22 Lifestyle Issues: Diet

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Keypoints

- Lifestyle interventions to improve glucose, blood pressure and lipid levels, and to promote weight loss or at least to avoid weight gain remain the underlying strategy throughout the management of diabetes even when additional medications are needed.
- Metabolic variables, such as HbA_{1c}, post-prandial blood glucose concentrations, serum triglyceride and low density lipoprotein cholesterol levels, can be used to suggest the most appropriate intakes of carbohydrate-containing foods.
- Vegetables, legumes, fruits and wholegrain cereal-based foods should be part of the diet because they are rich in dietary fiber, low in glycemic index or load and provide a range of micronutrients.
- In those treated with insulin or oral hypoglycemic agents, the timing and dosage of medication should match the quantity and nature of carbohydrate to avoid hyperglycemia or hypoglycemia. Blood glucose self-monitoring may help to make appropriate choices.
- Saturated, trans-unsaturated fatty acids and dietary cholesterol should be restricted to reduce the risk for vascular disease, whereas oils rich in monounsaturated fatty acids as well as oily fish rich in n-3 polyunsaturated fatty acids are useful fat sources.
- In patients with type 1 or 2 diabetes without evidence of nephropathy, usual protein intake (up to 20% of the total energy intake) need not be modified. In those with established nephropathy, protein restriction to 0.8 g/kg normal body weight per day may be beneficial.
- Alcohol intake should be moderate.
- Foods naturally rich in dietary antioxidants, trace elements and other vitamins are encouraged. Routine supplementation and the use of so-called special diabetic foods are not recommended.
- Individual dietary advice by physicians and dietitians and structured nutritional training are an essential part in the continuing treatment and education process of people with type 1 and 2 diabetes.

Introduction

Nutritional management in diabetes aims to assist in optimizing metabolic control and reducing risk factors for chronic complications. This includes the achievement of blood glucose and glycosylated hemoglobin (HbA_{1c}) levels as close to normal as is safely possible and serum lipid concentrations as well as blood pressure values that may be expected to decrease the risk for macrovascular disease. Individual therapeutic needs and the quality of life of the person with diabetes have to be considered when nutritional objectives are defined [1,2].

Diabetes health care teams should use the best available scientific evidence while giving dietary advice to the individual patient with diabetes. During recent years, the development of evidence-based guidelines in the management of type 1 (T1DM) and type 2 diabetes (T2DM) has adopted a more formal approach to the evaluation of evidence underlying the guidance [3].

Currently available evidence-based nutritional recommendations for individuals with diabetes have involved a formal search of the literature using agreed sets of descriptors and relevant databases. The strength of evidence for the different nutritional recommendations is graded according to the type and quality of published studies as well as by statements from expert committees, which also take into account clinical experiences of respected authorities. Ideally, evidence-based guidelines are formulated from trials with fatal or non-fatal clinical endpoints; however, as this information is often not available, surrogate endpoints, such as glycemia, body composition, lipoprotein profile, blood pressure, insulin sensitivity and renal function, are frequently used to determine the potential of dietary modification to influence glycemic control and risk of acute and chronic complications of diabetes [1]. Tables 22.1–22.3 provide important dietary recommendations for people with T1DM and T2DM and the degree of evidence assigned to these recommendations by the Diabetes and Nutrition Study Group of the European Association for the Study of Diabetes (DNSG EASD) and the American Diabetes Association (ADA).

Energy balance and body weight

Controlling body weight to reduce risks related to diabetes is of great importance. When weight loss and increased levels of activ-

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ity are achieved and maintained, in T2DM in particular, these interventions represent an established and effective therapeutic strategy for achieving target glycemic control [1,2,4]. Therefore, there is a consensus that such lifestyle interventions should be initiated as part of the treatment of new-onset T2DM [5–8]. Even modest weight loss, especially in abdominal fat, improves insulin sensitivity and glucose tolerance and reduces serum lipid concentrations and blood pressure. Weight loss may lead to greater benefit for cardiac risk factors in people with a high waist circumference [1,4]. Visceral body fat, as measured by waist circumference, is used in conjunction with body mass index (BMI) to assess the risk of diabetes and cardiovascular disease (CVD).

Overweight patients with T1DM may also become insulin resistant and weight reduction in these people may lead to a decrease of the insulin dose and improved glycemic control [1].

Prevention of weight regain is an important target in those who have lost some excess weight. Long-term restricted energy intake is necessary to sustain the metabolic improvements that can be achieved by weight reduction.

Losing weight is particularly difficult for those genetically predisposed to obesity. Nevertheless, the potential of structured weight loss programs should be exploited in overweight patients to achieve the possible beneficial effects [1,4,9]. Standard weight loss strategies plan 500–1000 fewer calories than estimated for weight maintenance. This may result in an initial loss of 0.5–1.0 kg body weight per week; however, many people regain the weight they have lost, and continued support by the health care team is needed to achieve long-term improvements of body weight and waist measurement. Advice concerning the reduction of high-fat and energy-dense foods, in particular those high in saturated fat and free sugars, will usually help to achieve weight loss. In addition, fiber intake should be encouraged. Regular physical activity should also be an important component of lifestyle approaches to the treatment of overweight. So far, the consensus by experts is that the use of very low energy diets, as an approach to promote initial weight loss, should be restricted to people with a BMI >35 kg/m^2 [1,2]. The evidence for recommendations regarding energy balance and body weight published by the ADA and by the DNSG EASD is summarized in Tables 22.1 and 22.3.

Table 22.1 Nutritional recommendations with the evidence grade A for persons with type 1 and type 2 diabetes. Evidence obtained from meta-analyses of randomized controlled trials or at least one randomized controlled trial [1,2].

	DNSG EASD	ADA
Energy balance and body weight	Energy reduction in overweight (BMI >25 kg/m^2) to move towards recommended BMI range Prevention of weight regain	Weight loss in overweight and obese individuals (improves insulin resistance) For weight loss low CHO or low fat calorie restricted diets may be effective in the short-term (up to 1 year)
CHO	Metabolic characteristics suggest the most appropriate intake: vegetables, legumes, fruits, wholegrain foods, naturally occurring foods rich in fiber Fiber intake should be ideally ≈20 g/1000 kcal/day Low glycemic index foods provided other attributes of these foods are appropriate Moderate amounts of free sugars (up to 50 g/day)	Monitoring carbohydrate by CHO counting, CHO exchanges or experience-based estimation of CHO remain a key strategy in achieving glycemic control Sucrose-containing foods can be substituted for other carbohydrate; if added should be covered with insulin or other glucose-lowering medication, excess intake should be avoided
Dietary fat	Saturated and trans-unsaturated fatty acids <10% total energy (<8% if LDL cholesterol is elevated) Dietary cholesterol <300 mg/day (further reduction if LDL is elevated)	Saturated fat <7% total energy
Protein	0.8 g/kg normal body weight in patients with type 1 diabetes and established nephropathy	Protein should not be used to treat or prevent nighttime hypoglycemia; it can increase insulin response without increasing plasma glucose in type 2 patients
Micronutrients	Salt intake should be <6 g/day; further reduction for patients with elevated blood pressure	No clear evidence of benefit from vitamin or mineral supplementation Routine supplementation (e.g. vitamins E, C and carotene) is not advised; because of concern related to long-term safety
Type 1 diabetes		Patients using rapid-acting insulin should adjust the meal and snack insulin based on the carbohydrate content of meals and snacks
CVD risk		Sodium intake (<2300 mg/day) Diet high in fruits, vegetables and low-fat dairy products in normotensive and hypertensive individuals
Hypoglycemia		15–20 g glucose is the preferred treatment (also other glucose-containing carbohydrate possible)

ADA, American Diabetes Association; BMI, body mass index; CHO, carbohydrate; DNSG EASD, Diabetes and Nutrition Study Group of the European Association for the Study of Diabetes; HDL, high density lipoprotein; LDL, low density lipoprotein.

Table 22.2 Nutritional recommendations with the evidence grade B for persons with type 1 and type 2 diabetes. Evidence obtained from at least one well designed and controlled study without randomization, well-designed quasi-experimental or non-experimental descriptive studies [1,2].

	DNSG EASD	ADA
CHO	There is no justification for the recommendation of very low carbohydrate diets in persons with diabetes Cereal-based foods should, whenever possible, be wholegrain and high in fiber	CHO from fruits, vegetables, whole grains, legumes and low fat milk is encouraged Consumption of a variety of fiber-containing foods is recommended The use of glycemic index and load may provide a modest additional benefit over that when total CHO is considered
Dietary fat	Oils rich in mono-unsaturated fatty acids are encouraged (10–20% total energy), total fat <35% total energy 2–3 servings of oily fish/week and plant sources of n-3-fatty acids (e.g. rapeseed oil, soybean oil, nuts) are recommended	2 or more servings of fish/week (n-3-poly-unsaturated fatty acids) are recommended
Protein	10–20% total energy in patients with no evidence of nephropathy	
Alcohol	Moderate use up to 10 g/day for women and up to 20 g/day for men is possible In patients treated with insulin or insulin secretagogues alcohol should be taken with carbohydrate to avoid hypoglycemia	Moderate intake (when ingested alone) has no acute effect on glucose and insulin, alcohol co-ingested with CHO may raise blood glucose
Microvascular complications		0.8–1 g protein/kg body weight/day in early stages of chronic kidney disease (microalbuminuria, decline in glomerular filtration) 0.8 g protein/kg body weight/day in later stages (macroalbuminuria) of kidney disease
CVD risk		HbA_{1c} to be kept as close to normal as possible without significant hypoglycemia
Acute illness Long-term care facilities		Adequate amounts of fluids and carbohydrate (glucose and ketone testing) Caution when prescribing weight loss diets in elderly; avoid undernutrition

ADA, American Diabetes Association; CHO, carbohydrate: CVD, cardiovascular disease; DNSG EASD, Diabetes and Nutrition Study Group of the European Association for the Study of Diabetes.

Macronutrient distribution in weight loss diets

The optimal macronutrient distribution of weight loss diets has not yet been established [2,10–12]. Low fat diets have been traditionally and effectively promoted for weight loss [1,13]; however, recently it has been demonstrated that low carbohydrate, higher fat diets may result in even greater weight loss over short periods of time, up to 6 months [2,10,14]. Although changes in serum triglycerides and high density lipoprotein (HDL) cholesterol were more favorable with low carbohydrate, higher fat diets than with high carbohydrate and lower fat diets in these trials, low density lipoprotein (LDL) cholesterol was significantly higher in patients on high fat, low carbohydrate diets [2]. However, long-term metabolic effects of low carbohydrate, high fat diets are unclear and no controlled long-term trials are available to prove their safety with regard to CVD. Such diets eliminate several foods that are important sources of fiber, vitamins and minerals. It has also been shown that it was difficult to substitute monounsaturated fatty acids (MUFA) as the favorable fat source for carbohydrate because foods providing appreciable amounts of MUFA are limited, and even in Mediterranean areas, nowadays, people tend to consume undesirably high amounts of saturated fat in high fat diets. The ADA has summarized the current recommendations for weight loss in diabetes as follows: "For weight loss either low-carbohydrate or low-fat calorie restricted diets may be effective in the short-term (up to 1 year)" [2]. After initial weight loss it is important to avoid regain of weight [1].

Weight loss in the prevention of diabetes

With regard to weight loss in the prevention of diabetes in individuals at high risk for developing T2DM, lifestyle changes that included a reduced energy and a reduced dietary fat intake, and an increased fiber consumption together with regular physical activity (e.g. 150 minutes/week) [15,16] have shown improvements in several vascular risk factors including dyslipidemia, hypertension and markers of inflammation in addition to the significant reduction of the development of T2DM. So far, clinical trials on the efficacy of low carbohydrate diets for primary prevention of T2DM are not available.

Carbohydrate and diabetes

It is important that the advice for carbohydrate intake is individualized, based on the patient's nutrition assessment, metabolic

Table 22.3 Nutritional recommendations for persons with type 1 and type 2 diabetes with lower grades (C–E) of evidence. Evidence obtained from expert committee reports or opinions and/or clinical experiences of respected authorities [1,2].

	DNSG EASD	ADA
Energy balance and body weight	Prevention of weight regain Avoidance of further weight gain Advise reduction of energy-dense foods high in saturated fat and free sugars	When low CHO diets are used for weight reduction monitor lipid profiles, renal function, protein intake (in those with nephropathy) and adjust hypoglycemic therapy
CHO, fiber, sucrose and other free sugars	Consider quantity, sources and distribution of CHO to facilitate near-normal long-term glycemic control Timing and dosage of insulin or hypoglycemic agents should match quantity and nature of CHO Daily consumption of 5 servings of fiber-rich vegetables or fruits and 4 servings of legumes per week help to achieve recommended fiber intake Total free sugars should not exceed 10% total energy	When fixed daily insulin doses are used CHO intake (time and amount) should be consistent For planned exercise extra CHO may be needed Blood glucose tests can be used to monitor appropriate adjustments There is no evidence to support prescribing diets such as "no concentrated sweets" or "no sugar added"
Dietary fat	Polyunsaturated fatty acids should not exceed 10% total daily energy Total fat intake should not exceed 35% total energy	Intake of trans-fats should be minimized (evidence grade B in the guidelines of 2009) Cholesterol below 200 mg/day
Protein	Insufficient evidence for recommendations about the preferred type of dietary protein For type 1 diabetes with incipient nephropathy and type 2 diabetes with incipient or established nephropathy no firm recommendations regarding protein restriction	For persons with diabetes and normal renal function insufficient evidence to modify usual protein intake (15–20% of energy) High protein diets are not recommended as a method for weight loss Long-term effects of protein >20% of calories on kidney function are unknown
Alcohol	Intake should be limited in overweight, hypertensive, hypertriglyceridemic individuals as well as during pregnancy and in advanced neuropathy	Daily intake should be limited to a moderate amount (1 drink for women, 2 drinks for men) Alcohol should be consumed with food in individuals treated with insulin or insulin secretagogues to reduce the risk of nocturnal hypoglycemia
Micronutrients	Foods naturally rich in dietary antioxidants, trace elements and other vitamins are encouraged: daily consumption of a range of vegetables and fruit, regular intake of wholegrain breads, cereals and oily fish	Benefit from chromium supplementation is not proven and therefore not recommended

ADA, American Diabetes Association; CHO, carbohydrate; DNSG EASD, Diabetes and Nutrition Study Group of the European Association for the Study of Diabetes.

results and treatment goals [1,2,17–19]. There is a broad range of possible carbohydrate intake in people with diabetes (e.g. 45–60% of total energy intake). This advice is mainly based on recommended restrictions for the intakes of fat and protein. In many European countries, the mean carbohydrate intake of people with diabetes is only around 42% of total energy intake (Table 22.4) [20,21]. In the EURODIAB Complications Study, which included 3250 people with T1DM coming from 31 different European centers, the mean carbohydrate intake did not show major changes at the 7-year follow-up investigation compared with these intakes at baseline. Similar relatively low proportions of carbohydrate consumption and high intakes of total and saturated fatty acids have also been demonstrated in people with T2DM from the Mediterranean area [22,23].

Usually, carbohydrate intake in people with diabetes is lower than recommended by nutrition associations for the general population who receive advice to consume around 50% of total energy intake as carbohydrate. Many people with diabetes tend to reduce their carbohydrate intake because they fear an increase in blood glucose concentrations after the ingestion of carbohydrate-containing foods. In affluent countries, lower carbohydrate diets are usually accompanied by high fat, predominantly an undesirable high saturated fat intake. With such a diet it is also difficult to achieve sufficient fiber intake to meet recommendations [1,24,25]. Having this in mind, it does not appear to be productive to overemphasize the present renaissance of low carbohydrate strategies in diabetes. Furthermore, several recent reports on this topic do not clearly define what is meant by "low" or "high" carbohydrate and whether a carbohydrate intake of around 40% of total energy, which is consumed by many people with diabetes, already corresponds to a low carbohydrate diet [26,27].

Glycemic effects of different carbohydrate

Not only the amount of carbohydrate, but also the quality of carbohydrate is important for individuals with diabetes. Vegetables, legumes, fresh fruit, wholegrain foods and low fat milk products should be part of a healthy diet [1,2]. These foods provide also a range of micronutrients and fiber.

Table 22.4 Nutritional intake and further life-style factors in persons with type 1 diabetes. Data are presented for the total EURODIAB cohort (31 centres, n = 3250) and different European regions [21].

	South (n = 1371)	East (n = 539)	Northwest (n = 1340)	All (n = 3250)	Center range
Total energy (kcal/day)[a]	2148	2352	2407	2288	1851–2786
Carbohydrate (% of energy)	43.0	41.9	42.3	42.5	36.7–48.1
Fiber (g/day)[a]	17.0	15.4	18.4	17.3	13.9–21.9
Total fat (% of energy)	36.5	39.7	38.6	37.9	30.3–45.1
Saturated fatty acids (% of energy)	12.5	14.8	15.1	14.0	9.4–17.2
Cholesterol (mg/day)[a]	286	415	342	328	232–487
Protein (% of energy)	18.3	17.8	16.9	17.6	15.2–21.1
Alcohol (g/day)[b]	0.8	0	1.5	0	0–4.2
Current smokers (n %)	31.2	39.0	30.5	32.2	21.9–46.4
Ex-smokers (n %)	16.6	15.5	20.1	17.9	1.6–28.6
Vigorous exercise ≥ once/week (n %)	13.6	11.1	15.1	13.8	2.4–26.3

Data are means or prevalences: a, geometric mean; b, median.
Southern European Centers (n = 12): Athens, Bari, Cagliary, Lisbon, Milan, Padua, Perugia, Pisa, Rome, Turin, Thessaloniki, Verona.
Eastern European Centers (n = 4): Bucharest, Budapest, Krakow, Zagreb.
Northwestern European Centers (n = 15): Cork, Düsseldorf (two centres), Gent, Helsinki, Leiden, London, Luxembourg, Manchester, Munich, Paris, Sheffield, Valenciennes, Vienna, Wolverhampton.

The amount of carbohydrate is an essential factor for post-prandial glucose results in people with T1DM and T2DM [28–30]. In the process of achieving desirable glycemic control, many individuals with diabetes use either carbohydrate counting, carbohydrate exchanges or experience-based estimation of carbohydrate intake as a helpful means to monitor their consumption of carbohydrate at meals or snacks [2]. Different carbohydrates have different glycemic effects. Besides the amount of carbohydrate, other factors including the nature of starch, the amount of dietary fiber and the type of sugar influence the glycemic response to carbohydrate-containing foods [31–34].

The glycemic index (GI) of a carbohydrate-containing food describes its post-prandial blood glucose response over 2 hours in the area under the blood glucose curve compared with a reference food with the same amount of carbohydrate, usually 50 g glucose (or white bread in some studies). Foods can be differentiated into high (GI: 70–100), average (GI: 55–70) or low (GI: <55) glycemic index foods; however, measured GIs are only available for a range of foods, with the data mainly coming from investigations in Canada and Australia. The glycemic load considers the amount as well as the quality of carbohydrate and is defined as gram of carbohydrate within the food multiplied with the GI of the food divided by 100.

It has been shown that the use of the GI or glycemic load of a food may confer moderate additional benefits – over that observed when only total carbohydrate is considered – not only for post-prandial glycemia, but also for the lipid profile [2,35]. Therefore, foods with known low GI (e.g. legumes, pasta, parboiled rice, wholegrain breads, oats, certain raw fruits) should be substituted when possible for those with a high GI (e.g. mashed potatoes, white rice, white bread, cookies, sugary drinks) [36–39]. For example, eating fresh fruits is superior to a fruit juice with the same amount of carbohydrate. Low GI foods are only favorable, however, provided other attributes of these foods are also in line with a healthy nutrition [1]. Some foods with a low GI are high in fat and energy. Chocolates are such an example, with low GI but a high content of saturated fat. Some products specifically advertised for people with diabetes have reduced the GI of usual foods by replacing sucrose with sugar alcohols or fructose. A substantial benefit from these expensive so-called "diabetic" preparations has not been proven. Therefore, special foods for people with diabetes are not recommended. Proper food labeling may help the person with diabetes to make healthy choices from available usual foods.

Potential of dietary fiber

In many countries, people with diabetes consume only few foods that are rich in dietary fiber and therefore total fiber intake is much lower than recommended (Figure 22.1). With the relatively low carbohydrate intake in people with diabetes it is not easy to meet recommended quantities of fiber. Total dietary fiber intake in the EURODIAB Complications Study was on average only 8.0 g/1000 kcal or 19.5 g/day [20,21]. People with diabetes should be encouraged to choose a variety of fiber-containing foods (vegetables, fruits, wholegrain products) to profit from the proven benefits for glycemic control, insulinemia and serum lipid concentrations [32–34,40]. Although total fiber intake was not high, epidemiologic data based on the EURODIAB Complications Study showed an inverse association between dietary fiber intake and HbA_{1c} independent of possible confounders [32], an inverse association between fiber and LDL cholesterol and a positive association between fiber and HDL cholesterol. In addition,

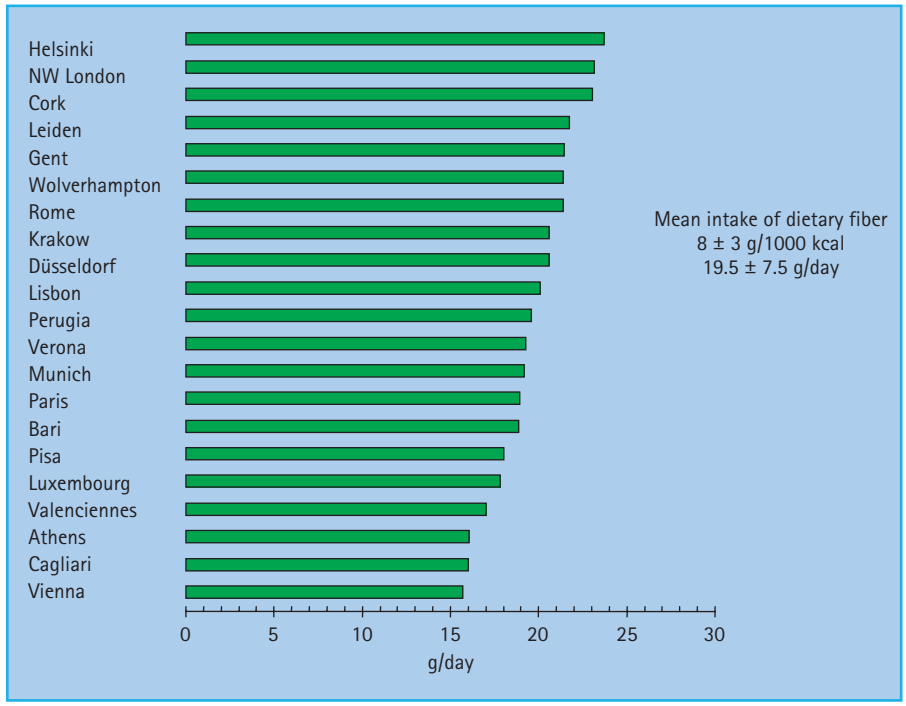

Figure 22.1 Fiber intake (g/day) in persons with type 1 diabetes (total n = 1102) from 21 centers in Europe. Data from EURODIAB Complications Study [20,21].

dietary fiber was inversely and significantly related to cardiovascular disease [34]. Dietary fiber was also associated with lower levels of BMI [26]. The degree of evidence for recommended carbohydrate and dietary fiber intakes is shown in Tables 22.1–22.3.

Sucrose and other sugars

Moderate intake of sucrose (<10% total energy) or other added sugars may be included in the diet of people with diabetes without worsening glycemic control [1,2,25,41]. Although fructose produces a reduction in post-prandial glycemia when it replaces sucrose, this potential benefit is tempered by the fact that fructose may adversely effect serum triglycerides as well as uric acid levels [1,8]. There is no reason to recommend that people with diabetes should avoid naturally occurring fructose (e.g. in fruits, vegetables or other foods) [1,2]; however, added fructose, added sugar alcohols or other nutritive sweeteners are energy sources that do not have substantial advantage over sucrose and therefore should not be encouraged. Higher quantities of sugar substitutes may promote undesirable gastrointestinal side effects. Furthermore, it is unlikely that energy-containing sugar substitutes such as sugar alcohols in the amounts likely to be consumed will contribute to an appreciable reduction in total energy intake although they are only partially absorbed from the small intestine [2,8].

Approved non-nutritive sweeteners may also be used by people with diabetes although a special long-term benefit in metabolic control has not been proven. Nevertheless, they are safe when acceptable daily intakes (ADI values) are followed [2,8].

Adjustment of insulin or insulin secretagogues to carbohydrate intake

For people who are treated with insulin or hypoglycemic agents, it is important to match the medication with the amount, type and time of carbohydrate intake to avoid hypoglycemia as well as excessive post-prandial hyperglycemia [1,2]. Individuals receiving intensive insulin treatment should adjust their premeal insulin dose based on the amount of carbohydrate in snacks or meals while considering also the GI of these foods [37,42,43]. This advice is now part of many nutrition education programs for people with diabetes who are treated with intensified insulin regimens [18,44]. Self-monitoring of blood glucose offers a helpful means of determining the most appropriate timing of food intake and to make optimal food choices [1]. Individual preferences and the needs of different treatment strategies remain the most important determinants of appropriate meal frequency, portion sizes and carbohydrate intake. Extra carbohydrate may be needed prior to exercise although adjustment of the insulin dosage in those on intensified insulin treatment is often an alternative and preferred choice. Structured training and continuing advice by the diabetes team is needed to enable the people with diabetes to adjust the insulin dosage while considering all three components: blood glucose results, amount and quality of carbohydrate intake as well as the degree of physical activity.

Dietary fat

The primary goal concerning dietary fat intake is to restrict the consumption of saturated fatty acids, trans-fats and dietary

cholesterol to reduce the risk for vascular disease [1,2,45,46]. Compared with the non-diabetic population, people with diabetes have an increased risk of developing vascular disease. Fat modification in people with diabetes is an established principle to assist in achieving desirable serum lipid concentrations and to avoid vascular lesions in high-risk groups. Although most of this evidence is obtained from studies of people without diabetes, it seems that the recommendations are also relevant in the diabetic population as their risk for vascular disease is even higher than in the general population [1,47]. Even if statins are often needed to meet the treatment goals for serum lipid concentrations, possible lifestyle modifications should always be exploited, and remain the basic therapeutic approach to achieve a desirable lipid profile. The degree of evidence for the recommendations relating to the recommended amounts of fat intake or fat modification, respectively, is shown in Tables 22.1–22.3.

Reduction of saturated fatty acids

It is suggested that saturated fatty acids could be either replaced by carbohydrate foods rich in fiber or by unsaturated fatty acids, particularly by *cis*-monounsaturated fatty acids for people on a weight-maintaining diet. Such diets have been shown to achieve improvements in glycemia, insulin sensitivity and serum lipid values, compared to diets high in saturated fat [47–51].

Omega-3-fatty acids

Observational evidence supports the intake of n-3 polyunsaturated (omega-3) fatty acids as they have the potential to reduce serum triglycerides and have beneficial effects on platelet aggregation and thrombogenicity, thus offering cardioprotective effects [52]. A consumption of 2–3 servings of oily fish and plant sources such as rapeseed oil, soya bean oil and nuts will help to ensure an adequate intake of n-3 fatty acids [1,2,53,54].

Trans-fats and dietary cholesterol

Unfortunately, in most countries, the quantity of trans-unsaturated fatty acids is not well documented on many food products. The effects of trans-fats are similarly adverse as those of saturated fatty acids in raising LDL cholesterol. Therefore, their intake should be minimized [1,2]. Trans-fats are found in many manufactured products such as biscuits, cakes, confectionery, soups and some hard margarine. Food labeling informs whether hydrogenated fats and oils were added to a food product and the ranking of ingredients on the food label gives at least some information whether high quantities of trans-fats could have a role.

Data from healthy people and individuals with T1DM support the recommendation to restrict dietary cholesterol. With increasing intake, serum cholesterol levels may increase and contribute to the development of CVD [1,55].

Current fat intake in individuals with diabetes

Fat intake data of European people with T1DM from the EURODIAB Complications Study demonstrated that on average the current target to keep the intake of saturated fatty acids below 7% of total energy was not achieved (Table 22.4). In the whole cohort of this study, the mean intake of saturated fatty acids was 14% of total energy (twice as high as recommended by the ADA) (Figure 22.2) [20,21], and even patients from the Mediterranean area who traditionally consumed a favorable fat intake no longer reach the goal to remain below 7% of saturated fat consumption [22,23]. In conclusion, fat modification remains an important

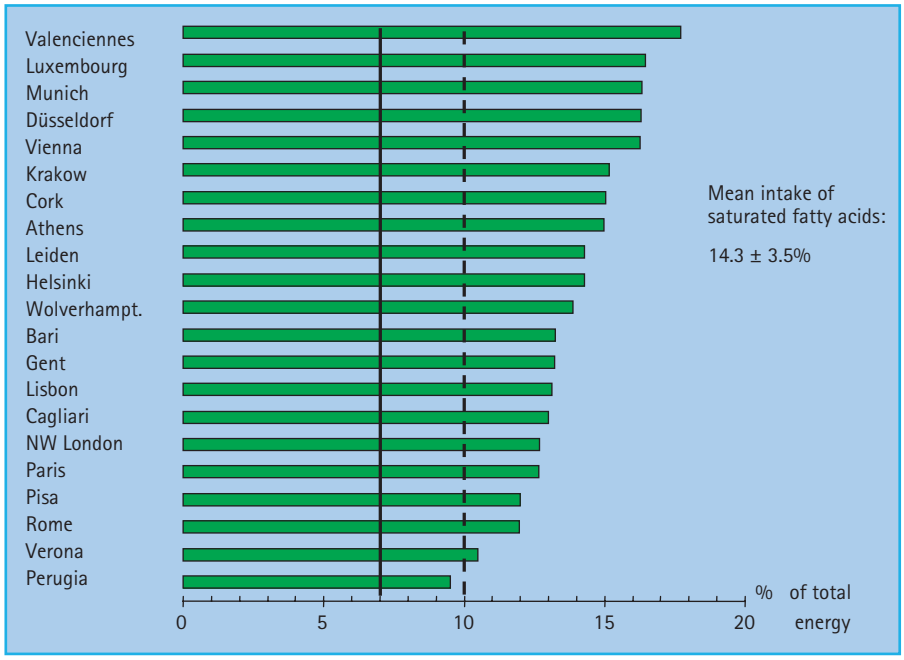

Figure 22.2 Intake of saturated fatty acids (% of energy) in persons with type 1 diabetes (total n = 1102) from 21 centers in Europe. The solid vertical line marks the currently recommended upper limit of intake for saturated fatty acids by the ADA (7% total energy) The dotted vertical line represents the limit of 10% total energy for saturated fatty acids recommended by Diabetes and Nutrition Study Group of the European Association for the Study of Diabetes (DNSG EASD) in 2004. Data from the EURODIAB Complications Study. [20,21].

target nutritional education topic to reduce the risk for vascular disease in people with both T1DM and T2DM.

Dietary protein

For individuals with diabetes and normal renal function, there is insufficient evidence that usual protein intake should be modified [1,2]. From nutrition intake data of different countries and patient groups, it is documented that there seems to be little concern that people with diabetes may develop protein deficiency (Table 22.4) [20–23]. However, it is unclear whether a long-term high protein intake above 20% of total energy would have untoward effects on renal function [2,56,57]. Although such diets may produce short-term weight loss and improved glycemia, it has not been established that these benefits are maintained long term. Therefore, high protein diets are not recommended as a method for weight loss at this time [2].

Protein restriction

Several studies have focused on protein restriction as a means to reverse or retard the progression of proteinuria in people with diabetes [58–60]. Progression of diabetes complications may be modified by improving glycemic control, lowering blood pressure and potentially reducing protein intake. Normal protein intake (15–20% of energy) does not appear to be associated with an increased risk of developing diabetic nephropathy [1,2]. In some studies of subjects, particularly with T1DM and macroalbuminuria, urinary albumin excretion rates and decline in glomerular filtration were favorably influenced by a reduction of protein intake to around 0.8 g/kg body weight/day [59]; however, there is insufficient evidence to make recommendations about the preferred type of dietary protein. The evidence for recommended protein intake in diabetes is summarized in Tables 22.1–22.3.

Micronutrients

Regular consumption of a variety of vegetables, fresh fruit, legumes, low fat milk products, vegetable oils, nuts, wholegrain breads and oily fish should be encouraged to ensure that recommended vitamin and mineral requirements are met [1]. Salt or sodium intake, respectively, should be limited particularly when elevated blood pressure is a problem [61,62]. Replacement of added salt intake using salt substitutes with potassium and magnesium in hypertensive people with T2DM has been shown to lead to a significant reduction in systolic but not in diastolic blood pressure. Such substitutes may be tried in selected patients but cannot generally be recommended to lower high blood pressure in people with diabetes.

People with diabetes may have increased oxidative stress and several studies have investigated the potential benefit of recommending the intake of antioxidant vitamins [63]. These trials have failed to show clear benefit from supplementation [64]. Therefore routine supplementation (e.g. of vitamins E, C and carotene) is not advised because of concern related to long-term safety [1,2]. Also, the role of folate supplementation in reducing cardiovascular events is not clear and still under further investigation. In the light of current evidence, diabetes associations do not offer recommendations regarding supplements or functional foods [1,2]. Most of the promoted fiber-enriched products, margarines which contain plant sterols or stanols, supplements containing various n-3 fatty acids, minerals, trace elements and herbs, some of which have been shown to have potentially relevant functional effects, have not been tested in long-term formal clinical trials. As long as there is insufficient evidence from randomized studies to demonstrate significant benefit without causing undesirable side effects they cannot be recommended [1,2,65]. Vitamin or mineral supplementation in pharmacologic dosages should be viewed as a therapeutic intervention and recommended only in cases of proven deficiencies [1]. Given the importance of vitamin D in bone metabolism and the bony consequences associated with diabetes, it appears that dietary vitamin D intake, sunshine exposure and vitamin D levels should be monitored. Nutrition education to promote healthy eating and to meet recommended intakes is important for people with T1DM and T2DM.

Alcohol

Alcohol may have both undesirable and beneficial effects [66–69] which exhibit a U-shaped relationship. The intake of moderate amounts (5–15 g/day) is associated with a decreased risk of coronary heart disease, while a strong association between excess habitual alcohol intake (>30–60 g/day) and undesirable raised blood pressure is found in both men and women. The amount of alcohol seems to be predictive whereas the type of alcohol-containing beverages consumed does not appear to be of major importance. If people with diabetes choose to drink alcohol, intake should be moderate, with no more than 10 g/day alcohol (1 drink) for females and no more than 20 g/day alcohol (2 drinks) for males [1,2]. These limits are also recommended to the healthy population by nutrition associations.

In studies where alcoholic beverages were consumed with carbohydrate-containing food by people with diabetes, no acute effects were seen on blood glucose. The recommendation, particularly to patients treated with insulin or insulin secretagogues, to consume carbohydrate when alcohol is taken is made because of the potential risk of alcohol-induced hypoglycemia [70,71]. The risk increases with the quantity of alcohol consumed and may last well into the following day. Abstention from alcohol is advised in women during pregnancy, people with a history of pancreatitis or alcohol abuse as well as in those with hypertriglyceridemia and advanced neuropathy. Alcohol may also be an important energy source which should be considered in people with overweight. High alcohol consumption is associated with

greater waist:hip ratio independently of BMI. The evidence obtained from studies and expert reports concerning alcohol intake are shown in Table 22.2 and 22.3.

Diet in special circumstances

Diet in pregnancy

To avoid fetal and maternal complications it is essential to achieve blood glucose concentrations as close to normal as possible without inducing hypoglycemia [72]. Nutritional therapy should assist in achieving recommended fasting blood glucose values of 60–90 mg/dL (3.3–5.0 mmol/L) and post-prandial values below 120 mg/dL (6.7 mmol/L). To reach this goal, women with known T1DM as well as women who develop gestational diabetes during pregnancy need detailed dietary counseling as an essential part of therapy. Energy intake should be adequate to provide appropriate weight gain and nutrient intakes should consider special needs during pregnancy. In women with normal weight additional energy intake may be 70–240 kcal/day in the first and second trimester and 300 kcal in the third trimester of pregnancy. Additional calorie intake should be less in obese pregnant women; however, total daily energy should not be under 1600 kcal/day.

During pregnancy, hyperglycemia as well as ketonemia and starvation ketosis should be avoided. As in all pregnant women, folic acid supplementation is recommended to prevent neural tube defects. Several bodies (e.g. National Institute for Health and Clinical Excellence) have recommended using higher doses of folate supplementation (5.0 mg vs 400 µg) in women with diabetes because of the higher risk of neural tube defects in women with diabetes. Further individual supplementation with calcium, iron and iodine may be considered to avoid deficiencies (Table 22.5).

Table 22.5 Diet in pregnancy.

Food choices for adequate weight gain, normoglycemia and absence of ketones
Weight loss is not recommended
For overweight or obese women with gestational diabetes, modest energy and carbohydrate intake
Starvation ketosis should be avoided
Pregnant women on insulin therapy need individualized carbohydrate-controlled recommendations with consistency of times and amounts of food to avoid hypoglycemia
Insulin and meal plan adjustments should be guided by blood glucose self-monitoring
Consider changes in insulin sensitivity and the necessity to adjust the insulin dosage during the different trimesters of pregnancy
Consider special needs of protein (1.2–2 g/kg body weight), calcium (1300 mg/day), iron (30 mg/day), iodine (230 µg/day) and folate (600 µg/day) beginning in the second trimester of pregnancy

Diet in children with diabetes

Dietary recommendations should focus on achieving desirable blood glucose concentrations without severe hypoglycemia. As in all healthy children, energy and nutrient intakes should be adequate to ensure normal growth and development. Healthy nutrition may also contribute to maintaining normal serum lipid values and blood pressure goals. Individualized counseling is necessary to support adequate decision-making for food intake and flexible insulin doses based on blood glucose self-monitoring. Meal plans must be individualized to accommodate food preferences and the eating pattern of the family.

Planning carbohydrate intake and premeal insulin dosage are the main educational targets in the training of children with T1DM and their parents. As energy requirements change with age, growth rates have to be monitored and the evaluation of a meal plan has to be rechecked at least once a year. In a case where the child becomes overweight, calories should be restricted. The child with diabetes has also to learn that early signs of hypoglycemia must lead to taking rapidly available carbohydrate (glucose) and that unusual exercise needs blood glucose monitoring before and after physical activity, which should be used to guide potential extra carbohydrate or insulin dosage adjustments [73].

Nutritional training in individuals with T1DM and T2DM

Nutritional training must be an integral component of disease management in all individuals with diabetes [2,18,72–75]. It requires the use of currently available scientific evidence on the potential of diet to assist in achieving treatment goals. A knowledgeable diabetes care team including the individual with diabetes should work together to maintain the pleasure of eating and drinking, while only limiting food choices when this is indicated by scientific evidence (Table 22.6). A balance must be achieved between the demands of metabolic control, risk factor management and the patient's well-being and safety [76]. Furthermore, it has to be taken into account that the therapeutic needs of an individual person will change with time and special life events, and therefore nutritional assessment and continuing dietary advice must be provided.

Evaluation of outcome

All steps in the dietary management of the individual with diabetes should be documented in the patient's record forms. The outcome should be evaluated by important markers such as HbA_{1c}, fasting and post-prandial blood glucose concentrations, blood pressure, serum lipids, albumin excretion rate, body weight, waist circumference and well-being of the individual with T1DM and T2DM [18,77].

Table 22.6 Dietary advice and structured nutritional training for individuals with diabetes.

How often is nutritional advice needed?

- Always at diagnosis of diabetes mellitus
- At each consultation if metabolic control is insufficient or vascular risk factors are not well controlled
- Every year as a routine
- At the initiation of insulin therapy
- When special nutritional problems come up

What should be checked on a regular basis?

- Is healthy eating part of the individual's lifestyle?
- Is energy intake appropriate to achieve or maintain a desirable body weight?
- Is alcohol intake moderate or could it be undesirably influencing hyperlipidemia, hypertension or the risk of hypoglycemia?
- Does the person consume unnecessary special diabetic food products?
- Does the selection and distribution of meals reflect the glucose-lowering medication?
- Does raised blood pressure suggest a benefit from salt restriction?

Which advice is essential to achieve a healthy diet?

- Restrict the intake of saturated fatty acids and trans-fats
  Choose only small portions of fatty meat, sausages, cheese, spreads and fatty bakery
  Prefer lower fat products
  Chocolates, cakes, cookies, cream, chips and fatty fast food should be eaten in small servings only and not consumed on a daily basis
- Consider the quality of fat
  Prefer vegetable oils (e.g. olive oil, rapeseed oil, soybean oil), nuts, seeds
  Consume oily fish 2–3 times per week
- Consume foods rich in dietary fiber and micronutrients
  5 servings of fresh fruit and vegetables per day as well as the consumption of legumes and wholegrain products are recommended
- Sugar is not forbidden; however, excessive intake is not desirable.
  Non-caloric sweeteners are safe, when daily allowances are followed
- Alcoholic beverages should only be taken in moderation
  1–2 small glasses of wine or beer are tolerable when no specific contraindication must be considered; however, consider the caloric amounts and also the risk of hypoglycemia when consumed without food
- Special dietetic foods for persons with diabetes are unnecessary. Persons with diabetes can enjoy usual foods
- Meals, snacks and food choices should match individual therapeutic needs, preferences and culture

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