Systematic Review of the Dietary Management of Children With Type 1 Diabetes

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ABSTRACT

The traditional cornerstones of the management of type 1 diabetes mellitus in children and adolescents include insulin, self-monitoring of blood glucose (SMBG) and nutrition therapy (meal planning). However, best practices in each of these areas remain controversial. The purpose of this paper was to systematically review the literature pertaining to the dietary management of type 1 diabetes in children and adolescents to assess the available data and to help inform future research in this area. Specifically, we reviewed data regarding the different dietary regimens, the glycemic index (GI) and the use of sucrose in children with type 1 diabetes. The evidence strongly suggests that adherence to nutrition therapy is poor unless patients are highly motivated. Some studies showed no difference in metabolic control with the use of strict dietary regimens, while others have shown the importance of maintaining consistency in carbohydrate intake. The GI has demonstrated good predictability in the context of a mixed meal; however, there is a need for further long-term studies in the pediatric population. Finally, sucrose in isocaloric substitution for starch does not negatively affect glycemic

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RÉSUMÉ

Les pierres angulaires classiques du traitement du diabète de type 1 chez les enfants et les adolescents sont l'insuline, l'autosurveillance de la glycémie et la thérapie nutritionnelle (planification des repas). Cependant, les meilleures pratiques dans chacun de ces domaines prêtent encore à controverse. L'objet de cet article est de faire une analyse systématique de la documentation sur le traitement diététique du diabète de type 1 chez les enfants et les adolescents afin d'évaluer les données disponibles et de guider la recherche dans ce domaine. Plus particulièrement, nous avons analysé les données concernant les divers régimes alimentaires, l'indice glycémique et l'usage du saccharose chez les enfants atteints de diabète de type 1. Les données donnent fortement à penser que la conformité à la thérapie nutritionnelle est médiocre, à moins que les patients ne soient très motivés. Certaines études ont montré que le fait de suivre un régime alimentaire strict ne modifiait pas le contrôle métabolique, tandis que d'autres ont montré l'importance de maintenir un apport glucidique uniforme. L'indice glycémique a eu une bonne puissance prédictive dans le contexte d'un repas mixte. Il faudra cependant mener d'autres études à long terme chez les enfants. Enfin, le fait de substituer de manière isoénergétique le saccharose aux glucides ne nuit pas à l'équilibre de la glycémie. Nous concluons que notre compréhension des meilleures pratiques en matière de thérapie nutritionnelle chez les enfants et les adolescents atteints de diabète de type 1 est encore rudimentaire et que des efforts concertés de recherche sont justifiés pour combler les lacunes considérables des connaissances.

control. We conclude that our understanding of best practice in nutrition therapy for children and teens with type 1 diabetes remains rudimentary, and that concerted research efforts are warranted to fill the considerable gaps in knowledge.

INTRODUCTION

The traditional cornerstones of the management of type 1 diabetes mellitus in children and adolescents include insulin, self-monitoring of blood glucose (SMBG) and nutrition therapy (meal planning). However, best practices in each of these 3 areas remain controversial. The purpose of this paper was to systematically review the literature pertaining to the dietary management of type 1 diabetes in children and adolescents to assess the available data and to help inform future research in this area. Literature regarding the different dietary regimens, the glycemic index (GI) and the use of sucrose in children with type 1 diabetes has been included as these continue to be controversial topics.

METHOD

A literature search was conducted in July 2001. Studies published from January 1990 to July 2001 were reviewed. Relevant studies (dated prior to 1990) cited in these papers were also included. Evidence from the American Diabetes Association's (ADA's) clinical practice recommendations was also considered (1). Each study was assigned a level of evidence according to the guidelines used in the development of the Canadian Diabetes Association 2003 Clinical Practice Guidelines for the Prevention and Management of Diabetes in Canada (Table 1) (2).

RESULTS

Dietary regimens

Current nutrition therapy for the management of type 1 diabetes includes the use of national guidelines for healthy eating (50% to 55% of energy from carbohydrate, <30% from fat and 15% to 20% from protein) (2). There is no consensus regarding which dietary regimen (i.e. exchange systems, carbohydrate counting or unrestricted diets) is the most appropriate in the pediatric population, nor is there a standard method of practice among pediatric centres.

Published studies in children with diabetes, although limited in number, have typically compared prescribed diets to unrestricted diets. In a study of 53 children (age: 8.3 years to 17.6 years) with type 1 diabetes, Price and colleagues *[Level 3]* used 24-hour recall to evaluate differences in compliance and metabolic control between children following a prescribed carbohydrate diet and those following an unrestricted carbohydrate diet (3). There were no significant differences in metabolic control, evaluated based on A1C, or in day-to-day variation in carbohydrate intake between the 2 groups. The A1C of subjects following a prescribed carbohydrate diet and those following an unrestricted carbohydrate diet were 12.4±1.7% and 11.9±0.9%, respectively. Both groups of children displayed highly variable carbohydrate intakes (3).

In 16 patients (age: 8.5 years to 15.8 years) with type 1 diabetes, Walker and colleagues *[Level 3]* also found no significant difference in A1C between those using a carbohydrate exchange diet and those using a nonquantified carbohydrate diet (4). Interestingly, no significant difference in total carbohydrate intake was observed between the types of diets followed (4). Pinelli and colleagues *[Level 4]* observed that a diet based on basic nutrition recommendations, including following a healthy, low-fat, low-sugar diet and conforming to the recommended dietary allowances (RDAs) without strict quantitative guidelines for carbohydrate exchanges, was successful in achieving a mean A1C of 7.1±0.9% in 194 patients with type 1 diabetes (age: 1 year to 23 years) (5).

Studies of dietary regimens in adults with type 1 diabetes have yielded conflicting results. For example, Henry and colleagues *[Level 2]* recorded the dietary intakes of 16 patients with diabetes for 6 weeks and found a lack of compliance with the conventional diet, a restricted diet containing 40% of energy as carbohydrate and using a 10-g exchange system. Regardless of their emphasis on consistency, carbohydrate intake was equally variable in adults using the conventional diet and those using the unrestricted diet (6). Mitchell and colleagues *[Level 3]* reported a reduction in A1C of 0.9% 3 months after patients received simplified nutrition instruction. The instruction included discussion with a dietitian about the effects of foods containing little carbohydrate, highly refined carbohydrate and unrefined carbohydrate on

Table 1. Criteria for assigning levels of evidence to published studies of treatment and prevention (2)

Level	Criteria
Level 1A	Systematic overview or meta-analysis of high-quality randomized, controlled trials Appropriately designed randomized, controlled trial with adequate power to answer the question posed by the investigators
Level 1B	Nonrandomized clinical trial or cohort study with indisputable results
Level 2	Randomized, controlled trial or systematic overview that does not meet Level 1 criteria
Level 3	Nonrandomized clinical trial or cohort study
Level 4	Other

blood glucose (BG) levels. Subjects were encouraged to avoid foods containing highly refined carbohydrate and to eat regular meals containing approximately the same amount of carbohydrate each day. Whether subjects received lists of the carbohydrate content of foods was not reported. No further improvement was observed after subjects switched to a diet using the 10-g carbohydrate exchange system (7).

Delahanty and Halford *[Level 4]* examined the dietary behaviours of subjects managed with intensive insulin therapy in the Diabetes Control and Complications Trial (DCCT) (8). In contrast to the results of the aforementioned studies, subjects who strictly adhered to a meal plan >90% of the time and used carbohydrate counting or an exchange system achieved A1C levels 0.9% lower than those who did not follow a meal plan (8). Wolever and colleagues *[Level 1B]* examined a group of 272 patients with type 1 diabetes 18 years to 64 years of age with a duration of diabetes of 2 years to 45 years. They found that consistency in the amount and source of carbohydrate intake from day to day resulted in improved glycemic control, evaluated based on A1C (9).

The concept of adjusting insulin dose based on carbohydrate intake has recently been explored. Advantages of using insulin to carbohydrate ratios include greater flexibility in food choice, portion size and timing, and physical activity. Mühlhauser and colleagues *[Level 1A]* found that intensive diabetes treatment and education, including adjustment of insulin based on carbohydrate intake, resulted in a significant improvement in A1C (10). Mühlhauser and colleagues *[Level 3]* also evaluated the effect of a liberalized diet in the context of intensive insulin therapy. The education program focussed on adjustment of preprandial insulin based on the carbohydrate content of foods. The results of their study indicated that liberalization of the diet motivated participants to perform extra insulin injections and did not have adverse effects on glycemic control. Furthermore, greater liberalization of the 'diabetes diet' resulted in a lower perceived burden of nutrition therapy (11). In similar studies, Rabasa-Lhoret and colleagues *[Level 1A]* (12), Chantelau and colleagues *[Level 3]* (13) and Delahanty and Halford *[Level 4]* (8) found that highly motivated patients who were familiar with carbohydrate counting achieved improved metabolic control.

Some studies have demonstrated that the type of dietary regimen encouraged has an impact on fat intake. Kalk and colleagues *[Level 3]* examined the dietary habits of 39 patients (mean age: 17.7±4.0 years) with type 1 diabetes who received dietary advice based on the ADA's recommendations for the distribution of macronutrients in the diet (>45% to 50% of energy from carbohydrate, <30% to 35% from fat and <20% from protein) (14). The results suggested that patients were consuming less carbohydrate and more fat than recommended; however, only 13% of the subjects were reported to be following the conventional meal plan exchanges about which they had been advised. The perceived restrictions on carbohydrate-containing foods, including the avoidance of sugar, may have resulted in a higher fat intake (14). Chantelau and colleagues *[Level 3]* reported that adult patients with diabetes following a less restricted diet tended to decrease their carbohydrate intake and increase their fat intake; however, this did not introduce any short- or long-term metabolic risk factors for cardiovascular disease (13).

The studies conducted by Kalk and colleagues (14) and Chantelau and colleagues (13) were published 12 years and 22 years ago, respectively. In recent years, a more liberal attitude toward the inclusion of carbohydrate in the diet has been adopted. Randecker and colleagues *[Level 3]* recently evaluated the total dietary intake of 66 children with type 1 diabetes and found that subjects' mean intake of total fat approached the recommended <30% of energy. Although the authors reported that subjects had received education about either the ADA's exchange system or a no concentrated sweets diet, they did not report the number of children educated about each diet, nor did they assess patient compliance with the diets (15).

Dietary therapy in both children and adults with type 1 diabetes remains controversial. It is unclear whether the literature on diabetes in adults is relevant to the management of children and adolescents with diabetes, as nutritional requirements in the latter focus on growth and physical development rather than on weight maintenance or loss. Adherence to nutrition therapy appears to be poor unless patients are highly motivated. Although some studies have revealed no difference in metabolic control with the use of strict dietary regimens, others have shown the importance of maintaining consistency in carbohydrate intake. The risk of increased fat intake with the use of less carbohydrate-restricted diets, shown in earlier studies, could be detrimental to general health in the long term but does not appear to be consistent with the results of more recent studies. The best metabolic control occurred when insulin dose was adjusted based on carbohydrate intake; however, patients must be highly motivated in order to achieve success with this approach.

The GI

The GI ranks carbohydrate-containing foods according to how quickly they are digested and their impact on BG levels compared to a standard food (usually glucose or white bread). The GI challenges the belief that carbohydrates, regardless of their source, will have the same effect on an individual's BG level. Numerous studies have been conducted on the use of the GI in the management of individuals with type 1 diabetes. The majority of these studies have targeted adults with type 1 diabetes, although a few have included children and adolescents.

Collier and colleagues *[Level 2]* conducted a 2-part study in 7 children with type 1 diabetes (16). The first part of the study demonstrated that consumption of a slowly absorbed, low-GI food (lentils) resulted in lower postprandial BG levels at 60 minutes, 90 minutes and 120 minutes than consumption of a high-GI food (corn flakes). In the second part of the study, the effects of following a low-GI vs. a high-GI diet were observed for 6 weeks. Although no significant change in A1C or insulin dose occurred, glycosylated albumin levels were significantly reduced when subjects followed the low-GI diet. Glycosylated albumin has been suggested to be an earlier indicator of changes in BG control than A1C (16).

Gilbertson and colleagues *[Level 2]* conducted a large, prospective, randomized trial to determine the long-term effects of low-GI dietary advice on metabolic control and quality of life in 104 children with type 1 diabetes (17). They compared the effects of following a measured carbohydrate exchange diet with those of following a low-GI dietary regimen. Outcome measures, including A1C, weight, height, dietary intake (3-day food diary), and incidence of hypoglycemia (BG <3.5 mmol/L) and hyperglycemia (BG >15 mmol/L), were recorded at study entry and at 3 months, 6 months and 12 months. At 12 months, children following the low-GI dietary regimen had significantly lower A1C levels than those following the carbohydrate exchange diet (8.05±0.95% vs. 8.61±1.37%, respectively, p=0.05). Rates of excessive hyperglycemia (>15 episodes per month) were significantly lower with the low-GI dietary regimen vs. the carbohydrate exchange diet (35% vs. 66%, respectively, p=0.006). No differences in insulin dose, hypoglycemic episodes or dietary composition were found between groups. The low-GI dietary regimen was associated with better quality of life for both children and their parents, as assessed by a questionnaire completed independently by the patients and their parents at each time point during the study (17).

Only 1 study has refuted the use of the GI in children with type 1 diabetes. Birnbacher and colleagues *[Level 3]* investigated the glycemic response to commonly ingested carbohydrates with different GIs (corn flakes, 119; white bread, 100; dark rye bread, 95; and muesli, 96) in 14 children with type 1 diabetes (18). Although the BG response after consumption of corn flakes was significantly higher than after the other breakfasts, the areas under the BG curve were not significantly different between the 4 groups. Furthermore, the time of the peak increase in BG was not different after a high-GI or a low-GI breakfast. One limitation of this study was the lack of significant difference between the GIs of the different test meals, however, one could expect a significantly higher BG response following the ingestion of corn flakes when compared to a low-GI food (e.g. a GI of 55). The study design was also a limitation, as each breakfast was consumed only once (18).

Some studies have suggested that dietary fibre is a factor when examining BG response to a meal (16,19,20). The authors reviewed 2 studies examining the effect of fibre on carbohydrate absorption in children with type 1 diabetes. In the study conducted by Collier and colleagues *[Level 2]* in 7 children with type 1 diabetes, the lower BG levels achieved with the test diet may be attributed to its significantly higher fibre content (16). Furthermore, Kinmonth and colleagues *[Level 2]* compared the effect of substituting high-fibre, unrefined whole foods for refined, processed foods in liberal carbohydrate diets (50% to 55% of energy from carbohydrate) on BG in a randomized, crossover study in 10 children with type 1 diabetes (19). The unrefined diet provided 60 g/day of dietary fibre from whole grain breads, and fresh fruits and vegetables (including dried beans) and the refined diet provided 20 g/day of dietary fibre from processed foods (i.e. white bread and cereal, processed fruits and vegetables). The diets were isocaloric for carbohydrate, fat and protein.

Glycemic control was significantly better when the unrefined diet was used. On profile days, mean preprandial and postprandial BG levels on the unrefined diet were 5.5 mmol/L and 8.5 mmol/L, respectively, and on the refined diet were 8.4 mmol/L and 12.2 mmol/L, respectively. The mean 24-hour urinary glucose excretion was 9.3 g after following the unrefined diet for 6 weeks and 38.0 g after following the refined diet for 6 weeks. However, no significant changes in A1C were observed. The authors suggested that 4 weeks to 6 weeks of improved glycemic control may not have been sufficient to observe a change in A1C (19). Neither of these studies assessed whether the relationship between fibre and A1C is independent of GI (16,19).

The use of the GI has been more extensively researched in adults than in children. Buyken and colleagues *[Level 3]* examined the effect of the GI, evaluated from a 3-day food record, on A1C in 2810 patients with type 1 diabetes (20). They found that lower GI diets were associated with significantly lower A1C levels, independent of dietary fibre intake. Adjusted A1C levels among subjects in the lowest GI quartile were 8% lower than among those in the highest GI quartile, and A1C increased significantly as GI increased (20).

Brand-Miller and colleagues *[Level 1A]* recently performed a meta-analysis of 14 randomized, crossover or parallel studies that evaluated the use of low-GI diets in the management of diabetes (21). After an average period of 10 weeks, subjects with either type 1 diabetes or type 2 diabetes following low-GI diets had A1C levels ≈0.4% points lower than those following high-GI diets. Examination of A1C in studies of >6 weeks' duration and fructosamine levels in studies of ≤6 weeks' duration suggested that these glycosylated proteins were reduced by 7% or 8% with the low-GI diets compared to the high-GI diets (21).

The authors reviewed only 1 study evaluating the difference in glycemic response to a test meal between adults and children. Wolever and colleagues *[Level 3]* evaluated the glycemic response in 7 children and 10 adults to either a portion of white bread containing 50 g of carbohydrate or a portion of red lentils containing 50 g of carbohydrate, with the addition of 8 g of butter and 100 g of tomato for palatability (22). The test meal was provided on 3 occasions. The glycemic response to the lentils was identical in both adults and children, suggesting that glycemic response is not affected by age (22).

It is difficult to reach definitive conclusions regarding the use of the GI in children and adolescents with type 1 diabetes because of the limited number of published studies in this area. Long-term studies exploring the use of the GI in children and adolescents are required to clarify the issues surrounding this topic; studies addressing the impact of protein and fat on the GI would be of benefit. Regardless, the GI has demonstrated good predictability in the context of a mixed meal, as shown by the findings of Brand-Miller and colleagues (21), and in all age groups, as shown by Wolever and colleagues (22).

Sucrose

Nutrition guidelines provided to individuals with diabetes have traditionally emphasized the elimination of sugars, primarily sucrose and glucose, from the diet. This exclusion was based on the belief that sugars are more quickly absorbed into the bloodstream than are starches, resulting in higher postprandial BG levels and, ultimately, poorer glycemic control.

In a randomized, crossover study of 9 children (age: 11 years to 16 years) with type 1 diabetes, Rickard and colleagues *[Level 2]* compared the glycemic response to 2 mixed meals containing either 2% sucrose or 17% sucrose and matched for energy and nutrient content, with sucrose isocalorically replacing starch in the 17% sucrose meal (23). Over the 4-hour study period, the glycemic response to the 17% sucrose meal was lower than the response to the 2% sucrose meal. Peak BG response occurred 1 hour earlier and was 2.2 mmol/L to 2.8 mmol/L lower with the 17% sucrose meal compared to the 2% sucrose meal. The authors speculated that the lower glycemic response may have occurred with the 17% sucrose meal because it contained less available glucose. While starch is hydrolyzed and absorbed as glucose, sucrose is hydrolyzed to equimolar amounts of glucose and fructose. Furthermore, the 17% sucrose meal contained more fructose than the 2% sucrose meal and fructose elicits a lower glycemic response than glucose (23).

In a similar study, Loghmani and colleagues *[Level 2]* evaluated the glycemic effects of sucrose-free (2% of total energy from sucrose, 10 ± 1 g of sucrose) and sucrose-containing (10% of total energy from sucrose, 52 ± 2 g of sucrose) diets in 10 children with type 1 diabetes (24). The children were randomly assigned in a crossover design to follow 1 of the 2 diets for 2 consecutive days. The diets were isocaloric, with similar nutrient composition divided among 3 meals and 3 snacks. No significant differences were observed between subjects' glycemic responses to the 2 diets (24).

Schwingshandl and colleagues *[Level 2]* studied the effect of sucrose on long-term metabolic control in children and adolescents for a mean observation period of 83 days (25). A diet containing 5% of total energy as sucrose was recommended to 11 children who were permitted sucrose in cakes, ice cream and snacks (e.g. chocolate bars), but not as a sweetener in beverages. The substitution of a main meal for sucrose-containing foods was discouraged. A control group of 13 children continued following their 'sucrose-free' (2% of total energy as sucrose) diet for a mean observation period of 77 days. A1C was similar between the groups at baseline and follow-up. However, fibre consumption decreased with increased consumption of sucrose (25).

Cedermark and colleagues *[Level 3]* examined the glycemic effects of exchanging 26 g of carbohydrate in white bread (standard meal) for sucrose/glucose in the form of gum drops (test meal) in the afternoon snack of 12 adolescents (age: 13 years to 16 years) with type 1 diabetes (26). The macronutrient compositions of both snacks were similar. The BG peak occurred 60 minutes earlier after the test meal than after the standard meal. No significant difference in total postprandial BG response was observed between the 2 snacks (26). Santacroce and colleagues *[Level 2]* (27) and Forlani and colleagues *[Level 2]* (28) reported similar results in adults.

Peters and colleagues *[Level 2]* compared the BG response to the isocaloric substitution of a piece of chocolate cake for a baked potato in a mixed meal with the BG response to the addition of chocolate cake to a mixed meal in adult subjects. The authors concluded that dessert exchange is not harmful to glycemic control, but the addition of dessert without reduction in the carbohydrate content of the meal results in a significant increase in postprandial BG (29). The results of this study are clinically relevant to the dietary management of children with type 1 diabetes who wish to incorporate similar foods into their meal plan on a regular basis.

The replacement of sucrose with other nutritive sweeteners in meals to potentially improve metabolic control has been evaluated. The findings of studies that compared the glycemic response to different carbohydrates support the view that dietary sucrose does not aggravate postprandial hyperglycemia compared to other types of carbohydrate. Primavesi and colleagues *[Level 2]* reported similar findings in a study of 10 children (age: 6 years to 17 years) randomly assigned to receive no snack or 1 of 3 different mid-morning snacks containing fibre and fructose, fibre and sucrose or no sucrose (30). The nutrient composition of the 3 snacks was similar: 132 kcal to 144 kcal, 1.8 g to 2.2 g of protein, 8.0 g to 8.7 g of fat, 13.5 g to 15.0 g of carbohydrate, 0 g to 1.3 g of fibre. On 2 subsequent afternoons, 10 of the 18 children were randomly assigned to receive either no snack or a sucrose-free snack. No significant differences in BG levels were observed between the different snacks or no snack in both the morning and the afternoon study periods. In the morning study period, 2 patients experienced hypoglycemia when assigned to receive no snack. Although not statistically significant, this finding is of clinical relevance (30).

In an 8-month, randomized, controlled trial, Nadeau and colleagues *[Level 2]* compared the metabolic control of 48 free-living subjects with type 2 diabetes who received education about either the incorporation of 10% of total energy as added sugars into their diet or a conventional meal plan (31). Subjects were counselled to avoid concentrated sweets during the first 4 months of the trial, after which they were randomized to either the test diet or the conventional diet. Dietary advice for those randomized to the test diet followed the Canadian Diabetes Association's (CDA's) current recommendations of substituting 10 g of carbohydrate from the 'sugars' group for other carbohydrate choices; intake of sugars of up to 10% of their total daily energy was permitted. At baseline, both groups consumed sweets. Subjects who were educated about the incorporation of choices from the 'sugars' group tended to reduce their carbohydrate intake during the study period and did not experience deterioration in their metabolic control (31).

Steel and colleagues *[Level 2]* (32) and Bantle and colleagues *[Level 2]* (33) reported similar findings in adults. Both studies found no significant differences between the glycemic effects of fructose, sucrose and starch (32,33). However, the findings of Hassinger and colleagues *[Level 2]* in adults consuming xylitol, sucrose or starch contradict the results of the aforementioned studies, as insulin requirements were significantly greater after a sucrose-containing meal compared to a xylitol- or starch-containing meal (34). Unfortunately, the results of these studies cannot be directly compared because fructose was used in the former studies whereas xylitol was used in the latter (32-34).

The evidence available from the published literature suggests that isocaloric substitution of sucrose for starch at moderate intakes does not negatively affect glycemic control in individuals with type 1 diabetes. However, the addition of sucrose to a meal without concomitant reduction of the total carbohydrate content of the meal resulted in compromised glycemic control in the short term. The results of studies in free-living subjects suggest that there is no significant difference over the longer term when sucrose is added to the diet; however, with additional education, patients may reduce their intake of other carbohydrate-containing foods when increasing sucrose intake. Increased consumption of sugars may lead to a reduction in dietary fibre. Various types of carbohydrates elicit similar glycemic responses when equally interchanged. More data on the effect of sugar alcohols on metabolic control in children with type 1 diabetes are required.

CONCLUSION

The only conclusive finding in this systematic review pertains to the use of sucrose in the diets of individuals with diabetes. The studies continue to show that sucrose does not negatively affect glycemic control and can be permitted in the diet. In 1994, the CDA incorporated this finding into their dietary guidelines with the addition of the 'sugars' group to the *Good Health Eating Guide* (35).

The use of different dietary regimens, namely, carbohydrate counting, exchange systems and unrestricted diets, remains controversial. Evidence in favour of both restricted and unrestricted meal plans is available for the pediatric population with type 1 diabetes. Of considerable interest is the evaluation of episodes of hypoglycemia and hyperglycemia in patients with diets of variable carbohydrate intake to determine glycemic control on a day-to-day basis. While most studies used A1C to assess glycemic control, only Gilbertson and colleagues reported episodes of both hyperglycemia and hypoglycemia (17).

Implementation of dietary regimens in the pediatric population is also influenced by the individual's family and stage of life. Infants and toddlers have unpredictable eating habits, rendering attempts at implementing a strict meal plan difficult. Therefore, implementation of a meal plan is easier in older children as their eating behaviours are more consistent and predictable. Insulin to carbohydrate ratios may be appealing to adolescents who are able to use this method since it allows them to more easily adapt the management of diabetes to their lifestyles. All of these factors should be considered when determining the appropriate dietary regimen for the individual child and family.

Studies evaluating the use of the GI in children and adolescents with type 1 diabetes are limited. Given the evidence for the use of the GI in adults, use of the GI may not be detrimental to people with diabetes, but may, in fact, be of clinical benefit. Further evaluation in the pediatric population would strengthen the evidence for this benefit.

Therefore, the current Canadian recommendations regarding dietary sucrose remain valid; however, no recommendations regarding the use of a specific dietary regimen or the GI in the pediatric population can be made until further research has been completed in these areas.

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