

## Educational Points for Prevention of Type 1 Diabetes and its Complications: A Systematic Review

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### Abstract

**Background/Objectives:** Type 1 diabetes is perceived as a chronic immune-mediated disease with a subclinical prodromal period characterized by selective loss of insulin-producing cells in the pancreatic islets in genetically susceptible subjects. To systematically review the evidence for the prevention of type 1 diabetes and its complications by vitamin D and E supplementation, diet and exercise and educational interventions are required.

**Methods:** This was a systematic review –from 1996 to 2012–using Medline, EMBASE, CINHAL, Cochrane Central Register of Controlled Trials and reference lists of retrieved articles. The main outcome measure was development of type 1 diabetes and controlled trials and observational studies that had assessed the effect of vitamin D and E supplementation on risk of developing type 1 diabetes, diet and exercise on prevention of complications were included in the analysis.

**Results:** 35 controlled trials and cohort studies and 7 systematic reviews that addressed education and prevention of type 1 diabetes and its complication were used. There was a suggestion that the timing of supplementations might be important for the subsequent development of type 1 diabetes. Also educational intervention for breast feeding, healthy diet and, controlled exercise can prevent type 1 diabetes and its complication.

**Conclusions:** With regard to the content above, educational intervention for diet, importance of breast feeding, obesity, exercise and role of vitamin E and D can prevent the incidence of type 1 diabetes or its complications in high risk clients and patients with type 1 diabetes. Therefore these factors should be considered in educational plan of clients with type 1 diabetes.

**Keywords:** Type 1 diabetes; Education; Prevention

### Introduction

Diabetes mellitus is the general name for a group of chronic metabolic diseases characterized by high blood glucose levels that result from defects in insulin secretion and/or action. The two main forms of diabetes are type 1 diabetes and type 2 diabetes [1]. Type 1 diabetes occurs when the beta cells of the pancreatic islets of langerhans, which are responsible for insulin production, are progressively destroyed by the immune system. The body's ability to produce insulin becomes progressively impaired until eventually no insulin is produced [2]. Considering the risk of maternally acquired positives in the first year of life and in light of the rarity of presentation of clinical disease in infancy [3].

Type 1 diabetes is the third most common chronic condition in children and adolescents in the United States [4]. This condition affects 1 in every 400 to 600 children, and more than 13,000 children are newly diagnosed each year [5,6]. Type 1 diabetes and its treatment have two major acute complications: DKA and Hypoglycemia [7]. Chronic complications associated with type 1 diabetes include micro-vascular complications such as retinopathy, nephropathy, and neuropathy, and macro-vascular complications [2]. Patients with type 1 diabetes and their families should have knowledge about control of diabetes and prevention of its complications. Some studies show that education program alone improves glycemic control [8,9] and can help to prevent complication of type 1 diabetes. Educational interventions can take many forms. Didactic education, computer games, board games, cognitive behavioral therapy, and telephone calls are some of the possible methods of delivery. The education

may be directed at the patient alone, the whole family and even peers [10]. The aim of the educational interventions may be, among other things, to improve metabolic control, reduce complications, gain skills in self-management, improve quality of life [9,11]. Thus, this study has been done for providing points that must be educated to clients with type 1 diabetes and their families for prevention of diabetes and its complications. Then we have done conducting systematic reviews by looking in several valid sources and variety of articles. The studies show that a controlled diet, supplements such as vitamin E and D and exercise can play an important role for prevention of type 1 diabetes and its complications. In the following, each of them will be pointed out briefly.

### Materials and Methods

This was a systematic review– from 1996 to 2012 using Medline, EMBASE, CINHAL, Cochrane Central Register of Controlled Trials and reference lists of retrieved articles. The main outcome measure was

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development of type 1 diabetes and controlled trials and observational studies that had assessed the effect of vitamin D and E supplementation on risk of developing type 1 diabetes, diet and exercise on prevention of complications were included in the analysis (Figure 1).

## Results

We searched 771 articles and obtained 42 related articles (35 controlled trials and cohort studies and 7 systematic reviews that addressed education, role of vitamin D and E and interventions to prevention of type 1 diabetes and its complication). In the following, summary of them have been presented.

### Assesses diet

Nutritional therapy is fundamental for the effective management of diabetes and plays a vital role in helping people with diabetes achieve and maintain optimal glycemic control and reduce the risk of long-term tissue damage [12,13]. Although it is recommended that a registered dietitian with specialist knowledge should take the lead in delivering nutritional care, it is important that all members of the multidisciplinary team can deliver and implement evidence based nutritional advice. Achieving nutritional goals requires a coordinated approach, with the person with diabetes at the center of the decision-making process. All advice should be based upon scientific evidence and tailored for the individual, taking into account personal and cultural preferences, beliefs, lifestyle and willingness and ability to change [2]. Increased weight gain in infancy has been consistently associated with an enhanced risk of type 1 diabetes [14-16]. 4 case-control studies have provided evidence for a relation between diet after infancy and the development of type 1 diabetes. All of the studies focused on the diet before symptoms of diabetes occurred [9]. Infant milk and food introduction may be linked to type 1 diabetes risk in high incidence populations. An approximately one and a half-fold increased risk of type 1 diabetes was associated with decreased breast feeding duration and use of cow's milk or other milk substitutes before three months. The age of dietary introduction to potential beta cell-specific auto-

antigens may be important [17]. There is overall evidence for an association between childhood obesity, or higher BMI, and increased risk of subsequent type 1 diabetes [18]. Therefore, dietary education in high risk clients should be included: prevention of obesity, emphasis on importance of breast feeding, delay onset supplementary food and consumption of low fat and low carbohydrates diet.

### Assesses vitamin D

Vitamin D can be taken up from food (e.g. fatty fishes and their oils), but most people achieve their vitamin D needs through direct ultraviolet B (UVB)-mediated synthesis in the skin. Two hydroxylation steps are needed to activate vitamin D, one in the liver and a second in the kidney, leading to the active secosteroid hormone, 1 $\alpha$ ,25-dihydroxyvitamin D<sub>3</sub> [1 $\alpha$ ,25(OH)<sub>2</sub>D<sub>3</sub>] [19,20]. Vitamin D, the essential vitamin in Ca<sup>2+</sup> and bone metabolism, has beneficial effects on B-cell function and normal immunity [21-23]. Lower serum concentrations of active vitamin D (1,25-dihydroxy D<sub>3</sub>) were observed in adolescents and adults with newly diagnosed type 1 diabetes [24]. Vitamin D deficiency in pregnancy probably increases the incidence of autoimmune diseases, such as type 1 diabetes, in genetically predisposed individuals [21]. Several epidemiological studies provide evidence that vitamin D intake can prevent type 1 diabetes [13]. Then if patients with type 1 diabetes and their families receive good education about vitamin D intake, it will prevent incidence of type 1 diabetes and its complications.

### Assesses vitamin E

Vitamin E is a lipid soluble group of compounds with similar biological activity. Because it is lipid soluble, ingested vitamin E is absorbed with lipids, packaged into chylomicrons, and transferred to the liver, after which it appears in plasma due to the expression of a tocopherol transfer protein in the liver [25]. Once in tissue, vitamin E resides in the membranes of the cell, where it primarily serves as a chain-breaking antioxidant to prevent lipid per oxidation. With its potent antioxidant properties, high serum vitamin E concentrations have been associated with reduced risk of diseases like cardiovascular disease [26] and cancer. Also researches shows that Vitamin E supplementation in addition to insulin can have additive protective effects against deterioration of renal function [27] and short-term daily oral supplementation with vitamin E improves EVF in both the conduit and resistance vessels of young subjects with type 1 diabetes [28]. Education seems necessary both at diagnosis, where there is usually no knowledge base and patient and family are given the basic skills for controlling the disease, referring to physician for giving vitamin E supplementation and throughout the patient's lifetime, with ongoing attention to self-management skills, screening and prevention of complications.

### Assesses exercise

Type 1 diabetic subjects without any complications and with a good control could participate in all levels of sports activities, both recreational and professional. But, there are some limitations for subjects who have chronic side effects of diabetes [29]. Physical activity and exercise can be beneficial in controlling serum lipoprotein, reducing blood pressure, and improving cardiovascular fitness, psychological well being and social interaction and reaction [30,15]. Exercise and training help patients to feel that they are in control of their condition [31]. To gain these beneficial effects, patients should be encouraged to do sports and exercise in both recreational and competitive levels

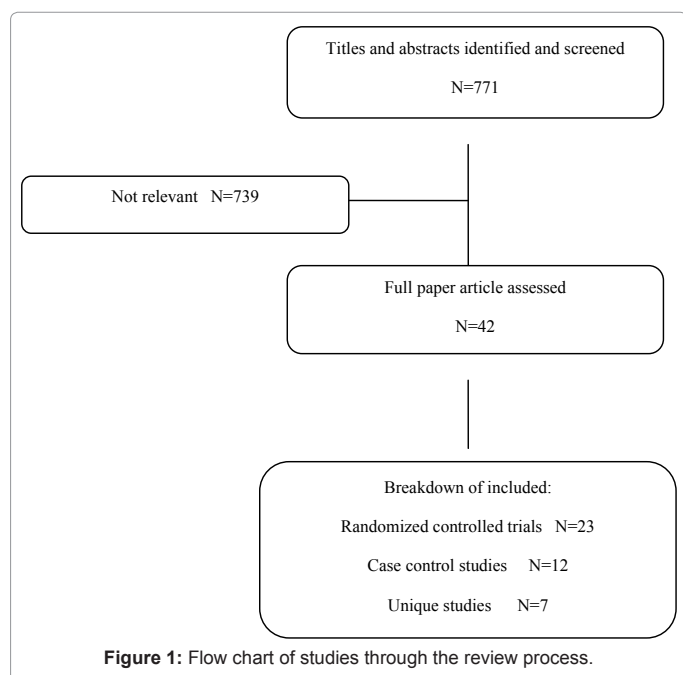


Figure 1: Flow chart of studies through the review process.

### 1. Metabolic control before physical activity

- Avoid physical activity if fasting glucose levels are >250 mg/dl and ketosis is present, and use caution if glucose levels are >300 mg/dl and no ketosis is present.

- Ingest added carbohydrate if glucose levels are <100 mg/dl.

### 2. Blood glucose monitoring before and after physical activity

- Identify when changes in insulin or food intake are necessary.

- Learn the glycemic response to different physical activity conditions.

### 3. Food intake

- Consume added carbohydrate as needed to avoid hypoglycemia.

- Carbohydrate-based foods should be readily available during and after physical activity.

**Table 1:** General guidelines of ADA/ACSM in regulating the glycemic response to physical activity [16,17].

[15,16]. Schneider et al. [32] reported that some patients who seriously adjust their insulin and manage their blood glucose levels could improve their diabetes control. Before starting exercise, patients must have a good control at their blood sugar. Table 1 shows guidelines of suitable conditions for physical activity.

The recommendations of the FIMS are rather general. They recommend that insulin doses should be decreased by 20% or food intake should adequately be increased before starting exercise. Also, they advise to consume a small carbohydrate snack 30 minutes before exercise to prevent hypoglycemia. Moreover, during more prolonged exercise, 10 g of carbohydrate snack (fruit, fruit juice, or soft drink) should be taken for each 30 minutes of exercise [33]. All diabetics should be encouraged in performing suitable exercise and sports. The recommended physical activities are moderate aerobic activities [16,18]. Furthermore recommendations for fluid intake in diabetics are the same as non-diabetics athletes and in a hot weather; the rate of insulin absorption may increase due to vasodilatation and increase the blood flow in the skin. Therefore the risk of hypoglycemia is higher when exercising in hot and humid conditions. Also, in cold weather fuel consumption is increased because of shivering and increased resting metabolic rate. Therefore cold weather can also increase the risk of hypoglycemia. During exercise many factors might increase insulin absorption such as increased blood flow to the site of insulin injection, increased ambient temperature and massage to the injected site which may all lead to hypoglycemia [15].

To prevent acute diabetic side effects of exercise, diabetic athletes should have an adequate control of blood sugar before starting exercise [34]. Of course special attention should be provided for foot problems especially for the cases with longstanding diabetes. Therefore, if patients become aware of the effects of exercise in prevention of diabetes complications, they will be encouraged to do exercise regularly.

## Conclusions

In summary, educational intervention for diet, importance of breast feeding, obesity, exercise and role of vitamin E and D can prevent the incidence of type 1 diabetes or its complications in high risk clients and patients with type 1 diabetes. Therefore these factors should be considered in educational plan of clients with type 1 diabetes.

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