Dietary Education and Outcomes for Young People With Type 1 Diabetes

Sheridan Waldron PhD

Leicestershire Nutrition and Dietetic Service, Leicester Royal Infirmary, Leicester, United Kingdom

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ABSTRACT

Diet is integral to successful diabetes care, yet dietary education methods remain controversial and poorly evaluated. There is limited evidence regarding the effect of diet on glycemic control, serum lipids, cardiovascular (CV) outcomes, the incidence of hypoglycemia, weight management and adherence to medical recommendations in children with type 1 diabetes. Dietary education is concerned primarily with glycemic control, and rarely focuses on dietary factors in relation to CV risk. The 2000 International Society for Pediatric and Adolescent Diabetes Consensus Guidelines recommend that nutritional strategies should place equal importance upon glycemic control and reduction of CV risk. The paper is a review of various approaches to dietary education and their effect on glycemic control and CV risk factors.

RÉSUMÉ

Une bonne alimentation est essentielle à la réussite des soins diabétologiques, mais les méthodes d'éducation en matière d'alimentation restent controversées et insuffisamment évaluées. Il existe peu de données sur l'effet de l'alimentation sur l'équilibre glycémique, les lipides sériques, les risques cardio-vasculaires, l'incidence de l'hypoglycémie, la gestion du poids et la fidélité aux recommandations médicales chez les enfants atteints de diabète de type 1. L'éducation en matière d'alimentation met surtout l'accent sur l'équilibre glycémique et porte rarement sur les facteurs diététiques liés au risque cardio-vasculaire. Le Consensus sur les lignes directrices 2000 de la Société internationale du diabète chez les enfants et les adolescents recommande que les stratégies nutritionnelles accordent autant d'importance à l'équilibre glycémique qu'au risque cardio-vasculaire. Ce compte rendu passe en revue divers modes d'approche de l'éducation en matière d'alimentation et leur effet sur l'équilibre glycémique et les facteurs de risque cardio-vasculaire.

Address for correspondence:
Sheridan Waldron
Leicestershire Nutrition and Dietetic Service
Leicester Royal Infirmary
Leicester
LE1 5WW United Kingdom
Telephone: 44 116 258 7568
Fax: 44 116 258 5841
E-mail: sheridan.waldron@uhl-tr.nhs.uk

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INTRODUCTION

Successful self-management education for young people with diabetes results in the achievement of optimum glycemic control, prevention of hypoglycemia and a reduction in microvascular and macrovascular complications (1-8). Emerging evidence confirms the increased incidence of cardiovascular disease (CVD) in young people with type 1 diabetes compared with the general population. While dietary management has historically focused on glycemic control, the increased CVD risk highlights the potential importance of dietary education that also addresses CV risk factors.

THE ROLE OF DIET IN GLYCEMIC CONTROL

The Diabetes Control and Complications Trial (DCCT) highlighted the importance of dietary management not only with respect to achieving glycosylated hemoglobin (A1C) targets, but also to an expanded role for dietitians (9,10). While the importance of achieving optimum glycemic control for children and adolescents with diabetes is universally acknowledged, many centres find optimum A1C levels difficult to achieve. Results from the Hvidøre International Study Group indicated that A1C levels vary between centres (from 7.6 to 10.2%) (11). Importantly, apart from the DCCT, there has been little evaluation of the link between dietary management and its effect on glycemic control and CV risk.

The DCCT (9) used many methods to achieve target A1C levels, including meal planning, exchange systems, carbohydrate counting, and weighing and measuring foods. In that trial, the particular method of dietary education was less important than diet behaviours, which were associated with a statistically significant reduction in A1C levels. These included adherence to a meal plan, adjusting food and insulin if hyperglycemic, appropriate treatment of hypoglycemia and consistent snacking behaviour (9).

HISTORICAL PERSPECTIVES ON CARBOHYDRATE MANAGEMENT

The key element in carbohydrate education is the understanding of the relationship between food and the postprandial effect. Both the source and the amount of carbohydrate consumed influence blood glucose (BG) and insulin response (12,13). The terms "simple" and "complex" are not useful as they do not describe the effect of carbohydrates on BG levels (14). Many

Table 1. Comparison of carbohydrate management methods

Method	*Description*	*BG monitoring*		*Insulin therapy*	
		Regular	**Intensive**	**Daily changes**	**Adjustment around meals and snacks**
Restriction of carbohydrate	• Precise quantities of carbohydrate ingested at each meal and snack	Yes	No	No	No
Carbohydrate counting: Level 1	• Consistent carbohydrate intake (may use exchanges or portions)	Yes	No	No	No
Carbohydrate counting: Level 2	• Consistent carbohydrate intake • Identifies patterns in BG response to meals and exercise over several days	No	Yes	No	No
Carbohydrate counting: Level 3/DAFNE	• Accurate estimation of carbohydrate content of food portions • Estimation of insulin-to-carbohydrate ratio • Flexible carbohydrate intake with adjustments of rapid-acting insulin	No	Yes	Yes	Yes
"Judge by eye"	• Visual estimation of carbohydrate, in conjunction with pre- and postprandial BG monitoring	No	Yes	No	Yes
Portions/qualitative carbohydrate education	• Average household portions, measured by the eye only • Regular carbohydrate intake at each meal and snack	Yes	No	No	No
GI	• Low-GI foods at every meal and snack • No specific quantity of carbohydrate is defined	Yes	No	No	No

BG = blood glucose
DAFNE = Dose Adjustment for Normal Eating
GI = glycemic index

factors influence the postprandial BG response to foods: composition, starch structure, particle size and cooking methods all influence carbohydrate absorption rate from the small intestine and the resulting postprandial response (15). Consequently, pre- and postprandial BG testing provides important information on the absorption of carbohydrate as part of a mixed meal. The child and parents must be taught how to interpret BG test results and adjust insulin accordingly.

Different approaches to carbohydrate education are used around the world (16). These methods range from the historic restriction of carbohydrate (by counting grams), to the more recent "intensified" carbohydrate counting with flexible carbohydrate intake and daily adjustments of insulin to facilitate a flexible approach to diet (also the basis of pump management), to carbohydrate portion assessments, to qualitative diets (no carbohydrate counting) and to low glycemic index (GI) diets. Many centres use a combination of these approaches (16) to suit the child and family, but most have no scientific evaluation to support their use. Table 1 summarizes each of the methods described below.

Carbohydrate restriction

Historically, carbohydrate was counted in order to achieve regular carbohydrate intake, with great attention given to precise quantities. People with diabetes were expected to eat the same amount of carbohydrate per meal or snack to balance their prescription of insulin (17) and were not encouraged to adjust their own insulin doses. The quantity of carbohydrate was estimated using a diet history based upon a typical day's intake of carbohydrate. This method was inaccurate and was likely to underestimate true carbohydrate requirement. It is also likely that this method caused a restriction of carbohydrate and an attendant increase in fat in order to meet energy requirements. Changing one nutrient (e.g. carbohydrate) may have a detrimental effect upon another nutrient (e.g. fat), which may in turn affect other diabetes outcomes (i.e. CV risk factors).

The value of using precise measurements of carbohydrate to manage postprandial BG excursions has been challenged on many occasions. Several authors have examined groups of children and young people who followed restrictive carbohydrate prescriptions with those who followed a less prescriptive approach (18-22). No significant differences in glycemic control were found between the 2 groups, and the authors concluded that counting carbohydrate was unnecessary. A striking observation was that the children and young people in these studies often had a high fat intake, in one instance higher than a non-diabetic peer group (18).

Restricting carbohydrate also makes no allowances for diversity of energy expenditure (23) and growth. There is a danger that such dietary prescriptions can lead to carbohydrate constraint as the child is growing, restricting growth and creating abnormal eating practices that are detrimental to normal family functioning (24). Children and families find it difficult to follow a restrictive carbohydrate plan (25,26) and rigid approaches to diabetes management may contribute to disordered eating behaviour (27,28). These findings illustrate the importance of evaluating macronutrient intake following dietary education.

Most healthcare professionals have moved away from restricting carbohydrate in this rigid fashion due to its negative impact on psychological adaptation to diabetes and to the substantial evidence that the glycemic response to foods is not solely due to the carbohydrate content of the food.

Modern carbohydrate counting

Modern carbohydrate counting is a meal-planning approach that focuses on improving glycemic control while allowing maximum flexibility of food choices. This system is used in conjunction with self-management education for insulin dose adjustments, and while it is especially suitable for children and young adults, it is also appropriate for all individuals. A stepwise learning approach has been identified by the American Dietetic Association (29,30), as follows:

Level 1: Consistent carbohydrate intake

This level introduces the concept of carbohydrate as the food component that raises BG. A consistent intake of carbohydrate is encouraged using exchange or portion lists of measured quantities of food that contain all types of sugars and starches. This level allows a greater variety of carbohydrate foods (based on knowledge of the GI) than was previously accepted. With regular carbohydrate intake and BG monitoring results, it is possible for a dietitian (if permitted by regulatory body and within scope of practice), nurse or doctor to advise on appropriate baseline insulin doses.

Level 2: Pattern management principles

This level is an intermediate step in which patients continue to eat regular carbohydrate, use a consistent baseline insulin dose and frequently monitor BG levels. They learn to recognize patterns of BG response to carbohydrate intake modified by insulin and exercise. With this understanding, they learn to make their own adjustments to insulin doses, or alter carbohydrate intake or timing of exercise to achieve BG goals. Alterations to baseline insulin doses should be made in response to a pattern of BG results over a few days, not in response to a single high or low BG.

Level 3: Insulin-to-carbohydrate ratios

This level of self-management education for carbohydrate counting is appropriate for people on multiple dose insulin (MDI) or insulin pump therapy. It requires a solid understanding of the first 2 levels and motivation to closely monitor BG levels. Once the appropriate baseline insulin doses have been established on a regular intake of carbohydrate, an insulin to carbohydrate ratio can be calculated (e.g. 1.5 units rapid-acting insulin to 15 g carbohydrate exchange for additional

carbohydrate). With the determined insulin-to-carbohydrate ratio, the patient can vary the amount of carbohydrate eaten at any particular meal and adjust the insulin dose. This provides greater dietary flexibility than a traditional exchange diet and helps reduce the frequency of hypoglycemia as well as high BG levels after large meals. Extensive patient education materials are available in most countries to help people estimate the carbohydrate content of foods. Considerable time is spent educating patients on how to read and interpret food labels and assess the nutrient content of foods in order to make healthy choices and to calculate the carbohydrate content of their portion size of food. Most national diabetes associations also produce useful literature on how to read food labels.

Use of the full carbohydrate-counting system at Level 3 requires intensive self-management education, ongoing support from an experienced dietitian/nurse team and motivated patients. Levels 1 and 2 may assist in achieving better adherence to recommendations and improved BG control for all persons, even those not on intensive insulin regimens (6).

"Judge by eye"

Another way to calculate insulin-to-carbohydrate is to "judge by eye" the portion size of carbohydrate foods and adjust boluses of fast- or rapid-acting insulin accordingly. The Uddevalla Clinic, Uddevalla, Sweden (31), uses this method effectively as the majority of their children follow an MDI regimen (4 to 6 injections/day). Children and adults are taught to calculate the amount of insulin required for different foods using examples described in published studies (32,33), and by measuring the glycemic response to different carbohydrate foods and mixed meals through pre- and postprandial BG testing. Carbohydrate assessment is used for sweet treats that are not included in the normal meal plan. Candy is weighed and the carbohydrate content calculated (two-thirds of the weight will be sugar). One unit of insulin is given for every 10 g of carbohydrate.

Intensive insulin therapy

The goal of using MDI or pump treatment (especially with rapid-acting analogues before meals) with all carbohydrate counting methods is to prevent postprandial glycemic excursions and allow patients to respond to variations in BG response. There is some evidence that reducing postprandial BG excursions reduces the risk of microvascular complications. In the DCCT, rates of retinopathy in the intensive group were lower than in the conventional group at the same A1C level (34).

Dose Adjustment for Normal Eating

The Dose Adjustment for Normal Eating (DAFNE) approach is an intensive, skills-based educational program for people with type 1 diabetes in the United Kingdom (UK). Started in Germany, it has been successfully used throughout Europe in adults with diabetes for >2 decades (35,36). The program is based on estimating the carbohydrate content of food (using 10- to 12-g carbohydrate portions), adjusting insulin and intensive BG monitoring. The evaluation of the effectiveness and acceptability of DAFNE in adults in the UK (37) has shown positive outcomes: a reduction in A1C, no significant increase in hypoglycemia and improvements in quality of life measures. This has led to many centres adopting this approach for patients with type 1 diabetes. Its feasibility for children and young people in the UK is uncertain, but the preliminary results of the pilot study will be available later this year. The DAFNE approach has many benefits, although it requires extensive nutrition education. People enjoy the freedom of eating a wider variety of foods and the flexibility of a less rigid meal pattern, it is sensitive to the varying daily energy expenditure of childhood, and it addresses postprandial glycemic excursions, all of which are inadequately managed by conventional therapy.

Carbohydrate portions and qualitative dietary education

During the 1990s, many healthcare professionals involved in educating children with diabetes changed their approach to the assessment of carbohydrate (16,38), adopting a less rigid approach that was often termed a "portion system" or "qualitative diet." A portion system uses average household portions, measured by the eye only, to estimate carbohydrate. A qualitative diet involves eating regular amounts of complex carbohydrate, with moderate amounts of sucrose and soluble fibre, but carbohydrate is not counted. There was little evaluation of this change in approach, but from the limited amount of evidence available, it appears that the change did not cause a deterioration in the glycemic control of children with diabetes (21,22,39).

Activity

An important aspect of flexible carbohydrate education methods is their ability to respond to increased energy requirements of growth (24) and physical activity (23,40). It is not sufficient to simply decrease insulin doses during episodes of physical activity, as vigorous or prolonged exercise demands extra carbohydrate to prevent acute and nocturnal hypoglycemia. Braatvedt and colleagues (40) describe a summer camp where the treatment strategy to achieve target BG levels was to decrease insulin doses rather than increase portions of carbohydrate. Although the mean insulin dose of the 33 children decreased by 40%, the portions of carbohydrate were restricted to those normally eaten prior to the camp. Consequently, 169 episodes of hypoglycemia were recorded in the children during the week of the camp. This illustrates the importance of adjusting both insulin and carbohydrate to meet the needs of the individual child, especially during periods of increased physical activity, in order to prevent hypoglycemia.

Glycemic index

The glycemic index (GI) expresses the rise in BG by a carbohydrate food as a percentage of the rise in BG that would occur if an equal amount of carbohydrate were ingested from glucose or white bread (used as the standard reference [GI 100]). The higher the GI number, the greater the glycemic impact. Extensive GI tables are available (41).

The role of GI diets in diabetes remains controversial, but positive outcomes have been achieved in people with type 2 diabetes using low-GI foods such as legumes, barley, pasta and whole grains (15). Further evaluation of the practical application of the GI (especially in children) is required. However, a recent study in children showed a statistically significant reduction in A1C levels after they were taught to follow a low-GI diet (42). Other advantages of this method are that it is easy for children and families to implement by including low-GI foods at every meal and snack without having to adhere to defined quantities of carbohydrate.

The method of education used for carbohydrate management must be adapted to each child, taking into consideration the child's and family's preferences, capabilities and changing needs. Intensive methods require highly motivated children and parents and will not suit all children. The method should be thoughtfully selected and evaluated for the best patient outcomes and optimal use of the dietitian/educator's time. Further evaluation is required to determine the most effective methods of dietary education for a given population.

CARDIOVASCULAR CONSIDERATIONS

Since the 1980s, evidence has suggested that type 1 diabetes in young people accelerates atherosclerosis compared with young people without diabetes. This implicates high A1C as an independent risk factor in the development of premature atherosclerosis and increased CV events. Laing and colleagues (2) examined the UK mortality data on 23 752 patients with type 1 diabetes diagnosed age <30 years, and found that mortality from CVD was 2 to 4 times higher than in people without diabetes. In addition, the relative risk of death was higher for females than males at all ages, indicating that the protective effect of female gender seen in the general population was lost in the diabetic population (2). These higher mortality figures have also been reported elsewhere (43).

Studies of young people are limited, but Valsania and colleagues (44) reported advanced atherosclerotic lesions in young people with type 1 diabetes compared with their non-diabetic peers. In the DCCT, the effect of intensive therapy on atherosclerosis-related events was examined. The number of macrovascular events was twice as high in the conventional therapy group compared with the intensive therapy group, although this difference did not reach statistical significance (45). The more recent follow-up study of the DCCT population has confirmed that the intensive therapy group had decreased progression of atherosclerosis 6 years after the end of the trial compared with the conventional group (3). Larsen and colleagues (4) reported a high prevalence of silent coronary atheroma in a group of younger people with long-standing type 1 diabetes followed over 18 years. The authors also found a positive correlation between A1C levels and the degree of atheroma. Laing and colleagues (2) concluded that early detection and treatment of CVD are essential.

Nutritional recommendations regarding CVD

Dietary fat

Fat is necessary in children's diets to provide energy, fat-soluble vitamins and essential fatty acids for normal growth and development. The Canadian Paediatric Society and Health Canada (46) recommend that from the age of 2 years to the end of linear growth, there should be a transition from the high-fat diet of infancy to a diet that includes no more than 30% of energy as fat and no more than 10% of energy as saturated fat. During this transition, energy intake should be sufficient to achieve normal growth and development. Food patterns should emphasize variety, complex carbohydrate intake and lower-fat foods. Adequate energy and nutrients for growth and development are the most important considerations, and there is a paucity of evidence to support lowering fat intake to adult levels during childhood to prevent chronic diseases of adulthood (46).

After growth has finished, young people should be introduced to *Canada's Guidelines for Healthy Eating*, as these are considered suitable for most people with diabetes (47). A key goal for all people is to decrease total fat intake, with particular attention given to decreasing saturated and trans fatty acids (48). Daily fat intake should be ≤30% of total energy requirements, comprised of ≤10% saturated fat, ≤10% polyunsaturated fat, with the remainder coming from monounsaturated fat (48). In addition, eating fish rich in omega-3 fatty acids at least once a week is encouraged (48).

The nutrition recommendations of the 2000 International Society for Pediatric and Adolescent Diabetes (ISPAD) consensus guidelines (1) state that total fat, saturated and trans fatty acids should be reduced due to their effect on cholesterol and low-density lipoprotein (LDL) levels. The beneficial effects of increasing monounsaturated fats were demonstrated in a study in children with type 1 diabetes, where positive effects on glycemic control, insulin sensitivity, cholesterol and LDL levels were noted (49).

Vitamins and antioxidant nutrients

Foods naturally rich in dietary antioxidants (tocopherols, carotenoids, vitamin C and possibly flavanoids) should be strongly encouraged, as adolescents with diabetes have an increased risk of CVD compared with their non-diabetic peers. Highly reactive oxygen free radicals are increasingly implicated in the pathogenesis of atherosclerosis. Foods rich in antioxidants, such as fresh fruit and vegetables (5 portions daily), may provide a means of protecting against long-term CVD in populations at increased risk.

Scientific evidence on the benefits of vitamins and dietary antioxidants is still evolving and further research is required in children before firm recommendations can be made. In the meantime, it is appropriate to achieve at least the recommended values for dietary vitamins and promote foods that naturally contain significant quantities of dietary antioxidants, especially fruit and vegetables (50). Current evidence does not support the routine use of dietary supplementation with vitamins or minerals.

CAN CHILDREN ADHERE TO DIETARY RECOMMENDATIONS?

In a review of international comparisons of the dietary intake of children with diabetes, Virtanen and colleagues (51) illustrated how difficult it is for many children with diabetes to achieve the ISPAD nutritional recommendations. Many of the studies reviewed indicated a high intake of fat and saturated fat, and some concluded that poor national diets were partly to blame (39,52). In contrast, Pinelli and colleagues (53) reported how dietary recommendations and good glycemic control can be achieved in Northern Italy, where the national diet is already low in total fat, high in monounsaturated fat, and the intake of fruits and vegetables is good.

Audit of dietary outcomes

It is important to develop outcome measures against which the effect of dietary education can be measured. This evaluation is essential to establish the contribution that diet can make to reduce diabetes-related morbidity and mortality.

Glycemic control

The gold standard for glycemic assessment is A1C. The ISPAD consensus guidelines recommended an A1C target of <7.6% (1), while the Canadian Diabetes Association 2003 clinical practice guidelines recommended targets vary by age (Table 2) (54). The target set for and achieved by each individual child depends on many factors. Goals must be realistic and management strategies clearly formulated, taking into account the psychosocial and developmental aspects of the child and family. Regular dietary review permits interpretation of A1C values in the context of BG readings and clinical parameters.

Assessing food choices

A food intake questionnaire originally designed for children without diabetes (55) was used to examine the food intake of children in the Children's Diabetes Clinic, Leicester, UK, (56). The questionnaire asked, "Did you at any time yesterday eat any of the following foods/drinks?" The results were compared with previously published data using the same questionnaire (57). The children with diabetes made many positive food choices compared with their non-diabetic peers. Children with diabetes consumed more low-sugar and low-fat foods, more healthy foods and less salty, fatty, sweet, sugary or unhealthy foods compared with the non-diabetic children. A disappointing finding was the low intake of high-fibre foods and fruit and vegetables in both children with and without diabetes. The low intake of these foods is characteristic of the UK diet, and both local and national efforts are needed to remedy this. It is especially important for children with diabetes, who need to eat the recommended 5 portions of fruit and vegetables per day in order to consume sufficient cardioprotective antioxidants.

The assessment of food choices not only establishes whether dietary advice has been implemented, but also provides evidence to target dietary education. An annual collection of such information would describe the eating behaviours of children with diabetes. Data on the same information in age- and sex-matched non-diabetic peers would serve as a useful comparison.

Serum cholesterol levels in children with diabetes

Dyslipidemia is common in type 2 diabetes, itself a major risk factor for CVD. The situation is less clear in type 1 diabetes, but disturbed lipid profiles have been demonstrated in adults (58,59), and high serum cholesterol and LDL-C are important predictors of CVD in people with type 1 diabetes (3,4). High serum cholesterol and LDL-C levels have been documented in children with type 1 diabetes (60-62). These studies have also found a positive correlation between high serum lipid levels and A1C. High cholesterol levels were confirmed in the Children's Diabetes Clinic, Leicester, UK. The National Cholesterol Education Program (NCEP) guidelines (63) on acceptable cholesterol levels were used

Table 2. Glycemic targets for children and adolescents (adapted from reference 54)

Age (years)	*A1C (%)*	*Preprandial PG (mmol/L)*	*Considerations*
<5	≤9.0	6.0–12.0	Extreme caution is required to avoid severe hypoglycemia because of the risk of cognitive impairment in this age group
5–12	≤8.0	4.0–10.0	Targets should be graduated to the child's age
13–18	≤7.0	4.0–7.0	Appropriate for most patients
	≤6.0	4.0–6.0	Consider for patients in whom these targets can be achieved safely

A1C = glycosylated hemoglobin
PG = plasma glucose

to compare the serum cholesterol levels of children with diabetes in Leicester to national UK data on the general population of children (64). The NCEP guidelines (63) state the acceptable cholesterol level is <4.4 mmol/L. Only 49% (40/81) of the children with diabetes at the Leicester clinic had serum cholesterol levels <4.4 mmol/L, compared with 72% of children from the general population. The significance of these higher levels in relation to CV risk is unknown, and the influence of reducing total and saturated fat remains controversial. There have been no longitudinal studies in children and young people with diabetes to prove that a reduction in dietary fat and saturated fat will either reduce serum cholesterol or reduce CVD. However, it would seem prudent to promote all dietary factors recommended in the ISPAD consensus guidelines to reduce CV risk (1).

Weight management

Children and young people with diabetes are heavier at all ages when compared with healthy controls (65). In addition, female adolescents with diabetes are particularly at risk of being overweight (65-67). Achieving ideal body weight in type 1 diabetes is essential, as being overweight or obese predisposes individuals to insulin resistance and dyslipidemia, which are linked to increased risk of CVD.

Data collected at the Leicester Children's Diabetes Clinic found that mean energy intake was substantially higher for males (n=36) and females (n=46) compared with national UK data collected from the general child and adolescent population (males: 2500 kcal vs. 1900 kcal; females: 1892 kcal vs. 1650 kcal) (64). This excess energy intake was reflected in body mass index (BMI) scores of the children with diabetes. Seventy-six percent of males and 77% of females with diabetes had BMI scores above the 50th percentile when plotted on standard percentile charts (68). There was also a statistically significant increase in the BMI standard deviation scores of the females when the same data was collected 1 year later. However, while all children were given appropriate advice about nutrition, all were on a similar twice-daily insulin regimen that did not permit close matching of insulin to food intake.

Weight should be regularly monitored in children with diabetes and appropriate weight management advice provided. Targeting females would also seem appropriate, not only because of their higher risk of being overweight, but also because of their higher relative mortality rate from CVD compared with males with diabetes (2). However, it is important to approach weight management with sensitivity and care, as females with diabetes appear to be at a higher risk of eating disorders than their peers without diabetes (27,69).

Promoting a healthy weight should include eating habits, lifestyle and physical activity advice from diagnosis and should be part of the holistic care to promote CV health and prevent obesity. Successful weight management is difficult in this group of children, and carefully organized trials of lifestyle management and interventions are required.

DISCUSSION

The evidence for optimizing glycemic control to reduce both microvascular and macrovascular complications is now well established. Dietitians must be an integral part of evaluating the methods used to educate children to achieve optimum glycemic control. Many different approaches are currently being used to educate children and families, but there is very little evidence to support one method over another. In clinical practice, the introduction of insulin analogues has permitted greater flexibility in carbohydrate intake, timing of meals and variety of food. These changes may encourage unhealthy food choices. Therefore, education should include dietary recommendations that improve CV risk factors, for example, gradually reducing total fat, in particular saturated and trans fatty acids, and promoting cardioprotective foods such as those containing monounsaturated fats and antioxidants. The educational method chosen should also take into careful consideration the total energy requirements of the child. Regular weight assessment is essential to prevent children and young people becoming overweight. Monitoring food choices provides information on dietary changes and helps guide dietary messages. Further research is required to examine dietary interventions that improve all dietary targets, while maintaining the quality of life of the child and family — an essential outcome measure of good diabetes management.

CONCLUSION

Continued efforts to clarify and scientifically evaluate the contribution that different methods of dietary education make to diabetes outcomes in children and young people with diabetes are essential. Further research is required into behaviour change approaches that will facilitate optimal dietary outcomes. As the workload of dietitians is increasing, and time is at a premium, the methods and process of dietary education must be thoughtfully selected and clear outcomes identified for each child and family.

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