Fat intake in patients newly diagnosed with type 2 diabetes: a 4-year follow-up study in general practice

Floris A van de Laar, Eloy H van de Lisdonk, Peter L B J Lucassen, J M H Tigchelaar, Saskia Meyboom, Jan Mulder, Henk J M van den Hoogen, Guy E H M Rutten and Chris van Weel

SUMMARY

Background: *Although treatment targets for the consumption of dietary fat in patients with type 2 diabetes mellitus are well accepted, little is known about the actual fat consumption by newly diagnosed patients or the dietary adjustments that they make in the following years.*

Aims: *To measure fat intake in patients with type 2 diabetes in general practice at diagnosis, shortly after dietary consultation, and after 4 years.*

Design of study: *A prospective cohort study.*

Setting: *Thirty-three general practices in The Netherlands.*

Method: *One hundred and forty-four patients with newly diagnosed type 2 diabetes were referred to a dietician, and fat consumption (the main outcome measure) was assessed with a 104-item food frequency questionnaire at diagnosis, 8 weeks following diagnosis, and after 4 years. Reference values for fat consumption were obtained from an age-matched sample of a population-based survey.*

Results: *At diagnosis, total energy intake was 10.6 MJ/day and cholesterol intake was 300 mg/day. Total fat consumption was 40.9% of energy intake, with saturated fatty acids 15.0%, monounsaturated fatty acids 14.3%, and polyunsaturated fatty acids 9.2% of energy intake. All levels, except for polyunsaturated fatty acids, were significantly unfavourable compared with those for the general population. After 8 weeks, consumption of saturated fatty acids had decreased to a lower level than in the general population and all other levels measured were similar to those for the general population. After 4 years there was a slight increase in the consumption of total fat and monounsaturated fatty acids, but cholesterol and saturated fatty acid consumption had decreased further.*

Conclusions: *Patients with newly diagnosed type 2 diabetes have an unfavourable fat consumption at diagnosis. They adapt to a more desirable consumption shortly after diagnosis, and this improved dietary behaviour is sustained for 4 years. Recommendations regarding consumption of total and saturated fat are, in contrast to those for cholesterol, not met by patients in general practice.*

Keywords: *cohort studies; diabetes mellitus type 2; dietary fats; diet, diabetic; family practice; food habits.*

F A van de Laar, MD, general practitioner; E H van de Lisdonk, MD, PhD, senior lecturer in general practice; P L B J Lucassen, MD, PhD, general practitioner; J M H Tigchelaar, MD, general practitioner; J Mulder, BE, statistician; H J M van den Hoogen, statistician; C van Weel, MD, PhD, professor of general practice; University Medical Centre Nijmegen, Department of General Practice, Nijmegen. S Meyboom, RD, research dietician and nutritionist, Wageningen University, Division of Human Nutrition, Wageningen. G E H M Rutten, MD, PhD, professor of general practice, Julius Centre for Health Sciences and Primary Care, Utrecht, The Netherlands.

Address for correspondence

Floris van de Laar, UMC Nijmegen, Department of General Practice, 229 HAG, PO Box 9101, 6500 HB Nijmegen, The Netherlands. E-mail: f.vandelaar@ hag.umcn.nl

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Introduction

THE treatment of type 2 diabetes mellitus requires counselling on lifestyle modifications and dietary advice. Consultation with a registered dietician is advised in most guidelines for type 2 diabetes.[1-2] The recommended dietary advice should be tailored to patients' individual needs and aims. Diet therapy aims to reduce risk factors such as being overweight and dyslipidemia. To achieve these aims, (modest) weight loss by reducing total energy intake and the proportion of total fat (<30% of energy intake), as well as a reduction of saturated fat intake (<10% of energy intake) and cholesterol intake (<300 mg/day), are strongly recommended. Moreover, minimising trans-unsaturated fatty acid intake and a modest intake of polyunsaturated fat (~10% of energy intake) are advised (Box 1).[1]

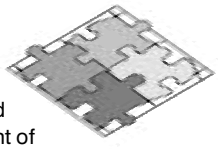
Although these guidelines are based on solid evidence from mostly experimental studies, they do not take into account the normal dietary habits of the general population. This might be partly because little is known about the fat consumed by recently diagnosed patients with type 2 diabetes in general practice, or about alterations in dietary habits after diagnosis and treatment. In the United Kingdom (UK) prospective diabetes study, the intake of total fat in a sample of 65 patients, both at baseline (38.2% of energy intake) and after 3 years (36.9% of energy intake), was higher than the recommended 30–35% of energy intake.[3] Data from a Dutch cross-sectional study showed no significant differences between diabetic and non-diabetic subjects regarding total energy intake or the consumption of total, saturated or polyunsaturated fats.[4]

The need for sensible treatment targets, which are rooted in the population for which they are aimed, has been discussed before in relation to type 2 diabetes. So far, targets for the treatment of type 2 diabetes do not account for what is feasible for patients to achieve in normal daily life.[5] We therefore investigated the fat consumption of patients with newly diagnosed type 2 diabetes in general practice.

The development of type 2 diabetes is associated with unfavourable eating habits, such as high consumption of total and saturated fat.[6-8] We expected that the amount of energy, and the amount and type of dietary fat consumed by patients newly diagnosed with type 2 diabetes would be unfavourable when compared with the intake of the general population. Confirmation of this hypothesis would support the above mentioned advice to refer all newly diagnosed patients with type 2 diabetes to a dietician.

We conducted our study with the following research questions:

HOW THIS FITS IN



What do we know?

Advice on fat consumption is considered to be an important issue for the treatment of patients with type 2 diabetes, but the actual fat consumption of these patients in general practice is not known. Nor is it known to what extent patients adjust their diets after diagnosis while receiving usual care by their general practitioner.

What does this paper add?

This study showed that patients with type 2 diabetes have an unfavourable fat consumption. However, shortly after diagnosis and dietary counselling, patients fat consumption improves significantly. These improvements are maintained 4 years after diagnosis.

Optimisation of fat consumption is an essential part of the dietary treatment of patients with type 2 diabetes mellitus. In general, the recommendations are similar to those of the general population aiming at a reduction of the consumption of saturated fatty acids and cholesterol. The main sources of saturated fatty acids in The Netherlands are meat, spreads, and dairy products. The total amount should be reduced or replaced by poly- or monounsaturated fatty acids. To achieve this, meat from pork or beef should be replaced by poultry, game or fish, which contain a lot of polyunsaturated fatty acids. Olive oil is rich in monounsaturated fatty acids, therefore it is recommended that olive oil is used instead of butter for frying. Cholesterol is consumed almost exclusively from egg yolk so egg consumption (or products that contain egg yolk) should be minimised.

Box 1. Dietary recommendations for patients with type 2 diabetes in The Netherlands.

- What is the fat consumption of patients with newly diagnosed type 2 diabetes in Dutch general practice compared with reference values for the general population?
- What are the alterations in fat consumption 8 weeks after the initial diagnosis and referral to a dietician, according to the Dutch guidelines for treatment of type 2 diabetes?[2]
- What is the fat consumption after 4 years of follow-up compared with initial consumption in these patients?

Method

This study was designed as a prospective cohort study. Reference values for the general population were obtained from the Dutch national food consumption survey (DNFCS) 1998.[9]

Patients and practices

Forty-six general practitioners (GPs), working in 33 general practices throughout The Netherlands, included patients with newly diagnosed type 2 diabetes aged between 40 and 70 years in the study. Diabetes mellitus was defined according to the criteria established by the World Health Organization:[10] patients were eligible for the study when they had symptoms suggestive of diabetes mellitus and a fasting blood glucose ≥6.7 mmol/l and <20.0 mmol/l. In patients with asymptomatic newly diagnosed diabetes, the fasting blood glucose had to be ≥6.7 mmol/l on two or more occasions.

Treatment

In accordance with the Dutch guidelines for the treatment of type 2 diabetes mellitus,[2] all included patients were referred to a registered dietician. Dietary intervention consisted of two consultation sessions within a 4-week period, in which patients received dietary advice concerning all aspects of medical nutritional therapy for diabetes, tailored to their individual needs. The dieticians were informed about baseline fat consumption in all patients. Otherwise, the dieticians did not receive extra training or use special protocols. Patients who still had a fasting blood glucose ≥6.7 mmol/l after 8 weeks were eligible for oral antidiabetic therapy. These patients were asked to participate in a 30-week randomised controlled trial comparing acarbose with tolbutamide.[11] After the 30-week period, all patients received usual care from their GP.

Measurements

Measurements took place at diagnosis, then after 8 weeks, and after 4 years. The consumption of dietary fat was measured using a 104-item food frequency questionnaire, in which the past month was used as the reference period.[12,13] This questionnaire was filled out by the patient and checked for errors by the investigator. Values for total energy per day (MJ/day), total fat (% of energy intake), saturated fatty acids (% of energy intake), monounsaturated fatty acids (% of energy intake), polyunsaturated fatty acids (% of energy intake) and cholesterol (mg/day) were calculated using a computer program (VET Expres 1.02, BaS Nutrition Software, The Netherlands) designed especially for the questionnaire. For the 4 years measurement, an updated version of the questionnaire was used (Wageningen University, The Netherlands, unpublished, 1997), including an updated calculation program (Komeet 3.0, BaS Nutrition Software, The Netherlands).

Body weight and height were measured without shoes and with light clothing. Data on medical history, comorbidity and use of medication were obtained from the patients' records by their GPs. Information regarding any additional visits to a dietician or the use of other sources for dietary information were recorded with the help of a short questionnaire. At the 4 years follow-up, GPs made the same assessment of medical history and comorbidity. Furthermore, GPs provided information about the use of antidiabetic and cholesterol-lowering medication during the interval. Central laboratories (Andreas Hospital, Amsterdam for baseline and short-term, Canisius Wilhelmina Hospital, Nijmegen for 4 years measurements) used standard techniques and reference ranges to measure glycosylated haemoglobin (HbA_{1c}) and lipids. Glucose measurements were performed locally using a calibrated glucose analyser.

Table 1. Baseline characteristics of 144 newly diagnosed patients with type 2 diabetes in general practice.

	n	Mean	SD
Male/female	69/75		
Age (years)	144	57.8	8.3
Body mass index (kg/m^2)	134	29.5	5.2
Fasting blood glucose (mmol/l)	144	10.5[a]	6.7–19.6[b]
HbA_{1c} (%)	131	9.0	2.6
Diastolic blood pressure (mm/Hg)	134	86	10
Systolic blood pressure (mm/Hg)	134	145	20
Total cholesterol (mmol/l)	130	6.2	1.1
LDL cholesterol (mmol/l)	125	3.9	1.0
HDL cholesterol (mmol/l)	126	1.1	0.3
Triglycerides (mmol/l)	131	2.7	1.5

[a]Median. [b]Range. HbA_{1c} = glycosylated haemoglobin; HDL = high-density lipoprotein; LDL = low-density lipoprotein; SD = standard deviation.

Reference values

Data from the DNFCS 1998 were used to serve as reference values for fat intake by the general population. The DNFCS was a cross-sectional study of a representative sample of the Dutch population, comprising 6250 subjects (aged 1–97 years) using a 2-day dietary record method. To match these with the cohort of patients with newly diagnosed diabetes, we used the proportion of subjects aged 40–70 years (n = 2296).

Statistical analysis

Results are given as mean ± standard deviation (SD). For comparison between groups (i.e., missing versus non-missing, male versus female), Student's two-sample t-tests were performed. For comparison of results between subsequent measurements, Student's one-sample test was used. Additionally, a repeated measure analysis was performed to assess an overall time effect. In order to correct for multiple testing, α was divided by the number of tests used. Therefore, for the t-tests $P<0.0024$ and for the repeated measure analysis $P<0.0072$ was considered significant.

Ethics approval

This study was performed in accordance with the declaration of Helsinki. The protocol for the 8-week study was approved by the Central Medical Committee for Studies in General Practice. The Local Ethics Committee of the University Medical Centre, Nijmegen approved the protocol for the 4-year study. All patients gave their informed consent.

Results

The GPs included 144 patients with newly diagnosed type 2 diabetes in the study. Baseline measurements were performed on all 144 patients, the 8-week measurements were performed on 110 of the 144 patients, and 106 patients participated in the long-term follow-up (4-year measurements) after a mean of 3.9 years (SD = 1.0) (Figure 1). The baseline characteristics of these 144 patients are displayed in Table 1.

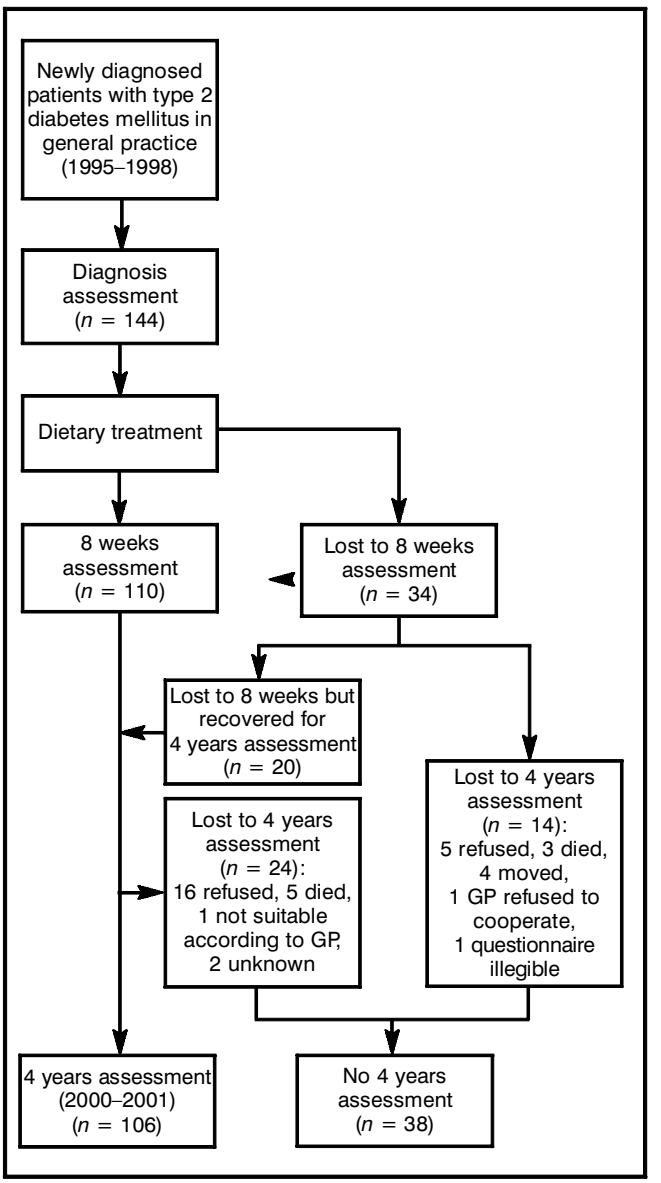


Figure 1. Study flow diagram.

With respect to blood glucose and lipid profile, the study population was representative for patients newly diagnosed with type 2 diabetes.[14] The baseline results for patients who did not participate in the 8-week or 4-year evaluation did not differ significantly from results of the patients whose measurements were not missing (data not shown).

Fat consumption

Table 2 shows the mean (SD) values for energy intake and fat consumption for newly diagnosed patients with type 2 diabetes at diagnosis, after 8 weeks, and after 4 years. Compared with reference figures for the general population, patients had a higher intake of energy and higher fat consumption. The mean changes for the three possible intervals are shown in Table 3. At the 8-week follow-up, we found a decrease in total energy intake, total fat, saturated fatty

Table 2. Consumption of total energy and fat by patients newly diagnosed with type 2 diabetes compared with reference values for the general population of similar age.

	Newly diagnosed patients with type 2 diabetes			Reference values for population[d] mean (SD)
	Diagnosis[a] mean (SD)	8 weeks[b] mean (SD)	4 years[c] mean (SD)	
Energy intake (MJ/day)	10.6 (3.4)	8.3 (2.2)	8.9 (2.7)	9.1 (2.8)
Total fat (En%)	40.9 (7.3)	35.5 (7.0)	37.7 (7.8)	36.3 (6.7)
Saturated fatty acids (En%)	15.0 (2.8)	12.5 (2.6)	11.9 (3.1)	14.4 (3.4)
Monounsaturated fatty acids (En%)	14.3 (3.0)	11.8 (3.1)	12.8 (3.5)	12.6 (2.9)
Polyunsaturated fatty acids (En%)	9.2 (3.2)	9.3 (3.0)	9.9 (3.9)	6.8 (2.5)
Cholesterol intake (mg/day)	300.8 (123.3)	226.3 (95.2)	201.1 (99.7)	225 (112)
Cholesterol intake (mg/MJ)	28.7 (8.2)	27.5 (8.5)	22.5 (6.0)	25.1 (11.3)

[a](n = 144). [b](n = 110). [c](n = 106). [d](n = 2296). En% = % of energy intake; SD = standard deviation.

Table 3. Changes in consumption of total energy and fat by patients newly diagnosed with type 2 diabetes: mean changes from diagnosis to 8 weeks, from diagnosis to 4 years, and from 8 weeks to 4 years. A negative value indicates a decrease in time.

	Change in mean difference diagnosis – 8 weeks[a] mean difference (95% CI)	Change in mean difference diagnosis – 4 years[b] mean difference (95% CI)	Change in mean difference 8 weeks – 4 years[c] mean difference (95% CI)
Energy intake (MJ/day)	-2.2 (-2.6 to -1.7)	-1.8 (-2.3 to -1.2)	0.5[d] (0.09 to 0.9)
Total fat (En%)	-5.1 (-6.6 to -3.5)	-3.0 (-4.8 to -1.2)	2.5 (1.1 to 3.9)
Saturated fatty acids (En%)	-2.4 (-3.0 to -1.8)	-3.1 (-3.8 to -2.3)	-0.5[d] (-1.1 to 0.1)
Monounsaturated fatty acids (En%)	-2.5 (-3.1 to -1.8)	-1.5 (-2.3 to -0.6)	1.0 (0.4 to 1.6)
Polyunsaturated fatty acids (En%)	0.3[d] (-0.4 to 0.9)	0.9[d] (0.0 to 1.7)	0.9[d] (0.0 to 1.8)
Cholesterol intake (mg/day)	-63.1 (-77.8 to -48.3)	-99.7 (-120.0 to -79.4)	-33.6 (-48.3 to -18.8)
Cholesterol intake (mg/MJ)	-0.3[d] (-1.5 to 1.0)	-6.2 (-7.8 to -4.6)	-5.6 (-7.2 to -4.0)

[a](n = 110). [b](n = 106). [c](n = 86). [d]All values except these are significant (P<0.0024).Significance tests are done with an α of 0.0024 (0.05:21) in order to account for multiple testing. En% = % of energy intake.

acids, and monounsaturated fatty acids. Polyunsaturated fatty acids and the relative cholesterol intake (mg/MJ) did not change significantly. At the 4-year follow-up, consumption of total fat and monounsaturated fatty acids increased significantly compared to 8 weeks, but remained significantly lower than the baseline. Consumption of cholesterol decreased significantly compared to baseline and 8 weeks. Other values did not differ significantly from the 8 weeks measurements. The repeated measure analysis showed similar results, with the exception that the difference in consumption of total fat between 8 weeks and 4 years was not significant. Male and female patients showed similar fat consumption at baseline, except for energy and cholesterol intake, which was higher in men. Women showed a more profound decrease in the consumption of total fat, monounsaturated fatty acids, and saturated fatty acids in both the 8 weeks and 4 years measurements (data not shown). When stratified for body weight (body mass index [BMI] <25, ≥25 and ≤30, >30 kg/m^2), results were similar. In both our study at all three time points, and in the reference figures for the general population, the people with BMI >30 kg/m^2 reported the lowest energy intake (data not shown).

Table 4 reports the percentage of patients that met the guidelines for fat consumption. The percentage of patients that met the guideline regarding saturated fatty acids (•10% of energy intake) increased from 7.6% at baseline to 27.4% at the 4 years measurement. Similarly, the percentage of patients that consumed less than 7% of energy intake by way of saturated fatty acids increased from 0.7 to 9.4%.

Plasma lipids, glycaemic control and body weight

After 8 weeks and two consultations with a dietician, 25.7% of the patients had a fasting blood glucose <6.7 mmol/l. HbA_{1c} had decreased from 9.0 to 7.8%, all plasma lipid values, except for HDL-cholesterol and triglycerids, had improved at the 8 weeks measurement (data not shown). After 4 years, HbA_{1c} and plasma lipids had significantly improved compared with the baseline and, except for triglycerides, to the 8 weeks measurement. BMI decreased at the 8 weeks measurement (from 29.5 to 28.3 kg/m^2, P<0.01) but was back at its baseline value at the 4 years measurement.

Diabetes treatment

At the 4 years measurement, 19 of the 106 patients (18%) were still being treated with lifestyle modification alone, and for two patients treatment for their diabetes was unknown. The use of cholesterol-lowering medications increased from 10/144 (7%) at baseline, to 34/106 (32%) at the 4-year follow-up (unknown for two patients). On average, after the first two visits, patients visited a dietician 0.6 times per year (SD = 0.9). Seventy-seven per cent of the patients visited a dietician less than once a year, 13% between one and two times year, and 10% had two or more consultations.

Discussion

Summary and interpretation of main findings

This study showed that patients in general practice with type 2 diabetes had an unfavourable fat intake at the time that the

Table 4. Proportion of patients newly diagnosed with type 2 diabetes at diagnosis, after 8 weeks, and after 4 years, that meet recommendations for the consumption of fat.

	Newly diagnosed patients with type 2 diabetes			Recommended consumption of fat[d]
	At diagnosis[a] (%)	8 weeks after diagnosis[b] (%)	4 years after diagnosis[c] (%)	
Total fat				
≤30 En%	8.3	21.8	17.0	<30 En%
≤35 En%	21.5	45.5	37.7	
Saturated fatty acids				
≤7 En%[e]	0.7	2.7	9.4	
≤10 En%	7.6	20.9	27.4	<10 En%
≤12 En%	15.3	50.0	57.5	
Polyunsaturated fatty acids				
<9 En%	41.7	39.1	40.6	
9–11 En%	36.1	39.1	30.2	~10 En%
>11 En%	22.2	21.8	29.2	
Monounsaturated fatty acids				
<9 En%	2.8	11.8	13.2	
9–11 En%	12.5	38.2	25.5	NSR
>11 En%	84.7	50.0	61.3	
Cholesterol				
≤200 mg/day[e]	16.0	47.3	54.7	
≤300 mg/day	60.4	84.5	93.4	<300 mg/day

[a](n = 144). [b](n = 110). [c](n = 106). [d]American Diabetes Association, 2002.[1] [e]Patients with LDL ≥2.6 mmol/l may benefit from saturated fatty acids ≤7% of energy intake and a cholesterol ≤200 mg/day. En% = % of energy intake; NSR = No specific recommendation.

diabetes was diagnosed compared with reference values for the general population. Shortly after the first dietary consultation, fat consumption decreased to levels similar to the general population. After 4 years, consumption of total fat had increased again, but was still lower than the baseline value. This increase was owing to a higher intake of both poly- and monounsaturated fatty acids. The intake of cholesterol had decreased at the 8 weeks assessment and decreased further after 4 years.

The observed changes in the reported fat consumption may have been owing to several factors. First, ongoing treatment for type 2 diabetes, including education by GPs and dieticians, may have had a sustained effect on patients' habits. The patients included in our study received usual care by their GPs, including initial dietary advice in two consultations, according to the Dutch guidelines on diabetes. Some patients received more consultations through their own initiative or on advice from their GP. No further interventions or efforts were made to improve compliance with diet. Of course, from the data of this observational study we cannot measure the contribution of specific aspects of diabetes counselling on the outcomes. But, because we observed patients who received usual care, we feel that the presented results should be regarded as the minimally achievable goals that can be reached regarding fat consumption.

Second, food habits in the general population are not constant. In the adult general population of The Netherlands, consumption of total fat had decreased by almost 1% of energy intake, but saturated fatty acids had increased by about 1% of energy intake from 1992 to 1998.[9] In our study, the decrease in total fat consumption was more profound and the consumption of saturated fatty acids decreased. Therefore, it is not likely that our main results are merely a reflection of the trend in the general population.

Third, the content of foodstuffs is not constant. Since 'light' and low-fat products are currently fashionable, manufacturers may tend to change the amount and type of fat in their products. In theory, it is possible that someone who does not alter their consumption in terms of foodstuffs will have a different consumption in terms of nutrients because the content of the foodstuffs has been changed. We have not identified studies in the literature to assess the influence of this potential bias.

Finally, the method of measuring food habits is a possible source of bias.[15] All available instruments to measure food intake are subject to recall bias and, therefore, a real gold standard does not exist. We used a semi-quantitative food frequency questionnaire, whereas the reference figures for the general population were based on a dietary record method. The comparison of the data from patients with type 2 diabetes with those from the general population should, therefore, be interpreted with caution.

Strengths and limitations of this study

The main strengths of our study were that it provided follow-up data (*a*) of sufficient length, (*b*) in a cohort of newly diagnosed patients with type 2 diabetes (data that provides knowledge of what happens during a patients' 'career' is important because it is helpful for formulating feasible treatment goals), (*c*) with a good long-term participation rate (74%), and (*d*) that were rooted in general practice. In The Netherlands, as in the UK, approximately 75% of patients with type 2 diabetes are treated by their GP.

One of the drawbacks of our study was that a relatively high number of patients did not complete the food frequency questionnaire at the 8 weeks measurement: this was partly owing to loss of motivation in the patients and the GPs. For the 4-year follow-up, 20 of these 34 patients could be

included again. The possibility of selective drop out was examined by comparing essential characteristics of patients with missing data at short-term and 4-year follow-up. No significant differences were observed, thus attrition bias was less probable. Furthermore, this study lacked a control group. We emphasise that this study was not meant as an intervention study but as a long-term study to assess the changes under usual care. The referral to a dietician is in concordance with the Dutch guidelines. After the first 8 weeks from diagnosis, patients were not given extra care regarding their lifestyle. Thus, using diabetic patients as a control group would have been unethical because, in our view, we would have deliberately undertreated them. Age-matched healthy volunteers as controls would have been helpful to estimate the secular trend for fat consumption.

Comparison with existing literature

To our knowledge, only one previous study has assessed fat consumption in newly diagnosed patients with type 2 diabetes at diagnosis and after several years.[3] In a small sample of the UK prospective diabetes study population (n = 65) half of the patients complied with recommendations regarding total energy intake after 3 years of follow-up. The results of this study cannot easily be compared with the findings in the present study because the types of fat were not specified. The overall decrease in total fat consumption was larger in our study than the UK prospective diabetes study (²3 versus 1% of energy intake, respectively). The differences between men and women that were found in the UK population could not be confirmed in our study.

Implications for future research and policy

The results regarding the percentage of patients that met with recommendations might be of particular interest in the development of future guidelines and treatment targets. The most important treatment targets were those for saturated fatty acids and cholesterol consumption (<10% of energy intake and <300 mg/day, respectively, and for patients with LDL cholesterol ≥2.6 mmol/l, which was the case for most patients in this study at diagnosis, <7% of energy intake and <200 mg/day, respectively). Only 27% of patients consumed less than 10% of saturated fatty acids measured as % of energy intake, and only 9% of the patients consumed less than 7% of their energy intake by way of saturated fatty acids. In contrast to this disappointing result, 93% (<300 mg/day) and 55% (<200 mg/day) of patients met the target for cholesterol intake. Therefore, the target for the consumption of cholesterol seems to be realistic and attainable for this general practice population, whereas the target for the consumption of saturated fatty acids is not.

This study reports patients' food habits in terms of nutrients. We realise that in normal daily life, patients and doctors do not talk about mono- or polyunsaturated fatty acids but about the food itself (for example, french fries, eggs, and tomatoes) instead. Future research should investigate what alterations in the choice of foods are more likely to be sustained. Furthermore, a better understanding of the characteristics of patients who have very good or very bad compliance with dietary advice might contribute to more effective dietary intervention strategies.

This study could help to remove some of the scepticism that doctors have about the feasibility of initiating and maintaining more favourable dietary habits in patients with type 2 diabetes. However, the very strict treatment targets for the consumption of saturated fatty acids and total fat are not very realistic. To optimise the dietary treatment of type 2 diabetes, further lasting care for diet and lifestyle are important, but also a reconsideration of treatment targets for dietary fats in diabetic patients remains necessary.

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