

Diabetes Prevention: Using New, Innovative Ideas to Decrease

Type 2 Diabetes Mellitus in Children

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Honors Thesis

Spring 2019

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Abstract

Diabetes mellitus is a disease with centuries of history, but knowledge about this disease and its treatment has increased exponentially in the past hundred years. Type 2 diabetes mellitus (T2DM) occurs when the body is not capable of producing a sufficient amount of insulin or when cells acquire insulin resistance (Polonsky, 2012). T2DM's prevalence has risen drastically in the previous 20 years, and it is predicted that 1 in 3 people will have diabetes by 2050 (Polonsky, 2012). Weight gain and obesity are associated with T2DM. Approximately one-third of children in the United States in 2014 were either overweight or obese (Pulgaron, 2014). Childhood obesity and the diagnosis of T2DM in younger children are both increasing (Pulgaron, 2014). The purpose of this research was to analyze articles for new, innovative ideas to assist with decreasing the prevalence of obesity and T2DM in children. Research was obtained using WyoLibraries and Pubmed to collect articles containing the key terms: "type 2 diabetes in children", "history of diabetes mellitus", "increase in type 2 diabetes", "obesity in children" "type 2 diabetes risk factors", "stress management type 2 diabetes", and "type 2 diabetes team based approach". Risk factors (lifestyle, gender, puberty, race/ ethnicity, genetics), prevention strategies and protective factors (distinguishing those at risk, lifestyle behavior changes, pharmacological therapy, early diagnosis) were identified. The introduction of teaching kitchens, improvement of communication in healthcare, reducing stress levels and team based approaches were recognized as ways to decrease T2DM's prevalence in children.

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Introduction

Diabetes mellitus is a complex heterogenous disorder involving the metabolism of lipids, carbohydrates, and proteins (Polonsky, 2012). An identifiable feature is hyperglycemia occurring from faults in insulin secretion or insulin resistance (Karamanou, 2016). The history of diabetes mellitus has provided valuable knowledge regarding its origin and symptoms. It displays a timeline of the progression of knowledge and how knowledge led to advancements regarding diabetes mellitus.

Diabetes in Ancient Times

Diabetes mellitus is centuries old and possibly dates to Antiquity, the period before the Middle Ages (Karamanou, 2016). Evidence of this disease from Ancient Egypt, India, Greece, Arab, and China has been analyzed. In these ancient cultures, there is mention of the presence of a disease containing similar characteristics to current diabetes mellitus. Common symptoms between then and now are: excessive thirst, excessive urination, weight loss, and sticky, sweet urine.

Analysis of the Sweet, Sticky Urine

One notable feature of diabetes mellitus is sweet, “honey-tasting” urine. Early in the 17th century, Thomas Willis, a neuroanatomist and physician, noticed this sweet urine and hypothesized that the sweetness originated in the blood (Eknoyan, 2005). This observation led to the addition of “mellitus” to the term, creating the term “diabetes mellitus” (Karamanou, 2016). Another phrase that Willis used to describe this condition was the “pissing evil” which can be

attributed to the excessive urination (Karamanou, 2016). Originally, he hypothesized that this disorder was caused by an infection of the blood, bacteremia (Karamanou, 2016).

The Role of the Pancreas

Claude Bernard took a critical step in gaining knowledge through observations obtained during experiments and post-mortem exams done on dogs. Bernard performed post-mortem exams on patients who had diabetes leading him to consider the possibility of the pancreas' crucial role in the disease (Karamanou, 2016). At first, Bernard thought the disease was a nervous infection of the lungs. During his experimentations on dogs, this was proved incorrect. He drew blood from the carotid artery of a dog and concluded it had a high concentration of glucose (Karamanou, 2016). The dogs he experimented on were all fed carbohydrate-rich diets. He observed high amounts of glucose in their livers which was not present in other organs. He defined this glucose in the liver, glycogen, a starchy, insoluble substance. After these findings, he assumed excess glycogen secretion was the cause (Karamanou, 2016). Bernard proved blood glucose levels are regulated by the absorption of carbohydrates by the liver and the liver assists with conversion of non-glucose precursors to glucose (Polonsky, 2012; Bernard's finding was critical to the understanding of blood glucose and hyperglycemia.

In 1889 more knowledge pertaining to the cause of diabetes was gained through Oskar Minkowski and Joseph Mering's findings. The experiments were performed on dogs. One involved removing the pancreas from a dog (Kyle, 2015). The dog acquired severe, fatal diabetes and began showing signs of polyuria, glycosuria and had urine containing 12% glucose (Karamanou, 2016; Kyle, 2015). In another experiment, they implanted a small amount of pancreatic tissue subcutaneously into the dog and the symptoms were reversed (Eknoyan, 2005). The prevention of hyperglycemia and indications that the pancreas had a role in the internal

secretion of hormones necessary for glucose regulation were discovered from these experiments (Karamanou, 2016).

During 1910 diabetes research began to escalate (Temneanu, 2016). Researchers knew the pancreas was critical for glucose regulation and that hyperglycemia was indicative of diabetes. It was now imperative to build upon this knowledge.

The Discovery of Insulin

Frederick Banting and Charles Best extracted and purified isletin from a dog's pancreatic islets in 1921 (Kyle, 2015). John MacLeod later named this purified isletin "insulin" (Karamanou, 2016). Patients with diabetes began to be injected with insulin. A 14 year old boy was the first human to receive an insulin injection. After his 2nd injection, his urinary ketones disappeared and blood glucose levels dropped significantly, from 520 mg/dL to 120 mg/dL (Karamanou, 2016). The boy died at the age of 27 from pneumonia after living for 13 years with diabetes. In 1922, an 11 year old girl was diagnosed with diabetes and became the 2nd human to receive injections of insulin. She lived until she was 74 then died from a heart attack (Karamanou, 2016).

The discovery of insulin was an impactful advancement of diabetes treatment. It enabled diabetic patients to live a more normal life, lengthen their lives and saved the lives of many. Because of how influential this discovery was, MacLeod and Banting received a Nobel Prize in 1923 (Karamanou, 2016).

Lilly Pharmaceutical Company was the world's first pharmaceutical company to produce commercial insulin. The name of this insulin was Iletin (Karamanou, 2016). People with diabetes now had access to a treatment that would help alleviate their pain and symptoms.

Developments pertaining to knowledge regarding pharmacological treatments were made during the 20th century. In the 1930's protamine-zinc insulin, a long-acting insulin, was discovered and produced (Karamanou, 2016). Fred Sanger discovered and delineated the structure of insulin in 1955 (Karamanou, 2016). In 1967, Donald Steiner invented proinsulin, leading to the production of a machine used to measure proteins, metabolites and other chemicals present in low concentrations, the radioimmunoassay for C-peptide (Karamanou, 2016). Specifically, it can be used to measure serum insulin levels (Polonsky, 2012). The first pancreas transplant occurred at the University of Minnesota in 1972 (Karamanou, 2016). Insulin was the first hormone to be cloned and produced by recombinant DNA technology in 1982 (Polonsky, 2012). The 1990's was when insulin pens started to become a popular treatment (Karamanou, 2016). Advances in diabetes information was increasing through the 20th century as was the prevalence of diabetes.

Diabetes Mellitus is Distinguished into 2 Types

Two of the types of diabetes are Type 1 Diabetes Mellitus (T1DM) and T2DM. Diabetes mellitus was distinguished into two different diseases in 1936 by Harold Himsworth (Temneanu, 2016). Distinguishing the diseases led to the need for awareness about variations in treatment and causations of the diseases. T1DM is an autoimmune disorder and was previously referred to as juvenile-onset diabetes. It involves an error in the production of insulin within the Beta-cells of the pancreas resulting in insulin deficiency (Polonsky, 2012).

T2DM is more common than T1DM and has increased in prevalence in our society (Polonsky, 2012). With this increase comes multiple challenges including an increase in complications related to T2DM, an increase in the burden on the healthcare system and a decrease in the country's health. In 2015, this disease accounted for 1 in every 5 healthcare

dollars spent and approximately \$245 billion annually (Monlezun, 2015). Because T2DM is an escalating issue affecting millions, it is necessary to increase prevention efforts.

T2DM was previously referred to as adult-onset diabetes. This type of diabetes is non-immune mediated and occurs when the body either cannot make enough insulin or when cells within the body acquire insulin resistance (IR) (Amschler, 2002). The patient is often either overweight or possibly obese, not a very noticeable increase in thirst levels, and no excessive urination (Amschler, 2002). Some consequences of T2DM are hyperinsulinemia, IR, and failure of pancreatic Beta-cells (Chatterjee, 2017). It affects a vast majority of organs in the body including the pancreas, liver, skeletal muscle, kidneys, the brain, the small intestine, and adipose tissue (Chatterjee, 2017). Because of T2DM's effects on various organ systems, it can lead to chronic complications such as cardiovascular disease, the greatest cause of mortality associated with T2DM, end-stage kidney disease, or retinopathy leading to blindness or potentially limb amputation (Temneanu, 2016).

The Rise of Diabetes Mellitus

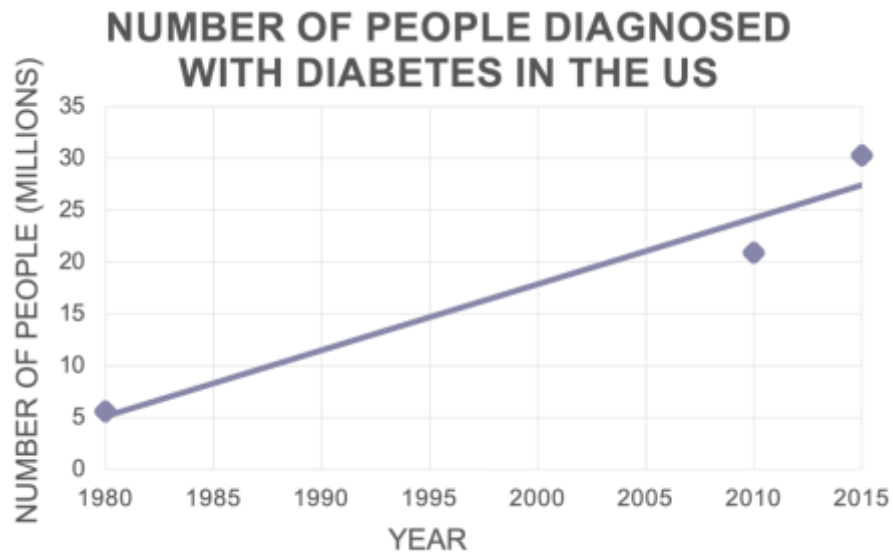


Figure 1: The number of people diagnosed with diabetes in the United States between 1980-2015 (Polonsky, 2012; American Diabetes Association (ADA), 2019).

The prevalence of diabetes mellitus has increased in the past 40 years (Polonsky, 2012). In 1960, the United States diabetes rate was about 1%, most of which were T1DM (Eisenberg, 2015). It is now one of the most common and serious medical conditions and has become a “world-wide epidemic” (Polonsky, 2012). In the United States alone, in 1980 5.6 million (2.5%) people had diabetes in 2010, 20.9 million (6.9%) had diabetes, and in 2015, 30.3 million people (9.4%) had diabetes (Polonsky, 2012; ADA, 2019). Figure 1 shows a depiction of how drastically diabetes prevalence has increased in the past 25 years. In 2015, 29.05 million of those with diabetes had T2DM (ADA, 2019). It is estimated that in 2010, 1.5 million people died due to diabetes (Karamanou, 2016). If the trends surrounding diabetes continue, it is estimated 1 in 3 people will have diabetes by 2050 (Polonsky, 2012). The severity of the issues surrounding T2DM prevalence increasing is reinforced by these statistics.

T2DM Becomes Present in Children

The ADA held a panel in 1999 discussing T2DM. “An underlying genetic susceptibility apparently can be triggered by the child’s exposure to certain behavioral, social and environmental factors, all of which augment insulin resistance within the body.” was a statement made during this panel (Amschler, 2002, p. 39). It is apparent that the ADA knew the possible risk associated with T2DM in children and prominence of the issue.

About 45% of new cases of diabetes in children in 2000 were T2DM (Scott, 2013). In 2008, the CDC reported that 2 million children between 12-19 years old had prediabetes (Scott, 2013). During 2011-2012, approximately 17,900 children had diabetes and 5,300 of these were T2DM (ADA, 2019). It is estimated that 193,000 people under age 20 have diabetes (ADA, 2019). The earlier a person develops T2DM, the more likely they are to have related health

complications. It is imperative to work towards the prevention due to the increase in health issues associated with T2DM.

The first known child diagnosed with T2DM was in 1979 (Amschler 2002). It is often difficult to diagnose children because they can be asymptomatic. Some possible symptoms are abnormal weight gain accompanied by a high body mass index (BMI), acanthosis nigricans (dark discoloration of the skin with a velvety texture usually in skin folds, used as a clinical indicator of hyperinsulinemia), elevated hemoglobin A1c (HbA1c) levels, hyperglycemia, hyperlipidemia, hypertension, or non-alcoholic fatty liver disease (Hutchings, 2016; Temneanu, 2016). The symptoms in children may differ from those seen in adults.

Correlation between the Rises in T2DM and Obesity

Obesity is a growing issue in both the United States and globally. Obesity rates in children and adolescents have almost tripled since 1980 (Scott, 2013). Approximately one-third of children in the United States were either overweight or obese in 2014 (Pulgaron, 2014). With this obesity epidemic comes concurrent other epidemics worldwide. One of these epidemics is increasing prevalence of T2DM because of the association between weight gain and T2DM risk. The increase in body weight connected with T2DM is an essential factor for the increase in prevalence. Obesity rates increasing can be attributed to eating a high-fat, high-calorie diet and living a sedentary lifestyle (Polonsky, 2012).

Risk Factors

Risk factors for T2DM include: lifestyle behaviors, gender, puberty, ethnicity, genetics, birth weight, and metabolic syndrome. A study consisting of 971 school-based health clinic records for children 1st grade through 5th grade was conducted to evaluate a screening process for risk factors. Approximately 40% of these students' BMI's were above the 85th percentile in

relation to their age and gender, 49% of these belonged to a “high-risk” group (Scott, 2013).

Almost half (48%) of these clinic records showed evidence of family history of diabetes (Scott, 2013).

Lifestyle behavior is a major risk factor. Obesity and weight gain are affected by lifestyle choices. Those who are obese, especially with a genetic predisposition, are more at risk because of their higher BMI (Temneanu, 2016). The World Health Organization reported that approximately 90% of people with diabetes develop it mainly because of excess body weight (Wu, 2014). A high BMI is a predictive factor for diabetes in children especially those under 5 years (Wheelock, 2016). There are a few major lifestyle behaviors that can increase risk.

One of these lifestyle behaviors is choice of diet. Nutritional factors such as diet are important when determining risk because low income is associated with a higher prevalence of T2DM (Byrne, 2017). High-fat and high-calorie diets increase risk due to their role in weight gain (Polonsky, 2012). In the United States, people have been altering their diets according to convenience rather than health factors. Packaged and processed foods are more commonly consumed than foods made from scratch (Byrne, 2017). Processed foods seem cheaper than typical “healthy” foods which is one of the biggest barriers to overcome with healthy-eating (Byrne, 2017). Foods that are either pre-prepared or easy to prepare have proved to have an increased caloric intake, decreased nutritional quality and ultimately lead to weight gain (Byrne, 2017). Foods made from scratch have shown to increase consumption of healthy foods, decrease BMI, and improve overall health (Byrne, 2017). Because of the dependence on convenience, there needs to be an increase in consumption of foods that are nutritious, but also simple and quick to make. In addition, drinking sugar-sweetened beverages is associated with weight gain and T2DM because of their effect on BMI (Bi, 2012). Increasing affordability and accessibility

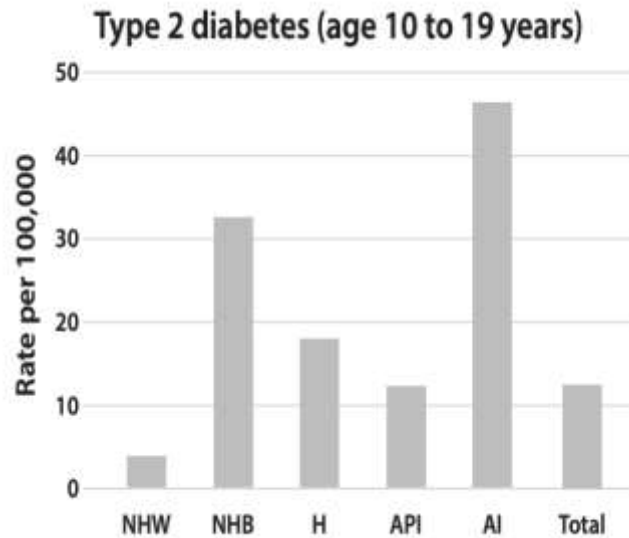
of healthy food options and limiting accessibility of sugary foods and beverages would help prevent T2DM.

Other lifestyle factors affecting T2DM risk are living a sedentary lifestyle and smoking. According to the US National health and Nutrition Examination Survey, spending 2 hours per day watching TV increases risk by 14% (Bi, 2012). When people watch TV, they tend to exercise less, eat more unhealthy food and have a lower energy expenditure (Bi, 2012).

Smoking has been shown to increase risk of T2DM. A study showed that men who smoked 25 or more cigarettes per day had a greater risk than those of nonsmokers (Maddatu, 2017). Another study compared 25 studies that tested the correlation between smoking and risk of T2DM and 24 of them found an association (Willi, 2007). More frequent smokers had a greater risk than those who did not smoke as often (Willi, 2007). After 10 years of quitting smoking, those who were frequent smokers reduced their risk to the same as nonsmokers (Maddatu, 2017). Hyperglycemia is associated with smoking and nicotine (Maddatu, 2017). People who smoke also tend to have a higher HbA1c (Maddatu, 2017). This relationship is not definitively causal (Willi, 2007). It is possible that heavy smokers overall live a less healthy lifestyle than those who do not smoke, leading to increased risk (Willi, 2007).

Gender is a factor associated with risk. T2DM is more common among both adult and child females (Temneanu, 2016). Female children are 1.63 times more likely than male children to develop T2DM (Scott, 2013). Women who have had gestational diabetes are also have increased risk (Fletcher, 2002). The onset of T2DM is typically seen earlier in females possibly due to an increase in hormones during puberty (Temneanu, 2016). Males with a lower birthweight have greater risk for metabolic disease and hypertension, increasing their risk (Temneanu, 2016). Various factors play a role on whether a certain gender is more susceptible.

For example, although females are typically more at risk, men who consume alcohol are at greater risk than women who consume alcohol (Li, 2016).



NHW: Non-Hispanic whites, NHB: Non-Hispanic blacks, H= Hispanics, API: Asians/ Pacific Islanders, AI: American Indians

Figure 2: The prevalence of Type 2 diabetes in children aged 10-19 years old according to ethnicity (ADA, 2019).

A 3rd risk factor is race and ethnicity. Non-Hispanic whites have the lowest percent of diagnosis at 7.4%. Asian Americans have the next lowest at 8%. The percentage of Hispanics diagnosed was 12.1% and was 15.1% for American Indians/Alaskan Natives (ADA, 2019).

Figure 2 shows a depiction of the proportions of different ethnicities aged 10-19 years old with type 2 diabetes. American Indians are shown to have the highest rate per 100,000 people. Non-Hispanic blacks have the second highest; whereas, non-Hispanic whites have the lowest rate. This corresponds to the percentages given earlier and reinforces ethnicity as a risk factor.

Genetics and family history are essential to examine while identifying risk. Various genes and environment factors may play a role in the development of disease. 40% of first degree relatives of patients with T2DM may develop the disease, but only 6% of the general

population may develop it (Wu, 2014). One study discovered people with one parent with diabetes have a 3.5 times increased risk (Fletcher, 2002). If both parents have diabetes, the child has a 6 times greater chance of risk (Fletcher, 2002). It has been difficult to assess the exact genetic determinant and factors due to multiplicity of genes (Polonsky, 2012). A strong indicator for showing the role of genetics is that there is a nearly 100% concordance rate for diabetes in identical twins (Fletcher, 2002).

Metabolic syndrome adds to chance of risk and is helpful when identifying the risk level (Wheelock, 2016). People with metabolic syndrome are at greater risk for both diabetes and cardiovascular diseases (Fletcher, 2002). Metabolic syndrome consists of IR, upper body density, hypertension (130/85 mm Hg), hypertriglyceridemia, and low levels of high-density lipoprotein (HDL) cholesterol, (Polonsky, 2012; Hsiao, 2017). Increased risk is due to the similarity between symptoms in T2DM and metabolic syndrome, both show IR. Hypertension and upper body density also correlate with obesity or being overweight which increases risk.

The development of T2DM has many effects on organ systems throughout the body. It has both short term and long term complications such as: hypertension, hyperlipidemia, heart attacks, coronary artery disease, strokes, cerebral vascular disease, retinopathy, nephropathy, neuropathy and cancers (Wu, 2014). With earlier onset of T2DM comes more complications that also present more severely.

Prevention

Identification of those most at risk is central in prevention. Knowledge about risk factors will help with this. Once risk has been identified opportunistic screenings can take place. The earlier the diagnosis or acknowledgment of risk, the better the prognosis because prevention strategies and behavioral modifications can be implemented sooner. Screening for microvascular

and macrovascular complications can be done sooner (Chatterjee, 2017). Screening those who are at risk is essential in the prevention process.

Once risk has been identified, management of weight should be employed (Chatterjee, 2017). Reduction of weight is a protective factor because of the correlation of obesity and T2DM. Lifestyle modifications such as a change in diet and becoming more active can help reduce risk.

Alteration of diet to emphasize healthier eating is an effective strategy. Eating a more balanced diet with an emphasis on fruits and vegetables is key. It is possible to decrease risk by eating a fiber-rich diet and including polyunsaturated fats in your diet (Bi, 2012). Attempting to eat a low-calorie diet will also help with weight loss because there is evidence that these diets produce initial weight loss (Foster, 2017). The Mediterranean diet is another option and consists of fruits, vegetables, legumes, extra virgin olive oil, nuts, fish, whole grains and red wine (Wu, 2014).

Limiting sedentary behaviors is essential to risk reduction. Examples of risk reducing activities are: walking, aerobic exercise, strength training, and flexibility exercises (Bi, 2012). It is possible that physical activity contributes to 30-50% of reduction in the development of the disease which reinforces the importance of it (Wu, 2014). The ADA has recommended 150 minutes of moderate/vigorous exercise per week (Foster, 2017). Using resistance training in conjunction with an alteration in diet has been shown to reduce weight more so than just a change in diet (Foster, 2017). The combination of alterations in diet and increasing activity could reduce diabetes prevalence by 60% within 4 years (Wu, 2014).

Self-education is essential when it comes to prevention. Prevention programs can vary in content and the way the information is portrayed. One type of program is Diabetes Self-

Management Education & Support. Needs, goals, and life experiences are taken into account when determining the layout. Improvement of clinical outcomes, health status and overall quality of life are the goals (Byrne, 2017) Prevention programs can help to provide information and assistance with lifestyle modifications.

Prevention can include pharmacological methods too. Metformin is a drug that is commonly used by both prediabetic and diabetic patients. It can be used to prevent the onset of T2DM, but is also used as a first line pharmacological treatment. Metformin works to decrease the progression of glucose tolerance by decreasing blood glucose and increasing insulin sensitivity (Wu, 2014). It has decreased cardiovascular and hypoglycemic risk and decreases the mortality rate of Type 2 diabetics (Wu, 2014).

Purpose

The purpose of this research was to analyze articles for new, innovative ideas to assist with decreasing the prevalence of obesity and T2DM in children.

Methods

A literature search was conducted to gather research about T2DM in general and its history. Next, obesity in children and its effect on T2DM in children was researched. Research was obtained using WyoLibraries and Pubmed to collect articles containing the key phrases: “type 2 diabetes in children”, “history of diabetes mellitus”, “increase in type 2 diabetes”, “obesity in children”, “type 2 diabetes risk factors”, “stress management type 2 diabetes”, and “type 2 diabetes team based approach”. Filters used when conducting the search were “scholarly & peer-reviewed” and publication dates no earlier than 2000. Articles were selected based on relevance in either the abstract or introduction. Selected articles were then read in entirety and annotated. During the annotation process, important, supporting and interesting information was

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noted then the article was summarized based on its main points. Information obtained was then used to construct an outline to be followed during the writing process.

New, innovative ideas were discovered. These ideas needed to be relevant to prevention in children and have research studies that took place within the previous 5 years. A literature search was conducted to search for various ways to prevent diabetes. More research was conducted pertaining to teaching kitchens, team-based approaches and health improvement classes. Research studies and experiments that were published in the past 5 years were considered. The experiments were read and analyzed. These studies needed to show that the approaches taken would impact the prevention and incidence of T2DM in children or could be implemented to help children.

Results

Teaching kitchens, health improvement classes, and team-based approaches all work towards the goal of preventing T2DM. Below are various experiments and studies that have analyzed these methods of prevention.

Category of Prevention	Title of Article	Summary	Outcome/ Acquired Information
Teaching Kitchen	“Medical school-based teaching kitchen improves HbA1c, blood pressure, and cholesterol for patients with type 2 diabetes: Results from a novel	This course involved medical students providing hands on cooking and education regarding nutrition, focusing mainly on the Mediterranean diet.	HbA1c, diastolic blood pressure and cholesterol were all lower after 6 months.

	randomized controlled trial.”	There was the possibility of a referral to the American Diabetes’s Association certified diabetes education class and an appointment with a registered dietician. HbA1c, blood pressure and cholesterol were measured before.	
Teaching Kitchen	“Dining with Diabetes Beyond the Kitchen an Online Course for Consumers”	An online course containing 40 presentations, virtual shopping tours, discussions, quizzes, and cooking videos to help families make healthier decisions during meal preparation, eating out or grocery shopping.	Self-efficacy was rated before and after. After, participants felt they could better manage their blood sugar, and make more informed choices regarding food,
Teaching Kitchen	“Cooking Classes: A Diabetes Self-Management Support	Diabetics veterans attended a “Healthy Teaching Kitchen”	The veterans HbA1c levels and blood pressure were tested before and

	<p>Intervention</p> <p>Enhancing Clinical Values”</p>	<p>classes and their attendance was measured. These kitchens work to provide healthy, economical food options and diabetes management strategies to veterans and the opportunity to meet with a registered dietician.</p>	<p>after. Their “after” values were compared to the frequency of attendance. Those who attended more frequently had better glycemic control. Lower HbA1c was independent of attendance though.</p>
<p>Team-Based Approach</p>	<p>“Practice Transformation: Using Team-Based Care Training to Improve Diabetes Outcomes”</p>	<p>A team-based care training program was implemented into 6 different primary care practices. Goals of this experiment were to: increase communication and the care team’s performances.</p>	<p>The mean hemoglobin A1c and LDL cholesterol levels for all the practices were significantly decreased. This experiment led to the utilization of more healthcare workers’ skills and feedback from all of the practices was positive regarding team-based approaches.</p>

<p>Team-Based Approach</p>	<p>“Team-based comanagement of diabetes in rural primary care”</p>	<p>To assess the impact of a clinic that has adapted services to the specific population vs. clinics that have not performed this adaptation. These adaptations were to improve chronic disease prevention and management. This experiment took place over the course of 3 years (Reyes, 2018).</p>	<p>The blood pressure for the patients at the adapted clinic was improved, but the patients at this clinic had an increase in their hemoglobin A1c compared to the non-adapted clinics. The results were mixed.</p>
<p>Team-Based Approach/ Stress Management</p>	<p>“Multidisciplinary Team-Based Obesity Treatment in Patients With Diabetes: Current Practices and the State of the Science”</p>	<p>This article recommends a diabetes treatment team consisting of: a physician with experience in pharmacotherapy, a nurse, a dietician, an exercise physiologist and a psychologist (Foster, 2017). Stress</p>	<p>A treatment team with these various specialties is suited to help the patient succeed with weight loss. Behavioral therapy can help to improve self-control, self-esteem, and stress management.</p>

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		management was also discussed by using psychotherapy.	
Improving Healthcare Communication	“The potential for motivational interviewing to improve outcomes in the management of diabetes and obesity in paediatric and adult population clinical review”	Motivational interviewing has been used to try to help decrease obesity in children. Six studies that included motivational interviewing in children were analyzed.	These studies showed a decrease in BMI, increase in high-density lipoprotein, and a decrease in low-density lipoprotein and diastolic blood pressure (Christie, 2014).
Stress Management	“Implementation of a stress management program in outpatients with type 2 diabetes mellitus: a randomized controlled trial”	Progressive muscle relaxation and diaphragmatic breathing sessions were used to determine if stress management plays a role in glycemic control (Koloverou, 2014).	Hemoglobin A1c and perceived stress both were significantly reduced in the group that partook in the relaxation sessions.
Stress Management	“The effectiveness of stress management training on blood	Stress is both a cause and consequence of diabetes because of its	The intervention group’s perceived stress score was significantly

	<p>glucose control in patients with type 2 diabetes”</p>	<p>impact on HbA1c levels and diabetes’ impact on stress levels. This study was conducted to determine whether self-efficacy and social support, using the social cognitive theory, have an effect on blood glucose control in diabetics (Zamani-Alavijeh, 2018).</p>	<p>different than the control group’s after the study. HbA1c levels were reduced significantly in the intervention group too (Zamani-Alavijeh, 2018).</p>
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Conclusion

Teaching Kitchens

Opinions regarding which diets to follow and what foods are healthiest seems to be constantly changing. With diabetes prevention though, it is important to eat fruits and vegetables and limit intake of saturated fats. Teaching kitchens enable people with diabetes and their families to become educated about nutrition and cooking. With this education comes self-awareness of what is being put into your body.

Diet has an impact on HbA1c. People with diabetes participated in a cooking class that involved following the Mediterranean diet (Monzelun, 2015). Their HbA1c lowered after 6 months (Monzelun, 2015). “Healthy Teaching Kitchen” consisted of veterans with T2DM

noticed a significant improvement in HbA1c levels at the end in all participants (Byrne, 2017).

The participants were given knowledge regarding nutrition concepts and healthy eating skills (Byrne, 2017). An improvement in dietary choices can work to decrease HbA1c before diabetic levels are reached.

Blood pressure is also affected by diet choices. After 6 months of eating a Mediterranean diet, participants part of the “Cooking for Health Optimization in Patients” had lower diastolic blood pressures (Monzelun, 2015). Participants in the “Healthy Teaching Kitchen” study who frequently attended the class had significantly reduced their blood pressure from the beginning (Byrne, 2017).

Educating those who are at risk for T2DM and those who have T2DM about nutrition has also been shown to decrease blood sugar levels and increase confidence in maintaining blood sugar levels. “Dining with Diabetes: Beyond the Kitchen” showed that after the participants were instructed more about grocery shopping, cooking, and various nutrients, they felt better about being able to maintain their blood sugar (Zies, 2018). Participants in the “Healthy Teaching Kitchen” study also had lower blood sugars at the end of the experiment. Enabling people to learn more about the effects that dietary choices can have on their body is one way to both prevent T2DM and decrease the prevalence of it.

Participants in these studies felt more comfortable all around deciding on what food to eat. Increased competency in grocery shopping and meal preparation were observed in participants in the “Cooking for Health Optimization in Patients” study (Monzelun, 2015). Self-efficacy pertaining to eating out and grocery shopping was increased in those who participated in the “Dining with Diabetes: Beyond the Kitchen” experiment (Zies, 2018). Those who

participated in the healthy cooking demonstrations for the “Healthy Teaching Kitchen” study found that they purchased healthier food and cooked healthier food afterwards. (Byrne, 2017).

These teaching kitchens and online nutrition courses could teach parents more about their own nutrition and dietary choices, in turn impacting their children’s diets and health. Once parents understand the consequences of a poor diet that is lacking in nutrients, they will understand why it is necessary for them to provide healthy options for their children. Children will then be taught by their parents how to eat healthier and the benefits of a nutritious diet. Provided by these teaching kitchens is also ways/possible ideas of how to maintain a healthy diet with a low income enabling parents to make find ways to provide wholesome diets for their children even if money may be an obstacle.

Improvement of Healthcare Communication

For healthcare professionals to teach about health improvement they need to make sure that they are up to date and knowledgeable about it. They should lead by example by living a healthy lifestyle themselves; therefore, showing others how to live an active lifestyle and maintain wholesome dietary habits (Eisenberg, 2015). Medical professionals should be taught more about sleep hygiene, stress relief and management, and other lifestyle choices. All of these have an influence on overall health. With this education, they are being given the tools and knowledge to educate and pass on information to those in their field and their patients/clients.

Motivational interviewing involves taking a person-centered approach to try to figure out what the patient is confused about or has mixed feelings about and increasing motivation for lifestyle change (Christie, 2014). A main point of this communication is the healthcare provider giving knowledge and trying to guide the patient, but also respecting the patient’s wishes to either change their behavior or not change their behavior (Christie, 2014). The patient does not

feel pressured or forced to do anything and they feel that it is ultimately their choice possibly making it more likely for them to take the first step to change. It has been shown to help with weight reduction and then weight maintenance, in addition to, improved eating behaviors and obesity status (Christie, 2014). Finding a way to effectively communicate risk is critical to T2DM prevention in children.

Reducing Stress Levels

Maintaining overall wellness, both mentally and physically, has positive impacts on body and mind. Psychological stress has been shown to have a link with T2DM and poor management of diabetes due to its impact on dietary choices, activity levels and medication adherence (Hackett, 2017). Improving sleep can lead to a decrease in stress further affecting other risk factors.

Behavioral therapy has been shown to help with stress management as well. This type of therapy will help to change the way that people act towards food (Foster, 2017). Behavioral therapy works to improve the patient's problem-solving skills and awareness of negativity using topics such as stress management, self-control and self-esteem (Foster, 2017). Cognitive therapy combined with behavioral therapy has showed to help reduce a patient's BMI, a critical risk factor (Foster, 2017).

Another study was directed to determine the association between stress and HbA1c. Patients with T2DM took part in this study that consisted of a control group and an intervention group. The intervention group attended an 8 week program consisting of twice daily sessions of diaphragmatic breathing and progressive muscle relaxation (Kolooverou, 2014). The results showed a significant decrease in both HbA1c and perceived stress in the intervention group (Kolooverou, 2014). Social support has proved to decrease both stress and HbA1c levels

(Kolooverou, 2018). A direct correlation between stress reduction and HbA1c reduction is shown in this study further emphasizing the importance of stress management in diabetic patients.

Team-Based Approaches

Following a team-based approach to healthcare can increase communication, performance of the healthcare team and positively impact patients' health statuses as well as overall quality improvement. Team based approaches would consist of healthcare professionals from different specialties. Physicians, nurses, nutritionists or registered dieticians, social workers, psychologists, exercise physiologists and podiatrists all have a role. Because diabetes can have so many complications and impact various organ systems, this would make sure that all aspects of diabetes are covered adequately and can be managed. By having an interprofessional team creates diversity in treatment strategies. The most effective and influential way to treat and prevent T2DM may be utilizing various healthcare professionals.

HbA1c was measured before and after a few studies to see if it is affected by the type of treatment that the patient with diabetes receives. In one study, HbA1c was significantly reduced in all of the practices that implemented a team-based approach to diabetes care (Bilello, 2018). In contrast, another study found that the control group had a greater decline than those in the experimental group (Reyes, 2018). These variations in results could be attributed to the differences in severity in patients between the clinics.

The BMI of patients at the experimental clinic was decreased over the course of the 3 year study (Reyes, 2018). Blood pressures were also reduced for the experimental clinic (Reyes, 2018). Also, low-density lipoprotein cholesterol levels decreased significantly in all of the practices with team-based care (Bilello, 2018). These results show that there is a need for more

research regarding effective and efficient diabetes care and the potential that team-based care can have on a patient's overall health.

Focusing on incorporating the patient in the treatment process is necessary. Making sure that the patient knows everything happening, possible complications that could occur and prevention methods is important and makes the patient feel respected and heard. Also, this is essential if a child has diabetes. Ensuring that the family, especially the parents and the child with diabetes, understands both prevention and possible treatment options. Main objectives of this type of care are to distribute responsibilities, create new roles, to use all the resources within the practice, and overall improve patient outcomes (Bilello, 2018).

Moving Forward

Overall increasing education is crucial for the prevention of type 2 diabetes in children. Increasing awareness and spreading knowledge will help to decrease T2DM. Instilling various public policies regarding health and nutrition may also be influential. Requiring healthcare professionals to be properly educated in all aspects of health would help to increase education and knowledge amongst the medical community and general public. Teaching people about the importance of a healthy diet and overall lifestyle as well as providing team-based approaches could have a positive impact on this issue. Overall, letting people know that there are options for them to learn about how to live healthier and making those options easily accessible is imperative to reduce the prevalence of diabetes in families and specifically children.

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