno Diabetes Center Copenhagen were assessed for eligibility. We included patients with diabetes-related complications that could influence the dietary intake (e.g. gastropareses and coeliac disease), however the number was small (4.5 %). Exclusion criteria included mental disorders or life-threatening disorders. A total of 774 patients (n=426 with T1D, n=348 with T2D) participated in the study (**Figure 1)**. Patients received a written invitation with information regarding the questionnaire including a personal token and a hyperlink to a website containing the study questionnaire. The online survey tool, Lime Survey (San Francisco, CA, USA), was connected to a server at the National Food Institute (Technical University of Denmark). Clinical data were extracted from the patients' electronic medical record (EMR). Patients were informed that completing the web-based questionnaire was regarded as consent to participate in the study according to Danish regulations for biomedical research. The dietary survey was approved by the local ethics committee and the Danish Data Protection Agency. Data from the cross-sectional

study were compared with data from the Danish National Survey of Dietary Habits and Physical Activity in 2011-13 (DANSDA)(5) performed by the National Food Institute and based on a random sample of 2,899 adults from the general population with no known history of diabetes.

Dietary assessment

Dietary intake of total energy, energy-contributing macronutrients and foods in patients with diabetes was assessed using a web-based semi-quantitative food frequency questionnaire (FFQ) whereas dietary intake in the general population based on DANSDA data was assessed using a pre-coded food diary. In collaboration with the National Food Institute, we have previously performed a study of the relative validity of the FFQ in patients with diabetes against the food diary used in DANSDA(12). The FFQ covers intake in the previous three months and consists of 270 food items and mixed dishes. Portion sizes were estimated using the same household measures and series of photographs that participants could select according to their habitual dietary intake similar to the food diary in DANSDA(5). Mean intake of foods and nutrients recorded in the FFQ and the food diaries were calculated using the same software system General Intake Estimate System (Mørkhøj, Denmark), to examine adherence to DNSG recommendations for patients with diabetes and NNR recommendations for the general population. DNSG(1) and NNR(2) use similar targets for recommended intake of carbohydrates (45-60 E%), added sugar (<10 E%), protein (10-20 E%), saturated fatty acids (SFA, <10 E%), monounsaturated fatty acids (MUFA, 10-20 E%), polyunsaturated fatty acids (PUFA, 5-10 E%), alcohol (women, <10 g/d and men, <20 g/d), vegetables (≥300 g/d), and fish (350 g/week)(1-3). DNSG guidelines recommend 5 daily servings of fruit and vegetables and 4 weekly servings of legumes(1), interpreted as 250 g fruit and 300 g vegetables (including legume recommendations), since the National Food Institute includes legumes in the calculation of total vegetable intake. DNSG and NNR have different targets for fruit: >250 g/d (DNSG) and ≥300 g/d (NNR), total fat: 25-35 E% (DNSG) and 25-40 E% (NNR) and dietary fibre: >40 g/d (or 20 g per 1000 Kcal/d) (DNSG) and ≥25 g/d for women and ≥35 g/d for men (NNR), or 3 g/MJ (NNR).

Assessment of the prevalence of misreporting of dietary energy intake was performed using The European Food Safety Authority recommendations for dietary surveys (13). Estimated basal metabolic rate (BMR_{est}) was calculated using equations by Schofield et *al.* based on gender, age, height and weight. The ratio of self-reported energy intake (EI_{rep}):BMR_{est} was used to identify possible under- and over-reporting using the *Goldberg* cut-off method according to age-specific

physical activity level with three categories (low, moderate and high)(14, 15). Median EI_{rep}:BMR_{est} was 1.186 (interquartile range (IQR) 0.922-1.461) in T1D and 0.900 (IQR 0.698-1.710) in T2D with a proportion of potential under-reporters of 34% (T1D) *vs.* 42% (T2D), compared to 12% in the general population. Proportion of potential over-reporters was low (~1-2%). A high proportion of the under-reporters were overweight or obese (~50-90% had a body mass index (BMI) >25 kg/m^2 and ~20-60% had a BMI >30 kg/m^2).

Other variables

Data on socio-economic status included occupational status (employed, unemployed, pensioner, other), and level of education divided into: 1. long further education (5 years in a university), 2. medium further education (2-4 years in a university (college)), 3. short further education (1-2 years in a university college), 4. vocational education (e.g. skilled worker), 5. no further education and 6. unspecified. Questions and classification of occupation and level of education are according to Statistics Denmark (www.dst.dk/en). The Danish version of the International Physical Activity Questionnaire short form (IPAQ-SF) was used to collect data concerning the level of physical activity for the previous seven days and converted to *Metabolic Equivalent of Task* (MET) minutes per week, and categorised to a level of low, moderate or high physical activity according to the IPAQ standard definitions (www.ipaq.ki.se). Clinical data including age, gender, type of diabetes, diabetes duration, height and weight, smoking habits, glycated haemoglobin A1c (HbA1c), levels of total cholesterol (total-C), high-density lipoprotein cholesterol (HDL-C), and low-density lipoprotein cholesterol (LDL-C), use of insulin pump, visits at a dietitian and participation in a weight reduction program were extracted from the patients' EMR.

Background data from the general population

Data from DANSDA was included to compare and adjust the statistical analyses. Data concerning smoking habits, occupational status and level of education were collected from personal interviews, BMI was calculated from weight and height and physical activity was assessed by a 7-day use of pedometer adjusted for biking time, and categorised into three physical activity level groups: low <7,500 daily steps, moderate 7,500-9,999 daily steps, and high ≥10,000 daily steps.

Statistical analyses

Analyses included standard descriptive statistics. All data were non-normally distributed and therefore presented as medians with interquartile range (IQR). Group differences were tested using Mann-Whitney U test or Kruskal-Wallis one-way analysis of variance as appropriate. Categorical data were compared by using the Chi-square test for differences in proportions. Due to the wide age range (18-75 years) we tested for age effect but did not find any major effects on dietary intake. Still we included age in the multiple linear regression analysis. Percentage differences in dietary energy intake (with 95% CI) deriving from carbohydrates, added sugar, total fat, SFA, MUFA, PUFA and protein in patients with T1D and T2D as compared to the general population were tested using multiple linear regression analysis adjusted for age, gender, BMI, physical activity level, and education level. Similarly, percentage differences in g/d of dietary fibre, vegetables, fruit, fish and alcohol were tested using multiple linear regression analysis adjusted for the same variables as first mentioned in addition to total energy intake. Variables were logarithmically transformed for statistical analyses and back transformed to natural units for presentation in the text and Forest Plot figures. For all statistical tests a two-sided significance level of $p < 0.05$ was used. All statistical analyses were performed with the SPSS software for Windows, version 22.0 (IBM Corp, Armonk, NY, USA).

RESULTS

Overall participation rate was 26% (T1D 29% and T2D 23%; **Figure 1**). The study participants were generally healthier than non-responders (**Table 1**). As shown in **Table 2**, patients with T2D were older and heavier compared with T1D and the general population. Compared with the general population, patients with diabetes were better educated, with less smokers (**Table 2**) and more users of dietary supplementation (see **Table 1** in Ref (16)). The median daily energy intake was lower in patients with diabetes (**Table 3**), and even after adjustments for age, gender, BMI, physical activity

and education level remained lower in T1D (-9.9 % (CI 95% -11.2 to -8.6), p<0.001) and T2D (-12.3 % (CI 95% -13.8 to -10.8), p<0.001) as compared to the general population (data not shown). The proportion of patients with diabetes and of the general population achieving the recommended intakes was high for MUFA, PUFA, and protein (80-100%; **Figure 2**) but low for dietary fibre, SFA, fruit and fish (<25%; **Figure 2**). All groups had higher than recommended intake of SFA (~13 E% in patients with diabetes *vs.* 15 E% in the general population), while the median intake of total fat was identical in all groups (~37-38 E%; **Table 3**). Using the DNSG recommendation for total fat intake (<35 E%) the adherence in patients with diabetes was low compared to the general population (NNR recommendation <40 E%) (**Figure 2**). Median intake of carbohydrates was ~45 E% and in the lower end of the recommended 45-60 E% (**Figure 2**). More patients with diabetes than in the general population were close to fulfilling the recommendations for reducing the intake of added sugar (97% *vs.* 67%; **Figure 2**). Although low (**Figure 2**), the median intakes of dietary fibre adjusted for total energy was higher in patients with diabetes compared to the general population (29-31 g/10 MJ *vs.* 23 g/10 MJ; **Table 3**). Patients with diabetes had the highest adherence to intake of vegetables (T1D 44% and T2D 36% *vs.* 15% of the general population), and when adjusted for total energy, median intake of vegetables were above the recommended lower limit of 300 g/d in T1D (346 g/10 MJ) compared to 290 g/10 MJ in T2D and 189 g/10 MJ in the general population. After adjustment for age, gender, BMI, energy intake, physical activity and education we found a 20% higher intake of vegetables in patients with diabetes compared with the general population (p<0.001, **Figure 3**). Participants with diabetes demonstrated a 30% lower intake of added sugar and 20-50% lower intake of alcohol as compared with the general population (p<0.001 for all, **Figure 3**). Patients with T2D had a 37% lower intake of alcohol as compared with patients with T1D (p<0.001).

DISCUSSION

In the present study we demonstrate that overall dietary adherence to recommendations, *e.g.* to limit intake of added sugar and alcohol, and increase intake of vegetables and dietary fibre, was significantly higher in patients with T1D and T2D as compared to the general population, even after adjusting for possible confounders (gender, age, physical activity and education). Only two smaller studies (n < 200 participants) have previously investigated patients with T1D and T2D(8, 9), and found low adherence to all dietary recommendations except for protein intake. Even though dietary recommendations are evidence-based, the current strength of evidence does not support *one* ideal

distribution of macronutrients in a diet that apply for all patients with T1D or T2D(4). For carbohydrates, the ideal dietary intake to achieve good glycaemic control in T1D or to obtain and maintain a weight loss in T2D is still under debate(17).

There is consensus to reduce intake of SFA and increase intake of dietary fibre, particularly from whole grain cereals, associated with lower CVD-specific and all-cause mortality in patients with diabetes, while only modest effects on glycaemic control have been found with intakes higher than 50 g fibre per day (4, 18). In our study, less than 10% of the patients with diabetes fulfilled the DNSG recommendations of 40 g of fibres per day. Perhaps the recommended dietary fibre intake is unrealistic for the majority why the North American dietary guidelines recommend that patients with diabetes should consume at least the amount of dietary fibre and whole grain as recommended for the general population, corresponding to the NNR(2, 4). When adjusted for total energy intake, we found intake of dietary fibre and vegetables to be significantly higher in patients with diabetes. Since consumption of fibre-rich vegetables, fruits, legumes and whole grain cereals are part of the dietary recommendations in most patients with diabetes this higher intake may reflect a greater awareness on eating a high-fibre diet. Less than 10% of patients with diabetes and of the general population fulfilled the recommendations for intake of SFA, reflecting a general problem of the abundance of SFA (and refined carbohydrates) in the western diet. Our findings are in accordance with findings in several observational studies, where intakes of total fat and saturated fat exceed recommendations, while the opposite goes for the intake of fibre in patients with diabetes (6, 7, 10, 11).

The strengths of our study are the large sample size, the standardized and validated method for dietary data collection, and the examination of possible differences in dietary habits between patients with diabetes and the general population. Another strength is the online survey for data collection, since it presented a minimal burden and maximal flexibility for the respondents and potentially reduced underreporting of e.g. alcohol consumption, which for many are sensitive topics in interviewer-administered surveys. A weakness is the low rate of participation (26%) and the possible biases this may have resulted in, since patients with healthier eating habits tend to be more prone to participate in comparable nutritional studies. Low participation rates have been reported for comparable surveys in contrast to surveys that involve a more personalized recruitment and data collection(19, 20). However, overall participation rates have declined in epidemiological studies in Denmark over the last 50 years: From ~85% (late 1970s) to ~45% (2006) (21). Quantifying differences in dietary intake based on dietary data from two different dietary assessment methods is

another study limitation, and another bias when interpreting our results, is the impact of possible non-response bias, since respondents had a higher education level compared to respondents from the general population. Only 12% in the general population had a long further education as compared to 15-24% in subjects with diabetes. Reflecting this, population-based studies of diabetes and obesity face selective and markedly lower participation among the lowest social classes, the most obese, the most inactive, ethnic minorities, and those with unfavourable risk profiles (22-25). However, we tried to reduce the risk of selection bias and increase participation rate by offering possible participants with difficulties in completing the online survey to be interviewed by the study recruiter by telephone or face-to-face.

In our analysis, after adjusting for several potential confounders including level of education, physical activity and BMI, we still managed to find significant differences in dietary intake of more than 20% between patients with diabetes and the general population suggesting an independent difference.

All data in our dietary survey of patients with diabetes are self-reported except for the clinical data, making the assessment of dietary intake and physical activity subjects to errors. The FFQ is a retrospective method for assessment of dietary intake where biases caused by errors in memory and perception of portion sizes of food are main issues, why our FFQ was only based on the last three months, an HbA1c period, in order to reduce the risk of memory bias. Our FFQ also included photos with the option of choosing habitual portion sizes instead of using predefined standard portion sizes as done in most FFQs, and we have previously performed a validation of our FFQ against the food diary used in DANSDA and found good alignment between the two dietary assessments methods(12). Our FFQ and the food diary used in DANSDA are based on the same principles using the same software system at the National Food Institute. However, some of the observed differences in intake of healthy foods and macronutrients may be explained by the different assessment methods for dietary data collection and differences in underreporting in our dietary study among patients with diabetes compared to participants in DANSDA. Consequently, we only present and discuss differences in dietary intake above 10 %, in the multiple regression analysis. Patients with diabetes had a 10-12 % lower energy intake as compared to the general population and underreporting of energy intake is a well-known problem in self-reported dietary assessment studies. Underreporting has been found in other nutritional epidemiologic studies including patients with T2D(7, 26) and a Danish population(27) and is associated with both the past and current high BMI(27, 28). The fact that most patients with diabetes acknowledges the

importance of healthy eating, foods less accepted especially in diabetes (e.g. added sugar), may have been under-reported to a greater degree in our diabetes populations. Underreporting could also be due to dieting attempts resulting in a negative energy balance and we found that up to 21% of the potential under-reporters in our study were in a calorie-restricted program assessed by a dietitian during the study period. Previous studies have reported that dieting is an important contributor do systematic bias(14), however, we did not exclude low-energy reporters in our analyses as others have done(11). Data suggest that calculated BMR may be over-estimated by the Schofield equations only in the most obese (BMI>35 kg/m^2) and that even when adjusting for BMR, this may not transfer the group into the category of acceptable/plausible reporters(14). The higher proportion of under-reporters in our diabetes population compared to that found in DANSDA, where physical activity was measured by pedometer, may also partly have been due to over-reporting of physical activity level in our study. A systematic review found that physical activity is generally overestimated using IPAQ-SF compared with objective measurements(29).

In conclusion, we found that Danish patients with T1D and T2D consume significantly less added sugar and alcohol and significantly more vegetables and dietary fibre as compared to the general population in Denmark. These findings support the hypothesis that dietary guidance by dietitians may lead to greater adherence to dietary recommendations in patients with diabetes. Still, the diet of Danish diabetes patients is too high in saturated fat and too low in dietary fibre, vegetables, fruit and fish compared to dietary recommendations as the diet of the general Danish adult population. Dietary education in patients with diabetes needs to focus more on strategies for improving the overall quality of the diet by focusing on a higher consumption of fibre-rich foods e.g. vegetables, fruit, legumes and wholegrain products and reducing/substituting foods high in saturated fat with foods high in monounsaturated fat to improve fat quality, and overall possibly improve metabolic control and reduce cardiovascular risk.

Conflict of interest none.

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BE planned the study design, was responsible for data collection, conducted the statistical analyses, and wrote the first draft of the manuscript. BE, ET, SSJ, TPA, DV, TV and JMB were involved in the data analysis and interpretation, revised the manuscript and approved the final version.

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Table 1 Characteristics of participants and non-responders

	T1D (n=1490)			T2D (n=1486)		
Characteristics	**Participants (n=426)**	**Non-respondents (n=1064)**	**P-value***	**Participants (n=348)**	**Non-respondents (n=1138)**	**P-value***
Gender (F/M), % (n)	49/51 (209/217)	44/57 (463/601)	0.052	29/71 (101/247)	40/60 (455/683)	<0.001
Age, years	53 (41-64)	48 (34-61)	<0.001	66 (58-71)	68 (58-75)	0.001
BMI, kg/m^2	24.9 (22.6-27.6)	25.1 (22.7-28.2)	0.164	29.2 (26.5-33.3)	30.0 (26.7-34.4)	0.040
Height, m	1.74 (1.67-1.80)	1.74 (1.67-1.82)	0.430	1.74 (1.68-1.81)	1.72 (1.63-1.79)	<0.001
Weight, kg	75.5 (66.8-84.6)	78.0 (66.3-88.2)	0.105	90.5 (78.5-102.8)	88.9 (76.8-102.3)	0.365
Insulin pump, % (n)	29 (122)	21 (222)	0.001	0 (0)	0 (0)	-
Years with diabetes, years	26 (14-39)	20 (12-33)	<0.001	15 (9-21)	16 (9-22)	0.312
Smokers, % (n)	14 (58)	24 (250)	<0.001	11 (39)	18 (207)	0.002
HbA1c, mmol/mol	58 (52-65)	62 (55-71)	<0.001	57 (51-66)	59 (51-70)	0.036
Total C, mmol/l	4.50 (4.00-5.10)	4.60 (4.00-5.20)	0.044	4.0 (3.50-4.70)	4.1 (3.50-4.80)	0.456
HDL-C, mmol/l	1.55 (1.31-1.94)	1.45 (1.19-1.80)	0.000	1.07 (0.89-1.30)	1.06 (0.88-1.30)	0.482
LDL-C, mmol/l	2.50 (2.00-2.90)	2.50 (2.08-3.10)	0.037	2.00 (1.50-2.40)	2.00 (1.50-2.60)	0.311
Systolic blood pressure, mmHg	128 (120-136)	127 (118-136)	0.077	130 (122-139)	130 (119-139)	0.118
Diastolic blood pressure, mmHg	76 (70-82)	76 (70-82)	0.995	77 (70-82)	76 (69-82)	0.024
Dietitian visits within the last year, % (n),						
- None	71 (304)	76 (804)	0.093	68 (238)	71 (813)	0.274
- 1-2 visits	22 (93)	18 (193)	0.102	19 (65)	17 (191)	0.413
- ≥ 3 visits	7 (29)	6 (67)	0.717	13 (45)	12 (134)	0.562
Weight reduction initiated with dietitian within the last year, % (n)	32 (39)	27 (71)	0.348	58 (64)	62 (203)	0.426

Data are medians (IQR: 25th to 75th percentile) or proportion (numbers).

T1D, type 1 diabetes; T2D, type 2 diabetes; BMI, body mass index; HbA1c, glycated haemoglobin A1C; total C, total cholesterol; HDL-C, high-density lipoprotein cholesterol; LDL-C, low-density lipoprotein cholesterol.

*Mann Whitney U test or Chi-square test for differences between participants and non-responders with T1D and T2D.

Table 2 Background characteristics

Characteristics	**Patients with T1D (n=426)**	**Patients with T2D (n=348)**	**General population (n=2899)**
Gender (F/M), % (n)	49/51 (209/217)	29/71 (101/247)	52/48 (1507/1392)
Age, years	53 (41-64)	66 (58-71)	48 (35-60)
BMI, kg/m	25.0 (22.7-27.6)	29.2 (26.5-33.3)	25.6 (23.1-28.6)
Smokers, %	13.6	11.2	20.8
Physical activity level			
Low activity, % (n)	18.3 (77)	39.4 (136)	32.9 (895)
Moderate activity, % (n)	42.9 (180)	36.5 (126)	25.2 (684)
High activity, % (n)	38.8 (163)	24.1 (83)	41.9 (1141)
Education level			
No further education, % (n)	13.1 (56)	11.2 (39)	22.5 (652)
Vocational education*, % (n)	20.0 (85)	26.4 (92)	38.0 (1101)
Short further education (1-2 y), % (n)	12.3 (52)	7.2 (25)	7.4 (213)
Medium further education (2-4 y), % (n)	26.7 (114)	26.2 (91)	20.3 (589)
Long further education (5 y), % (n)	23.9 (102)	15.2 (53)	11.8 (342)
Unspecified education, % (n)	4.0 (17)	13.8 (48)	0 (0)

Data are medians (IQR: 25th to 75th percentile) or proportion (numbers).

T1D, type 1 diabetes; T2D, type 2 diabetes; BMI, body mass index.

*Skilled worker, office worker, crafts education.

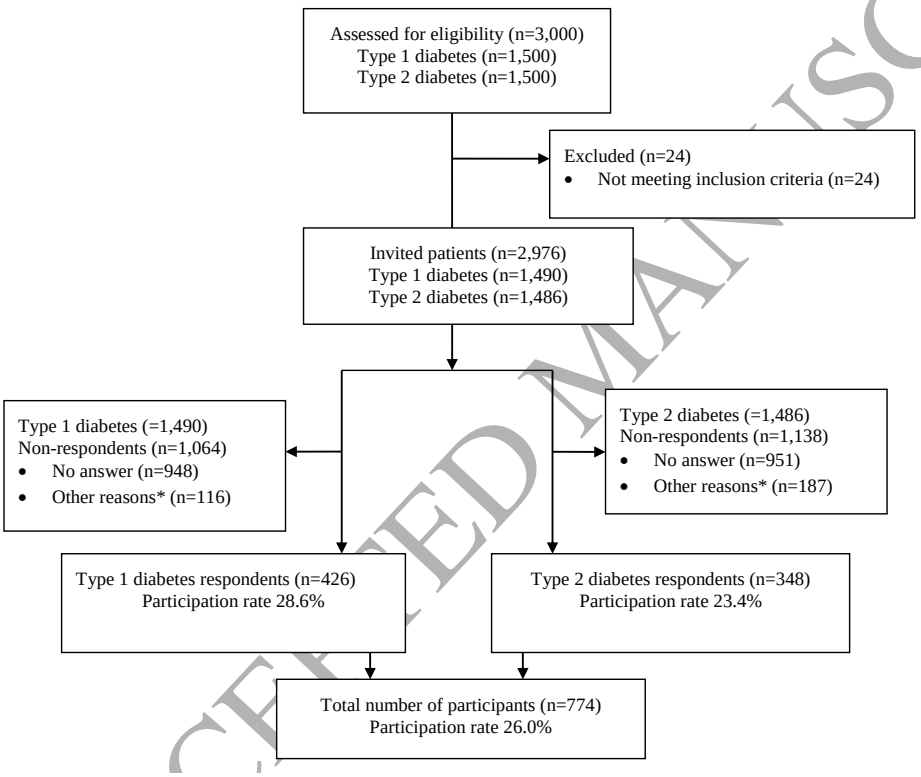
Table 3 Intake of energy, nutrients and healthy foods

Dietary intake	DNSG targets*	NNR targets†	T1D (n=426)	T2D (n=348)	General population (n=2899)
Energy, MJ/d			7.9 (6.2-9.6)	7.4 (5.9-9.4)	9.4 (7.7-11.4)
Carbohydrates, E%	45-60	45-60	45.2 (41.3-49.3)	46.1 (41.2-50.0)	45.9 (42.2-49.7)
Added sugar, E%	< 10	< 10	3.3 (1.9-5.0)	3.2 (1.9-5.1)	7.8 (5.1-11.3)
Fibre, g/d,					
- Men	> 40	> 35	22.8 (16.8-31.8)	21.5 (15.9-28.9)	21.5 (17.1-26.5)
- Women	> 40	> 25			
Fibre, g/10 MJ			30.6 (24.7-37.0)	29.0 (23.5-35.9)	22.7 (18.8-27.5)
Fat, E%	25-35	25-40	37.6 (34.1-41.8)	36.6 (32.9-40.1)	37.8 (34.2-41.4)
SFA, E%	< 10	< 10	13.1 (11.4-14.9)	13.4 (11.4-15.2)	14.9 (13.1-16.9)
MUFA, E%	10-20	10-20	14.7 (12.8-17.0)	13.9 (12.0-15.9)	13.9 (12.4-15.6)
PUFA, E%	≤ 10	5- 10	6.8 (5.8-8.0)	6.5 (5.5-7.4)	5.7 (5.2-6.4)
Proteins, E%	10-20	10-20	16.9 (15.7-18.7)	17.3 (15.8-19.2)	16.0 (14.4-17.9)
Alcohol, g/d,					
- Men	< 20	< 20	9.3 (2.7-19.0)	6.1 (2.1-16.3)	14.7 (3.5-29.7)
- Women	< 10	< 10	5.5 (1.7-12.9)	1.6 (0.1-5.3)	7.2 (1.0-17.4)
Vegetables, g/d	≥ 300	≥ 300	268 (169-413)	218 (139-368)	178 (122-254)
Vegetables, g/10 MJ			346 (225-540)	290 (196-447)	189 (126-270)
Fruit, g/d	≥ 250	≥ 300	102 (52-207)	103 (58-202)	161 (80-265)
Fruit, g/10 MJ			135 (72-232)	141 (74-255)	172 (84-287)
Fish, g/d	≥ 350	≥ 350	196 (105-308)	210 (119-315)	196 (70-371)

Data are medians (IQR: 25th to 75th percentile).

*The European dietary recommendations in diabetes according to DNSG.

†NNR for the general population in the Nordic countries including the Food-based Dietary Guidelines.



*Other reasons include; undelivered mail returned, died, refused to participate, not completing the questionnaire.

Figure 1 Flow chart of the study population and participation rates.

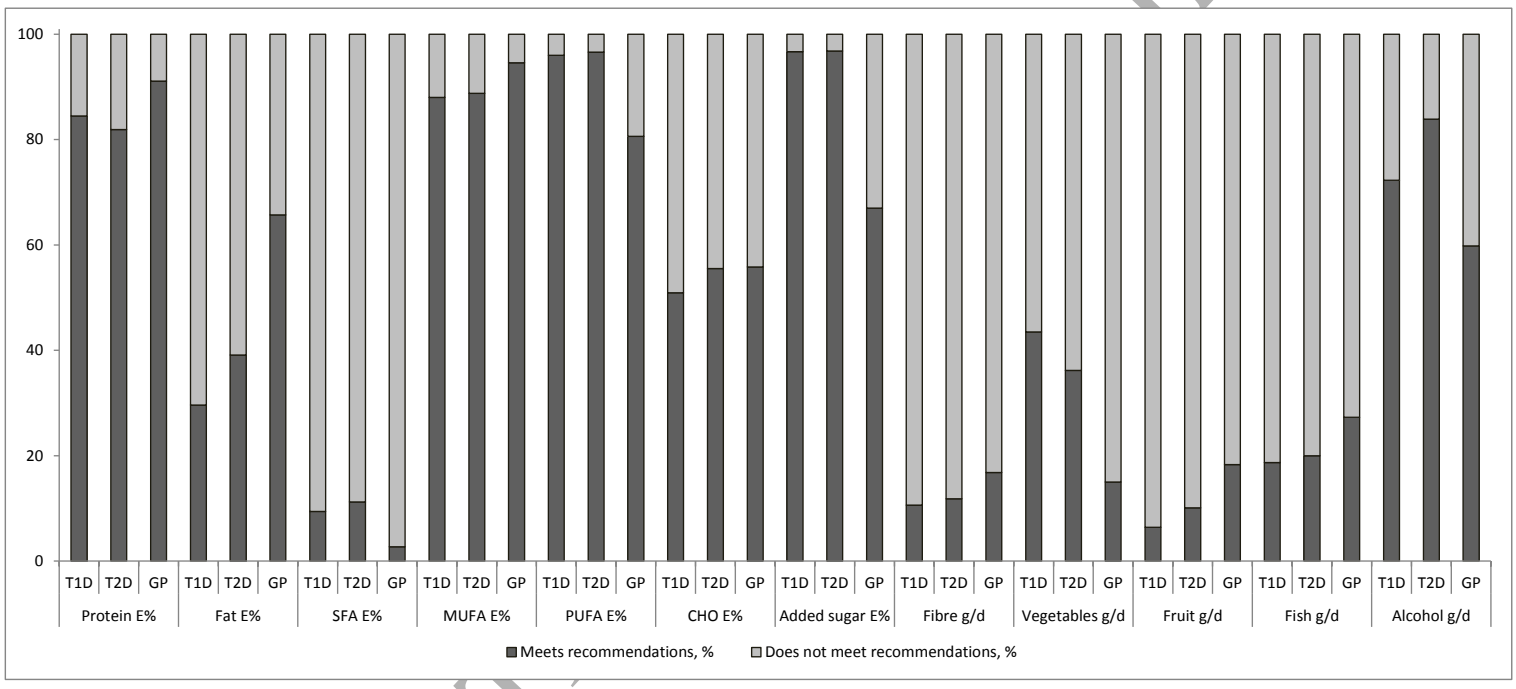
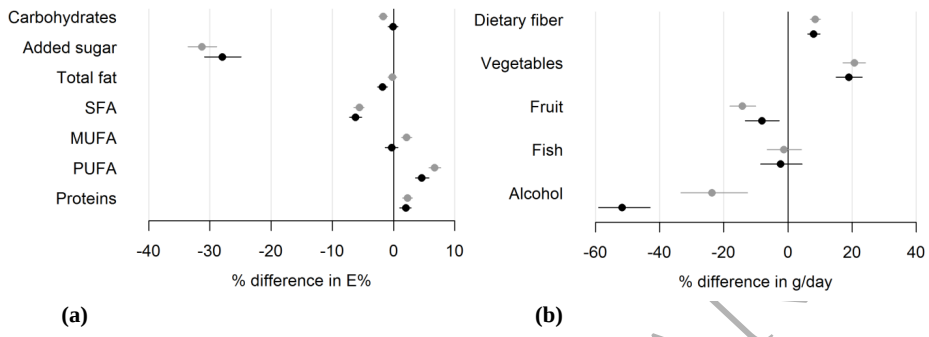


Figure 2 The percentages of patients with T1D and T2D, and the general population eating according to the dietary recommendations.

NNR recommendations for the general population: 10-20 E% protein, 25-40 E% fat, <10 E% SFA, 10-20 E% MUFA, 5-10 E% PUFA, 45-60 E% CHO, < 10 E% added sugar, ≥ 25 g/d dietary fibre for women and ≥ 35 g/d fibre for men, ≥ 300 g/d vegetables, ≥ 300 g/d fruit, ≥ 350 g/week fish, < 10 g/d alcohol for women and < 20 g/d alcohol for men. DNSG recommendations in diabetes: 10-20 E% protein, 25-35 E% fat, <10 E% SFA, 10-20 E% MUFA, ≤10 E% PUFA, 45-60 E% CHO, <10 E% added sugar, ≥40 g/d dietary fibre, ≥ 300 g/d vegetables, ≥250 g/d fruit, ≥ 350 g/week fish, < 10 g/d alcohol for women and < 20 g/d alcohol for men. GP, general population; T1D, type 1 diabetes; T2D, type 2 diabetes; E%, percentages of energy; SFA, saturated fatty acids; MUFA, mono unsaturated fatty acids; PUFA, poly unsaturated fatty acids; CHO, carbohydrates; DNSG: Diabetes and Nutrition Study Group; NNR, Nordic Nutrition Recommendations including Food-based Dietary Guidelines.



(a) **(b)**

Figure 3

(a) shows the % differences in energy intake (with 95% CI) for patients with T1D (grey lines) and T2D (black lines) compared to the general population, adjusted for age, gender, BMI, physical activity, and level of education and **(b)** shows the % difference in g/day (with 95% CI) for patients with T1D (grey lines) and T2D (black lines) compared to the general population, adjusted for age, gender, BMI, physical activity, level of education and energy intake. E%, percentage of total energy; SFA, saturated fatty acid; MUFA, monounsaturated fatty acid; PUFA, polyunsaturated fatty acid.