Effect of Health Education Program on Diabetic Children at *AL-Hasahisa* Pediatrics Teaching Hospital, Gezira State, Sudan (2015-2017)

Haifa Mohamed Eltayeb Elhassan

B. Sc., University of Khartoum (2002)

A Dissertation
Submitted to the University of Gezira in fulfillment of the Requirements for
the Award of the Degree of Master of Science

in
Community Health
Primary Health Care and Health Education Center
Faculty of Medicine

August, 2017
Effect of Health Education Program in the Control of Diabetes in Children at AL-Hasahisa Pediatrics Teaching Hospital, Gezira State, Sudan (2015-2017)

Haifa Mohamed Eltayeb Elhassan

Supervision committee:

<table>
<thead>
<tr>
<th>Name</th>
<th>Position</th>
<th>Signature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prof. Magda Elhadi Ahmed</td>
<td>Main Supervisor</td>
<td>............</td>
</tr>
<tr>
<td>Prof. HayderEldadi Mohamed</td>
<td>Co-supervisor</td>
<td>.............</td>
</tr>
</tbody>
</table>

Date: September, 2017
Effect of Health Education Program in the Control of Diabetes in Children at *AL-Hasahisa* Pediatrics Teaching Hospital, Gezira State, Sudan (2015-2017)

**Haifa Mohamed Eltayeb Elhassan**

**Examination Committee:**

<table>
<thead>
<tr>
<th>Name</th>
<th>Position</th>
<th>Signature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prof. Magda Elhadi Ahmed</td>
<td>Chairperson</td>
<td>...........</td>
</tr>
<tr>
<td>Prof. Yousif Abdelhamed Elsisi</td>
<td>External Examiner</td>
<td>...........</td>
</tr>
<tr>
<td>Prof. Salwa Elsanousi Hussein</td>
<td>Internal Examiner</td>
<td>...........</td>
</tr>
</tbody>
</table>

**Date of Examination:** 28/9/2017
Dedication

To the soul of my mother,

To my father,

My family, especially my husband and children

To Hagir and Alsheikh who really supported me.

Haifa
Acknowledgement

I would like to express my deepest appreciation to all those who provided me the possibility to complete this research.

A special gratitude I give to Gezira University, community health program and its supportive staff members.

Furthermore, I would like also to acknowledge with much appreciation the crucial role of my supervisor, Prof: Magda Elhadi Ahmed appreciating the guidance given by her that has improved my skills. Thanks to your comments and advices.

Finally yet importantly, I would like also to acknowledge the staff of Al-Hasahisa Pediatrics Hospital who helped me to collect the data and to complete my task.
Effect of Health Education Program in the Control of Diabetes in Children at AL-Hasahisa Pediatrics Teaching Hospital, Gezira State, Sudan (2015-2017)

Haifa Mohamed Eltayeb Elhassan

Abstract

The management of type 1 diabetes exhibited significant challenges for children and their caregivers as it requires continual monitoring of blood glucose levels and strict adherence to insulin, diet, and exercise regimens. This study was an interventional cohort study conducted to assess the effect of health education program in the control of diabetes in diabetic children at AL-Hasahisa Pediatrics Teaching Hospital, Gezira State, Sudan, from July 2015 to July 2017. All diabetic children and their caregivers (51) attended to the hospital during the study period were enrolled. A close ended questionnaire was used to collect the data at the beginning and end of the study. Children parameters including the height, weight, random blood sugar were collected in the 1st visit and every month, HbA1c was collected in the 1st visit and then every three month. The educational program contained general information about type 1 diabetes and its management, and the normal and hazardous levels of blood glucose and HbA1c. The results of this study showed that; the mean age was 12.15 ± 3.61 ranging from 3-17 years, 41.2% of them were 11-14 years old. The majority were females 58.8%. 68.6%, mostly living in urban areas. The duration of diabetes was 4-6 years in 37.3% and 96.1% of the parents were not diabetic. There was significant improvement in the level of knowledge, the attitude towards diet regimen, the exercise practice, the attendance to clinic, the timing of the visits, and the regularity of blood glucose check-up. All patients purchased glucometer after the end of study. Also there was significant progress in the weight, Random blood sugar, and HbA1c levels. The study concluded that: the health education program was effective in the control of diabetes and its management, improving nutritional behavior among children and their caregivers. And it is recommended; health education about diabetic care for children and their caregivers should be emphasized at all pediatric hospitals and diabetic centers.
ição الابحاث

ملخص الدراسة

شكلت معالجة مرض السكري من النوع الأول تحدياً كبيراً وسط الأطفال لأنها تتطلب مراقبة مستمرة لمستويات السكر في الدم والالتزام الصارم بنظام غذائي مراهق للأنسولين وتمارين التمرين الرياضي. أجريت هذه الدراسة لقياس أثر برنامج التثقيف الصحي في التحكم بمرض السكري لدى الأطفال في مستشفى الأطفال التعليمي بالخصائص، ولاية الجزيرة، السودان، من يوليو 2015 إلى يوليو 2017. وهي دراسة تدريجية تحق جمع الأطفال المصابين بداء السكري من النوع الأول وولاية أمرهم بالدراسة (51 طفل) خلال فترة الدراسة. تم استخدام استبيان استثني تخطيطه قبل البرنامج التعليمي، واعادة استخدامه بعد 6 أشهر من نهاية البرنامج التعليمي. تم جمع بيانات الأطفال بما في ذلك الطول والوزن ومعدل السكر العشوائي في الدم في زيارة الرى الأولى وفي كل شهر. تم رصد معدلات HbA1c في الزيارة الأولى ثم كل ثلاثة أشهر. وكان البرنامج التعليمي يحتوي على معلومات عامة عن مرض السكري من النوع 1 والمعدلات الطبيعي لقياس السكر في حالة الصيام بجانب المعايير الخطرة لهذه الفئات. وأظهرت نتائج هذه الدراسة أن من بين 51 مصاباً للسكري من النوع الأول في عمر من 3-17 سنة مع متوسط العمر 12.15±3.61 سنة، وكانت الفئة العمرية الأكثر شيوعاً هي 11-14 سنة (58.8٪) منهم إناث (68.6٪) من المناطق حضرية. (37.3٪) منهم مصابين بالسكري لمدة 4-6 سنوات. وكان الدخل الشهري للأسرة 1000-2000 في (54.9٪). وكان معظم أولياء الأمور اثارة علاج مصابين بالسكري (96.1٪). أدى البرنامج التعليمي إلى ارتفاع جميع المعارف إلى (100.0٪). تم إجراء اختبار كأختبار لقياس هذه التغيرات قبل وبعد الشتق، وكانت النتائج ذات دلالة إحصائية. وخلصت هذه الدراسة إلى أن: تأثير برنامج التثقيف الصحي في السيطرة على مرض السكري لدى الأطفال قد وجد فعالاً جداً، والمعرفة والمواقف والسلوك نحو العلاج الغذائي للأطفال وقدمي الرعاية لهم. لذا، توحي الدراسة بأنه ينبغي التأكد على التثقيف الصحي حول رعاية مرضى السكري للأطفال ومقدمي الرعاية لهم في جميع مستشفيات الأطفال ومراكز السكري.
Table of Contents

Dedication ................................................................. iii
Acknowledgement ........................................................ iv
Abstract ...................................................................... v
Arabic Abstract ............................................................ vi
Table of Contents ............................................................ vii
List of Tables .................................................................. viii
List of Figures .................................................................... ix
List of abbreviations ......................................................... x
Chapter One ..................................................................... 1
Introduction ...................................................................... 1
  Problem Statement: ....................................................... 3
  Justification .................................................................... 4
  Objectives ...................................................................... 5
Chapter Two ........................................................................ 6
  Literature Review ........................................................... 6
    Background: ................................................................. 6
    Previous studies: ......................................................... 26
Chapter Three ..................................................................... 29
  Methodology ..................................................................... 29
    Study Design: ............................................................... 29
    Study Area: ................................................................. 29
    Study duration: .............................................................. 29
    Study Population: .......................................................... 29
    Sample Size: ............................................................... 30
    Data Collection Tool: .................................................... 30
    Data management: ........................................................ 31
    Data Analysis: ............................................................... 31
    Ethical Consideration: ................................................... 31
Chapter Four ......................................................................... 32
  The Results ..................................................................... 32
Chapter Five ......................................................................... 47
  Discussion, Conclusion and Recommendations ...................... 47
    Discussion ................................................................... 47
    Conclusion .................................................................... 51
    Recommendations ......................................................... 52
References ........................................................................ 53
Annex (1) .......................................................................... 58
List of Tables

Table 1: Age distribution among the study sample (18 caregiver + 33 child), N=51 .32
Table 2: The socio-demographic characteristics of the study sample (18 caregiver + 33 child), N=51 ........................................................................32
Table 3: Knowledge about nature of diabetes (pre-post) among the study sample patients or caregivers, N=51 ........................................................................37
Table 4: Knowledge about symptoms of diabetes (pre-post) among the study sample patients or caregivers, N=51 ........................................................................37
Table 5: Knowledge about management of hypoglycemia (pre-post) among the study sample patients or caregivers, N=51 ........................................................................38
Table 6: Knowledge about regularity on diet (pre-post) among the study sample patients or caregivers, N=51 ........................................................................38
Table 7: Knowledge about effect of dietary regimen (pre-post) among the study sample patients or caregivers, N=51 ........................................................................39
Table 8: Knowledge about insulin types (pre-post) among the study sample patients or caregivers, N=51 ........................................................................39
Table 9: Knowledge about insulin storage (pre-post) among the study sample patients or caregivers, N=51 ........................................................................40
Table 10: Knowledge about insulin expiry (pre-post) among the study sample patients or caregivers, N=51 ........................................................................40
Table 11: Knowledge about correct method of insulin injection (pre-post) among the study sample patients or caregivers, N=51 ........................................................................41
Table 12: Knowledge about timing of checking HbA1c (pre-post) among the study sample patients or caregivers, N=51 ........................................................................42
Table 13: Overall knowledge of patients or caregivers among the study sample (18 caregiver + 33 child), N=51 ........................................................................42
Table 14: Attitude towards diet regimen (pre-post) among the study sample patients or caregivers, N=51 ........................................................................43
Table 15: Practice of exercise (pre-post) among the study sample patients, N=51 ........................................................................43
Table 16: Practice of regular visits to diabetes clinic (pre-post) among the study sample patients or caregivers, N=51 ........................................................................44
Table 17: Practice of timing of visits to diabetes clinic (pre-post) among the study sample patients or caregivers, N=51 ........................................................................44
Table 18: Practice of regularity of blood glucose levels check-up (pre-post) among the study sample patients or caregivers, N=51 ........................................................................45
Table 19: Presence of glucometer (pre-post) among the study sample (18 caregiver + 33 child), N=51 ........................................................................45
Table 20: Presence of diabetes complications among the patients, N=51 ........................................................................46
Table 21: Weight, height and BMI (pre-post) of the patients, N=51 ........................................................................46
List of Figures

Figure 1: Distribution of the mean of the children weight during the year among the study sample (18 caregiver + 33 child), N=51..........................................................34
Figure 2: Distribution of the mean of the children height during the year among the study sample (18 caregiver + 33 child), N=51..........................................................34
Figure 3: Distribution of the mean of the children BMI during the year among the study sample (18 caregiver + 33 child), N=51..........................................................35
Figure 4: Distribution of the mean of the children random blood sugar during the year among the study sample (18 caregiver + 33 child), N=51..........................................................35
Figure 5: Distribution of the mean of the children HbA1c levels during the year among the study sample (18 caregiver + 33 child), N=51..........................................................36
# List of abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Full Form</th>
</tr>
</thead>
<tbody>
<tr>
<td>AAP</td>
<td>American Academy of Pediatrics</td>
</tr>
<tr>
<td>ADA</td>
<td>American Diabetes Association</td>
</tr>
<tr>
<td>BG</td>
<td>Blood Glucose</td>
</tr>
<tr>
<td>BMI</td>
<td>Body Mass Index</td>
</tr>
<tr>
<td>CDC</td>
<td>Center for Disease Control</td>
</tr>
<tr>
<td>DCCT</td>
<td>Diabetes Control and Complication Trial</td>
</tr>
<tr>
<td>DM</td>
<td>Diabetes Mellitus</td>
</tr>
<tr>
<td>DSMP</td>
<td>Diabetes Self-Management Profile</td>
</tr>
<tr>
<td>GAD</td>
<td>Glucose Acid Decarboxylase</td>
</tr>
<tr>
<td>HbA1c</td>
<td>Glycated Hemoglobin</td>
</tr>
<tr>
<td>IDF</td>
<td>International Diabetes Federation</td>
</tr>
<tr>
<td>KAP</td>
<td>Knowledge, Attitude and Practice</td>
</tr>
<tr>
<td>P value</td>
<td>Calculated Probability</td>
</tr>
<tr>
<td>PCOS</td>
<td>Polycystic Ovarian Syndrome</td>
</tr>
<tr>
<td>SCCD</td>
<td>Sudan Childhood Center for Diabetes</td>
</tr>
<tr>
<td>SCDA</td>
<td>Sudan Childhood Diabetes Association</td>
</tr>
<tr>
<td>SPSS</td>
<td>Statistical Package for Social Sciences</td>
</tr>
<tr>
<td>T1DM</td>
<td>Type One Diabetes Mellitus</td>
</tr>
<tr>
<td>WDF</td>
<td>World Diabetes Foundation</td>
</tr>
<tr>
<td>WHO</td>
<td>World Health Organization</td>
</tr>
<tr>
<td>ZNT</td>
<td>Zink Transporter Autoantibodies</td>
</tr>
</tbody>
</table>
Chapter One

Introduction

Diabetes:

Diabetes usually known just as diabetes mellitus, is the name given to a group of disorders characterized by chronically high blood glucose levels. Glucose in the blood comes from food and from stores in the body, including the liver, muscle and fat. Blood glucose is the main source of energy for the cells, tissues and organs of the body. For the different cells, tissues and organs to use this glucose, the glucose has to move from the blood into the cells.

Diabetes is lifelong disease for which there is not yet a cure, there are several forms of diabetes, including:

- Type 1 diabetes often called juvenile or insulindendent diabetes
- Type 2 diabetes often called adult or non-insulin _dependent diabetes
- Type 3 Gestational diabetes which occurs during pregnancy(WHO, 2016)

For all types of diabetes, the metabolism of carbohydrates (including sugar such as glucose) protein and fats is altered. In type 1 diabetes, the beta cells of the pancreas produce little or no insulin, the hormone that allows glucose to enter body cells once glucose enters a cell, and it is used as fuel. (ADA, 2014).

The hormone insulin is required for glucose to move into the cells. Insulin is produced by the beta cells (β-cells) in the pancreas. Diabetes occurs either when the pancreas does not produce enough insulin, or the effect of insulin is decreased. Type 1 diabetes is the commonest type of diabetes in childhood and adolescence.

Most cases of type1 diabetes are due to destruction of the pancreatic-cells.

Diabetes mellitus was found to be one of the top 10 diseases which lead to hospital admission. (Emad M.A,et al,2011)

Type 1 diabetes mellitus cases among children is increasing, where it was 2839, 3152 and 3524 during 2005, 2006 and 2007, respectively.
Diabetes is a complex disease that requires daily self-management-making healthy food choices, staying physically active, monitoring your blood sugar and taking medications as prescribed. It is also important to talk regularly with your diabetes care team to problem solve, reduce risks for complications and cope with lifestyle changes. Successful self-management will help you feel better and can reduce your chance of developing complications including heart disease, dental disease, eye disorders, kidney disease, nerve damage and lower leg amputation. Diabetes is also a very personal disease. Upon being diagnosed, it’s not uncommon to feel a certain amount of fear. Fear of the unknown. Fear about how your lifestyle may change. Fear that you will experience life-threatening complications. A key member of the diabetes management team, a diabetes educator will help you learn how to take care of yourself – guide you through your treatment and help you with any fears, issues and problems you encounter along the way. (ADA, 2017)

Type 1 diabetes is managed by insulin replacement and balancing of diet and exercise in order to maintain glycemic control and prevent the occurrence of complications. Glycemic control, which is linked directly to complication rates, is monitored by the measurement of glycosylated hemoglobin (HbA1c), which reflects the mean blood glucose level over the previous 2 to 3 months. Lowering HbA1c has been associated with a reduction of micro vascular complications of diabetes.

In order to effectively manage diabetes, education about components of management such as blood glucose monitoring, insulin replacement, diet, exercise, and problem solving strategies must be delivered to the patient. Education is important both at diagnosis, where there is usually no knowledge base and patient and family are given the basic skills for controlling the disease, and throughout the patient’s lifetime, with ongoing attention to self-management skills, screening and prevention of complications, and to new developments in these areas. Since management of diabetes requires lifestyle changes, it is important that education be delivered to the whole family. (Steve B., 2014)

This reflects the importance of health education and what is called integrated management of diabetes in children project IMDCP. The aim of IMDCP project to create an integrated system for management of children with type 1 diabetes. (Lever M.R. M., 2006)
The American Association of Diabetes Educators (AADE) define diabetes education as the teaching and learning of this body of knowledge and skills, with ultimate goal being to promote the behavior changes necessary for optimal health outcomes. Diabetes education is considered a therapeutic modality, and it is integral to the care of these patients. Diabetes educators are healthcare professionals who focus on all aspects of diabetes care. They explain how foods affect blood sugar, give specific directions for taking medication correctly and offer guidance on how to lower the risk of developing complications. (ADA, 2017)

**Problem Statement:**

Sudan Childhood Diabetes Association (SCDA) warns against increasing rates of juvenile diabetes in Sudan (12 March 2016) the SCDA has repressed deep concern over the high incidence of diabetes among children in Sudan. The SCDA chairman Mohamed Ahmed Abdullah said that 60% of deaths among children in Sudan are caused by non-communicable disease of the 7th conference of the African Diabetes Association in Khartoum, pointing that 4,700 cases of endocrine and iodine deficiency were registered at the Sudanese center for childhood diabetes (SCCD) also received 2,700 cases of juvenile diabetes. The number of the cases of diabetes among children in Gezira State is increasing as part of the increasing number all over Sudan. (Sudan Tribune Newspaper, 2016)

The management of type 1 diabetes posed significant challenges for adolescents as it requires continual monitoring of blood glucose levels and strict adherence to insulin diet and exercise regimens. Parents and particularly mothers are actively involved in the management of their children diabetes, taking considerable responsibility for diabetes care during the preadolescent years, and then guiding the shift in responsibility to their children during adolescence. Illness regulation styles of mothers may therefore play a key role in the management of their children’s diabetes as well as in their children development of skills for diabetes control. (GDMDMC, 2011)

There is big huge responsibility of follow up of nutrition, symptoms, treatment drugs storage, and schooling on caregiver of diabetic children. This reflects the importance of health education and what is called integrated management of diabetes in children project. The aim of this project to create an integrated system for management of children with type 1 diabetes. (WDF, 2017)
Justification

Nowadays the role of diabetic educator is becoming more important in the management of diabetes mellitus by intensive education and counseling to the caregiver. This study was conducted to assess the effect of health education on awareness and its impact on reduction of diabetes complication and control of diabetes. (Steve Biri, 2014) Education of patients with diabetes is considered fundamental aspects of diabetes care and aims to improve knowledge skills and to improve the knowledge of the researcher of an educational program in the hospital but it is not regular and the standard mean to assess the effectiveness are lacking.

Since health education plays a major role in the management of diabetes mellitus, the proper education program for diabetic children will increase the awareness and knowledge about diabetes control and increase the number of people who live well with diabetes and effectively manage their disease to prevent or delay complication and improve quality of life. (Lever, 2006)
Objectives

General objective:

To study the effect of health education program in the control of diabetes in children at AL-Hasahisa Pediatrics Teaching Hospital, Gezira State, Sudan 2017.

Specific objectives:

- To determine the knowledge, attitudes and behavior towards diet therapy for children and their caregivers.
- To determine the level of control of diabetes before and after the educational program in term of diabetic measurements.
- To determine the effect of health education for children and their caregivers in changing knowledge, and nutritional behavior.
- To determine the effect of the educational program in the blood sugar, HbA1c values, weight, height, and BMI.
Chapter Two

Literature Review

Background:

Diabetes mellitus **type 1** (also known as **type 1 diabetes**) is a form of diabetes mellitus in which not enough insulin is produced. This results in high blood sugar levels in the body. The classical symptoms are frequent urination, increased thirst, increased hunger, and weight loss. Additional symptoms may include blurry vision, feeling tired, and poor healing. Symptoms typically develop over a short period of time. (WHO, 2016)

The cause of type 1 diabetes is unknown. However, it is believed to involve a combination of genetic and environmental factors. Risk factors include having a family member with the condition. The underlying mechanism involves an autoimmune destruction of the insulin-producing beta cells in the pancreas. Diabetes is diagnosed by testing the level of sugar or A1C in the blood. Type 1 diabetes can be distinguished from type 2 by testing for the presence of autoantibodies. (Chiang, J. L. et al, 2014)

There is no known way to prevent type 1 diabetes. Treatment with insulin is required for survival. Insulin therapy is usually given by injection just under the skin but can also be delivered by an insulin pump. A diabetic diet and exercise are an important part of management. Untreated, diabetes can cause many complications. Complications of relatively rapid onset include diabetic ketoacidosis and nonketotic hyperosmolar coma. Long-term complications include heart disease, stroke, kidney failure, foot ulcers and damage to the eyes. Furthermore, complications may arise from low blood sugar caused by excessive dosing of insulin. (Elfström P, 2014).

Type 1 diabetes makes up an estimated 5–10% of all diabetes cases. The number of people affected globally is unknown, although it is estimated that about 80,000 children develop the disease each year. Within the United States the number of people affected is estimated at one to three million. Rates of disease vary widely with
approximately 1 new case per 100,000 per year in East Asia and Latin America and around 30 new cases per 100,000 per year in Scandinavia and Kuwait. It typically begins in children and young adults. (ADA, 2015)

**Signs and symptoms:**

![Diagram of diabetes symptoms]

Overview of the most significant symptoms of diabetes

The classical symptoms of type 1 diabetes include: polyuria (excessive urination), polydipsia (increased thirst), dry mouth, polyphagia (increased hunger), fatigue, and weight loss. (WHO, 2016)

Many type 1 diabetics are diagnosed when they present with diabetic ketoacidosis. The signs and symptoms of diabetic ketoacidosis include dry skin, rapid deep breathing, drowsiness, increased thirst, frequent urination, abdominal pain, and vomiting. About 12 percent of people with type 1 diabetes have clinical depression. (Roy T, Lloyd CE, 2012).

About 6 percent of people with type 1 diabetes have celiac disease, but in most cases there are no digestive symptoms or are mistakenly attributed to poor control of diabetes, gastroparesis or diabetic neuropathy. In most cases, celiac disease is diagnosed after onset of type 1 diabetes. The association of celiac disease with type 1 diabetes increases the risk of complications, such as retinopathy and mortality. This
association can be explained by shared genetic factors, and inflammation or nutritional deficiencies caused by untreated celiac disease, even if type 1 diabetes is diagnosed first. (See JA, et al, 2015).

**Causes**

The cause of type 1 diabetes is unknown. A number of explanatory theories have been put forward, and the cause may be one or more of the following: genetic susceptibility, a diabetogenic trigger, and exposure to an antigen. (WHO, 2016)

**Genetics**

Type 1 diabetes is a disease that involves many genes. The risk of a child developing type 1 diabetes is about 5% if the father has it, about 8% if a sibling has it, and about 3% if the mother has it. If one identical twin is affected there is about a 50% chance the other will also be affected. Some studies of heritability has estimated it at 80 to 86%. (Narayan, K. M., et al 2010).

More than 50 genes are associated with type 1 diabetes. Depending on locus or combination of loci, they can be dominant, recessive, or somewhere in between. The strongest gene, IDDM1, is located in the MHC Class II region on chromosome 6, at staining region 6p21. Certain variants of this gene increase the risk for decreased histocompatibility characteristic of type 1. Such variants include DRB1 0401, DRB1 0402, DRB1 0405, DQA 0301, DQB1 0302 and DQB1 0201, which are common in North Americans of European ancestry and in Europeans. Some variants also appear to be protective. (Bluestone JA, et al, 2010)

**Environmental**

Environmental factors can influence expression of type 1. For identical twins, when one twin has type 1 diabetes, the other twin only has it 30%-50% of the time. Thus for 50%-70% of identical twins where one has the disease, the other will not, despite having exactly the same genome; this suggests that environmental factors, in addition to genetic factors, can influence the disease's prevalence. Other indications of environmental influence include the presence of a 10-fold difference in occurrence
among Caucasians living in different areas of Europe, and that people tend to acquire
the rate of disease of their particular destination country. (Knip M, et al, 2005)

**Virus**

One theory proposes that type 1 diabetes is a virus-triggered autoimmune response in
which the immune system attacks virus-infected cells along with the beta cells in the
pancreas. Several viruses have been implicated, including enteroviruses (especially
coxsackievirus B), cytomegalovirus, Epstein–Barr virus, mumps virus, rubella virus
and rotavirus, but to date there is no stringent evidence to support this hypothesis in
humans. A 2011 systematic review and meta-analysis showed an association between
enterovirus infections and type 1 diabetes, but other studies have shown that, rather
than triggering an autoimmune process, enterovirus infections, as coxsackievirus B,
could protect against onset and development of type 1 diabetes. (Rewers M, et al,
2016).

**Chemicals and drugs:**

Some chemicals and drugs selectively destroy pancreatic cells. Pyrinuron (Vacor), a
rodenticide introduced in the United States in 1976, selectively destroys pancreatic
beta cells, resulting in type 1 diabetes after accidental poisoning. Pyrinuron was
withdrawn from the U.S. market in 1979 and it is not approved by the Environmental
Protection Agency for use in the U.S. Streptozotocin (Zanosar), an antineoplastic agent, is selectively toxic to the beta cells of the pancreatic islets. It
is used in research for inducing type 1 diabetes on rodents and for
treating metastatic cancer of the pancreatic islet cells in patients whose cancer cannot
be removed by surgery. Other pancreatic problems, including trauma, pancreatitis, or
tumors (either malignant or benign) can also lead to loss of insulin production.

**Gluten**

Data suggest that gliadin (a protein present in gluten) may play a role in the
development of type 1 diabetes, but the mechanism is not fully understood. Increased
intestinal permeability caused by gluten and the subsequent loss of intestinal barrier
function, which allows the passage of pro-inflammatory substances into the blood,
may induce the autoimmune response in genetically predisposed individuals to type 1 diabetes. (Visser J, et al, 2009).
**Pathophysiology**

The pathophysiology in diabetes type 1 is a destruction of beta cells in the pancreas, regardless of which risk factors or causative entities have been present.

Individual risk factors can have separate pathophysiological processes to, in turn, cause this beta cell destruction. Still, a process that appears to be common to most risk factors is an autoimmune response towards beta cells, involving an expansion of autoreactive CD4+ T helper cells and CD8+ T cells, autoantibody-producing B cells and activation of the innate immune system. (Chatzigeorgiou A, et al, 2010)

After starting treatment with insulin a person's own insulin levels may temporarily improve. This is believed to be due to altered immunity and is known as the "honeymoon phase". (Aly H, Gottlieb P, 2009).

**Diagnosis**

<table>
<thead>
<tr>
<th>WHO diabetes diagnostic criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Condition</td>
</tr>
<tr>
<td>Unit</td>
</tr>
<tr>
<td>Normal</td>
</tr>
<tr>
<td>Impaired fasting glycaemia</td>
</tr>
<tr>
<td>Impaired glucose tolerance</td>
</tr>
<tr>
<td>Diabetes mellitus</td>
</tr>
</tbody>
</table>

Source: (WHO/IDF, 2006)

Diabetes mellitus is characterized by recurrent or persistent hyperglycemia, and is diagnosed by demonstrating any one of the following: (WHO, 1999)

Fasting plasma glucose level at or above 7.0 mmol/L (126 mg/dL).
Plasma glucose at or above 11.1 mmol/L (200 mg/dL) two hours after a 75 g oral glucose load as in a glucose tolerance test.

Symptoms of hyperglycemia and casual plasma glucose at or above 11.1 mmol/L (200 mg/dL).

Glycated hemoglobin (hemoglobin A1C) at or above 48 mmol/mol (≥ 6.5 DCCT %). (This criterion was recommended by the American Diabetes Association in 2010, although it has yet to be adopted by the WHO.) (ADA, 2010)

About a quarter of people with new type 1 diabetes have developed some degree of diabetic ketoacidosis (a type of metabolic acidosis which is caused by high concentrations of ketone bodies, formed by the breakdown of fatty acids and the deamination of amino acids) by the time the diabetes is recognized. The diagnosis of other types of diabetes is usually made in other ways. These include ordinary health screening, detection of hyperglycemia during other medical investigations, and secondary symptoms such as vision changes or unexplained fatigue. Diabetes is often detected when a person suffers a problem that may be caused by diabetes, such as a heart attack, stroke, neuropathy, poor wound healing or a foot ulcer, certain eye problems, certain fungal infections, or delivering a baby with macrosomia or hypoglycemia (low blood sugar).

A positive result, in the absence of unequivocal hyperglycemia, should be confirmed by a repeat of any of the above-listed methods on a different day. Most physicians prefer to measure a fasting glucose level because of the ease of measurement and the considerable time commitment of formal glucose tolerance testing, which takes two hours to complete and offers no prognostic advantage over the fasting test. According to the current definition, two fasting glucose measurements above 126 mg/dL (7.0 mmol/L) is considered diagnostic for diabetes mellitus. (Saydah SH, et al, 2001)

In type 1, pancreatic beta cells in the islets of Langerhans are destroyed, decreasing endogenous insulin production. This distinguishes type 1's origin from type 2. Type 2 diabetes is characterized by insulin resistance, while type 1 diabetes is characterized by insulin deficiency, generally without insulin resistance. Another hallmark of type 1 diabetes is islet autoreactivity, which is generally measured by the presence of autoantibodies directed towards the beta cells.
**Autoantibodies**

The appearance of diabetes-related autoantibodies has been shown to be able to predict the appearance of diabetes type 1 before any hyperglycemia arises, the main ones being islet cell autoantibodies, insulin autoantibodies, autoantibodies targeting the 65-kDa isoform of glutamic acid decarboxylase (GAD), autoantibodies targeting the phosphatase-related IA-2 molecule, and zinc transporter autoantibodies (ZnT8). By definition, the diagnosis of diabetes type 1 can be made first at the appearance of clinical symptoms and/or signs, but the emergence of autoantibodies may itself be termed "latent autoimmune diabetes". Not everyone with autoantibodies progresses to diabetes type 1, but the risk increases with the number of antibody types, with three to four antibody types giving a risk of progressing to diabetes type 1 of 60%–100%. The time interval from emergence of autoantibodies to clinically diagnosable diabetes can be a few months in infants and young children, but in some people it may take years – in some cases more than 10 years. Islet cell autoantibodies are detected by conventional immunofluorescence, while the rest are measured with specific radiobinding assays. (Knip M, et al, 2005)

**Prevention**

Type 1 diabetes is not currently preventable. Some researchers believe it might be prevented at the latent autoimmune stage, before it starts destroying beta cells. (Bluestone JA, et al, 2010)

**Immunosuppressive drugs**

Cyclosporine A, an immunosuppressive agent, has apparently halted destruction of beta cells (on the basis of reduced insulin usage), but its kidney toxicity and other side effects make it highly inappropriate for long-term use. (Bluestone JA, et al, 2010)

Anti-CD3 antibodies, including teplizumab and otelixizumab, had suggested evidence of preserving insulin production (as evidenced by sustained C-peptide production) in newly diagnosed type 1 diabetes patients. A probable mechanism of this effect was believed to be preservation of regulatory T cells that suppress activation of the immune system and thereby maintain immune system homeostasis and tolerance to self-antigens. The duration of the effect is still unknown, however. In 2011, Phase III
studies with otelixizumab and teplizumab both failed to show clinical efficacy, potentially due to an insufficient dosing schedule. (Macrogenics.com, 2010)

An anti-CD20 antibody, rituximab, inhibits B cells and has been shown to provoke C-peptide responses three months after diagnosis of type 1 diabetes, but long-term effects of this have not been reported. (Bluestone JA, et al, 2010)

**Diet**

Some research has suggested breastfeeding decreases the risk in later life and early introduction of gluten-containing cereals in the diet increases the risk of developing islet cell autoantibodies; various other nutritional risk factors are being studied, but no firm evidence has been found. Giving children 2000 IU of vitamin D daily during their first year of life is associated with reduced risk of type 1 diabetes, though the causal relationship is obscure. (Virtanen SM, et al, 2003).

Children with antibodies to beta cell proteins (i.e. at early stages of an immune reaction to them) but no overt diabetes, and treated with niacinamide (vitamin B3), had less than half the diabetes onset incidence in a seven-year time span than did the general population, and an even lower incidence relative to those with antibodies as above, but who received no niacinamide. (Elliott RB, et al, 1996)

People with type 1 diabetes and undiagnosed celiac disease have worse glycaemic control and a higher prevalence of nephropathy and retinopathy. Gluten-free diet, when performed strictly, improves diabetes symptoms and appears to have a protective effect against developing long-term complications. Nevertheless, dietary management of both these diseases is challenging and these patients have poor compliance of the diet. (Hogg-Kollars S, et al, 2014)

**Management**

**Lifestyle**

A low-carbohydrate diet, in addition to medications, is useful in type 1 DM. There are camps for children to teach them how and when to use or monitor their insulin without parental help. As psychological stress may have a negative effect on diabetes,
a number of measures have been recommended including: exercising, taking up a new hobby, or joining a charity among others. (Feinman R. D. et al, 2015)

Insulin

There are four main types of insulin: rapid acting insulin, short acting insulin, intermediate acting insulin, and long acting insulin. The rapid acting insulin is used as a bolus dosage. The action onsets in 15 minutes with peak actions in 30 to 90 minutes. Short acting insulin action onsets within 30 minutes with the peak action around 2 to 4 hours. Intermediate acting insulin action onsets within 1 to 2 hours with peak action of 4 to 10 hours. Long acting insulin is usually given once per day. The action onset is roughly 1 to 2 hours with a sustained action of up to 24 hours.

Injections of insulin—either via subcutaneous injection or insulin pump— are necessary for those living with type 1 diabetes because it cannot be treated by diet and exercise alone. In addition to insulin therapy dietary management is important. This includes keeping track of the carbohydrate content of food and careful monitoring of blood glucose levels using glucose meters. Today, the most common insulins are biosynthetic products produced using genetic recombination techniques; formerly, cattle or pig insulins were used, and even sometimes insulin from fish. (Shrivastava S., 2013)

Untreated type 1 diabetes can commonly lead to diabetic ketoacidosis which is a diabetic coma which can be fatal if untreated. Diabetic ketoacidosis can cause cerebral edema (accumulation of liquid in the brain). This is a life-threatening issue and children are at a higher risk for cerebral edema than adults, causing ketoacidosis to be the most common cause of death in pediatric diabetes. (ADA, 2015)

Treatment of diabetes focuses on lowering blood sugar or glucose (BG) to the near normal range, approximately 80–140 mg/dl (4.4–7.8 mmol/L). The ultimate goal of normalizing BG is to avoid long-term complications that affect the nervous system (e.g. peripheral neuropathy leading to pain and/or loss of feeling in the extremities), and the cardiovascular system (e.g. heart attacks, vision loss). This level of control over a prolonged period of time can be varied by a target HbA1c level of less than 7.5%. (ADA, 2010)
People with type 1 diabetes always need to use insulin, but treatment can lead to low BG (hypoglycemia), i.e. BG less than 70 mg/dl (3.9 mmol/l). Hypoglycemia is a very common occurrence in people with diabetes, usually the result of a mismatch in the balance among insulin, food and physical activity. Mild cases are self-treated by eating or drinking something high in sugar. Severe cases can lead to unconsciousness and are treated with intravenous glucose or injections with glucagon. Continuous glucose monitors can alert patients to the presence of dangerously high or low blood sugar levels, but technical issues have limited the effect these devices have had on clinical practice.

As of 2016 an artificial pancreas looks promising with safety issues still being studied. (Blauw, H; et al, 2016)

**Pancreas transplantation**

In some cases, a pancreas transplant can restore proper glucose regulation. However, the surgery and accompanying immunosuppression required may be more dangerous than continued insulin replacement therapy, so is generally only used with or sometime after a kidney transplant. One reason for this is that introducing a new kidney requires taking immunosuppressive drugs such as cyclosporine, which allows the introduction of a new pancreas to a person with diabetes without any additional immunosuppressive therapy. However, pancreas transplants alone may be beneficial in people with extremely labile type 1 diabetes mellitus. (Jennifer L. Larsen, 2011)

**Islet cell transplantation**

Islet cell transplantation may be an option for some people with type 1 diabetes that are not well controlled with insulin. Difficulties include finding donors that are compatible, getting the new islets to survive, and the side effects from the medications used to prevent rejection. Success rates, defined as not needing insulin at 3 years follow the procedure occurred in 44% in on registry from 2010. (Bruni A. et al, 2014).

**Complications**

Complications of poorly managed type 1 diabetes mellitus may include cardiovascular disease, diabetic neuropathy, and diabetic retinopathy, among others. However,
cardiovascular disease as well as neuropathy may have an autoimmune basis, as well. Women with type 1 DM have a 40% higher risk of death as compared to men with type 1 DM. The life expectancy of an individual with type 1 diabetes is 11 years less for men and 13 years less for women. (Livingstone S. J., et al, 2015).

**Urinary tract infection**

People with diabetes show an increased rate of urinary tract infection. The reason is bladder dysfunction that is more common in diabetics than in non-diabetics due to diabetic nephropathy. When present, nephropathy can cause a decrease in bladder sensation, which in turn, can cause increased residual urine, a risk factor for urinary tract infections. (James R., et al, 2014)

**Sexual dysfunction**

Sexual dysfunction in diabetics is often a result of physical factors such as nerve damage and/or poor circulation, and psychological factors such as stress and/or depression caused by the demands of the disease. (McCoy K., 2014)

**Males**

The most common sexual issues in diabetic males are problems with erections and ejaculation: "With diabetes, blood vessels supplying the penis’s erectile tissue can get hard and narrow, preventing the adequate blood supply needed for a firm erection. The nerve damage caused by poor blood glucose control can also cause ejaculate to go into the bladder instead of through the penis during ejaculation, called retrograde ejaculation. When this happens, semen leaves the body in the urine." Another cause for erectile dysfunction are the reactive oxygen species created as a result of the disease. Antioxidants can be used to help combat this. (Goswami S., et al, 2014)

**Females**

While there is less material on the correlation between diabetes and female sexual dysfunction than male sexual dysfunction, studies have shown there to be a significant prevalence of sexual problems in diabetic women. Common problems include reduced sensation in the genitals, dryness, difficulty/inability to orgasm, pain during sex, and decreased libido. In some cases diabetes has been shown to decrease
oestrogen levels in females, which can affect vaginal lubrication. (Diabetes.co.uk, 2014)

Oral contraceptives can be taken by diabetics. Sometimes, contraceptive pills can cause a blood sugar imbalance, but this usually can be corrected by a dosage change. As with any medication, side effects should be taken into account and monitored to prevent serious complications with diabetes. (Diabetes.co.uk, 2014)

Women with type 1 diabetes show a higher than normal rate of polycystic ovarian syndrome (PCOS). The reason may be that the ovaries are exposed to high insulin concentrations since women with type 1 diabetes can have frequent hyperglycemia. (Codner E., et al. 2007)

**Epidemiology**

Type 1 diabetes makes up an estimated 5–10% of all diabetes cases or 11–22 million worldwide. In 2006 it affected 440,000 children under 14 years of age and was the primary cause of diabetes in those less than 10 years of age. The incidence of type 1 diabetes has been increasing by about 3% per year. (Aanstoot HJ, et al, 2007)

Rates vary widely by country. In Finland, the incidence is a high of 57 per 100,000 per year, in Japan and China a low of 1 to 3 per 100,000 per year, and in Northern Europe and the U.S., an intermediate of 8 to 17 per 100,000 per year. (Kasper, 2005)

In the United States, type 1 diabetes affected about 208,000 youths under the age of 20 in 2015. Over 18,000 youths are diagnosed with Type 1 diabetes every year. Every year about 234,051 Americans die due to diabetes (type I or II) or diabetes-related complications, with 69,071 having it as the primary cause of death.

**Diabetes mellitus in Sudan**

Diabetes mellitus in Sudan is growing health problem in all socioeconomic classes. it is estimated that there are two million people with diabetes in Sudan with prevalence of 14% in the country and 19.6% in Khartoum state the national history of the disease is associated with poor glycaemia control, high prevalence of complication and low quality of life unfortunately, lack of financial resources to equip patients with long term treatment has led to the development of complications confined to disease,
leading to an increase in diabetes related morbidity and mortality. Between 1991 and 1995, 467 children were diagnosed as having type I diabetes in Khartoum hospital. (Elamin A., et al, 1997)

Sudan is one 19 countries and territories of the IDF MENA region. 415 million people have diabetes in the world and more than 35.4 million people in the MENA Region by 2040 this will rise to 72.1 million. (Gary T. L. et al, 2003)

The SCDA has repressed deep concern over the high incidence of diabetes among children in Sudan the SCDA chairman Mohamed Ahmed Abdullah said that 60% of deaths among children in Sudan are caused by non-communicable disease of the 7th conference of the African Diabetes Association in Khartoum, pointing that 4,700 cases of endocrine and iodine deficiency were registered at the Sudanese center for childhood diabetes (SCCD) also received 2,700 cases of juvenile diabetes. (Sudan Tribune Newspaper, 2016)

**History**

Type 1 diabetes was described as an autoimmune disease in the 1970s, based on observations that autoantibodies against islets were discovered in diabetics with other autoimmune deficiencies. It was also shown in the 1980s that immunosuppressive therapies could slow disease progression, further supporting the idea that type 1 diabetes is an autoimmune disorder. The name juvenile diabetes was used earlier as it often first is diagnosed in childhood. (Herold K. C., et al, 2013)

In Australia, approximately one million Australians have been diagnosed with type 1 diabetes and Australia ranks 7th-highest in the world with children under 14 years of age. Between 2000 and 2013, 31,895 new cases were established, with 2,323 in 2013, a rate of 10–13 cases per 100,00 people each year. Aboriginals and Torres Strait Islander people are less affected. (Shaw, Jonathan, 2012)
Treatments

A number of approaches have been explored to provide treatments for type 1.

Stem cells

Pluripotent stem cells can be used to generate beta cells but previously these cells did not function as well as normal beta cells. In 2014 more mature beta cells were produced which released insulin in response to blood sugar when transplanted into mice. Before these techniques can be used in humans more evidence of safety and effectiveness is needed. (Rezania, A., et al, 2014)

Vaccine

Vaccines to treat or prevent Type 1 diabetes are designed to induce immune tolerance to insulin or pancreatic beta cells. While Phase II clinical trials of a vaccine containing alum and recombinant GAD65, an autoantigen involved in type 1 diabetes, were promising, as of 2014 Phase III had failed. As of 2014, other approaches, such as a DNA vaccine encoding proinsulin and a peptide fragment of insulin, were in early clinical development. (Lernmark A., et al, 2013)

Diet

There is evidence from experiments conducted in animal models that removal of gluten from the diet may prevent the onset type 1 diabetes but there has been conflicting research in humans. (Kasper L. et al. 2005)

Labile diabetes

Insulin-dependent diabetes characterized by dramatic and recurrent swings in glucose levels, often occurring for no apparent reason, is sometimes known as brittle diabetes, unstable diabetes or labile diabetes, although some experts say the "brittle diabetes" concept "has no biologic basis and should not be used". The results of such swings can be irregular and unpredictable hyperglycemias, sometimes involving ketoacidosis, and sometimes serious hypoglycemias. Brittle diabetes occurs no more frequently than in 1% to 2% of diabetics. In a small study, 10 of 20 brittle diabetic patients aged 18–23 years who could be traced had died within 22 years, and the remainder, though
suffering high rates of complications, were no longer brittle. These results were similar to those of an earlier study by the same authors which found a 19% mortality in 26 patients after 10.5 years. (Cartwright A., et al, 2011)

Because labile diabetes is defined as "episodes of hypoglycemia or hyperglycemia that, whatever their cause, constantly disrupt a patient's life", it can have many causes, some of which include: errors in diabetes management, which can include too much insulin being given, in relation to carbohydrate being consumed interactions with other medical conditions psychological problems biological factors that interfere with how insulin is processed within the body hypoglycemia and hyperglycemia due to strenuous exercise; however, hypoglycemia is more frequent insulin exposed to higher temperatures that reduces effectiveness of the insulin hormone in the body spontaneous production of insulin in the body due to activity in the beta cells during the period shortly after diagnosis of type 1 diabetes. (Davidson MB, et al, 1991)

Exercise related hyperglycemia is caused when hormones (such as adrenaline and cortisol) are released during moderate to strenuous exercise. This happens when the muscles signal the liver to release glucose into the bloodstream by converting stored glycogen into glucose. The cause of exercise related hypoglycemia, on the other hand, occurs when the muscle group being exercised uses up glucose faster than it can be replenished by the body.

One of these biological factors is the production of insulin autoantibodies. High antibody titers can cause episodes of hyperglycemia by neutralizing the insulin, thereby causing clinical insulin resistance requiring doses of over 200 IU/day. However, antibodies may also fail to buffer the release of the injected insulin into the bloodstream after subcutaneous injection, resulting in episodes of hypoglycemia. In some cases, changing the type of insulin administered can resolve this problem. There have been a number of reports that insulin autoantibodies can act as a "sink" for insulin and affect the time to peak, half-life, distribution space, and metabolic clearance, though in most patients these effects are small. (Fineberg SE, et al, 2007)
**Education for children and their parents:**

**Definition of health education:**

“‘The process of providing the person with the knowledge and skills needed to perform diabetes self-care, manage crises and to make lifestyle changes to successfully manage the disease’”

Into diabetes and educational methods is important in improving clinical practice and this should be the responsibility of each nation/state and be a national priority.

Educational programmes must be carefully planned, have specific aims and learning objectives, which are shared with people with diabetes, carers and their families. It has remained contentious whether educational interventions per se are beneficial in diabetes care, particularly in children and adolescents because ‘educational, psychosocial and psychotherapeutic interventions are frequently combined for the purpose of improving knowledge, skills and self-efficacy across various aspects of diabetes self-management’. (Peter G.F., 2009)

**Purpose of Nutritional Care:**

Before the discovery of insulin, in 1921, the recommendations for the appropriate diet for diabetes used to suggest a strict, monotonous and rigid diet, with very high percentages of fat and protein and very low percentages of carbohydrates. This made it very difficult for diabetic subjects to adhere to these recommendations. Over the years, these recommendations have been adjusted, mainly because of the availability of insulin and new medications, as well as because prolongation of the life of the diabetic person is accompanied by an increase in cardiovascular disease. Nowadays, the diet for diabetes is synonymous with a healthy diet for the general population, with a wider variety of nutritional options and more complex (or slowly absorbed) carbohydrate-rich foods in the daily dietary plan.

**Nutritional management**

Nutritional management is one of the cornerstones of diabetes care and education. Different countries and regions have widely varying cultures and socioeconomic status that influence and dominate dietary habits. Although there is strong evidence
for nutritional requirements in young people the scientific evidence base for many aspects of diabetes dietary management is weak and often anecdotal. Thus, sensitivity to individual needs, and pragmatism rather than dogmatism are most helpful for effective dietary counseling.

Dietary recommendations for children with diabetes are based on healthy eating recommendations suitable for all children and adults and therefore the whole family. Nutritional advice must be adapted to cultural, ethnic and family traditions and the psychosocial needs of the individual child. (Peter G.F., 2009)

**Nutritional management in children and adolescents with diabetes:**

**The primary dietary goals for type 1 diabetics:**

The primary dietary goals for people with type 1 diabetes are the: maintenance of optimal metabolic outcomes and blood glucose levels reduction of the risk of complications of diabetes (e.g. macrovascular disease, vascular disease) and to treat them improvement of general health, through healthy food choices and physical activity modification of the person’s nutrient intake and lifestyle, as appropriate, for the prevention and treatment of obesity, dyslipidaemia, cardiovascular disease, hypertension and nephropathy coverage of the individual’s nutritional needs, according to personal and cultural preferences and lifestyle and their energy and nutritional needs maintenance of normal body weight. (Nikolaos K., et al, 2010)

**Body mass index and use in children**

BMI is a useful screening tool and the most widely used index for the identification of possible weight problems among children, although it is not usually considered a reliable indicator of body fatness in the individual as it fails to distinguish between lean body mass and fat. Certainly, from a public health and statistical perspective, BMI measurements of a population are still a very good indicator. Thus, the relationship between BMI and body fatness varies according to Body composition and proportions. The Centers for Disease Control and Prevention (CDC) and the American Academy of Pediatrics (AAP) recommend the use of BMI for the screening of overweight or obese children above the age of 2 years old. BMI for children and teens is combined with age growth charts (for either girls or boys). The growth charts
show the weight status categories (underweight, healthy weight, at risk of overweight, overweight) for children and teens. (Nikolaos K., et al, 2010)

**Calculate the body mass index**

BMI is the most recommended classification of body weight and one of the Simplest and most widely used methods for the estimation of body fat Developed by the Belgian statistician Adolph Quenelle, it can be calculated by a simple equation, dividing the subject’s weight by the square of his/her height BMI is typically expressed in either metric or imperial units and constitutes an indicator of the stores of body fat, being related to an increased danger of illness and mortality, for individuals. BMI classified individuals as underweight, Normal weight, overweight or obese:

$$
\text{BMI} = \frac{\text{Weight (in kg)}}{\text{Height (in m}^2\text{)}}
$$

Underweight (BMI <18.5)

Normal (BMI 18.5–24.9) eventually high (thin obese)

Overweight (BMI 25–29.9) Increased High

Obese Class I (BMI 30–34.9) High Very high

Obese Class II (BMI 35–39.9) Very high Very high

Extreme Obesity Class 3 (BMI>40)

Extremely high extremely high (2). (Nikolaos K., et al, 2010)

**Education Impact on Children and Adolescents with T1DM:**

Carbohydrate counting is the most common and effective diabetes specific nutrition education that is taught, however some foods are easier to carbohydrate count than others. One study tested the carbohydrate counting efficacy in children and adolescents ages 12-18 with T1DM using a carbohydrate counting accuracy test. Participants counted the carbohydrate amount in 29 food items that were typical foods consumed during breakfast, lunch, dinner or snack. Participants were divided into an intervention group and a control group. The intervention group attended a carbohydrate counting class and kept 3-day food records. The accuracy test was given again three months later. Results showed at baseline, more than half of the participants in the intervention group significantly over or underestimated
carbohydrate amounts in foods such as milk, orange juice, carrots, broccoli, chicken nuggets, and mixed meals. Results also showed that individuals exposed to nutrition education who had assistance from their parents, had a significantly lower HbA1c. Another study showed similar results in the child and adolescent population. Children and adolescents ages 8-18 with T1DM were asked to count the amount of carbohydrates in several different, common food items. Seventy-five percent of the study population over or underestimated the amount of carbohydrates by 10-15g. Prepared foods and foods that did not have nutrition label were more likely to be incorrectly estimated, but foods that had a nutrition label were estimated with the most accuracy. Both of these studies concluded there as anteed for providing skills to estimate carbohydrates in foods without nutrition labels.

Physical Activity:

Physical activity is vital for all children and young people and this is also true for children and young people with diabetes. Exercise of any kind increases the use of energy and therefore children and young people with diabetes are likely to see a drop in their blood glucose level. Therefore, they may need additional carbohydrate before, during or after sport.

There is evidence that exercise in type 1 diabetes improve physical fitness, insulin resistance, lipids and micro vascular risk in people with type 1 diabetes.

This should be documented on their care management plan. It is important to note that for some children and young people, exercise also includes running around, or long periods of walking. Children/young people with diabetes should be encouraged to check their blood glucose level before exercise, if they are going swimming, or the activity is strenuous or prolonged (more than 45 minutes). High blood glucose levels (above 14 mmol) may make it dangerous for some children to participate in certain activities – this will be documented in their care management plan. It is important that all teacher staff know the signs and symptoms of hypoglycemia (Low blood glucose) and how to treat it. It will also be necessary for teacher staff to carry hypo treatment (glucose and snacks) in the lesson at all times. (Steve B., 2014)
**Previous studies:**

In a study conducted by (Joubert, M., et al. 2016) to evaluate the effect of videogames on the therapeutic knowledge and behavior of children with type 1 diabetes. PedCarbQuiz (PCQ) and Diabetes Self-Management Profile (DSMP) questionnaires were used before (T0), immediately after (T1), and 6 months after (T2) the unstructured use of the videogame. **RESULTS:** The 38 children enrolled in the study were 42% boys and 58% girls; they had a mean age of 13.7±2.1 years old, a diabetes duration of 6.0±3.8 years, and (HbA1c) levels of 8.5±1.4% (69.4±9.4 mmol/mol). The children connected to the game 3.3±2.8 times during this 6-month study. Their PCQ score increased from 31.6±4.9 at T0 to 36.0±4.0 at T2 (P < 0.05). Analysis found a greater impact of the game in children with poor glycemic control.

Another study by (Stallwood, L. 2006) to describe the relationship between caregiver diabetes knowledge and socioeconomic factors on glycemic outcomes of young children with type 1 diabetes. With seventy-three caregivers of children less than 9 years of age were conveniently sampled and completed the Michigan Diabetes Research and Training Center Diabetes Knowledge Test and a demographic questionnaire. It found that higher caregiver knowledge was associated with lower (HbA1c) levels, higher income levels, and being married. Thirty-three (44%) children had HbA1c levels within the target range. Perform ongoing knowledge assessments and educational interventions related to deficits, with a special focus on families in lower socioeconomic situations.

(Makki Awouda, F. O., et al., 2014) conducted a study aimed to determine the effects of health education on the achievements of diabetic patients regarding control and improvement of their health status; at Diabetic Health Centers in Khartoum State, Sudan; 2007-2010. The target populations were diabetic patients, who attended the diabetic health centers to receive their treatment. Using simple random sampling 152 patients were selected (58 males and 94 females). Before and after comparison was done. Data was processed using SPSS and pair t-test was used to determine the effect of health education. P-value equal or less than 0.05 was considered statistically significant. It found that test for before and after comparison was found to be statistically significant (p<0.05) for diabetic patients. They gained more knowledge after the implementation of the program; particularly in the areas of the nature and
signs and symptoms of the disease, signs and symptoms of hypo & hyperglycemia, causes and warning signs of foot problems, foot care, and importance of exercises.

More previous studies found significant effects of attendance at diabetes camp on nutrition knowledge. (Tuchinda et al. 2002) using a non-validated instrument found average knowledge scores increased from 65% at the start of camp to 80% after camp, a 15% significant increase (p <0.001). also, (Bundak et al. 2005) reported increase in knowledge from 69.5% precampto 79.5% post-camp, a 10% significant increase (p<.05)

In the study by (Shobhana et al, 1997) a 1-hour didactic lecture on injection and monitoring skills and individualized diet counseling was delivered to 37 parent and child groups by a multidisciplinary team. A short questionnaire found that immediately post-intervention and at 3 months, there were significant increases in knowledge about diabetes, injections and hypoglycemia.

In an uncontrolled before-and-after study (Verrotti et al, 1993), they studied 30 adolescents who attended nine education sessions on general diabetes management. At the 12-month followup, a 20-item multiple choice questionnaire showed that the participants had statistically higher knowledge scores compared to baseline values.

Another study conducted by (Ahmed ME, 2006) and aimed to provide throw medical student health education to diabetics in the assigned families and it assess the impact of the student intervention it conducted three stages training of medical student education to diabetic patient and evaluation of the intervention finding that there was a highly significant difference in the student knowledge and skills including communication skills on the home management of diabetes mellitus , improvement in the knowledge , attitudes and practices of diabetes as a result of student intervention

From the Observational studies In the Diabetes Control and Complications Trial (DCCT) a study by(Delahanty and Halford, 1993) reported the results of cross-sectional survey intended to examinethe role of nutrition behaviors inachieving improved glycemic control in623 intensively treated patients with type1 diabetes. The control and intervention groups both received counseling by a dietitian however, the control group received nutrition counseling every 6months and the intensive management group received nutrition counseling every month. The four nutrition
behaviors associated with clinically significant reductions in HbA1c (0.9%) were: adherence to prescribed meal and snack plan, adjustment of insulin dose in response to meal size, prompt treatment of hyperglycemia and avoidance of overtreatment of hypoglycemia.

Another study by (Couch R et al. 2008) conducted to determine the effectiveness of diabetes education on metabolic control, diabetes-related hospitalizations, complications, and knowledge, quality of life and other psychosocial outcomes for children with type 1 diabetes and their families. Most studies that examined the effect of educational interventions on HbA1c found no evidence of increased effectiveness of the interventions over the education provided as part of standard care. Successful interventions were heterogeneous and included cognitive behavioral therapy, family therapy, skills training and general diabetes education. Most studies reported a positive effect on health service utilization, although less than half were statistically significant. There was no clear evidence that educational interventions had an effect on short-term complications. The effect of educational interventions on diabetes knowledge effects on knowledge scores included diabetes camp, general diabetes education, and cognitive behavioral therapy. The results of two studies examining refinements to intensive therapy education suggest that educational interventions may enhance the effects of intensive diabetes Management in reducing HbA1c.
Chapter Three
Methodology

Study Design:
This is an interventional cohort, hospital based study.

Study Area:
This study was conducted at AL-Hasahisa Pediatric Hospital. It is located in AL-Hashish city, Gezira State, Central Sudan. On the west bank of the blue Nile at an altitude of 401 meters (1316 feet) above sea level, and away from Khartoum capital the of Sudan by about 121 kilometers (75 miles) to the south east, and away from the city of wad Madame, capital of the state by 46 kilometers (28 miles).

Al-Hasahisa Pediatrics Teaching Hospital is located in AL-Hasahisa in the state of AL-Gezira. It was a ward in the general hospital, in 2002 it became a complete educational hospital.

The hospital consists of an emergency department and consists of an emergency clinic, referral clinics for specialists, emergency rehabilitation, EPI services, laboratory, pharmacy and information center and number of eight sections divided according to the cases. The hospital receives between 160 and 200 patients every day. There is also a number of hospital 4 specialist and 16 general practitioner and 32 house-officer 45 sister and 12 nutritionist and 1 social worker and many other helping staff.

Study duration:
The study was conducted from July 2015 to July 2017

Study Population:
All children with type 1 diabetes mellitus and their caregivers(33 child and 18 caregiver) attended to Hasahisa Pediatric Hospital in Gezira state, during the study period and agreed to participate.
Sample Size:
Total coverage, all diabetic children attended to Hasahisa Pediatric Hospital during the study period were enrolled in the study. The total number was 51 children with their caregivers.

Data Collection Tool:
A pretested structured close ended questionnaire (annex 1) was used to collect the data at the baseline level, by the researcher and the trained two assistances (sister and nutritionist) in July 2015, then reused at the evaluation phase at 18 months after the end of the educational program and the memory gap. Children parameters including the height, weight, random blood sugar were collected in the 1st visit and every month, HbA1c was collected in the 1st visit and then every three month.

Study stages:

( I ) Pre intervention phase:
The baseline point, where the KAP of participants was assessed, using the above mentioned questionnaire.

( II ) Intervention phase:
At this stage, a training was about the diabetes and it is education was delivered to 2 health workers (a nutritionist and a sister), the education was consist of 12 direct face to face interviews initiated with every diabetic child and/or his caregiver, by the researcher and the 2 trained health workers, it was contacting the addressing the following health education titles:

- Diabetes definition, symptoms, signs, management.
- Nutrition and suitable regimen for diabetics.
- Hyperglycemia the reason and symptoms and treatment.
- Hypoglycemia the reason and symptoms and treatment.
- Insulin storage, correct inject site, expiry date and expiration sings.
- Importance of exercise for diabetics.
- Glucometer correct use and reading of results.
• Normal ranges for fasting, random glucose levels and normal HbA1c level, and hazardous ranges and levels.
• Diabetes complications and how to avoid them.
• Importance of follow-up visits and regular check-ups.
• Educator phone number.
➢ Definition paper about diabetes giving to the schoolteacher for how they can deal with diabetic student.
➢ Follow-up chick-list was used to focus on the targeted points every month.

(III) Evaluation phase:

After a 6 months memory gap, the same mentioned questionnaire was re-used.

Data management:
A score was given to the questions about knowledge; each correct answer was given a score of 1 and each wrong answer or the answer of I don’t know was given the score of 0. The total sum scores were 9, so the respondent’s scores were categorized into 3 categories;

1. Low knowledge score from 1-3
2. Moderate knowledge score 4-6
3. Good knowledge score 7-9.

Data Analysis:
Data were coded then entered into the computer, organized and analyzed using Statistical Package for Social Sciences (SPSS) software version 20. General tabulations including frequency and percentage distribution were used together with Chi–square test, data about the knowledge. Categorical data were analyzed using chi-square test. P-value<0.05 was considered statistically significant.

Ethical Consideration:
Approval was obtained from the ethical committee (Faculty of Medicine, University of Gezira). An informed verbal consent was obtained from every participant before participation in the study, participants were assured that collected data will be strictly confidential, and will not be disclosed for any reason, and will be used only for research purposes.
Chapter Four
The Results

Frequency Tables:

Table 1: Age distribution among the study sample (18 caregiver + 33 child), N=51

<table>
<thead>
<tr>
<th>Minimum age</th>
<th>Maximum age</th>
<th>Range</th>
<th>Mean age</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.00</td>
<td>17.00</td>
<td>14.00</td>
<td>12.1569</td>
<td>3.61316</td>
</tr>
</tbody>
</table>

Table 2: The socio-demographic characteristics of the study sample (18 caregiver + 33 child), N=51

<table>
<thead>
<tr>
<th></th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age groups</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3-6</td>
<td>12</td>
<td>23.5</td>
</tr>
<tr>
<td>7-10</td>
<td>18</td>
<td>35.3</td>
</tr>
<tr>
<td>11-14</td>
<td>21</td>
<td>41.2</td>
</tr>
<tr>
<td><strong>Gender</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>21</td>
<td>41.2</td>
</tr>
<tr>
<td>Female</td>
<td>30</td>
<td>58.8</td>
</tr>
<tr>
<td><strong>Residence</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rural</td>
<td>16</td>
<td>31.4</td>
</tr>
<tr>
<td>Urban</td>
<td>35</td>
<td>68.6</td>
</tr>
<tr>
<td><strong>Duration of diabetes</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt; 1</td>
<td>2</td>
<td>3.9</td>
</tr>
<tr>
<td>1-3</td>
<td>13</td>
<td>25.5</td>
</tr>
<tr>
<td>4-6</td>
<td>19</td>
<td>37.3</td>
</tr>
<tr>
<td>7-9</td>
<td>17</td>
<td>33.3</td>
</tr>
<tr>
<td><strong>Type of the family</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nuclear</td>
<td>22</td>
<td>43.1</td>
</tr>
<tr>
<td>Extended</td>
<td>29</td>
<td>56.9</td>
</tr>
<tr>
<td><strong>Father educational level</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Illiterate</td>
<td>9</td>
<td>17.6</td>
</tr>
<tr>
<td>Primary</td>
<td>16</td>
<td>31.4</td>
</tr>
<tr>
<td>Secondary</td>
<td>24</td>
<td>47.1</td>
</tr>
<tr>
<td>University</td>
<td>2</td>
<td>3.9</td>
</tr>
<tr>
<td>Post-university</td>
<td>0</td>
<td>0.0</td>
</tr>
<tr>
<td>Mother educational level</td>
<td>Frequency</td>
<td>Percent</td>
</tr>
<tr>
<td>--------------------------</td>
<td>-----------</td>
<td>---------</td>
</tr>
<tr>
<td>Illiterate</td>
<td>7</td>
<td>13.7</td>
</tr>
<tr>
<td>Primary</td>
<td>19</td>
<td>37.3</td>
</tr>
<tr>
<td>Secondary</td>
<td>22</td>
<td>43.1</td>
</tr>
<tr>
<td>University</td>
<td>3</td>
<td>5.9</td>
</tr>
<tr>
<td>Post-university</td>
<td>0</td>
<td>0.0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Father Occupation</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jobless</td>
<td>2</td>
<td>3.9</td>
</tr>
<tr>
<td>Employee/Professional</td>
<td>8</td>
<td>15.7</td>
</tr>
<tr>
<td>Worker/self-employed</td>
<td>38</td>
<td>74.5</td>
</tr>
<tr>
<td>Business man</td>
<td>3</td>
<td>5.9</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Mother Occupation</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Housewife</td>
<td>43</td>
<td>84.3</td>
</tr>
<tr>
<td>Employee/Professional</td>
<td>3</td>
<td>5.9</td>
</tr>
<tr>
<td>Worker/self-employed</td>
<td>4</td>
<td>7.8</td>
</tr>
<tr>
<td>Business woman</td>
<td>1</td>
<td>2.0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Monthly household income</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 1000</td>
<td>17</td>
<td>33.3</td>
</tr>
<tr>
<td>1000-2000</td>
<td>28</td>
<td>54.9</td>
</tr>
<tr>
<td>&gt; 2000</td>
<td>6</td>
<td>11.8</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Parents diabetic status</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Father</td>
<td>0</td>
<td>0.0</td>
</tr>
<tr>
<td>Mother</td>
<td>2</td>
<td>3.9</td>
</tr>
<tr>
<td>Both</td>
<td>0</td>
<td>0.0</td>
</tr>
<tr>
<td>None</td>
<td>49</td>
<td>96.1</td>
</tr>
</tbody>
</table>

| Total                    | 51        | 100.0   |

Out of 51 diabetic patient aging from 3-17 years with mean age 12.15 ± 3.61 years, the most frequent age group was 11-14 years and the least one was 3-6 years. (41.2%) of them were males, while (58.8%) were females. (68.6%) were reside in urban areas. (37.3%) of them were diabetic for 4-6 years. (56.9%) were living in extended families. Concerning father educational level (47.1%) were secondary educated, while (43.1%) of the mothers were secondary educated. (74.5%) of the fathers were workers or self-employed, most of the mothers were housewives (84.3%). The household monthly income was 1000-2000 in (54.9%). Almost parents were non-diabetic (96.1%).
Figure 1: Distribution of the mean of the children weight during the year among the study sample (18 caregiver + 33 child), N=51

Figure 2: Distribution of the mean of the children height during the year among the study sample (18 caregiver + 33 child), N=51
Figure 3: Distribution of the mean of the children BMI during the year among the study sample (18 caregiver + 33 child), N=51

Figure 4: Distribution of the mean of the children random blood sugar during the year among the study sample (18 caregiver + 33 child), N=51
Figure 5: Distribution of the mean of the children HbA1c levels during the year among the study sample (18 caregiver + 33 child), N=51

HbA1c was tested 4 times during the year of intervention, every 3 months. There was a significant reduction for the average, from 11.63 MMol to 9.43 MMol. The test was performed either by the participant if he/she was under the umbrella of health insurance, or the expense were covered by the researcher.
Table 3: Knowledge about nature of diabetes (pre-post) during the year among the study sample (18 caregiver + 33 child), N=51

<table>
<thead>
<tr>
<th></th>
<th>Pre</th>
<th>Post</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No.</td>
<td>%</td>
<td>No.</td>
</tr>
<tr>
<td>Genetic</td>
<td>15</td>
<td>29.4</td>
<td>0</td>
</tr>
<tr>
<td>Infectious</td>
<td>45</td>
<td>88.2</td>
<td>0</td>
</tr>
<tr>
<td>Low insulin in blood</td>
<td>3</td>
<td>5.9</td>
<td>51</td>
</tr>
<tr>
<td>Don’t know</td>
<td>1</td>
<td>2.0</td>
<td>0</td>
</tr>
</tbody>
</table>

The knowledge about nature of diabetes among the study sample either the patients themselves or their caregivers was very low (5.9%), after the educational program it was increased to (100.0%). Chi squire was performed to measure the change it was significant (P. value = 0.000).

Table 4: Knowledge about symptoms of diabetes (pre-post) during the year among the study sample (18 caregiver + 33 child), N=51

<table>
<thead>
<tr>
<th></th>
<th>Pre</th>
<th>Post</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No.</td>
<td>%</td>
<td>No.</td>
</tr>
<tr>
<td>Sweating and shivering</td>
<td>22</td>
<td>43.1</td>
<td>51</td>
</tr>
<tr>
<td>Blurring of vision</td>
<td>2</td>
<td>3.9</td>
<td>51</td>
</tr>
<tr>
<td>Fainting</td>
<td>13</td>
<td>25.5</td>
<td>51</td>
</tr>
<tr>
<td>Don’t know</td>
<td>14</td>
<td>27.5</td>
<td>0</td>
</tr>
</tbody>
</table>

The knowledge about symptoms of hypoglycemia among the study sample either the patients themselves or their caregivers was good (73.5%), after the educational program it was increased to (100.0%). Chi squire was done to measure the change it was statistically significant (P. value = 0.000).
Table 5: Knowledge about management of hypoglycemia (pre-post) during the year among the study sample (18 caregiver + 33 child), N=51

<table>
<thead>
<tr>
<th></th>
<th>Pre</th>
<th>Post</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No.</td>
<td>%</td>
<td>No.</td>
</tr>
<tr>
<td>Juice</td>
<td>13</td>
<td>22.8</td>
<td>51</td>
</tr>
<tr>
<td>Sweet or sugar</td>
<td>20</td>
<td>35.1</td>
<td>51</td>
</tr>
<tr>
<td>Food</td>
<td>2</td>
<td>3.5</td>
<td>51</td>
</tr>
<tr>
<td>Don’t know</td>
<td>22</td>
<td>38.6</td>
<td>0</td>
</tr>
</tbody>
</table>

The knowledge about management of hypoglycemia among the study sample either the patients themselves or their caregivers was moderate (56.9%), after the educational program it was increased to (100.0%). Chi squire was performed to measure the change it was significant (P. value = 0.004).

Table 6: Knowledge about regularity on diet (pre-post) during the year among the study sample (18 caregiver + 33 child), N=51

<table>
<thead>
<tr>
<th></th>
<th>Pre</th>
<th>Post</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No.</td>
<td>%</td>
<td>No.</td>
</tr>
<tr>
<td>Yes</td>
<td>19</td>
<td>37.3</td>
<td>51</td>
</tr>
<tr>
<td>No</td>
<td>11</td>
<td>21.6</td>
<td>51</td>
</tr>
<tr>
<td>Sometimes</td>
<td>18</td>
<td>35.3</td>
<td>51</td>
</tr>
<tr>
<td>Don’t know</td>
<td>3</td>
<td>5.8</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>51</td>
<td>100.0</td>
<td>51</td>
</tr>
</tbody>
</table>

The knowledge about regularity of diet among the study sample either the patients themselves or their caregivers was good (72.5%), after the educational program it was increased to (100.0%). Chi squire was done to measure the change it was statistically significant (P. value = 0.000).
Table 7: Knowledge about effect of dietary regimen (pre-post) during the year among the study sample (18 caregiver + 33 child), N=51

<table>
<thead>
<tr>
<th></th>
<th>Pre</th>
<th>Post</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No.</td>
<td>%</td>
<td>No.</td>
</tr>
<tr>
<td>Better sugar levels</td>
<td>24</td>
<td>47.1</td>
<td>51</td>
</tr>
<tr>
<td>Good health</td>
<td>22</td>
<td>43.1</td>
<td>51</td>
</tr>
<tr>
<td>No difference</td>
<td>1</td>
<td>2.0</td>
<td>51</td>
</tr>
<tr>
<td>Better sugar levels and good health</td>
<td>4</td>
<td>7.8</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>51</td>
<td>100.0</td>
<td>51</td>
</tr>
</tbody>
</table>

The knowledge about effect of diet regimen among the study sample either the patients themselves or their caregivers was low (7.8%), after the educational program it was increased to (100.0%). Chi squire was performed to measure the change it was statistically significant (P. value = 0.021).

Table 8: Knowledge about insulin types (pre-post) during the year among the study sample (18 caregiver + 33 child), N=51

<table>
<thead>
<tr>
<th></th>
<th>Pre</th>
<th>Post</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No.</td>
<td>%</td>
<td>No.</td>
</tr>
<tr>
<td>Mixed</td>
<td>18</td>
<td>35.3</td>
<td>51</td>
</tr>
<tr>
<td>Mixed and usual or pure</td>
<td>31</td>
<td>60.8</td>
<td>51</td>
</tr>
<tr>
<td>Don’t know</td>
<td>2</td>
<td>3.9</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>51</td>
<td>100.0</td>
<td>51</td>
</tr>
</tbody>
</table>

The knowledge about insulin types among the study sample either the patients themselves or their caregivers was (60.9%), after the educational program it was increased to (100.0%). Chi squire was done to measure the change it was statistically significant (P. value = 0.034).
Table 9: Knowledge about insulin storage (pre-post) during the year among the study sample (18 caregiver + 33 child), N=51

<table>
<thead>
<tr>
<th></th>
<th>Pre</th>
<th>Post</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No.</td>
<td>%</td>
<td>No.</td>
</tr>
<tr>
<td>Refrigerator door</td>
<td>43</td>
<td>84.3</td>
<td>51</td>
</tr>
<tr>
<td>Container with cold water</td>
<td>3</td>
<td>5.9</td>
<td>51</td>
</tr>
<tr>
<td>Below zeer</td>
<td>4</td>
<td>7.8</td>
<td>51</td>
</tr>
<tr>
<td>Cold water and below zeer</td>
<td>1</td>
<td>2.0</td>
<td>51</td>
</tr>
<tr>
<td>Total</td>
<td>51</td>
<td>100.0</td>
<td>51</td>
</tr>
</tbody>
</table>

The knowledge about insulin storage among the study sample either the patients themselves or their caregivers was low (25.0%), after the educational program it was increased to (100.0%). Chi squire was done to measure the change it was statistically significant (P. value = 0.000).

Table 10: Knowledge about insulin expiry (pre-post) during the year among the study sample (18 caregiver + 33 child), N=51

<table>
<thead>
<tr>
<th></th>
<th>Pre</th>
<th>Post</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No.</td>
<td>%</td>
<td>No.</td>
</tr>
<tr>
<td>White dots</td>
<td>8</td>
<td>15.7</td>
<td>51</td>
</tr>
<tr>
<td>Dirty</td>
<td>1</td>
<td>2.0</td>
<td>51</td>
</tr>
<tr>
<td>Don’t know</td>
<td>42</td>
<td>82.3</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>51</td>
<td>100.0</td>
<td>51</td>
</tr>
</tbody>
</table>

The knowledge about insulin expiry among the study sample either the patients themselves or their caregivers was low (17.6%), after the educational program it was increased to (100.0%). Chi squire was done to measure the change it was statistically significant (P. value = 0.000).
Table 11: Knowledge about insulin inject site (pre-post) during the year among the study sample (18 caregiver + 33 child), N=51

<table>
<thead>
<tr>
<th></th>
<th>Pre</th>
<th>Post</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No.</td>
<td>%</td>
<td>No.</td>
</tr>
<tr>
<td>Hips</td>
<td>40</td>
<td>44.0</td>
<td>51</td>
</tr>
<tr>
<td>Stomach</td>
<td>11</td>
<td>12.1</td>
<td>51</td>
</tr>
<tr>
<td>Hands</td>
<td>38</td>
<td>41.8</td>
<td>51</td>
</tr>
<tr>
<td>Don’t know</td>
<td>2</td>
<td>2.1</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>91</td>
<td>100.0</td>
<td>51</td>
</tr>
</tbody>
</table>

The knowledge about insulin inject site among the study sample either the patients themselves or their caregivers was (44.6%), after the educational program it was increased to (100.0%). Chi squire was done to measure the change it was statistically significant (P. value = 0.009).

Table 12: Knowledge about correct method of insulin injection (pre-post) during the year among the study sample (18 caregiver + 33 child), N=51

<table>
<thead>
<tr>
<th></th>
<th>Pre</th>
<th>Post</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No.</td>
<td>%</td>
<td>No.</td>
</tr>
<tr>
<td>Shake hard</td>
<td>40</td>
<td>78.4</td>
<td>51</td>
</tr>
<tr>
<td>Shake gently</td>
<td>5</td>
<td>9.8</td>
<td>51</td>
</tr>
<tr>
<td>Don’t know</td>
<td>6</td>
<td>11.8</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>51</td>
<td>100.0</td>
<td>51</td>
</tr>
</tbody>
</table>

The knowledge about correct method of insulin injection among the study sample either the patients themselves or their caregivers was very low (9.8%), after the educational program it was increased to (100.0%). Chi squire was done to measure the change it was statistically significant (P. value = 0.000).
Table 13: Knowledge about timing of checking HbA1c (pre-post) during the year among the study sample (18 caregiver + 33 child), N=51

<table>
<thead>
<tr>
<th></th>
<th>Pre</th>
<th></th>
<th>Post</th>
<th></th>
<th>Sig</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No.</td>
<td>%</td>
<td>No.</td>
<td>%</td>
<td></td>
</tr>
<tr>
<td>Once monthly</td>
<td>1</td>
<td>2.0</td>
<td>51</td>
<td>100.0</td>
<td>0.044</td>
</tr>
<tr>
<td>Once every three months</td>
<td>5</td>
<td>9.8</td>
<td>51</td>
<td>100.0</td>
<td></td>
</tr>
<tr>
<td>Don’t know</td>
<td>45</td>
<td>88.2</td>
<td>0</td>
<td>0.0</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>51</td>
<td>100.0</td>
<td>51</td>
<td>100.0</td>
<td></td>
</tr>
</tbody>
</table>

The knowledge about timing of checking HbA1c among the study sample either the patients themselves or their caregivers was very low (9.8%), after the educational program it was increased to (100.0%). Chi square was done to measure the change it was statistically significant (P. value = 0.044).

Table 14: Overall knowledge of patients or caregivers during the year among the study sample (18 caregiver + 33 child), N=51

<table>
<thead>
<tr>
<th></th>
<th>Pre</th>
<th></th>
<th>Post</th>
<th></th>
<th>Sig</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No.</td>
<td>%</td>
<td>No.</td>
<td>%</td>
<td></td>
</tr>
<tr>
<td>Low knowledge</td>
<td>6</td>
<td>54.5</td>
<td>0</td>
<td>0.0</td>
<td>0.006</td>
</tr>
<tr>
<td>Moderate knowledge</td>
<td>3</td>
<td>27.3</td>
<td>0</td>
<td>0.0</td>
<td></td>
</tr>
<tr>
<td>Good knowledge</td>
<td>2</td>
<td>18.2</td>
<td>11</td>
<td>100.0</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>11</td>
<td>100.0</td>
<td>11</td>
<td>100.0</td>
<td></td>
</tr>
</tbody>
</table>

The overall knowledge about diabetes among the study sample either the patients themselves or their caregivers was generally low (54.5%), the moderate knowledge was (27.3%), after the educational program it good knowledge was increased to (100.0%). Chi square was done to measure the change it was statistically significant (P. value = 0.006).
Table 15: Attitude towards diet regimen (pre-post) during the year among the study sample (18 caregiver + 33 child), N=51

<table>
<thead>
<tr>
<th></th>
<th>Pre</th>
<th></th>
<th>Post</th>
<th></th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No.</td>
<td>%</td>
<td>No.</td>
<td>%</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>12</td>
<td>23.5</td>
<td>51</td>
<td>100.0</td>
<td>0.00</td>
</tr>
<tr>
<td>No</td>
<td>6</td>
<td>11.8</td>
<td>51</td>
<td>100.0</td>
<td></td>
</tr>
<tr>
<td>Sometimes</td>
<td>31</td>
<td>60.8</td>
<td>51</td>
<td>100.0</td>
<td></td>
</tr>
<tr>
<td>Don’t know</td>
<td>2</td>
<td>3.9</td>
<td>0</td>
<td>0.0</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>51</td>
<td>100.0</td>
<td>51</td>
<td>100.0</td>
<td></td>
</tr>
</tbody>
</table>

The attitude towards diet regimen among the study sample either the patients themselves or their caregivers was very low (23.5%), after the educational program it was increased to (100.0%). Chi square was done to measure the change it was statistically significant (P. value = 0.000).

Table 16: Practice of exercise (pre-post) during the year among the study sample (18 caregiver + 33 child), N=51

<table>
<thead>
<tr>
<th></th>
<th>Pre</th>
<th></th>
<th>Post</th>
<th></th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No.</td>
<td>%</td>
<td>No.</td>
<td>%</td>
<td></td>
</tr>
<tr>
<td>Walking</td>
<td>9</td>
<td>17.6</td>
<td>51</td>
<td>100.0</td>
<td>0.00</td>
</tr>
<tr>
<td>Football</td>
<td>7</td>
<td>13.7</td>
<td>51</td>
<td>100.0</td>
<td></td>
</tr>
<tr>
<td>Running</td>
<td>6</td>
<td>11.8</td>
<td>51</td>
<td>100.0</td>
<td></td>
</tr>
<tr>
<td>Nothing</td>
<td>29</td>
<td>56.9</td>
<td>0</td>
<td>0.0</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>51</td>
<td>100.0</td>
<td>51</td>
<td>100.0</td>
<td></td>
</tr>
</tbody>
</table>

The practice of exercise among the patients was (43.1%), after the educational program it was increased to (100.0%). Chi square was done to measure the change it was statistically significant (P. value = 0.000).
Table 17: Practice of regular visits to diabetes clinic (pre-post) during the year among the study sample (18 caregiver + 33 child), N=51

<table>
<thead>
<tr>
<th></th>
<th>Pre</th>
<th>Post</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No.</td>
<td>%</td>
<td>No.</td>
</tr>
<tr>
<td>Yes</td>
<td>42</td>
<td>82.4</td>
<td>51</td>
</tr>
<tr>
<td>No</td>
<td>1</td>
<td>2.0</td>
<td>0</td>
</tr>
<tr>
<td>Sometimes</td>
<td>8</td>
<td>15.6</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>51</td>
<td>100.0</td>
<td>51</td>
</tr>
</tbody>
</table>

The practice of regular visit to diabetes clinic among the patients was (82.4%), after the educational program it was increased to (100.0%). Chi squire was done to measure the change it was statistically significant (P. value = 0.000).

Table 18: Practice of timing of visits to diabetes clinic (pre-post) among the study sample patients or caregivers, N=51

<table>
<thead>
<tr>
<th></th>
<th>Pre</th>
<th>Post</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No.</td>
<td>%</td>
<td>No.</td>
</tr>
<tr>
<td>Once monthly</td>
<td>45</td>
<td>88.2</td>
<td>51</td>
</tr>
<tr>
<td>Twice monthly</td>
<td>1</td>
<td>2.0</td>
<td>51</td>
</tr>
<tr>
<td>Once every three months</td>
<td>5</td>
<td>9.8</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>51</td>
<td>100.0</td>
<td>51</td>
</tr>
</tbody>
</table>

The practice of timing of visit to diabetes clinic among the patients was (88.2%), after the educational program it was increased to (100.0%). Chi squire was done to measure the change it was statistically significant (P. value = 0.029).
Table 19: Practice of regularity of blood glucose levels check-up (pre-post) during the year among the study sample (18 caregiver + 33 child), N=51

<table>
<thead>
<tr>
<th></th>
<th>Pre</th>
<th>Post</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No.</td>
<td>%</td>
<td>No.</td>
</tr>
<tr>
<td>Yes</td>
<td>37</td>
<td>72.6</td>
<td>51</td>
</tr>
<tr>
<td>No</td>
<td>4</td>
<td>7.8</td>
<td>51</td>
</tr>
<tr>
<td>Sometimes</td>
<td>10</td>
<td>19.6</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>51</td>
<td>100.0</td>
<td>51</td>
</tr>
</tbody>
</table>

The practice of regularity of blood glucose check-up among the patients was (72.6%), after the educational program it was increased to (100.0%). Chi squire was done to measure the change it was statistically significant (P. value = 0.008).

Table 20: Presence of glucometer (pre-post) during the year among the study sample (18 caregiver + 33 child), N=51

<table>
<thead>
<tr>
<th></th>
<th>Pre</th>
<th>Post</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No.</td>
<td>%</td>
<td>No.</td>
</tr>
<tr>
<td>Yes</td>
<td>2</td>
<td>3.9</td>
<td>51</td>
</tr>
<tr>
<td>No</td>
<td>49</td>
<td>96.1</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>51</td>
<td>100.0</td>
<td>51</td>
</tr>
</tbody>
</table>

The presence of glucometer among the patients was very low (3.9%), after the educational program it was increased to (100.0%). Chi squire was done to measure the change it was statistically significant (P. value = 0.000).
Table 21: Presence of diabetes complications during the year among the study sample (18 caregiver + 33 child), N=51

<table>
<thead>
<tr>
<th></th>
<th>No.</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eye</td>
<td>1</td>
<td>2.0</td>
</tr>
<tr>
<td>Kidney</td>
<td>1</td>
<td>2.0</td>
</tr>
<tr>
<td>Nothing</td>
<td>49</td>
<td>96.0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>51</td>
<td>100.0</td>
</tr>
</tbody>
</table>

The presence of diabetes complications among the patients was very low (3.9).

Table 22: Weight, height and BMI (pre-post) during the year among the study sample (18 caregiver + 33 child), N=51

<table>
<thead>
<tr>
<th></th>
<th>Pre</th>
<th></th>
<th>Post</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>StD</td>
<td>Mean</td>
<td>StD</td>
</tr>
<tr>
<td>Weight</td>
<td>31.78</td>
<td>±11.20</td>
<td>35.0</td>
<td>±1.13</td>
</tr>
<tr>
<td>Height</td>
<td>140.31</td>
<td>±19.3</td>
<td>144.04</td>
<td>±18.88</td>
</tr>
<tr>
<td>BMI</td>
<td>15.49</td>
<td>±2.49</td>
<td>16.39</td>
<td>±2.55</td>
</tr>
<tr>
<td>Random</td>
<td>302.82</td>
<td>±130.21</td>
<td>183.49</td>
<td>±61.12</td>
</tr>
<tr>
<td>HbA1c</td>
<td>11.63</td>
<td>±1.92</td>
<td>9.43</td>
<td>±1.41</td>
</tr>
</tbody>
</table>

The mean weight of the patients was (31.78±11.20) pre the educational program, it increased to (35.0 ±1.13) after the one year intervention. The mean height of the patients was (140.31 ±19.3) pre the educational program, it increased to (144.04 ±18.88) after the one year intervention. The mean BMI of the patients was (15.49 ±2.49) pre the educational program, it increased to (16.39 ±2.55) after the one year intervention. This increase was due to their aging, which goes against the educational program target. Random blood sugar was measured 12 times every month, the first reading was (302.82 ±130.21) it was reduced to (183.49 ±61.12). The HbA1c level before the educational program was (11.63 ±1.92) the forth check-up was reduced to (9.43 ±1.41).
Chapter Five
Discussion, Conclusion and Recommendations

Discussion
The management of type 1 diabetes exhibited significant challenges for adolescents as it requires continual monitoring of blood glucose levels and strict adherence to insulin diet and exercise regimens. Parents and particularly mothers are actively involved in the management of their children diabetes, taking considerable responsibility for diabetes care during the preadolescent years, and then guiding the shift in responsibility to their children during adolescence. This is an interventional cohort, descriptive and analytical, hospital based study, it was conducted to study the effect of health education program in the control of diabetes in children at AL-Hasahisa Pediatrics Teaching Hospital, Gezira State, Sudan 2017. A sample of 51 diabetic children and their caregivers were selected by a total coverage sampling technique, all diabetic children attended to Hasahisa Pediatric Hospital during the study period were enrolled in the study. Out of 51 diabetic patient aging from 3-17 years with mean age 12.15 ± 3.61 years, the most frequent age group was 11-14 years and the least one was 3-6 years, which is nearly to be similar to Joubert, M., et al. (41.2%) of them were males, while (58.8%) were females, this is typically as the gender distribution of their sample. (68.6%) were reside in urban areas. (37.3%) of them were diabetic for 4-6 years, this matches Joubert, M., et al. (56.9%) were living in extended families. Concerning father educational level (47.1%) were secondary educated, while (43.1%) of the mothers were secondary educated. (74.5%) of the fathers were workers or self-employed, most of the mothers were housewives (84.3%). The household monthly income was middle to low in (88.2%), this is nearly to be similar with Emad et al. Almost parents were non-diabetic (96.1%).

At the baseline of this study the knowledge about nature of diabetes, symptoms of hypoglycemia, management of hypoglycemia, regularity of diet, effect of diet regimen, insulin types, insulin storage, insulin expiry, insulin inject site, correct method of insulin injection, timing of checking HbA1c, were assessed and the results were (5.9%), (73.5%), (56.9%), (72.5%), (7.8%), (60.9%), (25.0%), (17.6%), (44.6%), (9.8%), (9.8%), (54.5%), (27.3%) respectively, the responses were obtained from the study sample either the patients themselves or their caregivers. After the
educational program all these responses were increased to (100.0%). Thus in this study the overall knowledge about diabetes among the patients themselves and their caregivers was changed after the educational program from low/moderate to a very high. These results were similar to the results of other studies; (Povlsen et al.) after giving educational material and guidelines reported a mean increase in knowledge from baseline. Similarly to (Verrotti et al.) who gave nine education sessions on general diabetes management; showed that the participant’s had statistically higher knowledge scores compared to baseline values. Moreover (von Sengbusch et al.) assessed the impact of a mobile diabetes education service and found a statistical improvement in children’s knowledge at the 6-month follow-up.

Chi square test was performed to measure these changes before and after the intervention, it was statistically significant, and this is due to the major changes resulted by implementation of the educational program. Comparing this to (Makki Awouda, F. O., et al), who stated that “Test for before and after comparison was found to be statistically significant (p<0.05) for diabetic patients.”

The knowledge of caregiver is approved to be very effective in controlling diabetes in children, as many studies supported that, as found in (Couch R et al).

Increased caregiver knowledge was associated with lowering of the HbA1c levels; this result was supported by the results from UK in which the patients who had nutrition counseling had decreased HbA1c by 1.9%. Another study done by Kulkarni et al. also reported a decrease in HbA1c by 0.33% in patients given nutrition practice guidelines. Additional study which was carried out by (Delahanty and Halford) reported that patients who received nutrition counseling every month; had significant reductions in HbA1c (0.9%).

Moreover (Povlsen et al.) reported a significant difference in mean HbA1c levels immediately after the 12-month intervention (9.2±1.4); however, this improvement disappeared at the 6-month follow-up. Furthermore (Verrotti et al.) gave nine education sessions on general diabetes management and their results showed that At the 12-month follow-up, mean baseline levels of HbA1c had decreased significantly (11.8±2.8 to 10.0±2.7). On the other hand (von Sengbusch et al.) assessed the impact of a mobile diabetes education service in diabetic children, and they found that the
HbA1c levels did not change significantly. Also (Brown et al.) by using video game as an educational method found that the patients exhibited higher levels of HbA1c at the end of the 6-month study period. Moreover (Kemp et al.) gave diabetes education during a summer camp and they reported that after 1 year HbA1c levels had increased levels, higher income levels, this was found by (Stallwood, L).

Knowledge about diabetes among children and patents has been increased after the diabetes intervention by educational program, the difference between before and after is statically significant; the details of knowledge among diabetic children and their caregivers were also improved after intervention. This matches most of the studies addressing this issue; study conducted to find significant effects of attendance at diabetes camp on nutrition knowledge. (Tuchinda et al.) using a non-validated instrument found average knowledge scores increased significantly from 65% at the start of camp to 80% after camp. (Bundak et al.) also reported significant increase in knowledge from 69.5% pre-camp to 79.5% post-camp.

Also in a study by (Shobhana et al.) a 1-hour didactic lecture on injection and monitoring skills and individualized diet counseling was delivered to 37 parent and child groups by a multidisciplinary team. A short questionnaire found that immediately post-intervention and at 3 months, there were significant increases in knowledge about diabetes, injections and hypoglycemia.

In an uncontrolled before-and-after study (Verrotti et al.) studied 30 adolescents who attended nine education sessions on general diabetes management. At the 12-month follow-up, a 20-item multiple choice questionnaire showed that the participants had statistically higher knowledge scores compared to baseline values.

(Ovlsen et al.) assessed the effect of an intervention targeted at 37 families in Denmark. The intervention included adapted educational material and guidelines and re-education that focused on increasing knowledge and self-care. Using the results of a questionnaire, the authors reported a mean increase in knowledge from baseline.

The attitude towards diet regimen among the study sample either the patients themselves or their caregivers was very low (23.5%), after the educational program it was increased to (100.0%). This supports the hypothesis.

(this similar to (jocye et al)
2002) it finding that nutrition behaviors associated with clinically significant reduction in HbA1c (09%).

In this study the practice of exercise among the patients was (43.1%), after the educational program it was increased to (100.0%). The practice of regular visit to diabetes clinic among the patients was (82.4%), after the educational program it was increased to (100.0%). The practice of timing of visit to diabetes clinic among the patients was (88.2%), after the educational program it was increased to (100.0%).

In this study the practice of regularity of blood glucose check-up among the patients was (72.6%), after the educational program it was increased to (100.0%). Similar result were reported from study conducted on the role of medical student in patient education to promote home management of diabetes mellitus in Wad Medani town in Sudan it shows that there was a highly significant improvement in the knowledge, attitudes and practice of the diabetic as the result of the student intervention. (Ahmed ME et al, 2006)

In this study the presence of glucometer among the patients was very low (3.9%), after the educational program it was increased to (100.0%). due to (Elhasahisa Childhood Diabetes Association)

The presence of diabetes complications among the patients was very low (3.9).

The mean weight of the patients was (31.78±11.20) pre the educational program, it increased to (35.0 ±1.13) after the one year intervention. The mean height of the patients was (140.31 ±19.3) pre the educational program, it increased to (144.04 ±18.88) after the one year intervention. The mean BMI of the patients was (15.49 ±2.49) pre the educational program, it increased to (16.39 ±2.55) after the intervention. This increase was due to their aging, which goes against the educational program target. Random blood sugar was measured 12 times every month, the first reading was (302.82 ±130.21) it was reduced to (183.49 ±61.12). The HbA1c level before the educational program was (11.63 ±1.92) the forth check-up was reduced to (9.43 ±1.41). This supports the hypotheses.
Conclusion

From the results of this study, there was a significant effect of health education program in the control of diabetes in children at AL-Hasahisa Pediatrics Teaching Hospital, Gezira State, Sudan 2017, and it was found to be very effective.

The knowledge, attitudes and behavior towards diet therapy for children and their caregivers, before the intervention, was (54.5%), (23.5%) and (71.6%) respectively.

The level of control of diabetes in term of diabetic measurements, was not stable, after the educational program it was improved.

The effect of health education for children and their caregivers in changing knowledge, and nutritional behavior, was increased significantly.

The effect of the educational program in the blood sugar, there was a noticeable progress, HbA1c values was decreased from (11.6 to 9.4), weight, height, and BMI, were increased due to the ages of the participants and the nature of growing period.
Recommendations

- Health education about diabetic care for children and their caregivers should
  be emphasized at all pediatric hospitals and diabetic centers.
- All pediatrics staff should be included in continuous training programs to
  increase their awareness towards type 1 diabetes.
- Pediatric and child health nurses need to set an innovative health education
  intervention for diabetes control.
- Health education material such as posters, pamphlets, flyers and toys should be
  available at diabetic children clinics.
- Long term intervention is required for getting accurate diabetes control and
  more reduction of HbA1c.
- More researches with larger sample size, different locations to be conducted to
  assess the effectiveness of interventions on sustaining glycolic control.
References


Bruni, A; Gala-Lopez, B; Pepper, AR; Abualhassan, NS; Shapiro, AJ (2014). "Islet cell transplantation for the treatment of type 1 diabetes: recent advances and future challenges.". Diabetes, metabolic syndrome and obesity: targets and therapy. 7: 211–23.


Feinman, RD; Pogozelski, WK; Astrup, A; Bernstein, RK; Fine, EJ; Westman, EC; Accurso, A; Frassetto, L; Gower, BA; McFarlane, SI; Nielsen, JV; Krarup, T; Saslow, L; Roth, KS; Vernon, MC; Volek, JS; Wilshire, GB; Dahlqvist, A; Sundberg, R; Childers, A; Morrison, K; Manninen, AH; Dashti, HM; Wood, RJ; Wortman, J; Worm, N (January 2015). "Dietary carbohydrate restriction as the first approach in diabetes management: critical review and evidence base.". Nutrition (Burbank, Los Angeles County, Calif.). 31 (1): 1–13.

Goswami, Sumanta; Vishwanath, Manikanta; Gangadarappa, Suma; Razdan, Rema; Inamdar, Mohammed (Jul–Sep 2014). "Efficacy of ellagic acid and sildenafil in diabetes-induced sexual dysfunction". Pharmacognosy Magazine. 10 (39): 581.

Guidelines for diagnosis and management of diabetes mellitus in children.


Livingstone, SJ; Levin, D; Looker, HC; Lindsay, RS; Wild, SH; Joss, N; Leese, G; Leslie, P; McCrimmon, RJ; Metcalfe, W; McKnight, JA; Morris, AD; Pearson, DW; Petrie, JR; Philip, S; Sattar, NA; Traynor, JP; Colhoun, HM; Scottish Diabetes Research Network epidemiology group; Scottish Renal, Registry (6 January 2015). "Estimated life expectancy in a Scottish cohort with type 1 diabetes, 2008-2010.". JAMA. 313 (1): 37–44.


Rezania, A; Bruin, JE; Arora, P; Rubin, A; Batushansky, I; Asadi, A; O'Dwyer, S; Quiskamp, N; Mojibian, M; Albrecht, T; Yang, YH; Johnson, JD; Kieffer, TJ (November 2014). "Reversal of diabetes with insulin-producing cells derived in vitro from human pluripotent stem cells.". Nature Biotechnology. 32 (11): 1121–33.


Steve Birnie, Supporting children and young people with type 1 diabetes in education complied, pediatrics and adolescent diabetes UK. 2014


WHO, 10 facts on diabetes, 2017. www.who.int/..../en


Annex (1)


Hafez Muhammad T. Hassan

Name:                             
Age:                             
Sex: (M) (F)                     
Address:                         
Weight:                          
Height:                          
BMI:                              

Date or period of diabetes:      

What is your knowledge about the symptoms of diabetes?—Severe thirst and hunger, excessive urination especially at night, fatigue and weakness (yes/no), I don’t know.

What is your knowledge about hypoglycemia symptoms?—Severe sweating and tremors, dizziness with eyes blurred, dizziness and sometimes fainting (yes/no), I don’t know.

What do you know about diabetes?—Genetic disease (yes/no), infectious disease (yes/no), disease due to insufficient insulin in the blood (yes/no).

What is the way to treat hypoglycemia?—Give the patient freshly squeezed juice (yes/no), giving the patient candy or sugar (yes/no), giving the patient food (yes/no), I don’t know.

Were the parents of the child diabetic?—Mother (yes), Father (yes), Both (yes), Neither (yes), I don’t know.

Do you adhere to your child’s diet?—Yes, No, I don’t know.

Do you accept your child’s diet and follow it?—Yes, No, Sometimes.

Did you notice any difference after following the diet?—Improvement in diabetes measurements, improvement in general health (yes/no), No difference.

Do you refer your child's weight to a dietician or follow your child’s diet?—Yes, No, I don’t know.

Do you think your child has taken that diet?—Yes, No, I don’t know.

Is there any difference after taking the diet?—Yes, No, I don’t know.

Do you think your child has taken that diet?—Yes, No, I don’t know.
هل يعالج الطفل بالانسولين؟
نعم لا بالحبوب

هل تعرف أنواع الانسولين؟
مخلوط العادة أو الصافي لا يعرف

ماهي طرق حفظ الانسولين؟
في باب الثلاجة، في حافظة صغيرة بها ماء بارد تحت الزيت لا يعرف
كيف تعرف ان الانسولين انتهت صلاحيته؟
تري به حبوب بيضاء أو قطع صغيرة بيضاء الصافي يصبح عكرلا لا يعرف

هل تعتبر اماكن طعن الانسولين؟
في الفخذين، في البطن، اليدان لا يعرف
هل تعرف طريقة تعبئة الحقنة واستخدام الانسولين؟
ارجه بقوة واسحب افركه بلطف واسحب لا يعرف

ماهي أنواع الرياضة التي يمارسها طفلك؟
المشي الجري لا يمارس الرياضة
هل يعاني الطفل احدي مضاعفات السكري؟
مشاكل بالعين مشاكل بالكليتين، السمنة لا يعاني
هل الطفل منظم بزيارة اخصائي لمرض السكري؟
نعم لا احيانا
إذا كانت الإجابة نعم:
كم مرة؟ مرة واحدة شهريا مرة كل ثلاثة أشهر
هل يتم الفحص بصورة منتظمة؟
نعم لا احيانا

هل يمكننا فحص السكر التراكمي؟
مرة شهريا، مرة كل ثلاثة أشهر لا يعرف
هل لديك جهاز للفحص الذاتي بالمنزل؟
نعم لا
استمارة متابعات:

رقم الزيارة 1: تم التركيز على التثقيف في التغذية.

رقم الزيارة 2: تم التركيز على التثقيف في مواضع الحقن.

رقم الزيارة 3: تم التركيز في التثقيف على طريقة حفظ الأنسولين.

رقم الزيارة 4: تم التركيز في طريقة حقن وتعبئة الأنسولين.

رقم الزيارة 5: تم التركيز في التثقيف على اعراض انخفاض السكر.

رقم الزيارة 6: تم التركيز في التثقيف على طريقة معالجة انخفاض السكر.

رقم الزيارة 7: تم التركيز في اعراض ارتفاع السكر.

رقم الزيارة 8: تم التركيز في التثقيف على السكري والرياضة.

رقم الزيارة 9: تم التركيز في التثقيف على طريقة الفحص الزائني للسكري.

رقم الزيارة 10: تم التركيز في التثقيف على معرفة القياسات الطبيعية المطلوبة لمستويات السكر في الدم لمريض السكري.

رقم الزيارة 11: تم التركيز في تعريف مريض السكري على المضاعفات التي يمكن أن يتعرض لها المريض.

رقم الزيارة 12: تم التركيز في تعليم مريض السكري أهمية المتابعة والزيارة الدورية المنتظمة للاختصاصي السكري.
عيادة سكري الأطفال – مستشفى الحصاصية

إنخفاض السكر

( الهبوط السكري )

أعراضه:

1- شعور بالجوع
2- دوخة
3- عرق بكثرة
4- عدم التركيز
5- قلق و توتر
6- ارتعاش (رجلة)
7- بكاء
8- خفقات القلب (زيادة دقات القلب)
9- شحوب اللون
10- تصرفات غريبة و هياء
11- الشعور بالتعب والإرهاق
12- ن_blob (رجفة)
13- رؤية أحلام مزعجة و هلاوس و صراخ
14- إغماء

التشخيص:

الأعراض

نسبة السكر في الدم أقل من 70 ملجم

العلاج:

عصير مُحَلى أو ملعقة سكر كبيرة في نصف ماس ماء

في حالة الغيبوبة لا تعطى السوائل وإنما العلاج هو مسح عسل أو مربى في داخل الفم أو إعطاء حقنة الفلوكةانون إذا كان موجوداً

في حالة عدم التحسن يجب أن أخذ الطفل للمستشفى أو الإتصال بالفريق المعالج

أخذ الطفل لطبب في حالة وجود حمييات

أخذ الوجبات بانتظام خاصة بعد حقنة الأنسولين

أخذ وجبة خفيفة قبل و بعد التمارين الرياضية أو أثناء التمرين في حالة حدوث أعراض

التآكد من صحة جرعة الأنسولين

تدريب الأطفال و أسرهم و الأساتذة على أعراض و علاج هبوط السكري

الأسباب:

1- عدم تناول وجبات بعد أخذ الأنسولين أيام المرض

2- الخطأ أو إعطاء جرعات زيادة من الأنسولين

3- التمارين الرياضية دون أخذ وجبات قبلها و بعدها
إرشادات للتعامل مع طفل السكري أيام المرض

عيادة سكري الأطفال - مستشفى الحصاحيصا

1. عدم إيقاف إعطاء الأنسولين

2. تحليل الدم والبول للسكر والأستون كل 4 ساعات

3. إعطاء الطفل سوائل بكميات صغيرة ومتكررة لتجنب الإستفراغ وإعطاء وجبات خفيفة

4. إعطاء جرعات إضافية من الأنسولين العادي على حسب ما موضح في الجدول أدناه:

<table>
<thead>
<tr>
<th>جرعة إضافية</th>
<th>أستون في البول</th>
<th>نسبة السكر في الدم</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>نعم</td>
<td>لا</td>
</tr>
<tr>
<td></td>
<td>لا</td>
<td>نعم</td>
</tr>
<tr>
<td>✓</td>
<td>✓</td>
<td>لا</td>
</tr>
<tr>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>

الجرعة الإضافية سيحددها الطبيب وغالباًً تساوي عشر وزن الطفل أو 10 – 20 % من مجموع جرعات اليوم

(SCDA, 2015)
عيادة سكري الأطفال – مستشفى الحصاصيا

ارشادات عامة إلى إدارة المدرسة

1- يجب معاملة أطفال مرضى السكري كغيرهم من الأطفال في المدرسة و يمكنهم المشاركة في كل النشاطات والواجبات المدرسية بما في ذلك النشاطات والمجالس والمباريات و يجب إخطار كل المعلمين بمرض الطفل.

2- يجب الملاحظة بأن التمارين الرياضية عامل مساعد في علاج مرض السكري.

3- في حالة مشاركة الطفل في تمارين رياضية لمدة طويلة كمباراة كرة قدم يجب التأكد من أن يأخذ الطفل وجبة خفيفة.

4- في حالة المشاركة في تمارين السباحة يجب التأكد من وجود شخص كبير له خبرة في السباحة.

5- يمكن أن يعاني هؤلاء الأطفال (بشكل نادر) نوبات غيبوبة ناتجة عن هبوط أو ارتفاع للسكر في الدم.

- ينتج الهبوط عن عدم أخذ الوجبات بإنتظام أو أخذ جرعة الأنسولين دون تنحص الوجبات أو بعد التمارين الرياضية المرهقة دون أخذ وجبة خفيفة كبرتقال أو سندوتش أو سكسيت مثلا و تتمثل أعراض الهبوط في: ارتعاش ، عرق ، ضعف في النظر ، ضعف في النظر ، دوخة ، فقدان الوعي و تشنجات في حالة عدم العلاج . و يتم العلاج بإعطاء الطفل سكر أو إذا حدث فقدان الوعي تشير تشير إلى اتخاذ الطفل بسريع فرضية ممكنة الي أقرب مركز إسعاف و يجذب عدم انتظار حضور والدين الطفل لمثل ذلك و لتتجنب ذلك فأننا نشجع أن يحرص الطفل على أخذ سكر أو عصير في حقيبته يوميا إلى المدرسة.

- ارتفاع السكر : تتمثل أعراض ارتفاع السكر في:

- التبول بكثرة مع شرب الماء بكميات كبيرة أو النوم الإستراق و فقدان الوعي في حالة عدم الإسعاف . و يجذب في هذه الحالات اتخاذ الطفل إلى أقرب نقطة إسعاف أو الاتصال بالمستشفى.

6- في حالة الذهاب إلى الرحلات المدرسية خارج المدينة يجب التأكد من أن يأخذ الطفل كل المعدات التي يحتاج لها للعلاج و يجذب في ميمن الإستمالة على اعطاء العلاجات اللازمة.

7- قد يحتاج الطفل المصاب بمرض السكري للذهاب إلى مدرسة عدة مرات خلال اليوم كما يحتاج للشرب بصورة متكررة.

مع الشكر والتقدير

هيفاء محمد الطيب

0112545428