

Diet of the Diabetic Child

What You Need to Know

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Abstract-Type 1 Diabetes (T1D) is the most common endocrinopathy in children. Its incidence is increasing worldwide. Algeria is among the top 10 countries where the incidence is continuously rising. The management of T1D is complex and consists of several components, including diet. Knowing that a child is not just a smaller adult, they require care tailored specifically to them, which evolves with age. This care ranges from complete dependence on the parents, to an intermediate phase involving both the child and the parents, and finally to a transition phase towards acquiring self-management skills. Nutritional management is a challenge for healthcare providers, the child, and his family. It requires a behavior change within the entire family toward healthy eating and optimal lifestyle habits, with the goal of achieving good glycemic control, allowing the child to grow normally and integrate into a social life that meets their needs. Functional insulin therapy is a new method that has revolutionized the management of diabetic children. It is patient centered, allowing the treatment to be adapted to the child's life, requiring mastery of knowledge regarding diet. Nutritional education is also necessary for managing physical activity and certain comorbidities. Conclusion: Nutritional management plays a crucial role in balancing diabetes. It must adhere to recommendations for healthy eating in children, while also respecting cultural and social habits.

Keywords: Type 1 diabetes, healthy eating, nutritional therapy, functional insulin therapy, carbohydrate counting, glycemic balance.

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INTRODUCTION

The term "diabetes mellitus" describes a complex metabolic disorder characterized by chronic hyperglycemia resulting from abnormalities in insulin secretion, insulin action, or both. Although the etiology of diabetes is heterogeneous, most cases can be classified into two major etiopathogenic categories: Type 1 diabetes (T1D), which is characterized by the destruction of β -cells, usually through an autoimmune process, leading to a loss of endogenous insulin production.

Type 2 diabetes (T2D), which is defined by an inadequate insulin response in the presence of increasing insulin resistance.

While T1D remains the most common form of diabetes in children in many populations, T2D has become an increasingly significant global public health issue, particularly among young people and obese adolescents.

In 2021, an estimated 108,300 children and adolescents under the age of 15 were diagnosed with type 1 diabetes, and approximately 651,700 children

and adolescents were living with the disease worldwide [1-2].

The incidence of T1D in children varies by region, with the highest rate observed in Finland at 52.2 per 100,000. Among the top 10 countries listed in the latest edition of the International Diabetes Federation's Atlas are Algeria, Saudi Arabia, Kuwait, and Qatar [3].

Projections for 2040, based on 2021 data, suggest an increase in prevalent cases from 8.4 million individuals worldwide to between 13.5 and 17.4 million, with the highest relative increase expected in lower-middle-income countries.

NUTRITIONAL MANAGEMENT OF DIABETES IN CHILDREN

The management of a child with diabetes is based on several key components: insulin therapy, therapeutic education, nutritional education, and physical activity. Nutritional therapy is recommended for all young individuals with diabetes. Dietary advice should be adapted to cultural and family traditions, as well as to the cognitive and psychosocial specificities of the child and their family.

There is no longer a specific "diabetic diet" for children and adolescents with type 1 diabetes. Their diet should be the same as that of a healthy child and follow general nutritional recommendations [4-6]. Therefore, it can be shared by all family members.

The diet consists of macronutrients, which are present in large quantities in foods: proteins, lipids, and carbohydrates. It also includes micronutrients, which are present in smaller amounts: minerals (calcium, phosphorus, magnesium, sodium, etc.), trace elements (iron, zinc, copper, etc.), and vitamins (A, B, C, D, E, etc.).

The optimal distribution of macronutrients varies and should be based on an individualized assessment of each child. In children, carbohydrates should account for 40–50% of total energy intake, fats should be <35% (<10% saturated fats), and proteins should make up 15–25%.

MEAL TIMING AND INSULIN THERAPY

In type 1 diabetes, diet is closely linked to the insulin regimen followed. In the traditional insulin therapy system with two daily injections of a mixed insulin (combining rapid and long acting insulin) a method that is increasingly being phased out specific meal times must be observed, and food intake is divided into six meals to align with the insulin action profile.

If a child wishes to consume more carbohydrates at a given time, this can be done by administering an ultra rapid acting insulin at that moment.

For greater flexibility in meal timing and portion sizes, the basal-bolus regimen is preferred, as it more closely mimics the natural insulin secretion of a healthy child. This method involves administering a basal insulin once or twice daily and a rapid or ultra rapid acting insulin before each meal.

The primary goal of this nutritional approach for children with type 1 diabetes is to achieve glycemic targets without excessive hypoglycemia while supporting normal growth and development [7-8].

NUTRITIONAL THERAPY

Due to its complexity, nutritional therapy is often one of the most challenging aspects of diabetes management for families [9]. It is influenced by family context, social environment, dietary habits, food insecurity, non-compliance, peer pressure (siblings, school, friends), and the desire for independence, especially during adolescence [8]. Nutritional therapy must also take into account the constantly changing physiological needs due to growth, appetite fluctuations associated with growth spurts, varying

nutritional requirements, occasional meals, and physical activity sessions [8].

Nutritional education and lifestyle advice should be tailored to individual needs and centered on the person. It is essential to involve the entire family in implementing necessary changes based on the principles of healthy eating. Similarly, whenever possible, the choice of an insulin therapy regimen should consider the young person's eating habits and lifestyle.

Evidence from diabetes management in adults by dietitians and qualified nutrition professionals [10-11], as well as in other chronic diseases [12], supports their effectiveness as part of multidisciplinary care teams. However, data on pediatric patients remain limited.

The dietitian's role is to provide guidance on meal planning, content, and timing within the context of the child's individual situation, lifestyle, and prescribed insulin regimen. Nutritional education can be conducted individually with the child or adolescent and their family, as well as in small groups with other children with diabetes.

The dietitian must establish a long-term relationship of trust and support with families [13-14] and define clear objectives in collaboration with the multidisciplinary team [15]. Nutritional education should include strategies for behavior change within the entire family, motivational interviews, and counseling. It must be regularly reviewed to adapt to the evolving needs of the growing child. The implementation of these recommendations should consider the impact of food security on the family's ability to follow therapeutic guidelines.

The goal of continuous support at all ages is to help the child recognize carbohydrate-containing foods and determine appropriate portion sizes based on their age [16]. Guidance on food choices, portion sizes, and physical activity is crucial to reducing the risk of excessive weight gain and cardiovascular diseases (CVD).

Adolescents may exhibit greater independence in their food choices, deciding more freely what, when, and how much they eat. This can negatively impact glycemic control and dietary choices [17]. If the diagnosis was made in childhood, reinforcing education during adolescence on the importance of healthy eating and diabetes self-management is necessary.

Preventing overweight and obesity in young individuals with diabetes is a key management strategy that should be integrated into a family-centered approach.

Frequent episodes of diabetic ketoacidosis (DKA) or worsening glycemic control may be signs of eating disorders.

FUNCTIONAL INSULIN THERAPY (FIT)

Functional Insulin Therapy (FIT) allows for the adjustment of insulin needs (both long acting and rapid acting insulin) based on the patient's activities and the amount of carbohydrates consumed. In contrast, in the basal-bolus method, the doses of rapid-acting and long-acting insulin are generally prescribed by the physician, requiring the patient to maintain a relatively consistent carbohydrate intake. In other words, with FIT, the treatment adapts to the patient's lifestyle rather than the patient adapting to the treatment.

FIT is considered a physiological treatment aimed at closely mimicking natural insulin secretion [18-19]. Its implementation follows three key steps: "Live, Eat, Treat":

Fasting helps assess baseline insulin needs, determining the amount of insulin required simply to "live."

Mealtime doses, or "eat," are determined using carbohydrate ratios at meal times.

Correction doses, or "treat," involve evaluating the effect of a unit of rapid acting insulin on blood glucose levels to determine the necessary dose for restoring glycemia to the target range.

This approach teaches patients how to personalize their treatment to best replicate natural insulin secretion both at baseline and during meals. It also helps patients understand the role of different types of insulin and their mechanisms of action to ensure the right insulin is used at the right time and in the right dose [20].

FIT is taught by specialized healthcare professionals through a pedagogical, practical, and technical approach. This includes:

- Recognizing foods that contain carbohydrates,
- Estimating food portions,
- Understanding the carbohydrate content of different food categories,
- Learning to calculate the required insulin dose to process the carbohydrates in a meal.

Carbohydrate counting should ideally be introduced at the onset of type 1 diabetes (T1D), along with education on the impact of mixed meals on postprandial glycemic profiles.

Benefits of Functional Insulin Therapy (FIT)

With proper mastery, Functional Insulin Therapy (FIT) offers several advantages:

Better understanding of the child's needs and diabetes, leading to improved glycemic balance.

Reduced risk of hypoglycemia and hyperglycemia by more precisely adjusting insulin doses, ultimately improving overall glycemic control.

Greater flexibility and dietary freedom, as insulin doses are accurately calculated to meet the meal's carbohydrate intake [21-22].

Adaptability to various eating situations, such as restaurant meals, festive gatherings, irregular meal schedules, or occasional indulgences ensuring that treatment adjusts to the child's life, rather than the other way around.

Challenges of Functional Insulin Therapy (FIT)

While Functional Insulin Therapy (FIT) offers many advantages, it also presents certain challenges:

Learning curve: Implementing FIT requires specific skills, including calculating, identifying, and understanding the carbohydrate content of foods. This method can also be difficult for family members to grasp.

Frequent blood glucose monitoring: Regular checks are needed to ensure the insulin dose is correctly adjusted. While continuous glucose monitoring (CGM) systems help alleviate this burden, they are unfortunately not available in all countries.

Increased daily injections: For individuals using multiple daily injections (MDI), FIT leads to more frequent insulin administration.

Adolescents often engage in behaviors that may disrupt diabetes management, such as:

Late nights, sleeping in, and skipping insulin doses or meals, fasting during Ramadan in Muslim majority countries, which requires careful planning to maintain glycose regulation. Social events, vacations, and peer pressure to consume sugary foods.

It is essential to emphasize the importance of regular and healthy meals, particularly during growth spurts, to prevent excessive snacking on sugary foods in the afternoon or evening. FIT is particularly beneficial in these situations, as it allows meal and insulin timing to be adjusted according to fluctuating schedules.

Addressing adolescent needs several key topics should be discussed with adolescents, including: attending social gatherings, traveling on vacation, handling cravings for sugary foods with friends.

These challenges should be addressed through goal setting and personalized guidance. FIT also allows

greater flexibility for celebratory meals or breaking the fast during Ramadan, which are important cultural and social occasions. The dietitian plays a crucial role in

teaching adolescents nutritional assessment, including carbohydrate, calorie, and fat intake.

Frequent self-monitoring of blood glucose (SMBG) can help understand glycemic variability during fasting periods. This data enables the healthcare team to fine-tune treatment and carbohydrate intake to achieve optimal glycemic balance [23]. The integration of technology in diabetes care is essential, as it empowers children and their families to participate in treatment decisions and improve diabetes self-management.

CARBOHYDRATE COUNTING

There are several methods to quantify carbohydrate intake, including: counting by grams, portions of 10 to 12 g of carbohydrates, exchange system (15 g of carbohydrates per unit). No scientific evidence strongly favors one method over another.

Glycemic Index and macronutrient impact using the glycemic index (GI) provides additional benefits for blood glucose management compared to focusing solely on the total carbohydrate content.

Fats and proteins in food influence postprandial blood glucose levels both early and late. For meals rich in proteins and fats, insulin dosage and administration patterns must be adjusted accordingly.

Carbohydrate counting apps can be highly beneficial, helping children and parents understand how different foods affect blood sugar and emphasizing the importance of keeping a food journal [24].

Tracking carbohydrates, proteins, and fats and adjusting insulin doses or choosing the right bolus type for late postprandial glucose excursions can be particularly useful during special occasions. Family involvement and support are essential in helping children with diabetes adhere to their dietary regimen [25-27].

While type 2 diabetes (T2D) is rare in children, its prevalence is increasing among adolescents with obesity.

Nutritional management of T2D requires a family centered and community based approach to address: excessive weight gain, physical inactivity, increased cardiovascular disease (CVD) risk.

NUTRITIONAL EDUCATION AND PHYSICAL ACTIVITY

Nutritional advice is recommended to learn how to properly manage physical activity, whether it's regular

or unexpected. Engaging in competitive sports is not prohibited for a diabetic child, but we must teach the child to adjust their insulin doses by reducing them before physical exercise. They should consume a sugary food, with the quantity and frequency

determined by the intensity of the physical activity, and monitor their blood sugar levels during and after the activity. The risk of hypoglycemia can occur several hours after the activity.

NUTRITIONAL APPROACH AND COMORBIDITIES

- Among the degenerative complications of type 1 diabetes, dyslipidemia is a major complication due to its impact on the cardiovascular system. Lipid screening is part of the recommended tests according to international guidelines [28], but in practice, dyslipidemia is often overlooked or insufficiently treated, while cardiovascular diseases (CVDs) remain a leading cause of mortality in adult diabetes [29]. Hyperglycemia, insulin deficiency, and insulin resistance are associated with dyslipidemia, highlighting the importance of optimizing glycemic control as well.

Management of dyslipidemia involves reducing saturated fat intake to less than 7% and eliminating trans fats, ensuring total fat intake constitutes 25-35% of total energy intake, promoting a diet rich in fruits and vegetables (> 5 servings per day), increasing dietary sources of soluble fibers and antioxidants, eliminating sugary drinks and juices, reducing highly processed foods, and combating smoking in adolescents.

If dyslipidemia persists despite well implemented nutritional measures, medical treatment may be initiated according to guidelines [28].

- Celiac disease is a common comorbidity associated with type 1 diabetes. The only therapeutic alternative currently available is a gluten free diet, which makes managing diabetes even more complicated for families in terms of food.

CONCLUSION

Managing diabetes in children presents a challenge for healthcare providers. The main objective is to achieve optimal glycemic control, which requires the involvement of multiple stakeholders around the child and their family, empowering them with the knowledge and skills necessary to manage various situations.

Among these tools, nutritional education is an essential resource that will allow the child to grow and develop while delaying the onset of long-term

complications associated with their condition as much as possible. To achieve this a trusting relationship between the child or adolescent and healthcare providers is essential, as it will facilitate behavior

changes during the sensitive periods of childhood and adolescence.

Diabetes management takes place within the context of the family, the surrounding social system, the pressure from close relatives, the gradual process of gaining independence, and the goal of preserving quality of life.

It requires a deep understanding of the relationship between therapeutic regimens and the ever changing physiological needs, including growth, appetite variations associated with changing growth rates, fluctuating nutritional needs, and physical activity. Improving glycemic control requires an individualized approach to therapeutic education. This should involve targeting dietary goals associated with optimal glycemic balance.

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