Republic of Iraq

Ministry of Higher Education

& Scientific Research

Knowledge and Awareness of Mothers Regarding Diabetic Ketoacidosis among Type-1 Diabetic Children

A Thesis Submitted

By

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To

Submitted to the College of Nursing, University of Babylon

In Partial Fulfillment for the Requirements for The Degree of

Master sciences in nursing

Supervisor

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Oct. 2023 AD

Rabi A. 1445 AH

بِسْمِ اللَّهِ الرَّحْمَٰنِ الرَّحِيمِ

﴿ وَنُنَزِّلُ مِنَ الْقُرْآنِ مَا هُوَ
شِفَاءٌ وَرَحْمَةٌ لِّلْمُؤْمِنِينَ ۙ وَلَا
يَزِيدُ الظَّالِمِينَ إِلَّا خَسَارًا ﴾

صدق الله العلي العظيم

الاسراء الآية (82)

Supervisor Certification

I certify that this thesis, which is entitled **(Knowledge and Awareness of Mothers Regarding Diabetic Ketoacidosis among Type-1 Diabetic Children),** has been prepared under my supervision at the college of Nursing / University of Babylon, in Partial Fulfillment of the Requirements for the Degree of Master in Nursing Sciences.

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Certification

We, the examining committee, certify that we have read this thesis (**Knowledge and Awareness of Mothers Regarding Diabetic Ketoacidosis among Type-1 Diabetic Children**) which is submitted by Ali Kareem Jawad, from the Department community health Nursing, and we have examined the student, in its contents, and what is related to it and we decide that it is adequate for awarding the degree of Master in Nursing Sciences with the specialty of (Community health Nursing).

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Date: / / 2023

Dedication

To…

I dedicate this achievement to my father, my mother and my wife, their love

and effort have accompanied me in this process, without hesitating at any

moment to see my dreams come true, which are also their dreams.

To my siblings & friends, who have been my support in the

difficulties.

Ali Kareem

2023

Acknowledgments

First of all, thanks and praise are to Allah Almighty for my success in every step of my life. And thanks to you, my Allah, I have reached where I am today. Also, he who did not thank the creature did not thank the Creator. Therefore, I extend my thanks and appreciation to **(Prof. Dr. Amean Ageel Yasir)** Dean of the college of Nursing, Babylon University. and extend my thanks and appreciation to **(Prof. Dr. Amean Ageel Yasir)** Head of the community health department. I would like to express my gratitude, appreciation and sincere thanks to my role model and my supervisor in this work (***Prof. Dr. Salma K. Jihad***) where he provided me with all moral and scientific support in every step of my work with his efforts, ideas and positive spirits, and to listen to me with all interest and care, which increased my confidence and determination to complete my scientific career without hesitation. I gratefully acknowledge the endless generosity of the experts who kept me on the right track for their time and expertise in reviewing and evaluating the study instrument.

I would like to thank all members of the Community Health Nursing Department. Also extend my thanks to the library of the College of Nursing, University of Babylon. My thanks and gratitude to all the staff of Diabetes and Endocrinology Center in Hilla City. From the bottom of my heart, my thanks to all mothers for their cooperation with me

Finally, I would like to thank everyone who contributed to facilitating my mission to complete this work.

ABSTRACT

Background: Diabetic ketoacidosis (DKA) is an acute, serious, life-threatening complication of hyperglycemia, ketoacidosis, and ketonuria. It occurs when absolute or relative insulin deficiency prevents the ability of glucose to enter cells for using it as a metabolic fuel. As a result, the liver rapidly breaks down fat into ketones for use as a fuel source.

Methods: The study aims to assessment the knowledge and awareness of mothers regarding diabetic ketoacidosis among type-1 diabetic children. The descriptive study from the period of November 15th 2022 to April 19th 2023 was conducted at the Diabetes and Endocrinology Marjan Teaching Hospital Center in Hilla City, a non-probability (purposive) sample of (150) mothers of children with type 1 diabetes mellitus (T1DM).

Results of the study: The result shows (64.7%) of mothers expressed a poor knowledge of diabetic Ketoacidosis in children as described by a low total average and (51.3%) of mothers expressed a Fair awareness of diabetic Ketoacidosis in children as described by a moderate total average.

Conclusion: Regardless of their wealth or poverty, the mother's diabetes knowledge and education could aid her child in controlling their blood sugar. The importance of mothers' knowledge and education lies in improving blood sugar control and reducing acute and chronic complications of diabetes in children.

There were no statistically significant differences in mother’s knowledge with respect to their occupation, monthly income, respect to their age and gender of child.

Recommendation: Health education should be provided to mothers of children. [It must be properly achieved in a structured manner based on a

general outline that should include education at the onset of treatment and then repeated based upon an annual assessment.

Abstract in Arabic

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List of abbreviation

Symbols	Meaning
TIDM	Type-1 Diabetic
DKA	Diabetic Ketoacidosis
DM	DIABETIC. Mellitus
MENA MED.	Middle East and North Africa
DSME.	Diabetes self-management education
WHO	Word Health Organization
NCDS	Noncomuunicabl disease
IR	incidence rate
DERI	Diabetes Epidemiology Research International
IDF	International Diabetes Federation
T2DM	Type 2 diabetes
BSPED	British Society for Paediatri Emergency Diabetes
NICE	National Institute for Health and care Excellence
SGLT	Sodium Glucose Like Transport
HHS	Hyperosmoler Hyperglycemia state
CE	Chronic Encephalopathy
DSME	Diabetes Sele_Mangment Education
NIS	National Inpatient Sample
LOS	Length Of stay
CDIC	Canada Deposite Insurance Corporation
BIRDEM	Bangladesh Institute of Research and Rehabilitation in Diabetes, Endocrine and Metabolic Disorders)
HbA1c	Hemoglobin A1c
List of statistical symbol	
Symbols	Meaning
ANOVA	Analysis of variance
&	And
χ^2	chi-square
d.f.	Degree of Freedom
=	Equal to
F	Frequency
H.	High
H.S	Highly Significant
<	Less than
L.	Low

M.S	Mean Of Score
>	More than
N.S	Not Significant
No	Number
%	age%
P.	Probability
S or Sig.	Significant
SD	Standard Deviation
SPSS	statistical package of social sciences
t.	t-statistics

Chapter one

Introduction

Chapter one: Introduction

1.1. Introduction

The pancreas is a multifunctional organ with exocrine and endocrine functions . The separate islets of Langerhans, which comprise the endocrine system, contain five distinct endocrine cell types (alpha, beta, delta, epsilon, and upsilon), each of which secretes at least five distinct hormones, including glucagon, insulin, somatostatin, ghrelin, and pancreatic polypeptide (O'Toole, & Sharma, 2022).

Regarding the implementation of artificial pancreas (AP) technology, young children with type 1 diabetes (T1D) between the ages of 5 and 8 have clear needs, but face particular hurdles. Given their existing inadequacies in glycemic management, which include both substantial hypoglycemia and inadequate HbA1c levels, young children may benefit from an AP system (DeBoer et al., 2017).

Type 1 diabetes (T1D) is a chronic autoimmune illness in which autoreactive T-cells and inflammation lead to significant beta-cell loss in the pancreas . Insulitis, the pathological characteristic of T1D, is an inflammatory lesion composed of immune cell infiltrations surrounding and inside the islets (Pugliese, 2016).

Chronic hyperglycemia resulting from abnormalities in insulin secretion, insulin action, or both, characterises diabetes mellitus. Insulin is the principal anabolic hormone that stores all energy during and after meals . Inadequate insulin activity leads to anomalies in the metabolism of carbohydrates, fats, and proteins (Aldossary& Snelgrove 2020).

Type and duration of diabetes contributes to the severity of the symptoms . Some patients with diabetes are asymptomatic, particularly those with type-2 diabetes in the disease's early stages (American Diabetes Association, 2014).

In contrast, children with severe hyperglycemia and absolute insulin deficiency may experience polyuria, polydipsia, polyphagia, weight loss, and hazy eyesight . Uncontrolled diabetes can cause stupor, coma, and, if untreated, death from ketoacidosis or, in rare cases, nonketotic hyperosmolar syndrome (Miller et al., 2015).

Long-term difficulties affecting the eyes, kidneys, and cardiovascular system are the leading cause of morbidity and mortality among diabetics, and serious health issues are also associated with the disease (Aziz, 2014 and Aziz, 2016).

Type 1 diabetes is an immunodeficiency illness in which the body's immune system assaults the beta cells in the pancreatic islets that produce insulin . Diabetes affects around 180 million people globally. Sadly, it is highly probable that this number will more than quadruple by 2030 . Worldwide, the prevalence of Type 1 diabetes has been rising (Aldossary& Snelgrove 2020).

Type-1 diabetes is an autoimmune disease; diabetic ketoacidosis (DKA) is an acute metabolic disorder of type-1 diabetes that is primarily characterized by an increased presence of circulating ketone bodies and the development of severe ketoacidosis in the presence of prolonged uncontrolled hyperglycemia, usually as a result of insulin deficiency . DKA is more prevalent in adolescents and young people with type-1 diabetes, particularly those who are noncompliant with insulin therapy or who have severe infection or other problems (Maahs et al., 2010) & (Nyenwe, 2016).

Diabetic ketoacidosis (DKA) typically results from a lack of insulin. It is a severe acute consequence of diabetes that accounts for the majority of hospitalisations caused by severe insulin shortage . The biochemical trinity consists of ketonemia, hyperglycemia, and academia. DKA is diagnosed when blood glucose is above 11 mmol/L, venous pH is

below 7.3, or bicarbonate is below 15 mmol/L, and ketonemia with ketonuria is present (Savage et al., 2011).

Diabetic ketoacidosis (DKA) is a potentially life-threatening acute complication of type 1 diabetes (T1D) . It is characterised by a biochemical triad of hyperglycemia, ketonemia (ketonuria), and acetoacetate . The symptoms of uncontrolled diabetes that can lead to DKA are usually short-lived and include frequent urination, drinking, eating, weight loss, vomiting, abdominal pain, and eventually acidotic coma (Vicinanza, 2019).

The mother's knowledge of diabetes and education could help her child control their blood sugar, regardless of their wealth or poverty. Improved blood sugar control and reduction of acute and chronic complications of diabetes in children are dependent on mothers' knowledge and education. (Al Kaabba et al., 2021).

It is important to gain more knowledge from the parents' perspective on treatment issues as well as the everyday challenges parenting a small child with diabetes (Iversen et al.,2018).

Challenges include physical growth, monitoring during the day and night, adjusting insulin doses, changing food preferences, irregular physical activity patterns, not being able to clearly describe and talk about their symptoms, and always needing to be watched and cared for (Streisand & Monaghan, 2014).

1.2. Importance of the study

Diabetes mellitus (DM) is a major public health problem in Arab countries. In 2011, 20 Arab countries reported that 20.5 million people had DM. The number of people with Type 1 diabetes has been rising all over the world (Aldossary& Snelgrove 2020).

During childhood and adolescence, type 1 diabetes mellitus (T1DM) is the most common endocrine-metabolic disorder. About 1 in 300

young people develop type 1 diabetes. Worldwide, the number of people with type 1 diabetes is rising by 3-4% per year" (Alhomood et. al, 2020).

Type 1 diabetes (T1D) is the most common long-term metabolic disease in children . It causes 5–10% of all diabetes cases around the world (Zayed, 2016).

Diabetic ketoacidosis is the most common emergency situation for people with diabetes mellitus (DKA). Surprisingly, it happens more often when seeing type 1 diabetes patients with DKA. But people with type 2 diabetes have the same chance of getting this bad emergency as everyone else . Other than that, it was clear that people with type 2 diabetes who had a DKA were affected by things like surgery, an injury or accident, or an infection (Al Kaabba et al., 2021; Kitabchi et al., 2019).

DKA is said to be the cause of more than 100,000 hospital stays in the US every year, and it is mentioned in 4–9% of all hospital discharge summaries for people with diabetes (Alhowaish, 2013).

It is thought that the costs of health care and treatment for diabetes have gone up by more than 500% since 2000, and that diabetes management alone costs Saudi Arabia's health care budget about $25 billion . It's hard to know how many people have DKA, but the number keeps going up. In 2009, more than 500,000 hospital days were spent treating people with DKA in the US. Even though the statistics are good and more people are aware of it, as many as 30% of children with type 1 diabetes still have DKA (Alhomood et al., 2020).

In developed countries, the death rate for DKA ranges from 0.15% to 0.31%. In developing countries, where infections are still one of the most important causes of DKA, the rate is higher (13%) (Bialo et al., 2015).

In the Middle East and North Africa (MENA) region, which is mostly made up of Arabs, there are about 64,000 cases of T1D in children younger than 15 years old, with 10,700 new cases every year . Several

studies found that the number of people with T1D in Arab countries varies a lot, from 2.54/100,000 in Oman to 29/100,000 in Saudi Arabia (Foster et al., 2019).

DKA rates vary from place to place, depending on factors like geography, economy, and health care facilities . The number of people with DKA varies a lot from country to country, from 13 to 80%. The number of people with DKA is higher in developing countries than in developed countries. One to ten percent of children with type 1 diabetes get DKA every year (Listianingrum et al., 2019).

Twenty to twenty-six percent of people who are admitted with DKA have just been diagnosed with diabetes. Infections and not taking medications as prescribed account for thirty and twenty percent of admissions with DKA, respectively . Also, it has been said that a more intensive treatment plan might have cut death rates. However, diabetes mellitus is still said to be a leading cause of death (Shaltout et al., 2016).

About 79,100 children under 15 years old get T1D every year around the world. When they are diagnosed with diabetes, up to 80% of these young people already have DKA . The number of people who get DKA when they first get diabetes varies a lot from one place to another . In developed countries, the death rate for DKA is between 2% and 5%, and in developing countries, it is between 6% and 24%. The death rate from DKA is higher in developing countries because there are more infections, protein-energy malnutrition, poorer medical services, and people wait longer to get help when they are sick (Atkilt et al., 2017).

When compared to other Middle Eastern countries, Iraq has a medium rate of DM (9.3%). Bahrain has the highest rate of DM in the area (25.7%). Most deaths from DKA are caused by cerebral edoema, but the exact order of events that lead to DKA cannot be predicted in every case . But DKA is a common clinical problem and one of the main reasons why young people with DM die (Abdullah & Alsaffar, 2022).

When they are diagnosed with diabetes, up to 80% of these young people already have DKA. The number of people who get DKA when they first get diabetes varies a lot from one place to another . The number of people with DKA may be affected by things like climate and location. Countries close to the equator have a lot of DKA because their climates are hot, which makes people lose water and get hyperglycemia quickly, especially young children (Hassoon, & Ayoub, 2021).

In people who already know they have diabetes, DKA can be caused by infections, other illnesses, mental stress, and not following their treatment plan. Worldwide, infection is still the most common underlying cause, happening in 30–50% of cases. Most infections are caused by urinary tract infections and pneumonia . Stress, trauma, infections, vomiting, and major mental disturbances, in addition to the first symptoms, are thought to have caused the disorder (Hassoon, & Ayoub, 2021).

If the child's parents know a lot about diabetes, they should follow the "day of illness" rules by looking for signs and symptoms of DKA, increasing insulin doses, and giving the child more fluids before taking the child to the emergency room. Should be cared for at home. This has been shown to make DKA problems less likely. Children with DKA who have just been diagnosed need to stay in the hospital for a short time to control related metabolic problems and start insulin therapy (Alasmari et al., 2021).

If mothers of young children with diabetes are well-educated about it, they can deal with stress at home by following the rule of sick day management, recognising the signs and symptoms of DKA, and increasing insulin dose and water intake before going to the emergency room . This has been shown to reduce the complications of DKA.

1.3. **Statement of the problem**

Diabetic ketoacidosis (DKA) is a [life-threatening complication involving hyperglycemia, ketoacidosis, and ketonuria]. "It happens when a relative or total insulin deficit prevents glucose from entering cells to be used as a metabolic fuel. As a result, the liver rapidly converts fat into ketones for use as a source of energy" (Vicinanza, 2019).

The overproduction of 'ketones causes their accumulation in the blood and urine and acidification' of the blood. DKA "occurs mostly in patients with type 1 diabetes, however it is not uncommon in persons with type 2 diabetes. Polydipsia and polyuria are the most noticeable early symptoms of DKA, as they increase subtly. "Malaise, generalised weakness, fatigability, nausea and vomiting, diffuse stomach discomfort, and decreased appetite are further symptoms" (Al Kaabba et al., 2021).

Diabetes self-management education (DSME) is a key part of caring for people with diabetes. [Education and self-awareness about diabetes have been shown to improve glycemic control and quality of life, especially for type-1 diabetics] (Majumder, 2013).

[DKA can be avoided if people have better access to medical care, get the right health education, and talk to their doctor or nurse when they are sick more than once]. Family members should be encouraged to take part]. They need to be taught how to take insulin and how to measure their blood sugar (Gosmanov & Dillard, 2014). Type 1 diabetes (T1D) is the most common long-term metabolic disease in children'. It causes 5–10% of all diabetes cases around the world" (Zayed, 2016).

[Diabetic ketoacidosis is the most common emergency situation for people with diabetes mellitus (DKA). Surprisingly, it happens more often when seeing type 1 diabetes patients with DKA. [But people with type 2 diabetes have the same chance of getting this bad emergency as everyone else]. "Other than that, it was clear that people with type 2 diabetes who had a DKA were affected by things like surgery, an injury or accident, or an infection" (Al Kaabba et al., 2021; Kitabchi et al., 2019).

[DKA is said to be the cause of more than 100,000 hospital stays in the US every year, and it is mentioned in 4–9% of all hospital discharge summaries for people with diabetes] (Alhowaish, 2013).

1.4. Objectives of the study are to:

1. Assess knowledge of mothers regarding diabetic ketoacidosis among type-1 diabetic children .
2. Assess awareness of mothers about diabetic ketoacidosis among type-1 diabetic children .
3. Find out relationship between knowledge and awareness of mothers regarding diabetic ketoacidosis among type-1 diabetic children .
4. Find out relationship between knowledge and awareness with demographics characteristics.

1.5. Definition of terms

1.5.1. **Knowledge**

Theoretical definition

Understanding or awareness of a topic either by one person or by individuals in general, that gets from experience or study (Ehrlinger & Wöß, 2016)

Operational definition

It is more than information a learned concept that mothers' must encompass in regard to DKA .

1.5.2. **Awareness**

Theoretical definition

Awareness is the state or ability to perceive, to feel, or to be conscious of events, objects, or sensory patterns . In this level of consciousness, sense data can be confirmed by an observer without necessarily implying understanding (Gafoor, 2012).

Operational definition

Ability of mothers to directly know and perceive, to feel, or to be cognizant of DKA.

Chapter Two

Review of Literature

2.1. Historical overview of Type-1 Diabetic Children.

More than 3,000 years ago, the ancient Egyptians mentioned an illness that appears to have been type 1 diabetes. The symptoms were increased urination, thirst, and weight loss. By presenting urine to ants, it was discovered in ancient India that diabetes could be diagnosed using ants. If ants were attracted to the pee, it indicated a high sugar concentration. The ailment was referred to as madhumeha, which means honey urine (Deborah, 2020).

Eventually, Greek physicians also distinguished between diabetes and. The ancient Roman physician Galen mentioned diabetes, but remarked that he had only ever met two people with it, indicating that it was a rather uncommon condition in antiquity. During the fifth century C.E., people in India and China had determined that there was a distinction between type 1 and type 2 diabetes. They observed that type 2 diabetes was more prevalent among overweight, affluent individuals than among others. This may have suggested at the time that these individuals consumed more food than others and were less active (Deborah, 2020).

Currently, the abundant availability of processed foods has lessened the correlation between affluence and overeating, but obesity, diet, and lack of physical activity continue to be risk factors for type 2 diabetes (Popkin, Adair & Ng, 2012).

In the Medieval Ages, people believed that diabetes was a disease of the kidneys, but an English physician discovered in the late 18th century that it was caused by a pancreas damage (Bliss, 2021).

In 1776, Matthew Dobson established that the urine of diabetics might be sweet-tasting. According to an article published in the journal Medical Observations and Inquiries, he analysed glucose levels in diabetics' urine and discovered that they were elevated (Porta, 2020).

Dobson further clarified the distinctions between type 1 and type 2 diabetes by noting that type 1 diabetes is lethal while type 2 diabetes is chronic. During the beginning of the 19th century, there were no statistics on the prevalence of diabetes, there was no effective therapy, and persons typically died within weeks to months after exhibiting their initial symptoms (Deborah, 2020).

2.2. Incidence of Type-1 diabetic children.

WHO has prioritised diabetes as one of four noncommunicable diseases (NCDs). Despite the fact that diabetes covers both type 1 and type 2 diabetes, type 2 diabetes receives more attention due to its common risk factors with other NCDs and greater burden. The World Health Organization projected that 422 million adults had diabetes in 2014, without distinguishing between kinds of diabetes . The definition of type 1 diabetes is absolute insulin insufficiency of unknown origin. It is estimated that type 1 diabetes accounts for around 5–10% of the total prevalence of diabetes, or approximately 21–42 million individuals. However, such assertions are typically based on populations in northern Europe, which have the highest incidence and prevalence of type 1 diabetes . "There are few published incidence and prevalence estimates for type 1 diabetes in adults, as the vast majority of the existing literature focuses on estimates for children and adolescents." Data on the incidence of type 1 diabetes are acquired from incidence registries comparable to those produced for the WHO Diabetes Mondiale (DIAMOND) study and the Europe and Diabetes (EURODIAB) study, including children 0–14 years of age and adopting an uniform case definition (Green et al., 2021).

Type 1 diabetes is an immune-mediated disease characterised by the autoimmunity-mediated death of the insulin-producing -cells in the pancreatic islets due to a hereditary predisposition and environmental influences. A variable duration preclinical period characterised by the formation of autoantibodies linked with diabetes precedes the onset of

clinical symptoms and subsequent diagnosis. Type 1 diabetes is one of the most prevalent chronic childhood disorders, particularly in Finland, where the highest incidence of the condition has been frequently documented. The worldwide prevalence of type 1 diabetes has increased alarmingly, particularly among young children. In the past, this was also the situation in Finland. Between 1980 and 2005, the incidence rate (IR) in Finnish children younger than 15 years of age quadrupled, with the biggest yearly growth of 4.7% in children younger than 5 years of age, and it was expected that the incidence would double again by 2020. However, the rate of growth in certain high-incidence nations slowed between 2004 and 2013, and a plateau in IR was recorded in Finland between 2006 and 2011 (Parviainen et al.,2020).

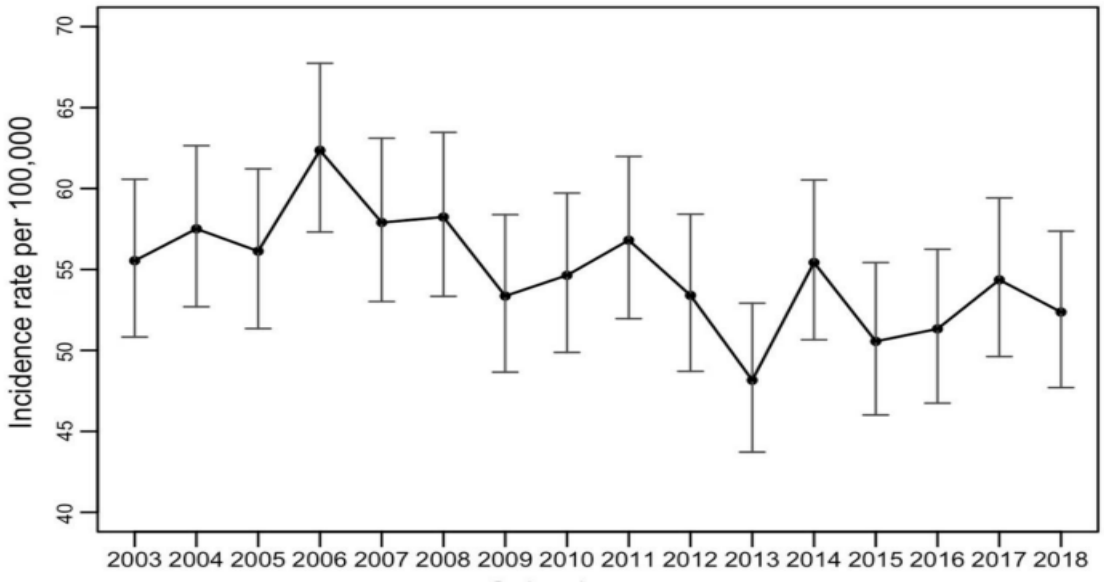

Figure (2-1): The annual incidence rates of type 1 diabetes per 100,000 person years in Finnish children under age 15 from 2003 to 2018 (Parviainen et al., 2020).

Formerly known as insulin-dependent diabetes, type 1 diabetes mellitus is a diverse condition that often manifests throughout childhood and adolescence. The absence of insulin synthesis, which is caused by the death of pancreatic cells, is a hallmark of the syndrome, and it requires patients to receive insulin treatment for the rest of their lives. Diabetes

Epidemiology Research International (DERI), Eurodiab Aetiology of Childhood Diabetes on an Epidemiological Basis (ACE), World Health Organization's Diabete Mondial (WHO DIAMOND), International Diabetes Federation (IDF) Atlas, Search For Diabetes in youth (SEARCH), and the Australian Diabetes Data Network are some of the international study organisations and systematic reviews that have taken an interest in the epidemiology of type 1 diabetes mellitus(Almahfoodhetal.,2017).

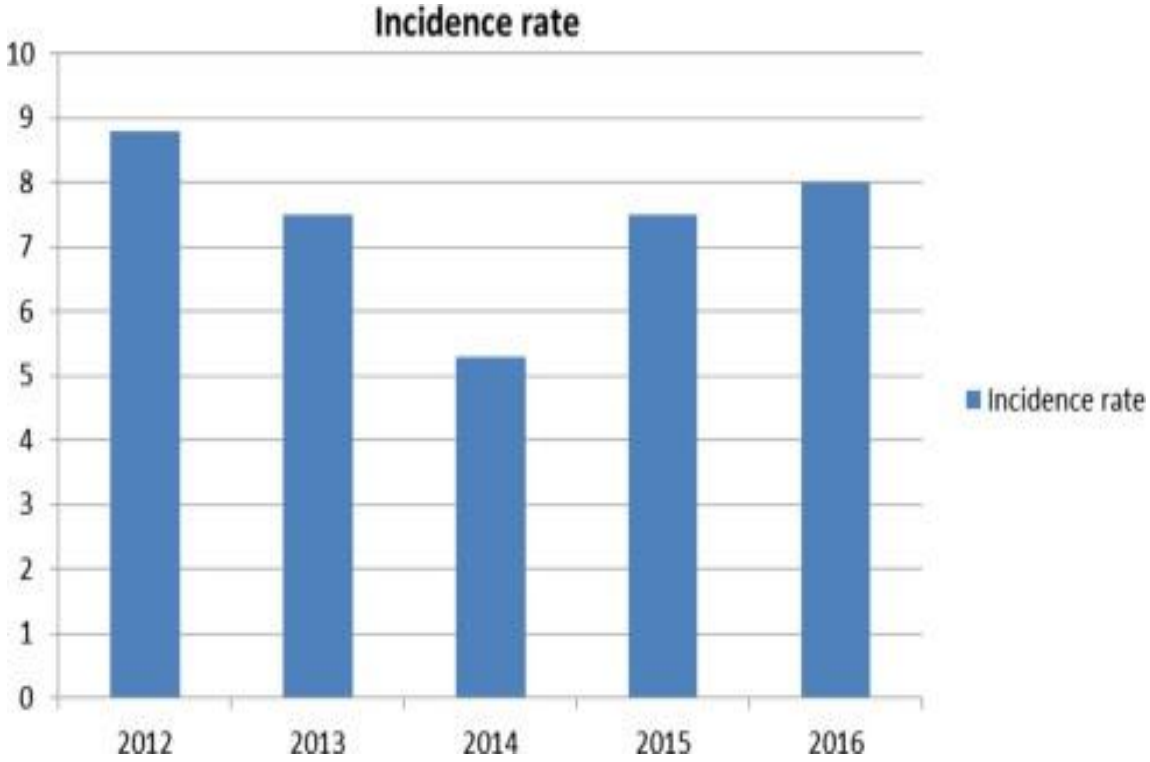

Figure (2-2): Epidemiology of type 1 diabetes mellitus in Basrah, Southern Iraq (Almahfoodh et al., 2017).

Type 1 and type 2 diabetes with beginning during adolescence are significant chronic diseases. People with diabetes diagnosed in childhood are at risk for early complications, comorbidities, and excess mortality, especially those who acquire type 2 diabetes and those from racial and ethnic minorities. The SEARCH for Diabetes in Youth Study found increases in the prevalence of type 1 diabetes and type 2 diabetes from 2001 to 2009, and projected that 187 246 youths in the United States aged 19 or younger had diabetes in 2009. (Lawrence et al., 2021).

Type 1 diabetes mellitus is a heterogeneous disease with many distinct characteristics, but two major pathways can be distinguished based on the presence of either insulin autoantibodies or glutamic acid decarboxylase autoantibodies as the first autoantibody indicating the initiation of the autoimmune process . Many clinical trials targeted at avoiding the beginning of the illness at various stages of the autoimmune process are ongoing or planned (Ilonen, Lempainen & Veijola, 2019).

Furthermore, a person's perception of the condition and its adaption process might be influenced and moderated by their gender. Compared to boys, females are more likely to have a disrupted psychological transition, as evidenced by low life satisfaction, many health complaints, and lower self-rated health and health-related life quality outcomes (Maatta et al., 2013). Varying internalisation and externalisation patterns, in addition to gender-specific puberty experiences, may help to explain this. Moreover, resilience may facilitate the adjustment to poor health situations, resulting in an improved quality of life (Santos, et al., 2018).

Chronic diseases are illnesses that last for at least a year and necessitate continuing medical treatment, a limitation of daily activities, or both. Included among the chronic diseases are arthritis, cardiovascular disease (heart attacks and strokes), cancer (breast and colon cancer), asthma, epilepsy, and seizures. Symptoms of chronic illness can be alleviated via treatment and changes in lifestyle, but none of the most prevalent chronic diseases are curable. Regrettably, the symptoms and illness cannot be totally cured (Elaine, 2019).

Diabetes Type 2 is a disorder in which cells are unable to use blood sugar (glucose) as an energy source. This occurs when cells become insulin-resistant and blood sugar levels rise to dangerously high levels. Type 1 and type 2 diabetes mellitus are both present. In type 2 diabetes, the pancreas continues to produce insulin, but the cells are unable to utilise it

efficiently. Due to the autoimmune loss of insulin-producing beta cells, the pancreas cannot produce insulin in type 1 diabetes (Hockenberry & Wilson, 2018).

In up to 25 percent of patients, the presentation of DMT2 ranges from asymptomatic hyperglycemia in a child who is otherwise healthy, which may be detected by accident, to ketoacidosis. The hyperglycemic non-kenotic hyperosmolar state, which is associated with a high death rate, also poses a threat to these individuals. Diagnosis of DMT2 in adolescents comprises both a diabetes diagnosis and a classification of diabetes type. In the majority of paediatric populations, the prevalence of DMT1 is roughly 10 times higher than the prevalence of DMT2. In the acute context, a DMT1 diagnosis should be made if there is any doubt regarding diabetes subclassifications (Kung-Ting Kao, 2016).

Table (2-1): Characteristic of DMT1 and DMT2 in children and adolescents Kao & Sabin, 2016).

	T1DM	T2DM
Age range	Any age – often young children	More often seen in peri-pubertal and post-pubertal youth
Ethnic distribution	All groups	Increased in certain groups (eg Hispanic, Polynesian, Aboriginal and Torres Strait Islander, Indian and Chinese peoples)
Sex distribution	Equal between sexes	More common in females
Symptom duration	Acute – can be severe	Often insidious – rarely severe
Obesity	As in population	Varies according to ethnicity, but up to 85%
Family history of diabetes	Present in 3–5%	Present in 75–100%
Acanthosis nigricans	12% – can vary in different populations[58]	50–90% – can vary in different populations[58]
Circulating insulin	Usually low	Usually elevated
Ketosis at presentation	More likely to be present	Less likely, but can be present in up to 25%
Islet autoimmunity	Autoantibodies to insulin (IAA), islet cell cytoplasm (ICA), glutamic acid decarboxylase (GAD), tyrosine phosphatase (insulinoma associated) antibody (IA-2 and IA-2β), or zinc channel antibody (ZnT8) are present at diagnosis in 85–98% of patients with T1DM[58,59]	Usually negative, but can be present in up to 10–20% of patients. If present, islet cell antibodies predict a more rapid requirement of insulin and development of other autoimmune disorders.
Associated disorders	Autoimmune disorders such as autoimmune thyroiditis, coeliac disease	Other comorbidities of obesity (eg non-alcoholic fatty liver disease, obstructive sleep apnoea, hyperlipidaemia, polycystic ovarian syndrome)

2.3. Pathophysiology of type-1 diabetic children.

Type 1 diabetes mellitus (T1DM) is caused by the immune system-mediated death of pancreatic -cells. T1DM is caused by a mix of several genetic and environmental variables that vary between patients. Genetic risk is determined by the existence of specific allele combinations that influence T cell recognition and tolerance to foreign and autologous molecules at the primary susceptibility locus (the HLA region). Many additional loci regulate and impact certain immune response characteristics and modify -cell susceptibility to inflammatory mediators. Environmental variables that influence the development of T1DM are less well understood

than genetic factors, but interaction with certain microbes is emerging as a crucial component. Some infections may impact immune regulation, and commensal bacteria, such as the gut microbiota, play an essential role in the development of the immune system. Other evidence indicates that nutritional issues are also significant. From weeks to twenty years before the development of clinical disease, several islet-specific autoantibodies are detected in the blood, and this pre-diabetic phase presents a potential chance to regulate the islet-specific immune response to prevent or postpone -cell loss. Understanding the variability of T1DM and identifying the different subgroups of the illness may facilitate the development of preventative interventions (Ilonen, Lempainen & Veijola, 2019).

Type 1 diabetes (T1D) is characterised by the selective loss of insulin-producing beta cells from the islets of Langerhans in the pancreas, necessitating lifelong administration of exogenous insulin. It is now known that the disease affects people of all ages, despite the fact that it was formerly believed to affect young people primarily. As a result, it is possible that a substantial proportion of elderly people with T1D have been misdiagnosed with Type 2 diabetes (T2D). These two data suggest that the prevalence of T1D may be more than previously estimated (Lernmark, 2016).

Type 1 diabetes is caused by a mix of genetic, immunological, and environmental factors that, as noted in recent extensive studies, are poorly understood, Specifically, environmental influences have been difficult to identify; however, studies dating back to the 1960s have implicated viral infection, especially by human enteroviruses (HEV; single-stranded RNA (+) viruses from the picornavirus family), as a potentially important factor in both the initiation of islet autoimmunity and the onset of clinical disease. Supporting this, a 2011 meta-analysis of 26 earlier studies found that enteroviral infection was 3.7 times more frequent in individuals

with islet autoimmunity and 9.8 times more prevalent at the beginning of disease compared to matched controls. Since then, other investigations have supported this notion. Particularly, a number of large prospective cohort studies have shown evidence that enterovirus infections are more frequent before the emergence of islet autoantibodies. Recent analysis of unique pancreatic biopsies from Norwegian individuals with T1D indicated considerable evidence for the presence of HEV and enhanced islet antiviral responses in newly diagnosed patients. In addition, increasingly sensitive technologies to detect or analyse viral infection and antiviral responses in blood, islets, faeces, and other tissues are being developed. Presently, they are being used in new collaborative projects combining several facilities utilising varied expertise and complementary technologies to study blinded tissue samples from the Pancreatic Organ Donors with Diabetes Network. It is hoped that further investigations will provide additional evidence for the enteroviral hypothesis in T1D (Lernmark, 2016).

The genetic aetiology of type 1 diabetes is dominated by the influence of certain HLA haplotypes involving the class II DR-DQ region . In genetically susceptible children with the DR4-DQ8 haplotype, unknown external stimuli are believed to initiate an autoimmune response against insulin, which is signalled by insulin autoantibodies as the first autoantibodies to develop. In children with the DR3-DQ2 genotype, GAD autoantibodies (GADA) serve as the first-appearing autoantibody that initiates the triggering reaction. During the first few years of life, the incidence rate of insulin autoantibodies as the first-appearing autoantibody reaches its peak and then falls. The incidence of GADA as the first-appearing autoantibody reaches its peak later but does not drop. In an apparently non-HLA-associated pathophysiology, the first autoantibody may be followed by a second, third, or fourth autoantibody. Although not all individuals with a single kind of autoantibody develop diabetes, the

presence of numerous autoantibodies appears to usually be followed by loss of functional beta cell mass, dysglycaemia, and eventually symptoms. Infiltration of mononuclear cells into and around the islets appears to be a late occurrence in multiple-autoantibody-positive individuals with hyperglycemia (Regnell & Lernmark, 2017).

Many indicators suggest that dietary factors during the perinatal period, lactation, infancy, and childhood may play a role in the aetiology of type 1 diabetes. Cow's milk consumption has been connected with an elevated risk of preclinical and/or clinical type 1 diabetes and sugars with the progression of disease from preclinical to clinical stages. On the other hand, breast milk may be protective. Due to their higher levels of advanced glycation end products, processed foods may be associated with an increased risk of type 1 diabetes. The presence of nitrites or N-nitroso compounds in processed meat may enhance the chance of contracting this condition. N-3 fatty acids, vitamins D and E, and zinc are nutrients that may protect against preclinical and/or clinical type 1 diabetes. The microbial makeup of foods or other effects of foods on gut microbiota are gaining increased interest, presumably due to their role in the onset of type 1 diabetes . Nonetheless, there are few prospective studies in this field of study, and the majority of the findings must be repeated (Virtanen, 2016).

Environmental variables play a significant influence in the aetiology of type 1 diabetes and can determine whether a genetically vulnerable person develops the condition . There is growing evidence that some virus infections, among other external agents, can contribute to the process of beta-cell destruction. Much research has been conducted on the potential viral aetiology of type 1 diabetes, but definitive proof of causality is still absent . The group of enteroviruses (EVs) is currently regarded the strongest candidate. Epidemiology studies indicate that diabetics are more susceptible to EV infection than healthy controls, and these viruses have

been detected in the pancreas of type 1 diabetes patients. Prospective studies, such as the Type 1 Diabetes Prediction and Prevention (DIPP) project in Finland, are vital to the evaluation of viral impacts because they can incorporate all phases of the beta-cell degradation process, including those before the disease's manifestation. Prospective studies, such as Finland's Type 1 Diabetes Prediction and Prevention (DIPP) project. Using prospective cohorts, the DIPP research conducted the most extensive virological examination yet conducted (Hyoty, 2016).

2.4. Clinical features of Type-1 diabetic children.

Patients had their medications and medical records evaluated, and their eyes were examined. Diabetic onset, age, and Hba1c values were reported. The subject's eyesight was tested at a distance of 4 meters using an ETDRS chart. A noncontact tonometer was used to assess IOP (Topcon CT-80A, Japan). Each patient had a slit-lamp biomicroscopy and an indirect dilated binocular ophthalmoscopy using a +90 D condensing lens. Retinal swelling (including macular edema), exudates (pale, fatty deposits on the retina), cotton-wool patches (damaged nerve tissue), and neovascularization (changes to the blood vessels) are diagnostic of DR. The Schirmer test and the break-up time of the tear film (BUT) verified the presence of dry eye. "The cornea and conjunctiva were looked at under a slit lamp. A complete blink followed by the appearance of dry spots in a fluorescein-stained tear

film within 10 seconds was considered abnormal (Akil et al., 2016). A history of respiratory tract infection (48%), dyspnea (48%), sunken eyelids (24%), and polyphagia (21%), together with polyuria (96%), polydipsia (92%), dry lips (81%), body weight loss (79%), nocturia (77%), and polyuria (21%) were the most prominent early clinical symptoms in children aged 6 years. Clinical outcomes did not substantially differ between children aged 6 and those aged 6-18 . Although there were

statistically significant variations in the prevalence of dry lips (81% vs 63%), the frequency of prior respiratory tract infections (48% vs 22%), and dyspnea (46% vs 22%, p 0.05) (Chen et al., 2017).

2.5. Diagnosis of Type-1 diabetic children.

HbA1c is a proxy for a patient's average blood glucose levels during the previous three months. HbA1c levels of 7.5% or 58 mmol/mol are advised; greater HbA1c levels suggest inadequate glycemic management (Goethals, et al., 2017). Diabetic ketoacidosis (DKA) was diagnosed with a pH of 7.3, hyperglycemia, ketonemia and/or ketonuria, and a bicarbonate level of 15mM in the blood. Full histories, including family histories, and physical examinations were documented for all T1DM patients at the time of diagnosis. Blood glucose, glycated haemoglobin (HbA1c), ketone bodies, serum sodium, potassium, chloride, blood gas analysis, antiglutamic acid decarboxylase 65 autoantibodies (GADA), anti-insulinoma antigen-2 autoantibodies (IA-2A), insulin autoantibodies (IAA), and C-peptide levels at glucagon test were all performed upon diagnosis. C-peptide levels were measured using commercially available kits, while the conventional procedure for a 6-minute glucagon test was followed. As reported before, islet-cell autoantibodies including GADA, IA-2A, and IAA were measured (Chen et al., 2017).

Diabetes mellitus is diagnosed on the basis of one of the following four abnormal glucose metabolism symptoms: Several instances of 126 mg/dL (7 mmol/L) of fasting plasma glucose". "Fasting is defined as not consuming any calories for a minimum of eight hours. 200 mg/dL (11.1 mmol/L) random venous plasma glucose in a patient with characteristic hyperglycemic symptoms". Two hours after a glucose load of 1.75 g/kg) maximum dosage of 75 g) during an oral glucose tolerance test, plasma glucose is 200 mg/dL (11.1 mmol/L. (OGTT). Thus, OGTT is rarely necessary to diagnose type 1 diabetes in children and adolescents.

Glycated haemoglobin (A1C) under 6.5% (using an assay that is certified by the National Glycohemoglobin Standardization Program). Hyperglycemia should be utilised to validate this diagnostic criteria for type 2 diabetes mellitus (T2DM) in adults (Levitsky & Misra, 2018).

These diagnostic criteria are similar to those used to diagnose people with diabetes, and are based on recommendations from the American Diabetes Association (ADA). Clinical hyperglycemia should be confirmed by further testing if there is any doubt about the first results. The average blood sugar levels during the past 10–12 weeks are revealed by the A1C test, which measures the proportion of haemoglobin A bound to glucose by non-enzymatic glycation. The A1C cutoff for diagnosing diabetes in adults is currently 6.5%. Yet, A1C's diagnostic significance in kids is less proven than in adults. Diagnosing diabetes in adults requires an A1C level of 6.5%; nevertheless, a score of 6.5% does not rule out diabetes. The A1C levels of children with transient hyperglycemia ranged from 4.5 to 6.10%, whereas those with symptomatic, new-onset T1DM had levels of 6.35%. A1C readings may not be a reliable indicator of typical blood sugar levels in those with abnormal haemoglobins or fast red blood cell breakdown (Levitsky & Misra, 2018).

2.6. Management of Type-1 diabetic children.

To the parents and carers of diabetic children, The management of diabetes requires constant monitoring of glucose levels. Continuous glucose monitoring (CGM) is widely accepted as beneficial for children with diabetes . There is a dearth of peer-reviewed literature demonstrating a link between CGM usage and better glycemic control in children . There was no statistically significant difference in the rate of decline in glycated

haemoglobin (HbA1c) levels between the intervention and control groups (JDRF) in the CGM trial. Several studies have shown a decrease in HbA1c values in mixed adult and paediatric cohorts or have limited their sample size to insulin pump users," The importance of supplying standardised CGM data with HbA1c has increased, and with it, the importance of time in target range results for speeding awareness of the hurdles to better glucose management. The goal of this study was to examine the relationship between SMBG and TIG in children and adolescents (4-17 years old) with type 1 diabetes utilising the flash glucose monitoring device (Campbell et al., 2018).

Insulin therapy is the cornerstone of type 1 diabetes medical management. There are numerous insulin regimens available, but few have been examined in children with newly diagnosed diabetes . Many factors, including the child's age, length of diabetes, family lifestyle, school support, socioeconomic considerations, and family, patient, and physician preferences, influence the choice of insulin regimen. All children should be treated to reach glycemic objectives, regardless of the insulin regimen used. All children with type 1 diabetes should be counselled by a licenced dietician with paediatric diabetes expertise. Children with diabetes should consume a healthy diet, as suggested in Canada's Food Guide for children without diabetes. This requires ingesting foods from the four food groups (grain products, vegetables and fruits, milk and alternatives, and meat and alternatives). Hypoglycemia is a significant barrier for children with type 1 diabetes and can hinder their ability to reach glycemic goals. Children with type 1 diabetes diagnosed at a young age are at the highest risk for cognitive dysfunction and neuropsychological deficits, but the effects of hypoglycemia and hyperglycemia in their development remain unclear (Wherrett et al., 2018). All kids, even those with diabetes, don't get enough exercise. More exercise is linked to more efficient metabolic control. Programs that encourage more physical activity have been shown to lower

A1C by 0.5 percentage points, according to recent systematic reviews and meta-analyses. Getting an annual flu shot has long been recommended for children with type 1 diabetes by national guidelines. There is no evidence that influenza is increasing the risk of hospitalization or mortality in children with type 1 diabetes at this time. Nonetheless, sickness can complicate type 1 diabetes treatment, so parents should be informed of how to handle sick days and provide extra care when their child is unwell. This is one reason why parents could opt to vaccinate their kids (Wherrett et al., 2018).

Children who develop chronic diseases during childhood may react differently from adolescents who develop chronic conditions. The largest impact on school-aged youngsters will result from their inability to attend class and form friendships with their peers. Despite avoiding overprotection, parents should foster their adolescents' self-reliance within their capacities. Teenagers should struggle with their incapacity to reach independence if they require assistance from parents and others for many of their daily needs; Adolescents are at an age where being similar to their peers is crucial, thus it is particularly difficult for them to be perceived as different (Mitchell, 2020).

Living with a chronic illness, when profound bio-psychosocial changes occur, presents young people with an entirely new set of complex challenges, such as understanding daily habits and functioning, adopting healthier lifestyles, tracking symptoms, and coping with confusion about the disorder's prognosis. It is a stressful experience that can affect many dimensions of adolescents' life, including adjustment across multiple domains, as well as cognitive control, emotional regulation, behavioural regulation, physiologic regulation, and social interaction. Thus, a chronic disease in adolescence might threaten psychological development, resulting in greater adjustment difficulties, poor health-related quality of life (HRQoL), and a negative influence on overall life quality (QoL). In

addition, the diagnosis, rehabilitation, and ongoing management of chronic illness are traumatic for children, families, and healthcare professionals. Thus, this population is disadvantaged and may be more prone to adverse health effects (Santos, et al., 2018).

Chronic disease management is essential for patients to reduce symptoms, enhance health outcomes, avoid further disability, and save money on healthcare. One aspect of chronic disease treatment is adherence to therapy, or the capacity of patients to follow their healthcare provider's agreed-upon criteria for prescribed medications. In contrast, only fifty percent of people with chronic illnesses take their medications as prescribed, making medication adherence a public health risk (Fernandez-Lazaro et al., 2019).

Based on the evaluation and quantification methodologies employed, medication adherence in Middle Eastern nations ranges from 1.4% to 88.8%. Recent findings from diabetic patients in Kuwait indicate that disease awareness, a large gap between therapeutic aims, misconceptions about medications and diabetes, attitudes towards diabetes, views of self-expertise with the condition, and societal stigma all influence medication adherence. According to statistics, people with hypercholesterolemia who have many comorbid diseases adhere to statin therapy better. In addition, a study in Kuwait that examined the effect of health attitudes on medication adherence among depressed patients revealed that patients who intended to take their medications or who believed that depression was best treated with medication had a higher rate of medication adherence (Lemay et al., 2018).

While it demands patients and their families to adhere to a set of behavioral recommendations, stress may be one of the most prevalent chronic illnesses among young adults e.g., blood glucose control, insulin therapy. Nonadherence can have both immediate and long-term effects on health. Through their active and direct involvement in DMT2 management

(i.e., diabetes-specific parental regulation) and the consistency of their more general parenting style as indicated, for example, by the dimensions of parental responsiveness and psychological control, parents play a crucial role in adherence to care (Goethals, et al., 2017).

Parenting style is defined as a collection of parents' attitudes and behaviours towards their children and adolescents, as well as the emotional context in which these attitudes and behaviours manifest. Adolescence is a crucial developmental stage in which parents and adolescents must reevaluate their relationships (Bi et al., 2018).

In a second study conducted in Tilburg, the Netherlands, a more attentive parenting style was associated with lower levels of haemoglobin A1c (Hba1c) in boys. Children who were not hospitalised for ketoacidosis had a more aware parenting style. A more mindful parenting style was associated with better overall and diabetes-specific proxy-reported quality of life in both boys and girls with diabetes. Finally, attentive parenting can play a role in helping teenagers manage T1DM (Serkel-Schrama et al., 2016).

Family support for diabetes care (especially for daily disease management duties) is associated with increased adherence and, ultimately, better metabolic control. In order to engage the child and facilitate positive conversations on measuring carbohydrate consumption and maintaining a balanced diet, parents must be flexible during mealtimes and in their interactions with their child and avoid becoming overly judgmental. By creating opportunities for open communication, the kid and parent will be able to discuss the child's priorities and areas for increasing diabetes management monitoring (Nabors et al., 2015).

2.7. Complication of Type-1 diabetic children.

Family members with diabetes may experience serious repercussions. More than 2,000 family members of patients with type 1 or DMT2 participated in one study, and it was discovered that a third of the

participants thought that having diabetes was a significant burden and had a detrimental influence on their mental health, financial status, leisure time, and physical health. According to a recent poll, more than half of mothers of teenagers with DMT1 had to reduce their work hours or change careers. Diabetes medications can be out of reach for many families, especially in low- and middle-income nations with restricted access to and coverage of healthcare. The cost of insulin and blood glucose management alone will consume half of a typical family's disposable income in many of these nations. Diabetes and other chronic diseases can have a negative economic impact on families through indirect costs including job capacity effects for patients and family members (Diabetes, 2018).

The importance of a planned pregnancy should be understood by teenage girls with diabetes. Congenital abnormalities, preterm birth, and foetal mortality are among risks associated with poor glucose control during pregnancy. Preconception counselling and education should start well before there is a chance of conception, with a focus on maintaining ovulation even in the context of suboptimal metabolic control and irregular monthly cycles. Understanding the significance of excellent glycemic control prior to pregnancy, with an emphasis on the risks to the developing embryo and baby, as well as the importance of excellent glycemic control during pregnancy in preventing foetal macrosomia and neonatal hypoglycemia as well as maternal hypoglycemia and ketoacidosis, as well as the significance of excellent glycemic control prior to pregnancy, with a focus on the risks to the developing embryo and baby (Delamater et al., 2018).

Several age-related factors affect how diabetes complications are monitored and investigated. Puberty raises the likelihood of microvascular issues developing. According to an observational study, diabetic nephropathy, retinopathy, peripheral neuropathy, arterial stiffness, hypertension, and cardiovascular disease affected 5.8% of children with

type 1 diabetes who had a mean duration of 7.9 years (Wherrett et al., 2018).

2.8. Diabetic ketoacidosis in children.

Diabetic ketoacidosis (DKA) is a complication of type 1 diabetes mellitus caused by inadequate insulin production (T1D). Decreased insulin secretion leads to hyperglycemia and osmotic diuresis due to increased gluconeogenesis, glycogenolysis, lipolysis, and muscle proteolysis. Ketogenesis, the process through which ketones are produced and released into the circulation, is induced when counter-regulatory hormone levels rise. The subsequent release of hydrogen ions from the dissociation of these entities causes severe acidosis. It's been said that "hyperglycemia, ketoacidosis, and dehydration" sum up this medical condition. Effective therapies include insulin replacement, water replacement, and electrolyte replacement. Reduced rates of DKA and complications including cerebral edoema in children may result from better means of early identification, management, and prevention. Yet, new pharmacologic and technological advances in the management of type 1 diabetes (T1D) have the potential to increase the frequency of diabetic ketoacidosis (DKA) (Castellanos et al., 2020).

The most common acute consequence of paediatric diabetes is still diabetic ketoacidosis (DKA), which is mostly avoidable. Whether based on its typical brief hospital stay and extremely low inpatient mortality, juvenile DKA has been turned by improved care into a comparatively mild consequence at a community level in the US. Applying institute-specific DKA management guidelines derived from consensus statements from organisations like the American Diabetes Association, the International Society of Pediatric Adolescent Diabetes, the European Society of Paediatric Endocrinology, and the Pediatric Endocrine Society has contributed to the country's improved healthcar. However, there is variation in how the illness is managed, and hospitalised patients are

commonly admitted to the intensive care unit (ICU), which comes with hazards and, though it's rare, can have life-threatening complications. The health-related costs and economic costs of DKA go beyond hospital discharge as well (Kalla Vyas & Oud, 2021).

Hyperglycemia (RBS > 200 mg/dL), severe anion gap metabolic acidosis (pH 7.3 and/or HCO3 15 mmol/L), and ketonemia (Beta-hydroxybutyrate > 3) are the symptoms of diabetic ketoacidosis (DKA), a life-threatening emergency. The basics of management include replacing any lost fluids, increasing insulin levels, and avoiding complications such cerebral edoema, electrolyte imbalances, and acute kidney injury (AKI). The discovery of insulin therapy, which has reduced mortality, was the biggest advance in the treatment of DKA. On the basis of fresh evidence, the dose range has changed throughout time. From 1923 through 1940, high dose insulin therapy predominated, with little attention paid to fluid management. Similar to this, there has been considerable discussion on the type and quantity of fluid, which has resulted in changes to management protocols, with minor variances among the numerous guidelines published by various societies. Since its introduction in 1972, low-dose insulin infusions combined with vigorous fluid resuscitation have become increasingly and more popular. The main causes of death in children with newly diagnosed type 1 diabetes mellitus still remain delayed diagnosis, poor pre-referral care, and the emergence of complications such cerebral edoema and AKI, particularly in poorer nations. The foundation of DKA management is routine blood gas, blood glucose, and electrolyte monitoring to ensure proper fluid, insulin, and fluid glucose content titration (Ravikumar & Bansal, 2021).

2.9. Incidence and prevalence of diabetic ketoacidosis in children.

The prevalence of type 1 diabetes has increased globally, with the highest annual increases occurring in children under the age of five. In

the Silesia region of Poland, incidence rates increased by a factor of 3.80, with the greatest annual increases occurring among children aged 5 to 9. Diabetic ketoacidosis may develop in newly diagnosed type 1 diabetes (T1D) patients who are insulin-deficient for an extended period (DKA). Previous research indicates that between 12.8% and 80% of newly diagnosed diabetics develop DKA. DKA is a potentially deadly acute complication caused by cerebral oedema, which occurs in between 0.3% and 1% of newly diagnosed individuals. Many studies have shown the possibility of modest brain injury in the absence of clinically apparent cerebral oedema (Szypowska et al., 2016).

According to Cameron et al., the frontal lobes of the brain of the youngest children with the most severe DKA exhibit the most significant alterations. These brain alterations are associated with enduring shifts in attention and memory . Also, the admission of a child with DKA increases the cost of treating diabetes. The average additional medical costs associated with a single episode of DKA for privately insured Americans. Parents' ignorance of hyperglycemia symptoms may contribute to the prevalence of diabetic ketoacidosis (DKA) at the onset of diabetes. A decreased incidence of diabetic ketoacidosis (DKA) is associated with having a diabetic first-degree relative. Yet, it appears that the knowledge of medical professionals regarding the signs and symptoms of diabetes is a crucial role in preventing DKA (Szypowska et al., 2016).

DKA is the leading cause of morbidity and mortality among children. This increases the likelihood of cognitive impairment and cerebral edoema. DKA patients had a greater frequency of cerebral edoema (12.4 per 1000 episodes) than DM patients without DKA, according to a study (3.8 per 1000). Mortality (24%) and morbidity (35%) are both elevated. In addition, DKA facilitates a crisis in terms of medical costs, lost workdays, and missed school days. Hospitalization due to diabetic ketoacidosis might cost between $4,125 and $11,968 USD. In cases with established diabetes,

patients with a younger age (5 years), infections, insulin omission, a lower socioeconomic status, and less parental education were more likely to develop DKA. In Ethiopia, little study has been conducted on the prevalence and risk factors of diabetic ketoacidosis in children, despite the increase in diabetes. Our research aims to bridge this information gap (Assefa et al., 2020).

2.10. Pathophysiology of diabetic ketoacidosis in children.

The DKA results in aberrant glucose, protein, and lipid metabolism as well as fluid and electrolyte homeostasis. In the context of increased counter-regulatory stress hormones such as glucagon, adrenaline, norepinephrine, cortisol, and growth hormone, the underlying pathogenetic mechanism is a decrease in the net effective action of circulating insulin. The elevated glucagon level plays a significant role in the pathophysiology of diabetic ketoacidosis (DKA), but it is not essential for the development of this illness (Nyenwe & Kitabchi, 2016).

Insulin exerts a variety of effects based on its concentration in circulation; at extremely low concentrations, insulin inhibits lipolysis and halts ketone formation. Insulin promotes the absorption of glucose into cells, inhibits glycogenolysis, and accelerates glycogen synthesis at increasing doses. Hence, if insulin is absent or if concentrations of counter-regulatory hormones – cortisol, catecholamines, or glucagon – are elevated, such as during acute sickness, glucose levels will rise.

The most frequent causes of this potentially fatal syndrome are infection, concurrent sickness, poor adherence to recommended treatments, and technological failure, such as a malfunctioning pump or faulty injection device. In some places, depending on family history and ethnicity, up to fifty percent of occurrences of diabetic ketoacidosis (DKA) are attributable to type 2 diabetes. According to additional reports, the issue is care fragmentation and lack of continuity (Dhatariya, 2019).

Diabetic ketoacidosis is caused by a shortage of insulin in circulation and high levels of counter-regulatory hormones, such as glucagon, catecholamines, cortisol, and growth hormone. When the concentrations of counter-regulatory hormones increase dramatically in response to stress, infection, or insulin insufficiency, relative insulin deficiency ensues. The combination of absolute or relative insulin deficiency and high concentrations of counter-regulatory hormones results in an accelerated catabolic state characterised by increased glucose production by the liver and kidney (via glycogenolysis and gluconeogenesis) and impaired peripheral glucose utilisation, resulting in hyperglycemia and hyperosmolarity; increased lipolysis and ketogenesis, resulting in ketonemia and metabolic acidosis. Hyperglycemia and hyperketonemia result in osmotic diuresis, dehydration, and irreversible electrolyte loss. Acidosis is contributed to either hypoperfusion or sepsis-induced lactic acidosis. DKA occurs in a vicious cycle of life-threatening events, such as hyperglycemia, hyperketonemia, osmotic diuresis, severe vomiting, dehydration, and subsequent loss of electrolytes, increased stress hormone release, and deteriorating insulin resistance. If exogenous insulin, fluid, and electrolyte therapy were not delivered, it would lead to fatal dehydration, hypoperfusion, and metabolic acidosis (Raghupathy, 2015).

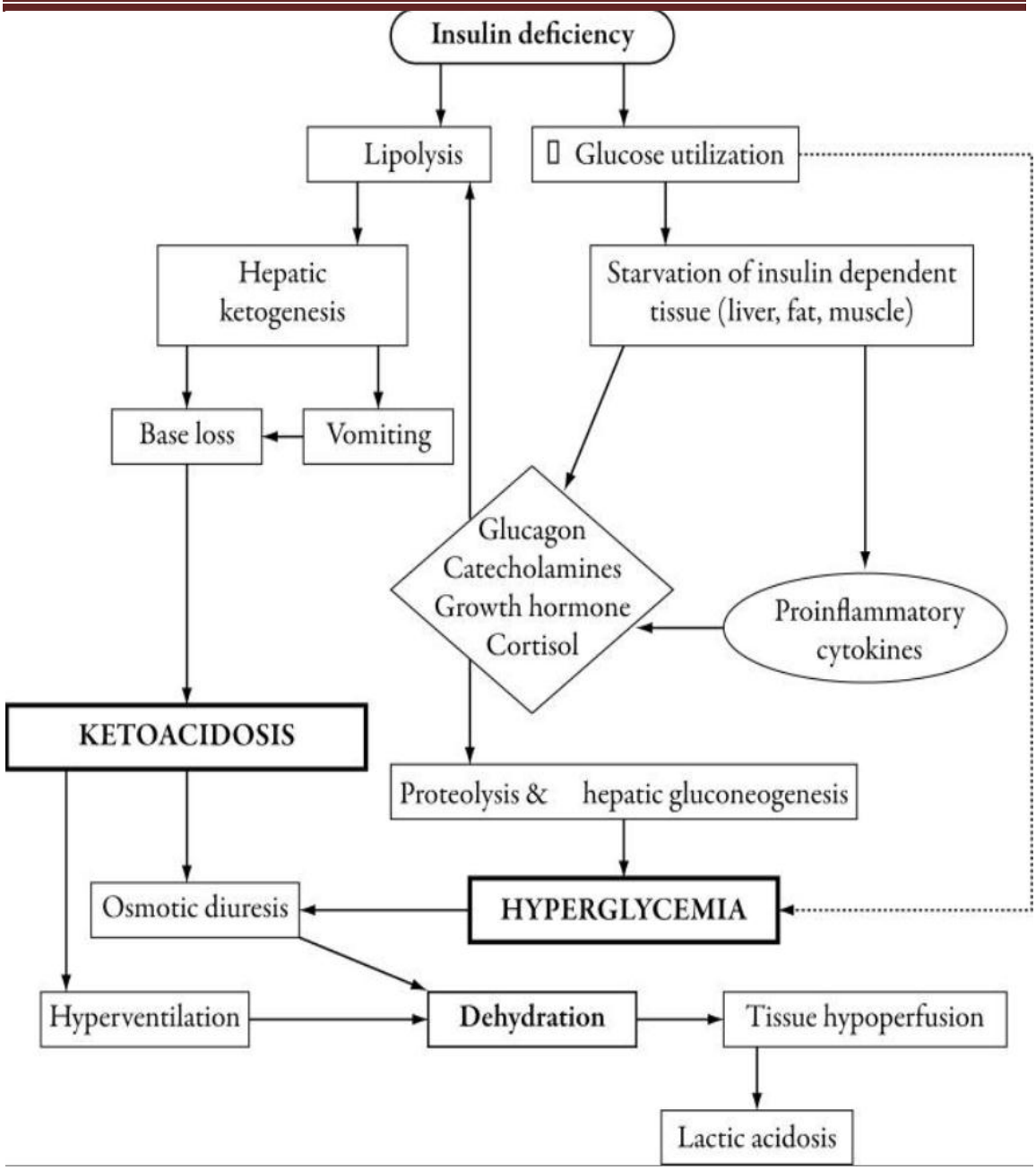

Figure (2-3): The pathophysiology of diabetes ketoacidosis (Rosenbloom, 2010).

2.11. Clinical features of diabetic ketoacidosis in children.

DKA develops swiftly over a short period of time, typically hours, and individuals may be unaware that they have the disease. Typical hyperglycemic symptoms include polyuria, polydipsia, polyphagia, and weight loss. Additional symptoms include vomiting, abdominal pain, dehydration, weakness, and, in severe cases, mental state changes. During physical examination, indicators of dehydration include low skin turgor, Kussmaul respirations, and tachycardia (Nyenwe & Kitabchi, 2016).

DKA is characterised by hyperglycemia that is out of control, ketosis, and ultimately metabolic acidosis. Figure 22-4 depicts how a "variable constellation of non-specific systemic signs and symptoms," such as polyuria, polydipsia, weight loss, tiredness, vomiting, and stomach discomfort, can lead to disorientation, coma, and death if left untreated. Diagnostic delays are common since the earliest symptoms are often puzzling (Rugg-Gunn, Deakin, & Hawcutt, 2021).

The diagnosis of diabetic ketoacidosis in children was based on clinical history (polyuria/polydipsia, weight loss, abdominal pain, weakness, vomiting, and confusion), clinical signs (dehydration, kussmaul breathing ketotic smell, lethargy and drowsiness), and biochemistry (hyperglycaemia (>11mmol/l), acidaemia (ph7.3), ketosis (blood ketones >3mmol/ (Rugg-Gunn, Deakin, & Hawcutt, 2021).

Clinical manifestations of "DKA" include: dehydration (which can be hard to detect), tachycardia, tachypnoea (which can be mistaken for pneumonia or asthma), deep sighing (Kussmaul) respiration with a characteristic smell of ketones in the breath (variously described as the odour of nail polish remover or rotten fruit), nausea, vomiting (which can be mistaken for gastroenteritis), abdominal pain, and a (which can mimic an acute abdominal condition), Younger age (2 years), delayed diagnosis, and lower socioeconomic level with restricted access to medical treatment are risk factors for DKA in newly diagnosed patients. Risk factors for diabetic ketoacidosis (DKA) in patients with known diabetes include insulin omission, poor metabolic control, previous episodes of DKA, acute gastroenteritis with persistent vomiting and inability to maintain hydration, psychiatric (including eating) disorders, challenging social and family circumstances, pubertal and adolescent girls, those with limited access to medical services, and insulin pump therapy failure (Raghupathy, 2015).

2.12. Diagnosis of diabetic ketoacidosis in children.

The biochemical diagnostic criteria for DKA include hyperglycemia (blood glucose [BG] >11 mmol/L or 200 mg/dL) with a venous pH 7.3 and/or a bicarbonate (HCO3) level 15 mmol/L; ketonemia and ketonuria. Blood -hydroxybutyrate concentration should be tested whenever possible; a reading of 3 mmol/L indicates DKA. Ketones of considerable to substantial size (usually >2+) in the urine are also diagnostic of DKA. The degree of acidity categorises the severity of DKA: Moderate DKA is characterised by a venous pH of 7.2 and/or an HCO3 level of 10 mmol/L, while severe DKA is described by a venous pH of 7.1 with or without an HCO3 level of 5 mmol/L. (Raghupathy, 2015).

The onset of diabetic ketoacidosis is a life-threatening emergency for those with type 1 diabetes mellitus (T1D)P. (DKA). Blood glucose levels >11 mmol/l (200 mg/dl), a Venous PH of 7.3 or a bicarbonate level of 15 mmol/L, ketonemia, and ketonuria constitute the diagnostic criteria for DKA according to the International Association for Pediatric and Adolescent Diabetic. Treatment, monitoring, and vigilance are required for various metabolic anomalies and outcomes in people with DKA, making it a medical emergency. In children and teenagers with newly diagnosed diabetes, it is the leading cause of mortality and permanent impairment (Atkilt, Turago & Tegegne, 2017).

2.13. Management of diabetic ketoacidosis in children

Using the Holliday-Segar formula and 0.9% sodium chloride without added glucose, the British Society for Paediatric Emergency Medicine and the National Institute for Health and Care Excellence (NICE) recommend the following fluid maintenance requirements: 100 mL/kg for the first 10 kg (0-10 kg body weight), 50 mL/kg for the second 10 kg (10-20 kg body weight), and 20 mL/kg for each subsequent kilogramme (>20 kg body weight). Unless the child or young person is in shock, initial bolus

volumes should be removed from the overall fluid deficit when determining the total fluid replacement (Raghupathy, 2015).

Unless the patient is anuric or hyperkalemic, 40 mmol/L potassium chloride should be added to all fluids (after the initial IV bolus) given to replace insulin and electrolytes. Include if hypokalaemia is present at presentation, 0.9% sodium chloride should be used without added glucose unless plasma glucose is 14 mmol/L; initial assessment for hyponatraemia; continued monitoring throughout treatment; and treatment as soon as blood glucose falls if hypokalaemia is present at presentation. Always monitor salt levels during therapy, and do an initial calculation to rule out hyponatraemia. As soon as blood sugar levels begin to drop, treatment should begin. Patients with DKA should receive a soluble insulin infusion of 0.05 to 0.1 units/kg/hour, 1 to 2 hours after intravenous fluids have been started, unless they have compromised cardiac contractility due to life-threatening hyperkalaemia or severe acidosis and you have discussed this with a paediatric intensivist (Rugg-Gunn, Deakin, & Hawcutt, 2021).

Unless the patient has severe DKA or is a teenager, BSPED recommended a rate of 0.05 units/kg/hour. Before starting intravenous insulin therapy, disconnect them if they are already hooked up to a "continuous subcutaneous insulin infusion. Those receiving long-acting insulin for the first time should be evaluated for the addition of long-acting subcutaneous insulin. While NICE classifies DKA into two categories based on severity, BSPED distinguishes between levels of severity (a, b, and c) to better guide fluid replacement. When a child or teenager was using basal insulin before to DKA, the NICE guidelines "indicate that subcutaneous basal insulin may be maintained in collaboration with a diabetes expert (Rugg-Gunn, Deakin, & Hawcutt, 2021).

When estimating fluid deficit, there is a disparity between the maximum weight specified by the recommendations and the actual weight. The difference in deficiency fluids might be up to 1850 mL (5%75

kg=3750 mL for NICE versus 7%80 kg=5600 mL for BSPED), given that the maximum weight considered for each is 75 kg for NICE and 80 kg for BSPED. A bolus of 0.9% sodium chloride (10 mL/kg) should be given to individuals who are clinically dehydrated but not in crisis at arrival. A 60-minute or 30-minute (NICE) session is recommended (BSPED). The overall fluid deficit takes this volume into consideration. NICE advises including a paediatrician experienced in DKA management when giving more than one intravenous bolus. Only after reevaluating the patient's clinical situation can a second bolus be considered in order to increase tissue perfusion. The initial disagreement between the two guidelines derives from a careful balance between increasing the risk of osmolar shift attributable to quick fluid delivery and the danger of dehydration and subsequent CO due to delayed fluid administration. Both NICE and BSPED suggest an intravenous 0.9% sodium chloride bolus dosage of 20 mL/kg in the treatment of hypovolaemic shock. Inotropes should be administered as quickly as possible, according to NICE, whereas BSPED advises repeated infusions over 15 minutes up to a maximum of 40 mL/kg (Rugg-Gunn, Deakin, & Hawcutt, 2021).

The bolus for shock is not subtracted from the overall fluid deficit in any of the recommendations. Although having different names, these two sets of rules are likely to cover around the same period of time. A 20 mL/kg 0.9% sodium chloride bolus should be given as quickly as feasible to treat shock. NICE recommendations propose a maximum weight of 75 kg or the 97th centile weight for age, whichever is lower, for calculating fluid replacement, but BSPED standards indicate a maximum weight of 80 kg or the 97th centile weight for age, whichever is lower. In the course of routine paediatric care, this disparity is quite unlikely to arise. If teenage weight greatly exceeds 75 kg, it may be more sensible to control them according to adult norms because of their changing body habitus. In addition, it can be difficult to discover a CYP in the 97th percentile, and

this may be missed in an emergency situation (Rugg-Gunn, Deakin, & Hawcutt, 2021).

Table (2-2): Comparison of NICE and BSPED DKA classification and dehydration status.

Guidelines	Severity of DKA	Dehydration
NICE	Mild-moderate: blood pH≥7.1	5%
	Severe: blood pH<7.1	10%
BSPED	Mild (venous pH: 7.2–7.29 or bicarbonate: <15 mmol/L)	5%
	Moderate (venous pH: 7.1–7.19 or bicarbonate: <10 mmol/L)	7%
	Severe (venous pH: <7.1 or bicarbonate: <5 mmol/L)	10%

Maintaining blood glucose concentrations between 180–200 mg/dL (10–11 mmol/L) may necessitate 0.1 unit/kg subcutaneously per hour, which can be adjusted as necessary . Fluid expansion has a dilutional effect, lowering high blood glucose levels by up to 180–270 mg/dL (10–15 mmol/L). The rate of glucose reduction with insulin infusion should vary between 50 and 150 mg/dL (2.8 and 8.3 mmol/L/hour) and should not exceed 200 mg/dL (11 mmol/L/hour). If serum glucose levels are not falling sufficiently, the insulin dosage must be increased; however, this situation is uncommon. If the blood glucose level falls below 150 mg/dL (8.3 mmol/L), 10% dextrose solution should be supplied, and the insulin dose should be lowered to 0.05 U/kg/hour if the glucose level cannot be maintained. Insulin administration must continue in order to prevent ketosis and maintain anabolism. Assuming metabolic acidosis continues to improve, the dose may be lowered to 0.05 units/kg/hour or less if the patient displays marked insulin sensitivity. Defined as a bicarbonate value of 10 mmol/L after 8–10 hours of treatment, prolonged acidosis is often the result of insufficient insulin activity. Examine the dilution and

administration rate of insulin, and design a novel formulation (Rosenbloom, 2010).

A solution that is too dilute may increase insulin adhesion to the tube. If insulin is administered subcutaneously, there may be insufficient absorption. Infrequent causes of chronic acidosis include lactic acidosis due to hypotension or apnea or poor renal handling of hydrogen ion due to renal hypoperfusion . Monitoring problems closely is necessary for their successful management and early intervention. A flowchart should be used to record all episodes pertinent to the patient's condition. Recommendations for minimal monitoring frequency include vital signs and neurologic examinations every hour; blood glucose every hour; venous blood gases every 2 hours for 6 hours, then every 4 hours; Na, K, and ionised calcium every 2 hours for 6 hours, then every 4 hours; magnesium and phosphorus every 4 hours; and a basic metabolic profile at admission and then every morning . Depending on the initial K value, more regular (hourly) K measures and electrocardiogram (ECG) monitoring may be necessary, as well as more frequent neurologic and vital sign checks (20–30 minutes) if the patient's mental status is a cause for worry (Rosenbloom, 2010).

2.14. Prevention of diabetic ketoacidosis in children.

Diabetic ketoacidosis (DKA) is a serious acute complication of type 1 diabetes that is receiving more attention as a result of the increased risk posed by SGLT inhibitors. Socioeconomic deprivation, adolescent age (13–25 years), female sex, high Hba1c, a history of DKA, and mental comorbidities were among the sociodemographic and modifiable risk factors associated with an increased risk of DKA (eg, eating disorders and depression). Included in the proposed preventative strategies is the identification of those at risk based on fixed sociodemographic risk indicators. Organized diabetes self-management education that tackles modifiable risk factors is a second risk mitigation strategy. There is

evidence that structured education decreases the prevalence of DKA. Identifying subgroups of patients with an elevated risk of DKA demands understanding of these risk indicators and efficient risk mitigation strategies. This knowledge should also be utilised when contemplating adjunct therapies associated with an increased risk of DKA. Prevention of DKA in individuals with type 1 diabetes is an important clinical obligation that should also be addressed when SGLT inhibitors are used as a therapy (Vasireddy, Sehgal & Amritphale, 2021).

Diagnosis early through genetic and immunologic screening of high-risk children provides the most effective prevention of DKA at commencement. 7,15 Over a six-year period, the Italian School and Physician Awareness Program targeting at children aged 6 to 14 reduced new-onset DKA rates in the general population from 78% to practically 0%. The resources utilised for this work are accessible online (Rosenbloom, 2010).

A comprehensive approach that included outreach clinics, frequent routine and emergency telephone contact, and a state-funded camping programme for children with special healthcare needs significantly lowered the incidence of recurrent DKA in the 1970s. The project decreased the number of hospital admission days for private patients from 2.80 per patient per year before to intervention to 0.30 in the first year and to zero in the second. The number of state-sponsored children declined from 4,9 per patient per year to 1,8 and finally to 0 the next year. A disproportionate incidence of recurrent DKA episodes are attributable to noncompliance. In the UK surveillance study, 4.8% of patients were accountable for 22.5% of all episodes68, but in Colorado, 20% of patients were accountable for 80% of recurrent DKA incidences. Insulin omission, as shown by low or absent levels of free insulin, is the leading cause of recurrent DKA in children and adolescents. It is vital to ensure that only responsible individuals inject insulin (Rosenbloom, 2010).

2.15. Complication of diabetic ketoacidosis in children.

In children with Type 1 diabetes, DKA is the leading cause of both long-term complications and early death . Other causes of death or disability from DKA include: hypokalemia, hypophosphatemia, hypoglycemia, peripheral venous thrombosis, mucormycosis, rhabdomyolysis, acute pancreatitis, acute renal failure, sepsis, and aspiration pneumonia. The prevention of hypokalemia was covered in the fluid treatment subsection. Administering all of the K as KPO4 can lead to hypocalcemia, while giving half of the K as KPO4 can avoid the development of hypophosphatemia, which can lead to progressive muscular weakening and mortality due to cardiorespiratory arrest days after metabolic recovery from DKA. It is relatively uncommon for children with type 1 diabetes to develop renal failure, despite the fact that "renal failure is a significant cause of death in HHS, demanding early consideration of dialysis17 (Rosenbloom, 2010).

Rhabdomyolysis is a prevalent consequence of HHS and is linked to renal failure. It occurs with DKA but is not related with mortality in the absence of HHS. Extreme hyperglycemia, excessive osmolality, and hypophosphatemia are risk factors. In 2003, a 15-month-old was added to the rare recorded paediatric cases.60 The incidence of rhabdomyolysis in a 27-month-old patient 25 years earlier prompted a chart review of 133 children admitted with new-onset diabetes, 12 of whom had orthotolidine responses, which detect myoglobin in the urine (Rosenbloom, 2010).

In 1967, only three other adolescent patients with a comparable clinical history were identified in the medical literature. Following 13 years, just 13 fresh cases were documented. 64 Throughout the ensuing decade, a total of 40 instances were documented, and in 1990, 29 cases were added to one report and 11 to another. 49,65 Since that time, 160 new cases have been added. These publications provide incidence data and

emphasise the sporadic nature of CE and the lack of an iatrogenic origin (Rosenbloom, 2010).

Morbidity and Mortality Older reports may have skewed statistics on fatalities and residual morbidity, as well as a later date of recognition compared to more recent population-based observations. In these previously publicised and disputed cases, appropriate intervention was likewise less common. In 1990, the first complete series investigated 69 cases, including 40 previously published cases, and found an overall case fatality rate of 64%. 14% had no disability, 9% had a handicap that did not preclude independence, and 13% had a severe disability or vegetative state. Case fatality was just 30% among those who were treated before respiratory arrest, even if this was at the gasping stage, with 30% surviving without disability, 26% with disability not precluding independence, and 13% with severe disability or vegetative state. Despite the fact that the intervention in these instances was frequently poor and occurred after severe neurologic impairment, the treatment outcome is comparable to that of contemporary population research. There have been a few case reports of CE developing prior to the commencement of treatment for DKA, and a Canadian investigation revealed that 19% of instances of CE were present prior to treatment (Rosenbloom, 2010).

Cerebral edoema (CE) is a potentially catastrophic consequence of diabetic ketoacidosis (DKA) that almost always affects youngsters. Since its original description in 1936, various risk factors have been identified; nonetheless, the mechanisms that lead to its development continue to be unknown. Nowadays, the idea that CE is caused by ischemia–reperfusion injury is the most widely recognised, with inflammation and poor cerebrovascular autoregulation also contributing to its pathophysiology. The relevance of particular components of DKA treatment in the progression of CE remains debatable. This study analyses the literature on the pathophysiology of chronic encephalopathy (CE) and

seeks to classify the findings according to the three forms of brain damage that contribute to its development: cytotoxic, vasogenic, and osmotic (Azova, Rapaport, & Wolfsdorf, 2021).

According to the United States Diabetes Monitoring System of the Centers for Disease Control and Prevention (CDC), there was a 59.4% increase in DKA hospitalisation rates between 2004 and 2019, with the greatest rates among individuals younger than 45 years old. The development of cerebral edoema as a complication, which occurs in approximately 0.3% to 1.0% of cases, is mostly correlated with mortality in DKA. DKA results in lengthy hospital stays and costly medical expenses. A recent analysis of the National Inpatient Sample (NIS) revealed a greater incidence of DKA in children and adolescents aged 1 to 17 per 10,000 admissions. Throughout all age categories, males had a greater mortality rate than females. The rate of DKA cases and deaths per 10,000 admissions and 10,000 cases was highest among Blacks. From 2014 to 2017, the incidence of DKA per 10,000 hospitalisations increased significantly. According to a separate study, the average hospital charges per admission, after controlling for inflation, increased between 2003 and 2014, from $18,987 to $26,567. In these years, the average length of stay (LOS) showed a modest reduction. In 2017, the average hospital expenditures increased significantly, but the length of stay decreased slightly. Medicaid patients had the highest incidence of DKA per 10,000 admissions, while Medicare patients had the highest mortality rate per 10,000 DKA patients admitted (Vasireddy, Sehgal, & Amritphale, 2021).

2.16. Mother knowledge and awareness.

Education on how to manage diabetes on one's own (diabetes self-management education, or DSME) is essential. Glycemic management and quality of life are improved via education and self-awareness, especially in type-1 children. Moreover, maternal understanding is essential for managing pediatric diabetes. Women who have completed their

education have a greater chance of successfully raising their children. Managing sick days is also covered in classes on diabetes. Studies suggest that poorly managed diabetics may have lower leukocyte activity, leaving them more vulnerable to infection. During metabolic stress or insulin resistance, increasing insulin dose along with fluid intake is recommended. Most people ignore this concern and may progress to preclinical and then clinical DKA as a result. Reducing DKA problems with this method has been demonstrated (Othman et al., 2018).

Yet, achieving glycemic normalcy is no easy feat and calls for concerted effort and instruction. Diabetic ketoacidosis (DKA) is an acute metabolic disorder of type-1 diabetes characterized primarily by an increased presence of circulating ketone bodies and the development of severe ketoacidosis in the presence of prolonged uncontrolled hyperglycemia, usually due to insulin deficiency. Type-1 diabetes is an autoimmune disease. Diabetic ketoacidosis is more prevalent in young people with type 1 diabetes, especially those who aren't taking their insulin as prescribed. Polyuria, polydipsia, polyphagia, weight loss, vomiting, stomach pain, and eventually acidotic coma are all signs of uncontrolled diabetes that can progress to DKA; cerebral edoema is a rare consequence of severe DKA (Othman et al., 2018).

Patients and their families have been the subject of self-treatment and have served as own care administrators. When objectives are not met, the health care team sets the stage and increases its efforts. Instead of the diabetes health care team being the only ones to commence treatment, patients and parents are encouraged to review their data, identify patterns, and resolve food and exercise issues based on their actual blood glucose levels. A dynamic model of diabetes care delivery that effectively integrates patient-centered strategies, such as shared decision making, motivational interviewing techniques, shared medical appointments, and multidisciplinary team collaboration, holds promise for achieving glycemic

targets and enhancing patients' quality of life. Regardless of socioeconomic class, women with greater diabetes knowledge and better education maintained better glycemic control in their children. To improve glycemic control and decrease acute and chronic consequences of diabetes in children, knowledge and education of mothers are essential (Othman et al., 2018).

2.17. Previous related studies.

(Othman et al., 2018) The purpose of this research is to learn how well moms understand DKA symptoms in children and how they would react in an emergency. During the course of a year, 142 patients and their mothers participated in the research. "Information is collected from diabetes care centers and clinics at different medical facilities. Statistics show that just 3.5% of moms lacked a high school diploma, whereas 38.0% had completed college. They are more informed about DKS than other moms (67% vs. 33%). Nearly half (48.6%) learned about diabetes via a health educator, while 41% learned from a doctor and 15% learned through the internet or the media. The mother's reaction or action was recorded for 68% of individuals with a history of DKA. Sixty-seven percent went straight to the hospital, twenty-seven percent went to the ER only after their illness worsened, and twenty percent increased their insulin dosage, but none understood how to handle sick days. In order to reduce the prevalence of diabetic ketoacidosis and associated complications, the authors recommend that health education programs stress all aspects of diabetes self-management instruction through repeated group sessions.

The second study by Alhomood et al., (2020), assessed the knowledge of parents of children with type 1 diabetes mellitus (T1DM) on diabetic ketoacidosis (DKA). Methodology: A cross-sectional study was done among 385 parents of children with type 1 diabetes (T1DM) who visited the Diabetes Center in Abha City. The researcher developed a questionnaire in easy Arabic language. It featured personal information and

DKA knowledge". Results: More over one-third of parents (37.9%) possessed inadequate information of DKA. Their primary knowledge gaps concerned the normal range of fasting and postprandial blood sugar, the normal range for Hba1c, when a diabetic child should visit a doctor, and the causes of DKA. Being a father, being older than 40 years, having less than a bachelor's degree, being jobless or having a non-healthcare-related work, and having a monthly salary of less than 5,000 Saudi Riyals were significant predictors of inadequate parental knowledge. Conclusions: parental understanding of DKA is inadequate. Being a father of a diabetic child, having older parents, having less education or being unemployed, having a non-healthcare-related occupation, having a low monthly income, and having diabetic siblings are significantly associated with a lack of knowledge regarding diabetes and diabetic ketoacidosis . It is recommended that T1DM patients and their guardians get health education. It must include information on the independent management of diabetes and diabetic ketoacidosis as well as the identification of DKA symptoms.

The third study for Hussein., (2022) describes the knowledge of Saudi carers for diabetic children regarding Juvenile Diabetes Mellitus, its signs and symptoms, and its prevention, as well as the complications that can arise in children under their care. Situation and Players: Diabetic ketoacidosis (DKA) is a potentially fatal metabolic condition with avoidable consequences. In Saudi Arabia, the city of Riyadh was the site of a questionnaire-based cross-sectional study. Minimum sample size of 412 was necessary. There were a total of 414 respondents included in the analysis. The process of data collecting was conducted by data collectors. 399 carers participated in this study, the majority of them were Saudi (376; 94.2%) and graduated from college (300; 75.0%). The most frequently mentioned symptom of DM in children was elevated blood sugar (225; 56.4%), whereas the most frequently mentioned cause was malnutrition

(223; 55.9%) and the most frequently mentioned manifestation of diabetes was frequent urination (354; 88.8%). This study revealed that the majority of type-1 diabetes carers in Riyadh, Saudi Arabia, have knowledge and awareness of DKA. Nonetheless, there are some gaps. To improve the level of knowledge and awareness, as well as the efficacy of taking the appropriate action and response in relation to DKA, additional research is required to evaluate other components.

The fourth study for Rahman, (2021) that examined the awareness and diabetes care practises of parents of children and adolescents with type 1 diabetes. Diabetes is a chronic condition that can have a significant effect on the lives of children and adolescents, as well as their families and carers. In addition to insulin therapy, the management of diabetes should include education, support, and access to psychiatric therapies as needed. This is a cross-sectional study of 101 participants who attended Transforming Diabetes in Children (CDIC), BIRDEM between March and June 2019. Participants are parents of children and adolescents aged 7 to 18 with type 1 diabetes. There were both open-ended and closed-ended questions. Version 24 of Statistical (SPSS) was used to compile and analyse data. Parents of a total of 101 patients were interviewed during the course of the study. One of them Eighty-four (84.2%) respondents were aware of the signs and symptoms of diabetes, 60.4% of respondents provided a balanced diet for their children, 78.2% of parents regularly checked their blood glucose levels with a glucometer, and 95% of parents checked their HbA1C levels every three months. The urban population had considerably lower HbA1c levels (p= 0.003). Individuals with secondary education demonstrated greater self-control than those with primary education (p = 0.001). Individuals with a healthy lifestyle had much better control (p = 0.008). Those who regularly attended health education classes had good control (p = 0.003). The association between glycemic control and knowledge of complications was investigated, and it was shown that

parents with sufficient knowledge of diabetes and awareness of the condition had considerably better glycemic control.

The fifth study conducted by Faisal Hamed et al., (2021) to examined parental views of DKA symptoms in children with type 1 diabetes in the Northern Area of Saudi Arabia. DKA, a life-threatening emergency, is prevalent. Early ER therapy can create major consequences if not caught early. Type 1 diabetes management involves preventing hypoglycemia and maintaining blood sugar, HbA1c, blood pressure, lipids, and body weight. Type 1 diabetes treatment includes insulin, diet, exercise, preventive education, and patient self-care. During November 2020 - May 2021, researchers at the Diabetes Center in the Northern Region of Saudi Arabia used a pre-designed online questionnaire promoted through social media to collect data from parents of children with diabetes . SPSS (version 23) was used to conduct the analyses, and the results were reported in tabular and graphical formats. In the end, 42.9 percent said they had a solid grasp of DKA. Just 19.2% were sure that only children were impacted. Just 43.3% were aware that high blood sugar can lead to diabetic ketoacidosis. In comparison to the 22.9 percent who learned about DKA through doctors, the 31.8 percent who learned about it online is not surprising. Participants' children with DKA increased by 14%, with 91.6% requiring hospitalization. Significant factors were gender, parental age, and level of education, but not marital status. Ultimately, most diabetic parents have no idea what ketoacidosis is or how to treat it. Their main source is suspect. Their main reference is suspect. Thus, policymakers should inform parents and caregivers of children with type 1 diabetes about DKA. Instructions should be given initially at the beginning of therapy and afterwards yearly or whenever the patient requests it. Diabetes and diabetic ketoacidosis should be emphasized in health education.

Chapter Three

Methodology

Chapter Three

Methodology

Scientific research technique is a collection of scientific standards, criteria, and controls that are followed when conducting research.

3.1. Design of the Study

A descriptive study design aims Assessment of knowledge and awareness of mothers regarding diabetic ketoacidosis among type-1 diabetic children. the period from September 13th / 2023 to February 23th / 2023.

3.2. Administrative Arrangements

Before collecting the study data, the following official clearances were sought from appropriate authorities:

1. Approval from the University of Babylon/ College of Nursing Council for the study (Appendix A). Ethics and scientific committee.
2. Official permission have been obtained from Babylon Health Directorate in order to formally access to the Diabetes and Endocrinology Center in Hill City (Appendix A) .
3. In addition, the consent of the mothers to participate in the study, after explaining the objectives and usefulness of the study to them and assuring that all information provided will be confidential and for scientific and research purposes (autonomy and privacy).

3.3. Setting of the Study

The study was conducted at Diabetes and Endocrinology Center in Hilla City. It is one of the health institutions affiliated to the Babylon Health Directorate. It is an integrated center for the care of patients with diabetes and its complications.

3.4. Sample of the Study

To conduct the study, a non-probability (purposive) sample of (150) mothers of children with type 1 diabetes mellitus (T1DM) who attend Diabetes and Endocrinology Center in Hilla City was chosen based on a set of criteria, which include the following:

3.4.1. Inclusions criteria:

1. Mothers of child's (equal or less than 10 years) with T1DM who are volunteer to participate in the study after his consent.
2. All mother that have children with type 1 DM duration of disease started from 1 year at last.

3.4.2. Exclusion Criteria:

1. Mothers of child's with T1DM who are don't complete the interview during collecting the sample or her child age more than 10 years.
2. Mothers of children who have T1DM and other chronic diseases such as hypertension, cancer, renal and heart failure.

2.5. Study Instruments

The questionnaire is one of the means to help collect data that contribute to achieving the results expected by the study aimed to clarify the study objectives and significance by obtaining answers to the study questions.

So the questionnaire items was adopted by the researcher the questionnaire based on extensive review of related previous studies and consists of the following parts:

1.5.1. Sample Characteristics

This part deals with socio-demographic characteristics include mothers age, education level, occupation and monthly income; as well as, the child's with T1DM characteristics such ad age, gender, duration of disease and hospitalization (Number of hospitalizations).

1.5.2. Knowledge

This part deals with mothers knowledge towards diabetic Ketoacidosis which developed by the researchers according to extensive literature and previous studies and consist the following domains include:

1. Knowledge related to normal range of DM: Which composed of 4 items.
2. Knowledge related to causes of DKA: Which composed of 4 items.
3. Knowledge related to signs and symptoms of DKA: Which composed of 9 items.

Rating and scoring: A total of (17) items of knowledge measured on 3-level type of Likert Scale (1=I don't know, 2=Uncertain and 3=I know). Accordingly, points can be taken range from 17-51. The higher average defined as good knowledge.

3.5.3. Awareness

This part deals with mothers awareness towards diabetic Ketoacidosis which developed by the researchers according to extensive literature and previous studies and consist the following domains include:

1. Awareness related to intervention with DKA: Which composed of 5 items.
2. Awareness related to complications of DKA: Which composed of 5 items.
3. Awareness related to avoid complications of DKA: Which composed of 5 items.

Rating and scoring: A total of (15) items of awareness measured on 3-level type of Likert Scale (1=I don't know, 2=Uncertain and 3=I know). Accordingly, points can be taken range from 15-45. The higher average defined as positive awareness.

The researcher adhered to the rules of writing the questionnaire due to the importance of the type of information that the researcher is keen to be sufficient and comprehensive for all aspects of the problem and to be reliable and reliable. Vague and complex questions were avoided. The

type of questions were of the closed type requiring an answer with reference to what is relevant.

3.6. Validity of the Questionnaire

The term validity indicates how does the collected information covers the real examination's area. Measuring what the instrument intended to measure is basically the meaning of validity. The four main kinds of validity include: (face, content, construct, and criterion) validity (Taherdoost, 2016).

The study protocol and the study instrument underwent series of revisions and modifications and was achieved by experts from different scientific branches, each of those experts had greater than ten years of experience in their field of specialty. The researcher proposed each expert member to review the study instrument for content, simplicity, relevance, style, and suitability. Each expert revised the instrument in terms of the scientific content, sequence of information and its competence to perform the purpose of collecting the sample. So, the modification made to the instrument according to experts' recommendation.

The face validity of the study tool was conducted after the tool translated into Arabic, which assessed by specialists in diverse departments of nursing. Experts were invited to provide their thoughts and ideas on each study questionnaire item in terms of linguistic relevance, relationship to the dimensions of the study variables allocated to it, and applicability to the study community's setting.

Content validity is determined through the use of panel of (15) experts. They are (4) faculty member from the College of Nursing/ University of Babylon, (3) faculty member from the College of Nursing/ University of Baghdad, (2) faculty member from the College of Nursing/ University of Kufa and (2) a consultant physician from the Babylon Health Directorate (Appendix E).

The experts responses indicated that minor changes should be done to some items and it's were made according to their suggestions , then the final draft was completed to be ready for conducting the study.

3.7. Pilot Study

This preliminary study was carried out to determine the study tool's stability and credibility, as well as its clarity and efficiency, as well as the standard time required to collect data for each subject, which can be estimated during the interview procedures, and to identify any difficulties that may arise.

The pilot study aimed to achieve the following objectives.

1. Adequacy of research tools development and testing
2. Evaluation of the instrument's viability.
3. Identifying any logistical issues that may arise as a result of the proposed methods .
4. Assessment of proposed data analysis approaches for the detection of potential issues.
5. The researcher's time estimate during data collecting.

3.7.1. Results of pilot study

1. The questionnaire is reliable.
2. The time required for answering the questionnaire ranged from (15-20) minutes.
3. The instrument items were clarify and understood the phenomenon underlying of the study (Table 3-1).

The accepted coefficients reliability of the used study questionnaire regarding internal consistency (Alpha Cronbach) is 0.70 (as shows in table 3-1) by findings calculation in which the instrument was effective, significant, and valid to the research topic of (psychosocial aspects of women with breast cancer).

3.7.2.Reliability of the Questionnaire:

It was conducted on 10% of the research samples, or 15 mothers in total. A researcher meets the participants, introduces them, and then invites them to engage in the study by providing their opinion on their particular knowledge and awareness. The researcher then discussed the aim and title of the study and requested them to complete the study questionnaire through an interview to determine the questionnaire's ease of use and comprehension, as well as the time necessary to complete the instrument.

The researcher stays with the participants until they have finished the interview. The estimated time to fill out each form was approximately 15-20 minutes. The data obtained from the pilot study were analyzed and no adjustments were made so the pilot study was excluded from the original sample. The Cronbach α value ranged from 0.70 and higher, which indicating a high degree of reliability.

Table3-1: Reliability of the Studied Questionnaire (*n=20*)

Reliability Statistics

Variables	N of Items	Cronbach's Alpha	Ass.
Knowledge	17	.868	Acceptable
Awareness	15	.891	Acceptable

This table is statistically formed to show the reliability coefficient for the study instrument. The calculated result shows that the questionnaire is reliable measure to study the phenomenon of Knowledge and Awareness of Mothers about Diabetic Ketoacidosis among Type-1 Diabetic Children on the same population at any time in the future.

3.8. Ethical Considerations

Ethical obligations are one of the most important things that the researcher must follow and abide it when doing the study. Before the starting of collect the data from the community that has been identified for the study, the researcher should clarify the main purpose and desired goal

of conducting this study for the sample to be including in the study, as well as adhere to the strict confidentiality of the data taken from the study sample and pledge to use it for scientific purposes related to the study only.

Before the starting of gathering the data from the sample who are participating in the study, the researcher given a brief explanation about the scientific background of the research and the purpose of conducting. Mothers of children with T1DM were verbally informed about the study aims and were asked to participate and this participation were voluntary. After they consented to take part in the study, they were given an anonymous questionnaire to complete in order to protect the participants' privacy.

3.9. Data Collection

After obtaining the approval of the Babylon Health Directorate and verifying the validity and reliability of the questionnaire.

The researcher interviewee the participants (Mothers of children with T1DM), explained the instructions, answered their questions regarding the form, urged them to participate and thanked them for the cooperation. The interview techniques was used on individual bases, and each interview (15-20) minutes after taking the important steps that must be included in the study design and include the following:

1. Determining the data that will be collected through the questionnaire according to the study questions.
2. Determining the method and format of the questionnaire.
3. Determining the type of criterion that determines the type of answer in the questionnaire.
4. Presenting the questionnaire to the supervising to express his opinion and observations in developing the questionnaire and modifying it based on his observations.

5. Presenting the questionnaire to a number of panel of experts to express their opinion and observations in developing the questionnaire and modifying it based on what they submitted .
6. Conducting a reliability test on it by distributing the questionnaire to a sample of 15 Mothers.
7. Writing the questionnaire in its final form, then printing, reviewing and usage it for data collection.

3.10. Statistics Analysis

In order to statistically analyse the data collected from the study sample to arrive at the results, the researcher used the *SPSS-20* and Microsoft Excel (2010) program to analyse this data and deal with it statistically, to find the relationships between the variables, and obtain the final results of the research based on a set of statistical tests.

3.10.1.Descriptive approach

Descriptive statistics includes a set of mathematical and statistical methods that are adopted to describe the main features of a data quantitatively by using tables and charts. Descriptive statistics always aim to present and describe the data which is required to be processed, organized, summarized and categorized, as well as presenting them in a simple and clear manner that makes it easier for the recipient to recognize and understand its content. The analysis performed through use:

A. Statistical tables "Frequencies (No.) and Percent (%)"

B. Average of the scores M.s. and the overall average score (M±).

The average score can be calculated by using the following:

$$\textbf{\textit{total mean of scores}} = \frac{\textbf{\textit{Maximum total sores} - \textbf{\textit{Munimum total sores}}}}{\textbf{\textit{Levels}}}$$

For Knowledge Outcomes

[Poor=0-11.33; Fair= 11.34-22.66; Good= 22.67-34]

For Awareness Outcomes

[Negative=0-10; Neutral= 10.1-20; Positive= 20.1-30]

C. Standard Deviation test ±*SD*.

D. It uses a correlational coefficient "Cronbach alpha" used in estimating the internal consistency of the study tool.

3.10.2.Inferential approach

1. Analysis of Variance (ANOVA)

For equality of means, is used (variance test when the mean parameter varies).

Source of variance	Sum of square	d.f	Mean square	F
Between Groups	$SS_B = \sum \frac{(\sum xP1)^2}{n} - \frac{(\sum xP)^2}{n}$	$df_B = K-1$	$\frac{MS\beta}{MS\beta}$	
Within Groups	$SS_w = \sum \frac{(\sum xP1)^2}{N} - \frac{(\sum xP)^2}{N}$	$df_w = N-k$	$\frac{SSw}{DFw}$	$\frac{MSB}{MSW}$
Total	$SS_T = \sum \frac{(\sum xP1)^2}{N} - \frac{(\sum xP)^2}{N}$	$df_t = N-1$		

P-value (≤0.05)

2. Independent Sample t-test

The sample that is unrelated the *t-test* compares the means of two independent groups to check if there is statistical evidence that the associated population means differ significantly .

First, the mean and standard deviation, frequency and percentage then, paired sample t- test, person correlation and two ways ANOVA.

The statistical package for social sciences (SPSS) version 2021and a descriptive statistic method for 106 Samples for clients' pre pulmonary function test. The Significance level is at $p<0.05$.

Chapter Four

Results and Findings

Chapter Four

Results of the Study

The finding of data analysis systematically in following figures and tables based on stated objectives:

Table 4-1. Distribution of the Study Sample according to the Mothers Socio Demographic Variables (SDVs)

SDVs	Classification	No.	%
Age	20-29 years old	**74**	**49.3**
	30-39 years old	33	22.0
	40 and older	43	28.7
	Total	150	100.0
	Mean ± SD 32.45 ± 7.14		
Education level	Not read and write	26	17.3
	Read & write	27	18.0
	Elementary	**65**	**43.3**
	Middle school	14	9.3
	Secondary school	9	6.0
	College and above	9	6.0
	Total	150	100.0
Occupation	Employed	53	35.3
	Unemployed	**76**	**50.7**
	Free-business	21	14.0
	Total	150	100.0
Monthly income	Sufficient	**59**	**39.3**
	Sufficient to certain limit	56	37.3
	Insufficient	35	23.3
	Total	150	100.0

f= frequencies, %=Percentages, M = Mean of score, S.D = Standard Deviation

In table 1 the results show the characteristics of the participants, the mean age is 32.45 (±7.14) years, the age group 20-29 years was the highest recorded (49.3%). Regarding educational level, the participants graduated from primary school at most (43.3%). Occupation-related outcomes, (50.7%) are unemployed. In terms of monthly income, a most of the studied sample had sufficient income (39.3%).

Table 4-2. Distribution of the study sample according to the characteristics of Children with Type-1 DM

Characteristics	Classification	No.	%
Child's age	6 years old	21	14.0
	7 years old	22	14.7
	8 years old	22	14.7
	9 years old	**45**	**30.0**
	10 years old	40	26.7
	Total	150	100.0
	Mean ± SD **8.27 ± 1.37**		
Child's gender	Male	68	45.3
	Female	**82**	**54.7**
	Total	150	100.0
Duration of disease	1-3 years	**99**	**66.0**
	≥4 years	51	34.0
	Total	150	100.0
Hospitalization	Once	**108**	**72.0**
	More than once	42	28.0
	Total	150	100.0

f= frequencies, %=Percentages, M = Mean of score, S.D = Standard Deviation

The results showed in table 2 the characteristics of children with type 1 DM, the mean age of children was 8.27 (± 1.37) years, and the age group of 9 years was the highest recorded (30%). With regard to gender, most children with type 1 DM were female (54.7%). Duration of disease-related outcomes, (66%) offered 1-3 years. In terms of hospitalization (duration of stay in hospitals), a third of the studied sample was expressed as soon as hospitalization (72%).

Table 4-3. Mothers Knowledge towards Diabetic Ketoacidosis among Type-1 Diabetic Children

Domain	List	Items	Responses	No.	%	M.s	Ass.
Normal range of DM	1	Normal range for fasting blood sugar is 99 mg/dL, 100 to 125 mg/dL indicates prediabetes, and 126 mg/dL or higher indicates diabetes	I know	52	34.7	1.79	Fair
			Uncertain	15	10.0		
			I don't know	83	55.3		
	2	Normal range for post-prandial blood sugar is below 140 mg/dL. If between 140 and 199 mg/dL, it indicates that prediabetes	I know	52	34.7	1.79	Fair
			Uncertain	14	9.3		
			I don't know	84	56.0		
	3	Normal range for HbA1c is below 5.7% is normal, between 5.7 and 6.4% indicates prediabetes, and 6.5% or higher indicates DM	I know	40	26.7	1.62	Poor
			Uncertain	13	8.7		
			I don't know	97	64.7		
	4	Mild DKA is characterized by a venous pH of <7.3, moderate (pH of <7.2) and in severe (pH is <7.1)	I know	18	12.0	1.26	Poor
			Uncertain	3	2.0		
			I don't know	129	86.0		
Information of DKA	1	Causes of Ketoacidosis is high insulin dose	I know	40	26.7	1.55	Poor
			Uncertain	2	1.3		
			I don't know	108	72.0		
	2	The primary cause of DKA is absolute or relative insulin deficiency	I know	32	21.3	1.45	Poor
			Uncertain	4	2.7		
			I don't know	114	76.0		
	3	The child is dehydrated or has not been eating enough carbohydrates lead to DKA	I know	15	10.0	1.39	Poor
			Uncertain	28	18.7		
			I don't know	107	71.3		
	4	Acute Illness when his or her body experiences higher levels of stress lead to DKA	I know	42	28.0	1.58	Poor
			Uncertain	3	2.0		
			I don't know	105	70.0		
Signs and symptoms of DKA	1	High blood sugar levels cause your child to urinate more than usual	I know	35	23.3	1.65	Poor
			Uncertain	27	18.0		
			I don't know	88	58.7		
	2	The child may feel dehydrated and thirstier than usual	I know	38	25.3	1.58	Poor
			Uncertain	11	7.3		
			I don't know	101	67.3		
	3	Abdominal colic	I know	28	18.7	1.46	Poor
			Uncertain	13	8.7		
			I don't know	109	72.7		
	4	Repeated vomiting	I know	30	20.0	1.53	Poor
			Uncertain	20	13.3		
			I don't know	100	66.7		
	5	Loss of weight	I know	44	29.3	1.63	Poor
			Uncertain	7	4.7		
			I don't	99	66.0		

			know				
	6	Acetone-odor or breath	I know	39	26.0	1.61	Poor
			Uncertain	13	8.7		
			I don't know	98	65.3		
	7	Cold skin	I know	44	29.3	1.69	Fair
			Uncertain	15	10.0		
			I don't know	91	60.7		
	8	Disturbed consciousness	I know	58	38.7	1.81	Fair
			Uncertain	6	4.0		
			I don't know	86	57.3		
	9	Muscle weakness	I know	53	35.3	1.75	Fair
			Uncertain	7	4.7		
			I don't know	90	60.0		

Level of Assessment (Poor=1-1.66; Fair=1.67-2.33; Good=2.34-3)

In terms of statistical mean, table 3 shows that the mothers expressed a fair responses to normal range of DM at items number (1 and 2) as indicated by moderate mean scores (*M.s= 1.67-2.33*) and poor responses at items number (3 and 4) as indicated by low mean scores (*M.s≤ 1.66*). And demonstrates that the mothers expressed a poor responses to causes of diabetic Ketoacidosis at all studied items as indicated by low mean scores (*M.s≤ 1.66*). Also the results shows the mothers expressed a poor responses to signs and symptoms of diabetic Ketoacidosis at all studied items as indicated by low mean scores (*M.s≤ 1.66*) except, the items number (7, 8 and 9) the responses were fair as indicated by moderate mean scores (*M.s= 1.67-2.33*).

Table 4.4. Mothers Knowledge regarding Diabetic Ketoacidosis in Type-1 Diabetic Children by their Overall Domains

Knowledge Domains	Level	No.	%	M (±SD)
Knowledge related to normal range of T1DM	Poor (*M=4-6.66*)	88	58.7	6.46 ± 2.64
	Fair (*M=6.67-9.33*)	32	21.3	
	Good (*M=9.34-12*)	30	20.0	
	Total	150	100.0	
Knowledge related to causes of DKA	Poor (*M=4-6.66*)	109	72.7	5.97 ± 2.81
	Fair (*M=6.67-9.33*)	7	4.7	

	Good (*M=9.34-12*)	34	22.7	
	Total	150	100.0	
Knowledge related to signs and symptoms of DKA	Poor (*M=9-15*)	106	70.7	14.71 ± 5.29
	Fair (*M=15.1-21*)	12	8.0	
	Good (*M=21.1-27*)	32	21.3	
	Total	150	100.0	

M: Mean for total score, SD=Standard Deviation for total score

This table (4) shows the mothers knowledge towards DKA in children and include the following findings: Knowledge in terms of normal range of DM, (58.7%) of mothers expressed a poor level 6.46 (±2.64). Knowledge in terms of the causes of diabetic Ketoacidosis, (72.7%) of mothers expressed a poor level 5.97 (±2.81). Knowledge in terms of the signs and symptoms of diabetic Ketoacidosis, (70.7%) of mothers expressed a poor level 14.71 (±5.29).

Table 4.5. Overall Mothers Knowledge regarding Diabetic Ketoacidosis in Type-1 Diabetic Children

Knowledge	No.	%	*M (±SD)*
Poor	97	64.7	*27.14 ± 7.93*
Fair	38	25.3	
Good	15	10.0	
Total	150	100.0	

M: Mean for total score, SD=Standard Deviation for total score

[Poor=17-28.33; Fair= 28.34-39.66; Good= 39.67-51]

The results in table 7 demonstrates that (64.7%) of mothers expressed a poor knowledge towards diabetic Ketoacidosis in children as described by low total average, which is equal to 27.14 (±7.93).

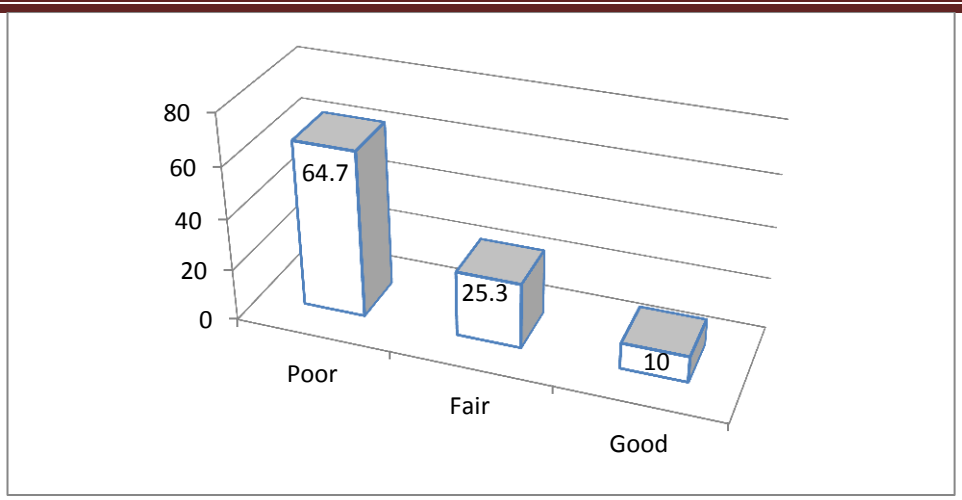

Figure 4-1. Mothers Knowledge regarding Diabetic Ketoacidosis in Type-1 Diabetic Children

4-6. Mothers Awareness towards Diabetic Ketoacidosis among Type-1 Diabetic Children (Awareness related to interventional)

Domain	List	Interventional awareness Items	Responses	No.	%	M.s	Ass.
Interventional	1	The hospital is the place for management of Ketoacidosis	I know	110	73.3	2.60	Good
			Uncertain	20	13.3		
			I don't know	20	13.3		
	2	Lab investigations for Ketoacidosis is assessment of blood glucose level, serum potassium level and ketonuria	I know	64	42.7	1.85	Fair
			Uncertain	0	0.0		
			I don't know	86	57.3		
	3	Steps for management of Ketoacidosis are Hospitalization, Insulin administration and Intravenous fluids	I know	90	60.0	2.53	Good
			Uncertain	50	33.3		
			I don't know	10	6.7		
	4	Administering the proper dose of insulin to prevent complication	I know	92	61.3	2.33	Fair
			Uncertain	15	10.0		
			I don't know	43	28.7		
	5	Blood sugar monitoring to prevent complication	I know	101	67.3	2.39	Good
			Uncertain	7	4.7		
			I don't know	42	28.0		
Complications of DKA	1	Severe dehydration	I know	48	32.0	1.67	Fair
			Uncertain	5	3.3		
			I don't know	97	64.7		
	2	Coma	I know	66	44.0	1.91	Fair
			Uncertain	4	2.7		
			I don't know	80	53.3		
	3	Brain edema	I know	23	15.3	1.34	Poor
			Uncertain	5	3.3		
			I don't know	122	81.3		
	4	Retinopathy	I know	40	26.7	1.60	Poor
			Uncertain	10	6.7		
			I don't know	100	66.7		
	5	Neuropathy	I know	56	37.3	1.75	Fair

			I don't know	94	62.7		
Avoid complications of DKA	1	Healthy food, exercise and proper treatment	I know	139	92.7	2.89	Good
			Uncertain	5	3.3		
			I don't know	6	4.0		
	2	Daily blood sugar monitoring	I know	96	64.0	2.28	Fair
			I don't know	54	36.0		
	3	Proper insulin dose administration	I know	126	84.0	2.84	Good
			Uncertain	24	16.0		
			I don't know	0	0		
	4	Assessment of Ketones in urine	I know	49	32.7	1.85	Fair
			Uncertain	29	19.3		
			I don't know	72	48.0		
	5	Going to the hospital in case of uncontrolled	I know	141	94.0	2.93	Good
			Uncertain	7	4.7		
			I don't know	2	1.3		

Level of Assessment (Poor = 1- 1.66; Fair= 1.67-2.33; Good = 2.34-3)

In table 6 the results shows the mothers expressed a good responses to interventional awareness as indicated by high mean scores (*M.s≥2.33*) except, items number (2 and 4) the responses were fair as indicated by moderate mean scores (*M.s= 1.67-1.33*). Also the results shows the mothers expressed a fair responses to complication of DKA as indicated by moderate mean scores (*M.s= 1.67-2.33*) except, items number (3 and 4) the responses were poor as indicated by low mean scores (*M.s≤ 1.66*). And the results shows the mothers expressed a good responses to avoid complication as indicated by high mean scores (*M.s≥2.34*) except, items number (2 and 4) the responses were Fair as indicated by fair mean scores (*M.s= 1.67-2.33*).

Table 4.7. Mothers Awareness towards Diabetic Ketoacidosis in Type-1 Diabetic Children by their Overall Domains

Awareness Domains	Level	No.	%	M (±SD)
Interventional awareness	Poor (*M=05-8.33*)	20	13.3	11.70 ± 2.93
	Fair (*M=8.34-11.66*)	34	22.7	
	Good (*M=11.67-15*)	96	64.0	
	Total	150	100.0	
Awareness related to complications of DKA	Poor (*M=05-8.33*)	80	53.3	8.27 ± 3.61
	Fair (*M=8.34-11.66*)	37	24.7	
	Good (*M=11.67-15*)	33	22.0	
	Total	150	100.0	
Awareness related to avoid complications of	Poor (*M=05-8.33*)	6	4.0	12.79 ± 1.49
	Fair (*M=8.34-11.66*)	29	19.3	

DKA	Good (*M=11.67-15*)	115	76.7	
	Total	150	100.0	

M = Mean of score, S.D = Standard Deviation

This table (7) shows maternal awareness towards DKA in children and includes the following findings: Awareness in terms of intervention, (64%) of mothers expressed a good awareness 11.70 (±2.93). Awareness of complications of diabetic Ketoacidosis, (53.3%) mothers expressed poor awareness 8.27 (±3.61). Awareness of avoid complications of diabetic Ketoacidosis, (78.7%) mothers expressed a good awareness 12.79 (±1.49).

Table 4.8. Overall Mothers Awareness regarding Diabetic Ketoacidosis in Type-1 Diabetic Children

Awareness	No.	%	*M (±SD)*
Poor	19	12.7	*32.75 ± 6.89*
Fair	77	51.3	
Good	54	36.0	
Total	150	100.0	

M: Mean for total score, SD=Standard Deviation for total score

[Poor=15-25; Fair= 25.1-35; Good= 35.1-45]

The results in table 8 demonstrates that (51.3%) of mothers expressed a Fair awareness towards diabetic Ketoacidosis in children as described by moderate total average, which is equal to 32.75 (±6.89).

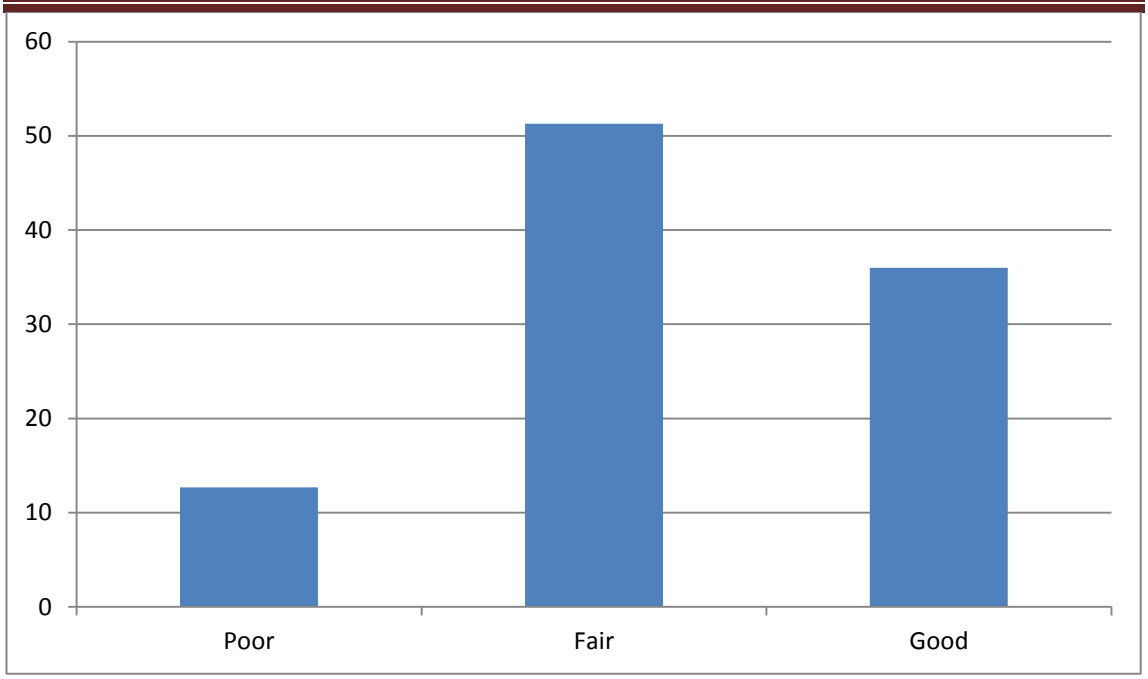

Figure 4-2. Mothers Awareness regarding Diabetic Ketoacidosis in Type-1 Diabetic Children

Table 4.9. The relationship of the mother Knowledge and Awareness with respect their Socio-Demographic Variables (Knowledge and Awareness of Mothers between Groups of Age)

Age groups	Source of variance	Sum of Squares	d.f	Mean Square	*F-statistic*	*P. value.*	*Sig*
Knowledge	Between Groups	5.990	2	2.995	16.635	.000	HS
	Within Groups	26.467	147	.180			
	Total	32.457	149				
Awareness	Between Groups	1.033	2	.517	2.494	.086	NS
	Within Groups	30.459	147	.207			
	Total	31.493	149				

P=probability value, NS: Non-Significant at P > 0.05, S: Significant at P < 0.05, HS: Highly Significant at P < 0.001.

In table 9 the analysis of variance showed that there were statistically significant differences in knowledge between mothers with respect to age groups (*F=16.635; p=.000*) (Fig. 4-3); and no statistically significant differences in awareness (*F= 2.494; p=.086*) between mothers according to their age groups.

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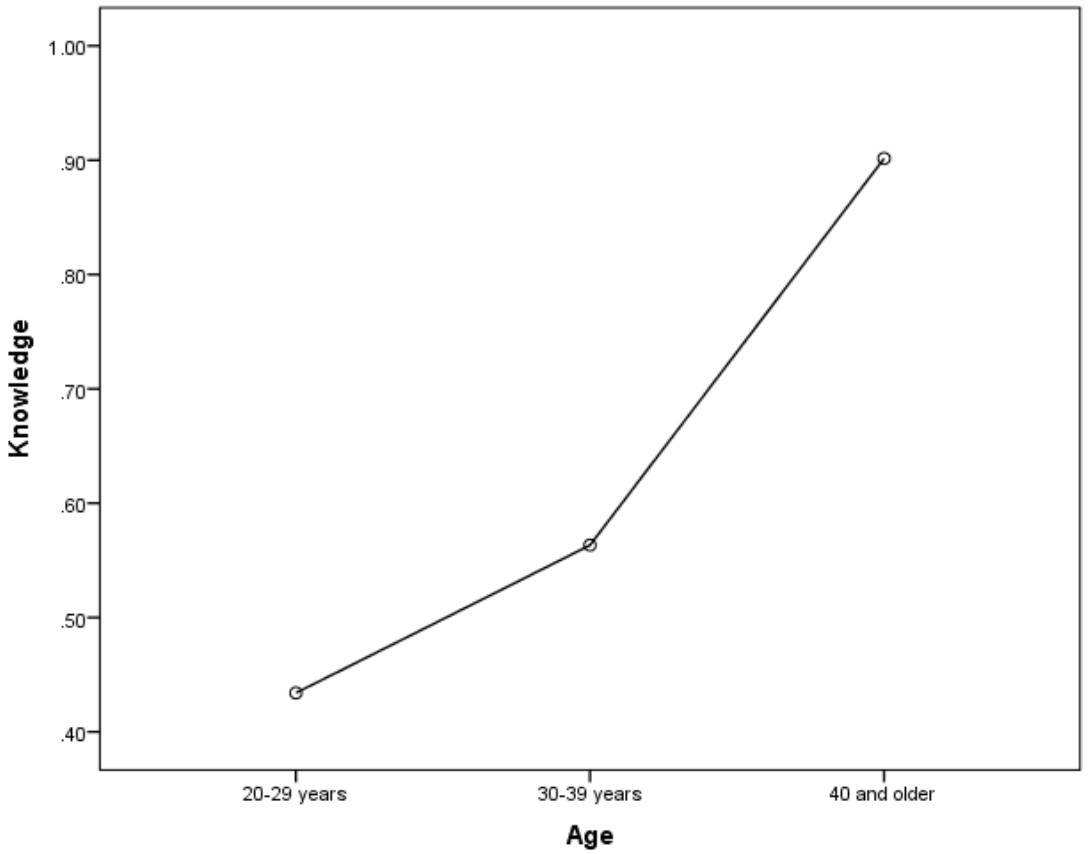

Figure 4-3. Distribution of Mothers Knowledge between Groups of Age

Table4-10. **Knowledge and Awareness of Mothers between Groups of Education Level**

Education Level	Source of variance	Sum of Squares	d.f	Mean Square	*F-statistic*	*P. value*	*Sig.*
Knowledge	Between Groups	19.506	5	3.901	43.376	.000	HS
	Within Groups	12.951	144	.090			
	Total	32.457	149				
Awareness	Between Groups	6.544	5	1.309	7.555	.000	HS
	Within Groups	24.948	144	.173			
	Total	31.493	149				

P=probability value, NS: Non-Significant at P > 0.05, S: Significant at P < 0.05, HS: Highly Significant at P < 0.001.

In table 10 the analysis of variance showed that there were statistically significant differences in knowledge (*F=43.376; p=.000*) (Fig. 4-4) and awareness (*F=7.555; p=.000*) (Fig. 4-5) between mothers with respect to their education level.

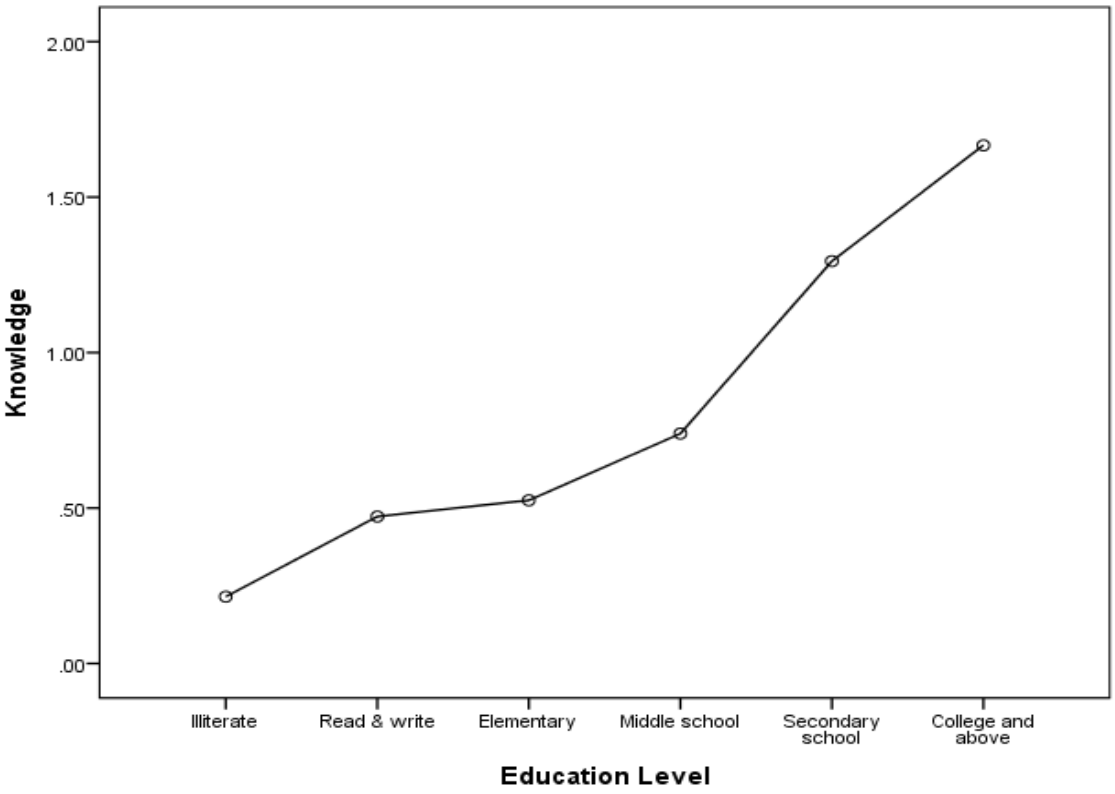

Figure 4-4. Distribution of Mothers Knowledge between Groups of Education Levels

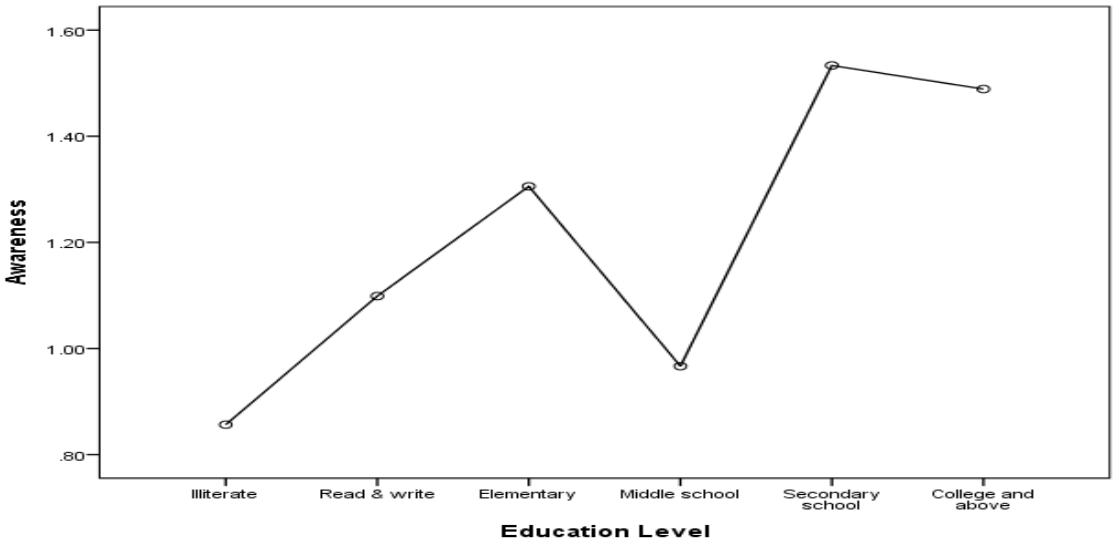

Figure 4-5. Distribution of Mothers Awareness between Groups of Education Levels

Table4-11. **Knowledge and Awareness of Mothers between Groups of Occupation**

Occupation	Source of variance	Sum of Squares	d.f	Mean Square	*F-statistic*		*Sig.*
Knowledge	Between Groups	.153	2	.077	.348	.706	

	Within Groups	32.304	147	.220			NS
	Total	32.457	149				
Awareness	Between Groups	1.228	2	.614	2.981	.054	NS
	Within Groups	30.265	147	.206			
	Total	31.493	149				

P=probability value, NS: Non-Significant at P > 0.05, S: Significant at P < 0.05, HS: Highly Significant at P < 0.001.

In table 11 the analysis of variance showed that there were no statistically significant differences in knowledge (*F= .348; p=.706*); and significant differences in awareness (*F=2.981; p=.054*) between mothers with respect to their occupation (Fig. 4-6).

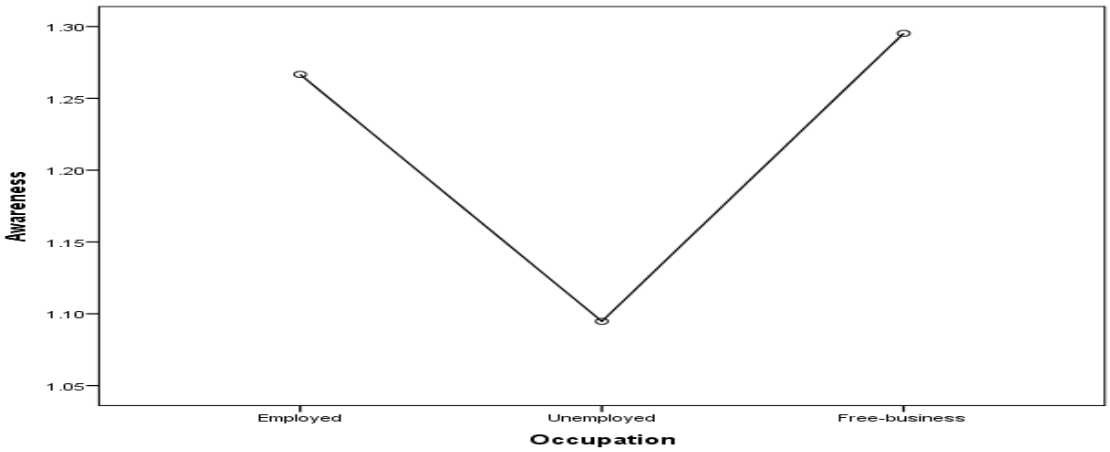

Figure 4-6. Distribution of Mothers Awareness between Groups of Occupation

Table 4-12. **Knowledge and Awareness of Mothers between Groups of Monthly Income**

Monthly Income	Source of variance	Sum of Squares	d.f	Mean Square	*F-statistic*		*Sig.*
Knowledge	Between Groups	.209	2	.104	.476	.622	NS
	Within Groups	32.248	147	.219			
	Total	32.457	149				
Awareness	Between Groups	2.797	2	1.399	7.164	.001	S
	Within Groups	28.696	147	.195			
	Total	31.493	149				

P=probability value, NS: Non-Significant at P > 0.05, S: Significant at P < 0.05, HS: Highly Significant at P < 0.001.

In table 12 the analysis of variance showed that there were no statistically significant differences in knowledge (*F= .476; p=.622*); and

significant differences in awareness (*F=7.164; p=.001*) between mothers with respect to their monthly income (Fig. 4-7).

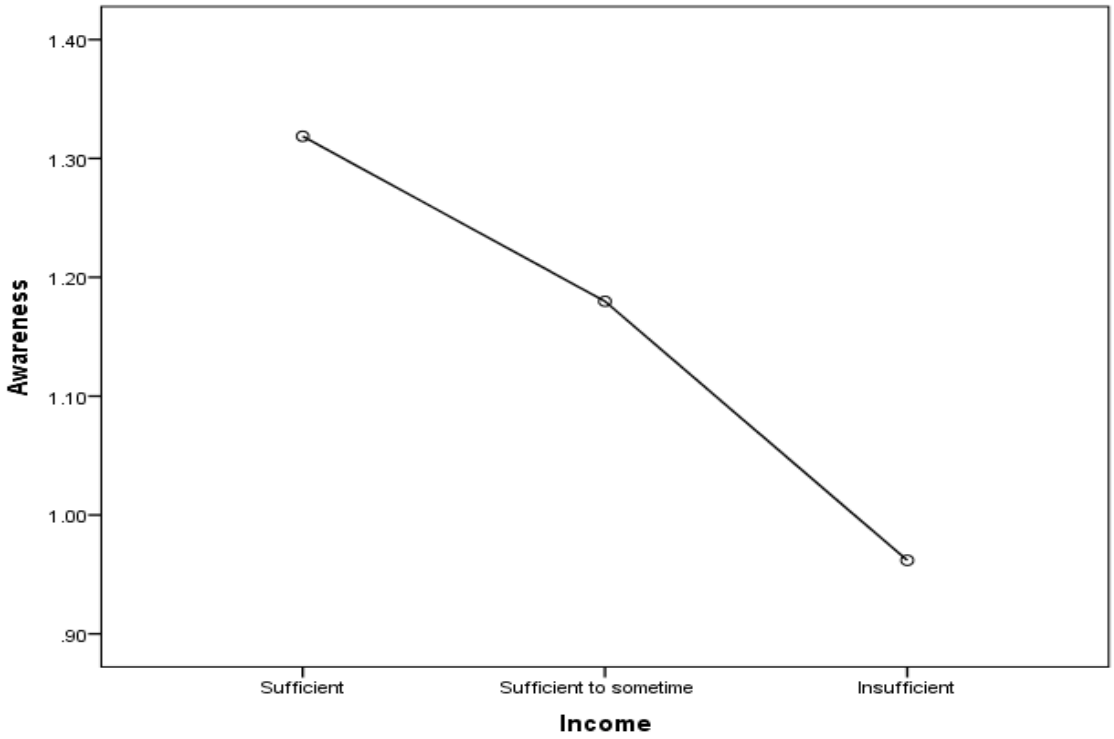

Figure 4-7. Distribution of Mothers Awareness between Groups of Monthly Income

Table 4-13. Knowledge and Awareness of Mothers between Child's Age

Child's Age	Source of variance	Sum of Squares	d.f	Mean Square	*F-statistic*	*P. value*	*Sig.*
Knowledge	Between Groups	1.210	4	.303	1.404	.236	NS
	Within Groups	31.247	145	.215			
	Total	32.457	149				
Awareness	Between Groups	.647	4	.162	.761	.553	NS
	Within Groups	30.846	145	.213			
	Total	31.493	149				

P=probability value, NS: Non-Significant at P > 0.05, S: Significant at P < 0.05, HS: Highly Significant at P < 0.001.

In table 13 the analysis of variance showed that there were no statistically significant differences in knowledge (*F= 1.404; p=.236*) and awareness (*F=.761; p=.553*) between mothers with respect to their child's age.

Table 4-14. Knowledge and Awareness of Mothers between Child's Age

Variables	Gender	Mean	SD	t-value	d.f	*p. value*	*Sig.*
Knowledge	Male	1.64	.509	1.232	148	.220	NS
	Female	1.55	.426				
Awareness	Male	2.09	.496	2.123	148	.035	S
	Female	1.25	.416				

P=probability value, NS: Non-Significant at P > 0.05, S: Significant at P < 0.05, HS: Highly Significant at P < 0.001.

In table 14 the analysis of variance showed that there were no statistically significant differences in knowledge (*t= 1.232; p=.220*); and significant differences in awareness (*t= 2.123; p= .035*) between mothers with respect to their child's gender.

Table 4-15. **Knowledge and Awareness of Mothers between Duration of Disease**

Variables	Duration	Mean	SD	t-value	d.f	*p. value*	*Sig.*
Knowledge	1-3 years	1.34	.222	14.211	148	.000	HS
	≥4 years	2.08	.421				
Awareness	1-3 years	2.15	.434	.964	148	.337	NS
	≥4 years	2.23	.505				

P=probability value, NS: Non-Significant at P > 0.05, S: Significant at P < 0.05, HS: Highly Significant at P < 0.001.

In table 15 the analysis of variance showed that there were statistically significant differences in knowledge (*t= 14.211; p=.000*); and no significant differences in awareness (*t= .964; p= .337*) between mothers with respect to their duration of child's disease.

Table 4-16. Knowledge and Awareness of Mothers between Groups of Hospitalization

Variables	Hospitalization	Mean	SD	t-value	d.f	*P. value*	*Sig.*
Knowledge	Once	1.48	.353	5.019	148	.000	HS
	More than once	2.88	.592				
Awareness	Once	2.14	.452	1.600	148	.112	NS
	More than once	2.23	.505				

P=probability value, NS: Non-Significant at P > 0.05, S: Significant at P < 0.05, HS: Highly Significant at P < 0.001.

In table 16 the analysis of variance showed that there were statistically significant differences in knowledge (*t= 5.019; p=.000*); and no significant differences in awareness (*t= 1.600; p= .112*) between mothers with respect to their hospitalization.

Chapter Five

Discussion of the results

Chapter five explains an organized discussion that interprets the results systematically presented in chapter four and is supported by other studies related to the research study. This chapter will answer and meet all objectives of the study.

Whereas the study main objectives were: First, to assess knowledge of mothers regarding diabetic ketoacidosis among type-1 diabetic children. Second, to assess awareness of mothers about diabetic ketoacidosis among type-1 diabetic children. Third, to find out relationship between knowledge and awareness of mothers regarding diabetic ketoacidosis among type-1 diabetic children. Four, to find out relationship between knowledge and awareness with demographics characteristics.

Section 1: Discussion of the Socio-Demographic Characteristics of the Study Sample, as shown in (Table 4-1) and figure (4.1):

In table 4-1 the results show the characteristics of the participants of the Study Sample according to the Mothers Socio Demographic Variables (SDVs). This finding is confirmed by a study that found that mother's age, ranging from 20 and up to more than 40 years and most of age group was between 36-40 years (31%), and the lowest age group was between 20-25 years (5%), According to Occupation-related outcomes, (66%) are unemployed. In terms of monthly income, a most of the studied sample had sufficient income (45%), where education level of mother. 3.5 % were illiterate, while 38% completed university level education (Othman et al., 2018).

In addition, other study not confirmed these socio-demographic characteristics. More than half of participated (56.4%) were aged 30-40 years, while 12.7% were aged less than 30 years, and 30.9% were aged more than 40 years. More than half of them (58.2%) were university

educated, while 1.8% was illiterate, 7.8% had primary education, 10.1% had intermediate education and 22.1% had secondary education (Alhomood et al., 2020).

In table 4-2 the results show the characteristics of the Socio Demographic to the Children with Type-1 DM, the results showed the mean age of children was 8.27 (± 1.37) years, and the age group of 9 years was the highest recorded (30%). With regard to gender, most children with type 1 DM were female (54.7%). Duration of disease-related outcomes, (66%) offered 1-3 years. In terms of hospitalization (duration of stay in hospitals), a third of the studied sample was expressed as soon as hospitalization (72%). The study result is consistent with previous study that stated the study categorizes the age of pediatric diabetic patients 2 percent were between one to two years of age. Maximum numbers were observed between 7 to 12 years of age (more than half percentage) . Other study stated that total 25 children below 20 years of age were admitted over this study period with diagnosis of Diabetic ketoacidosis. Among them, 15 (sixty percentage) were female and 10 (forty percentage) were male. Most of the children 18 (more than seventy percentage) belonged to rural areas and remaining 7 (twenty eight percentage) belonged to urban areas. The mean age at presentation was 10.5 ± 4.5 years, out of which 18 (72%) were from lower middle socioeconomic status and remaining 7(28%) were from middle socio-economic status. Six (24%) children had family history of diabetes (Muktan et al., 2019).

Section 2: Discussion Assess Mothers Knowledge Regarding Diabetic Ketoacidosis among Type-1 Diabetic Children, as Shown in Tables (4-3) (4-4), (4-5) and Figure (4-1):

The study findings manifested the assessment of Mothers Knowledge towards Diabetic Ketoacidosis among Type-1 Diabetic Children **(**knowledge related to normal range of DM), table 3 shows that the mothers expressed a fair responses to normal range of DM at items

number (1 and 2) as indicated by moderate mean scores (*M.s= 1.67-2.33*) and poor responses at items number (3 and 4) as indicated by low mean scores (*M.s≤ 1.66*).

Regarding to the Mothers knowledge related to Causes of DKA demonstrates that the mothers expressed a poor responses to causes of diabetic Ketoacidosis at all studied items as indicated by low mean scores (*M.s≤ 1.66*).

According to Mothers knowledge related to signs and symptoms DKA, the mothers expressed a poor responses to signs and symptoms of diabetic Ketoacidosis at all studied items as indicated by low mean scores (*M.s≤ 1.66*) except, the items number (7, 8 and 9) the responses were fair as indicated by moderate mean scores (*M.s= 1.67-2.33*).

Moreover, Mothers Knowledge regarding Diabetic Ketoacidosis in Type-1 Diabetic Children by their Overall Domains, the mother's knowledge towards DKA in children and include the following findings: Knowledge in terms of normal range of DM, (58.7%) of mothers expressed a poor level 6.46 (±2.64). Knowledge in terms of the causes of diabetic Ketoacidosis, (72.7%) of mothers expressed a poor level 5.97 (±2.81). Knowledge in terms of the signs and symptoms of diabetic Ketoacidosis, (70.7%) of mothers expressed a poor level 14.71 (±5.29).

Finally, Overall Mothers Knowledge regarding Diabetic Ketoacidosis in Type-1 Diabetic Children, the results demonstrates that (64.7%) of mothers expressed a poor knowledge towards diabetic Ketoacidosis in children as described by low total average, which is equal to 27.14 (±7.93).

This finding is confirmed by a study that found that the Parents' knowledge about DKA is suboptimal. Some characteristics are significantly associated with lower knowledge regarding diabetes and diabetic ketoacidosis, i.e., being a father of a diabetic child, older parents,

being less educated or unemployed parents, those whose occupation is not healthcare-related, having low monthly income and having diabetic sibling.

From these statistics, an estimated 35% had fair knowledge about the condition but with a lack of adequacy to qualify as knowledgeable. The rest, 29%, is an estimate of those with poor knowledge about the condition. In general, the sample did not show significant evidence to assert an adequate prevalence of GDM knowledge across pregnant women. When participants' awareness of GDM and its effects on both their health and those of their children was assessed, the results suggested that 42 participants, relating to 29% of the population were not aware of the condition. The high prevalence of positive answers (40.643.4%) towards knowledge of GDM was from the final third that assessed the effects of GDM on the infant. Otherwise, most participants did not confirm having enough knowledge of the condition. The study also found that none of the demographics highlighted a relationship with the knowledge of GDM across pregnant women (Alkaabba et al., 2022).

Other study, parents' knowledge on the sign and symptoms of DKA before the onset of DKA and infection prior to DKA onset, children between 9–12 years of age and children whose parents did not know the sign and symptoms of DKA (Atkilt et al., 2017).

Other studies were not confirmed by the current research findings that stated that Knowledge about DKA symptoms, signs, complications and prevention were two hundred and sixty-eight (64.7%) of the participants reported that they know about the seriousness of DKA, 326 (78.7%) of the participants considered it as a very life-threatening case for the child, compared to 31 (7.5%) who considered it a simple condition. While for the knowledge about complications of DKA, 262 (63.3%) reported that they know about them. 285 (68.8%) reported they knew it could lead to

coma, while 255 (61.6%) did not know that it could lead to brain swelling (Kaabba et al., 2021).

Section 3: Discussion Assess Mothers Awareness Regarding Diabetic Ketoacidosis among Type-1 Diabetic Children, as Shown in Tables (4-6), (4-7), (4-8) and Figure (4.2):

The results shows the mothers expressed a good responses to interventional awareness as indicated by high mean scores (*M.s≥2.33*) except, items number (2 and 4) the responses were fair as indicated by moderate mean scores (*M.s= 1.67-1.33*).

According to Mothers awareness related to complications of DKA, the results shows the mothers expressed a fair responses to complication of DKA as indicated by moderate mean scores (*M.s= 1.67-2.33*) except, items number (3 and 4) the responses were poor as indicated by low mean scores (*M.s≤ 1.66*). while, Mothers awareness related to avoid complications of DKA, The results shows the mothers expressed a good responses to avoid complication as indicated by high mean scores (*M.s≥2.34*) except, items number (2 and 4) the responses were Fair as indicated by fair mean scores (*M.s= 1.67-2.33*).

Whereas the study Mothers Awareness towards Diabetic Ketoacidosis in Type-1 Diabetic Children by their Overall Domains, this table (4-11) shows maternal awareness towards DKA in children and includes the following findings: Awareness in terms of intervention, (64%) of mothers expressed a good awareness 11.70 (±2.93). Awareness of complications of diabetic Ketoacidosis, (53.3%) mothers expressed poor awareness 8.27 (±3.61). Awareness of avoid complications of diabetic Ketoacidosis, (78.7%) mothers expressed a good awareness 12.79 (±1.49).

Consistently, Overall Mothers Awareness regarding Diabetic Ketoacidosis in Type-1 Diabetic Children, The results demonstrates that (51.3%) of mothers expressed a Fair awareness towards diabetic

Ketoacidosis in children as described by moderate total average, which is equal to 32.75 (±6.89).

This conclusion is supported by a research which revealed that 67% of mothers are aware of DKS, but 33% of mothers were uninformed of Diabetic Ketoacidosis. (Othman et al., 2018). Regarding the source of knowledge on diabetic ketoacidosis (DKA) among our participants, our data revealed that only 22.9% of our participants received information about DKA from doctors, whereas 31.8% of our participants obtained information about DKA via the internet. 14% of the patients in the current research reported having at least one kid with DKA, and 91.6% of them were hospitalized (Hamed et al., 2021; Jamarin & Marzuki, 2022).

The majority of mothers of children with type-1 diabetes in Riyadh, Saudi Arabia, were aware of diabetic ketoacidosis (DKA), contrary to the findings of other studies**"** (Kaabba et al., 2021).

Section 4: Discussion Distribution of the Association between the mother Knowledge and Awareness with respect their Socio-Demographic Variables. As Shown in Tables (4-9), (4-10), (4-11), (4-12), (4-13), (4-14) (4-15) (4-16):

In table 4-9 the analysis of variance showed that there were statistically significant differences in knowledge between mothers with respect to age groups (*F=16.635; p=.000*) (Fig. 4-3); and no statistically significant differences in awareness (*F= 2.494; p=.086*) between mothers according to their age groups.

Regarding to the occupation, in table (4-10) the analysis of variance showed that there were statistically significant differences in knowledge (*F=43.376; p=.000*) (Fig. 4-4) and awareness (*F=7.555; p=.000*) (Fig. 4-5) between mothers with respect to their education level . Moreover, in table (4-11) the analysis of variance showed that there were no statistically significant differences in knowledge (*F= .348; p=.706*); and

significant differences in awareness (*F=2.981; p=.054*) between mothers with respect to their occupation (Fig. 4-6).

This finding is confirmed by studies that found that illustrates the relation between knowledge about DKA with sociodemographic characteristics of participants. It shows a significant relation with gender, age of the parent, and educational level (Atkilt et al., 2017; Hamed et al., 2021). Other study stated that there are significant differences in awareness between mothers with respect to their education level and occupation (Kaleem et al., 2018).

Regarding to the monthly income, in table (4-12) the analysis of variance showed that there were no statistically significant differences in knowledge (*F= .476; p=.622*); and significant differences in awareness (*F=7.164; p=.001*) between mothers with respect to their monthly income (Fig. 4-7). Previous study stated that were significantly associated with lower parents' awareness and having a monthly income <5000 SR and no statistically significant differences between knowledge mothers with respect to their monthly income (Alaqeel, 2019; Kaleem et al., 2018).

In table 4-17 the analysis of variance showed that there were no statistically significant differences in knowledge (*F= 1.404; p=.236*) and awareness (*F=.761; p=.553*) between mothers with respect to their child's age. Moreover, in table 4-14 the analysis of variance showed that there were no statistically significant differences in knowledge (*t= 1.232; p=.220*); and significant differences in awareness (*t= 2.123; p= .035*) between mothers with respect to their child's gender. While, in table 4-19 the analysis of variance showed that there were statistically significant differences in knowledge (*t= 14.211; p=.000*); and no significant differences in awareness (*t= .964; p= .337*) between mothers with respect to their duration of child's disease. In equal important, previous study stated the mothers' knowledge was not significantly associated with their elder age ≥35 years, education level, family income ≥21000 PKR/month,

and significant differences in awareness between mothers with respect to their child's gender (Kaleem et al., 2018). other study stated the difference was statistically significant in Parents of type 1 diabetic children whose duration was four years or less had good knowledge grade than parents whose children had a longer disease duration (Alhomood et al., 2020; Arora et al., 2019).

In table 4-16, the study shows that the analysis of variance were statistically significant differences in knowledge (*t= 5.019; p=.000*); and no significant differences in awareness (*t= 1.600; p= .112*) between mothers with respect to their hospitalization. This finding is confirmed by a study that found they were no statistically significant differences in mother's awareness with respect to their duration of child's disease and hospitalization, and showed that there were statistically significant differences in knowledge mothers with respect to their hospitalization (Abd El Salam et al., 2023; Alhomood et al., 2020).

Chapter Six

Conclusion and Recommendation

Chapter Six

Conclusion and Recommendation

6.1. Conclusions

Based on the study's main findings of the present study, it can be concluded are as follows:

For mother's awareness towards DKA in children shows a good awareness among mothers in the Awareness of intervention and Awareness of avoid complications of diabetic Ketoacidosis. While, poor Awareness among mothers (53.3%) for complications of diabetic Ketoacidosis.

There are relationship between knowledge and awareness of mothers regarding diabetic ketoacidosis among type-1 diabetic children.

There are statistically significant differences in mother's knowledge with respect to age groups, education level, respect to their duration of child's disease and hospitalization. And there were no statistically significant differences in mother's knowledge with respect to their occupation, monthly income, respect to their age and gender of child.

There are statistically significant differences in mother's awareness with education level, occupation, monthly income, gender of child. And there were no statistically significant differences in mother's awareness with respect to their age groups, respect to their duration of child's disease and hospitalization.

6.2. Recommendations

According to the results and conclusions of the present study, the researcher recommends the following:

Health education should be provided to mothers of children. It must be properly achieved in a structured manner based on a general outline that

should include education at the onset of treatment and then repeated based upon an annual assessment.

During each consultation visit, health care providers should repeatedly offer information related to independent management of diabetes and diabetic ketoacidosis and how to identify symptoms of diabetic ketoacidosis. Areas of poor knowledge related to diabetes and diabetic ketoacidosis should be emphasized during health education sessions.

Diabetes care team and health educators should provide clear guidance to patients and families on how to manage diabetes during sick days or illnesses to avoid the complications of ketoacidosis, uncontrolled or symptomatic hyperglycemia, hypoglycemia and dehydration, never stop insulin, and the insulin dose .

Diabetes education is essential part of diabetes management and health education department should focus on all aspects of diabetes self-management education in multiple group sessions to prevent DKA and its complications.

Proper counseling and awareness of mothers to adhere with appropriate child feeding practices is highly recommended.

Using the mass media in all health care settings to deliver information to everyone about diabetic ketoacidosis among type-1 diabetic children, including parents of child .

Further studies are advised with larger samples would assess more factors to enhance the level of knowledge and awareness, and increase the effectiveness toward the right action and response regarding DKA.

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Appendices

Appendix A
Ethical consideration

University of Babylon
College of Nursing
Research Ethics Committee

جـامـعة بـابـل
كـلية التمريـض
لجنة اخلاقيات البحث العلمي

Issue No:

Date: 26 / 1 /2023

Approval Letter

To,
علي كريم جواد

The Research Ethics committee at the **University of Babylon, College of Nursing** has reviewed and discussed your application to conduct the research study entitled **" Knowledge and Awareness of Mothers about Diabetic Ketoacidosis among Type-1 Diabetic Children"**

The Following documents have been reviewed and approved:

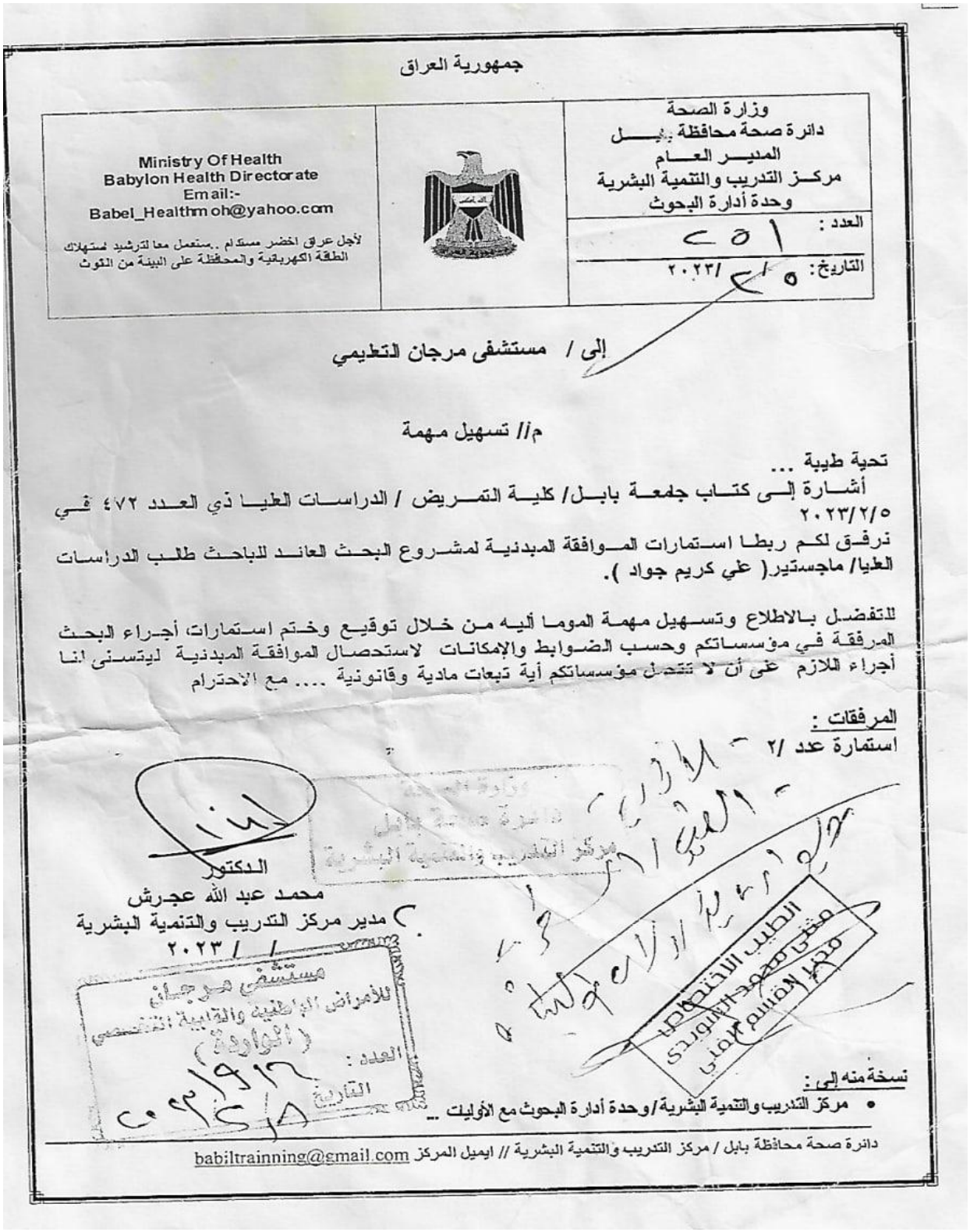
1. Research protocol
2. Research instrument/s
3. Participant informed consent

Committee Decision:

The committee approves the study to be conducted in the presented form. The Research Ethics committee expects to be informed about any changes occurring during the study, any revision in the protocol and participant informed consent.

Prof. Dr. Shatha Saadi Mohammed
Chair Committee
College of Nursing
Research Ethical Committee
26 / 1 /2023

Appendix B
Administrative agreements



جمهورية العراق

وزارة الصحة
دائرة صحة محافظة بابـــل
المديـــر العـــام
مركـــز التدريب والتنمية البشرية
وحدة أدارة البحوث

Ministry Of Health
Babylon Health Directorate
Email:-
Babel_Healthmoh@yahoo.com

لأجل عراق اخضر مستدام .. نستعمل معا لترشيد استهلاك الطاقة الكهربائية والمحافظة على البيئة من التلوث

العدد : ٥٠١
التاريخ : ٥ / ٢ / ٢٠٢٣

إلى / مستشفى مرجان التعليمي

م// تسهيل مهمة

تحية طيبة ...
أشـارة إلـى كتـاب جامعـة بابـل/ كليـة التمـريض / الدراسـات العليـا ذي العـدد ٤٧٢ فـي ٢٠٢٣/٢/٥
نرفـق لكـم ربطـا اسـتمارات المـوافقة المبدئيـة لمشـروع البحـث العائـد للباحـث طالـب الدراسـات العليا/ ماجستير(علي كريم جواد).

للتفضـل بـالاطلاع وتسـهيل مهمـة الموما أليـه مـن خـلال توقيـع وختـم اسـتمارات أجـراء البحـث المرفقـة فـي مؤسساتكم وحسـب الضـوابط والإمكانـات لاستحصـال الموافقـة المبدئيـة ليتسـنى انـا أجراء اللازم على أن لا تتحمل مؤسساتكم أية تبعات مادية وقانونية .... مع الاحترام

المرفقات :
استمارة عدد /٢

الدكتور
محمد عبد الله عجرش
مدير مركز التدريب والتنمية البشرية
/ / ٢٠٢٣

مستشفى مرجان
للأمراض الباطنية والقلبية التخصصي
(الجراحة)
العدد :
التاريخ :

نسخة منه إلى :
- مركز التدريب والتنمية البشرية/وحدة أدارة البحوث مع الأوليات ..

دائرة صحة محافظة بابل / مركز التدريب والتنمية البشرية // ايميل المركز babiltrainning@gmail.com

Appendix C
Statistical expert

جمهورية العـــراق

Ministry Of Health Babylon Health Directorate Email:- Babel_Healthmoh@yahoo.com Tel:282628 or 282621		وزارة الصحة والبيئة دائرة صحة محافظة بابـــل المديـــر العـــام مركـــز التدريب والتنمية البشرية لجنة البحوث

استمارة رقم :-٠٣ /٢٠٢١

رقم القرار :- ٢٠
تاريخ القرار :- ١٥/ ٢ /٢٠٢٣

قرار لجنة البحوث

تحية طيبة ...

درست لجنة البحوث في دائرة صحة بابل مشروع البحث ذي الرقم (٢٠٢٣/٠٢٦/ بابل)
المعنـون (معارف ووعي الأمهات حول الحامض الكيتوني السكري بين الأطفال المصابين بمرضى السكري من النوع الأول) ،
والمقـدم من الباحث(علي كريم جواد) إلى وحدة أدارة البحوث والمعرفي مركز التدريب والتنمية البشرية في دائرة صحة بابل بتاريخ ٢٠٢٣/٢/١٩ وقررت :

قبول مشروع البحث أعلاه كونه مستوفيا للمعايير المعتمدة في وزارة الصحة والخاصة بتنفيذ البحوث ولا مانع من تنفيذه في مؤسسات الدائرة .

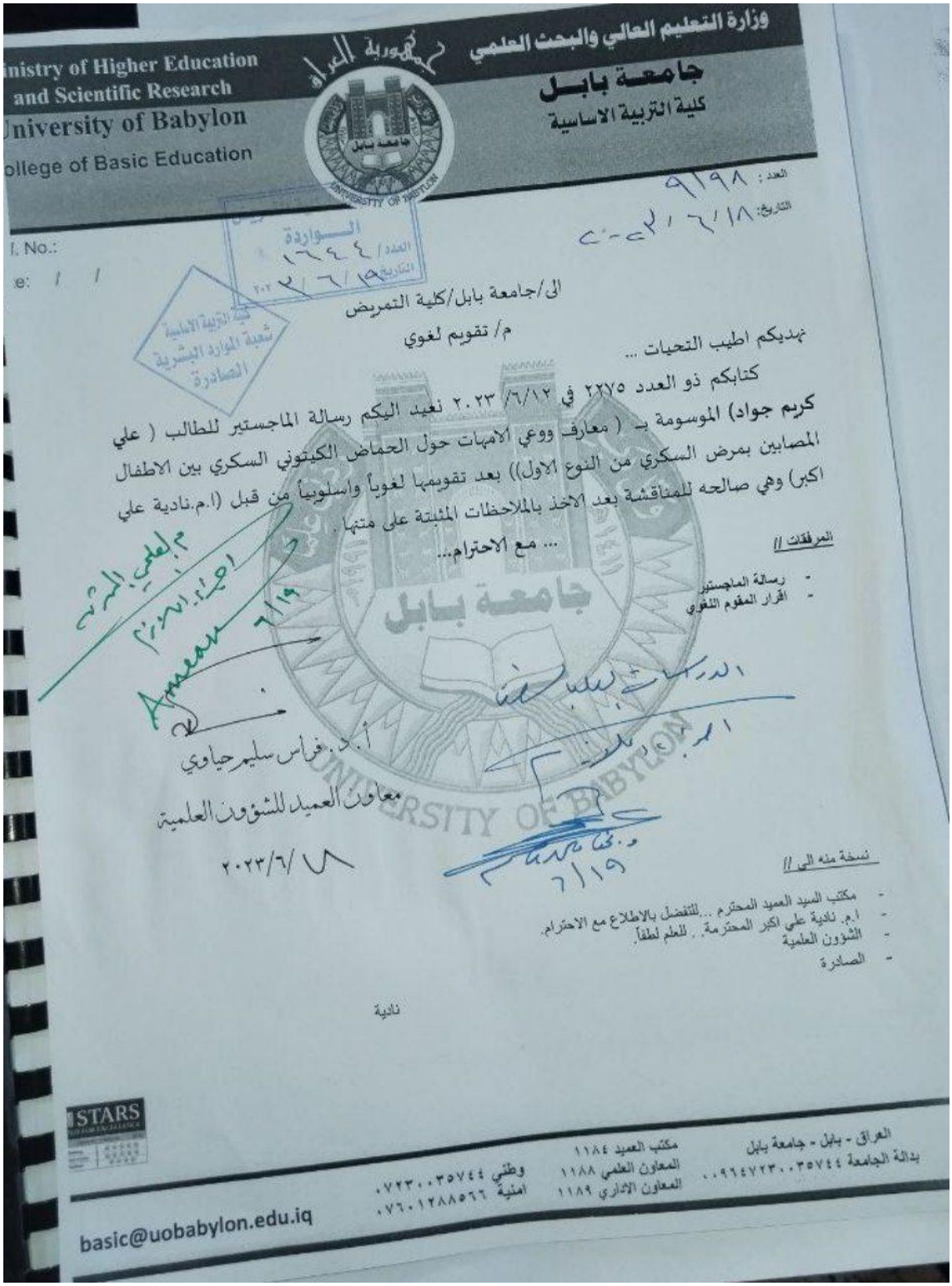
مـــــع الاحتـــرام

الـدكتور
محمد عبد الله عجرش
رئيس لجنة البحوث
/ / ٢٠٢٣

وزارة الصحة
دائرة صحة بابل
مركز التدريب والتنمية البشرية
لجنة البحوث

نسخة منه إلى :
- مكتب المدير العام / مركز التدريب والتنمية البشرية / وحدة إدارة البحوث ... مع الأوليات.

Appendix D
Linguistic calendar



وزارة التعليم العالي والبحث العلمي
جامعة بابل
كلية التربية الاساسية

Ministry of Higher Education and Scientific Research
University of Babylon
College of Basic Education

جمهورية العراق

العدد: ٩١٩٨
التاريخ: ٢٠٢٣/٦/١٨

الى/جامعة بابل/كلية التمريض
م/ تقويم لغوي

تهديكم اطيب التحيات ...

كتابكم ذو العدد ٢٢٧٥ في ٢٠٢٣/٦/١٢ نفيد اليكم رسالة الماجستير للطالب (علي كريم جواد) الموسومة بـ (معارف ووعي الامهات حول الحماض الكيتوني السكري بين الاطفال المصابين بمرض السكري من النوع الاول)) بعد تقويمها لغوياً واسلوبياً من قبل (ا.م.نادية علي اكبر) وهي صالحه للمناقشة بعد الاخذ بالملاحظات المثبتة على متنها .

... مع الاحترام...

المرفقات //
- رسالة الماجستير
- اقرار المقوم اللغوي

أ.د. فراس سليم حياوي
معاون العميد للشؤون العلمية
٢٠٢٣/٦/١٨

نسخة منه الى //
- مكتب السيد العميد المحترم ...للتفضل بالاطلاع مع الاحترام.
- ا.م. نادية علي اكبر المحترمة ...للعلم لطفاً.
- الشؤون العلمية
- الصادرة

نادية

العراق - بابل - جامعة بابل
بدالة الجامعة ٠٠٩٦٤٧٢٣٠٠٣٥٧٤٤
مكتب العميد ١١٨٤
المعاون العلمي ١١٨٨
المعاون الاداري ١١٨٩
وطني ٠٧٢٣٠٠٣٥٧٤٤
امنية ٠٧٦٠١٢٨٨٥٦٦
basic@uobabylon.edu.iq

Appendix E
Expert committee

ت	أسم الخبير	اللقب العلمي	مكان العمل	الاختصاص الدقيق	سنوات الخبرة
1	د.أمين عجيل ياسر	أستاذ	كلية التمريض/ جامعة بابل	تمريض صحة مجتمع	38 سنة
2	د.اركان بهلول ناجي	أستاذ	كلية التمريض /جامعة بغداد	تمريض صحة مجتمع	37سنة
3	د.نهاد محمد الدوري	أستاذ	كلية التمريض /جامعة بابل	تمريض اطفال	35سنة
4	د.سحر أدهم علي	أستاذ	كلية التمريض /جامعة بابل	تمريض بالغين	34سنة
5	د.حسن علوان بيعي	أستاذ	كلية الطب /جامعة بابل	طب اسرة	32 سنة
6	د.شذى سعدي محمد	أستاذ	كلية التمريض /جامعة بابل	تمريض بالغن	24 سنة
7	د.سلمان فارس حسين فارس	أستاذ مساعد	كلية التمريض /جامعة كربلاء	تمريض صحة المجتمع	32سنة
8	د.حسين عبدالله عذاري المالكي	أستاذ مساعد	كلية التمريض /جامعة كربلاء	تمريض صحة المجتمع	20سنة
9	د.حيدر فاضل البياتي	أستاذ مساعد	كلية الطب /جامعة بابل	تمريض بالغين	20 سنة
10	د.منصور عبدالله فلاح	أستاذ مساعد	كلية التمريض /جامعة الكوفة	تمريض صحة المجتمع	19 سنة
11	د.محمد باقر حسن	أستاذ مساعد	كلية التمريض /جامعة الكوفة	تمريض اطفال	18 سنة
12	د.غزوان عبد الحسين	أستاذ مساعد	كلية التمريض /جامعة كربلاء	تمريض بصحة المجتمع	18 سنة
13	د.وفاء عبد علي حطاب	أستاذ مساعد	كلية التمريض /جامعة بغداد	تمريض بالغين	17سنة
14	د.صادق عبد الحسين حسن	أستاذ مساعد	كلية التمريض /جامعة بغداد	تمريض بالغين	11 سنة
15	د.حسين منصور علي التميمي	مدرس	كلية التمريض /الكوفة	تمريض صحة المجتمع	12 سنة

Appendix F

Demographic information and Questionnaire

Part I/ Mother Socio-demographic Characteristics

1- **Age years** ☐

2- **Level of education**

Unable to read and write ☐ Primary school graduate ☐

Intermediate school graduate ☐ High school graduate ☐

Institute graduate ☐ college graduate and more ☐

3- **Mother occupation**

Government Employed ☐ Unemployed ☐ self-job retired ☐

4- **Monthly income**

Sufficient ☐ Sufficient to sometime ☐ Insufficient ☐

Part II/ Characteristics of type 1 diabetic children

1- **Age years** ☐

2- **Gender**

Male ☐ Female ☐

3-**Duration of disease**

1-3 Years ☐ 4 Years and more ☐

4-**Hospitalization for diabetes complications** in last year.

Once ☐ Several times ☐

Part III/ Mother Knowledge and awareness regarding DKA

General knowledge items	I know	Uncertain	I don't know
Normal range			
1. Normal range for fasting blood sugar is 99 mg/dL, 100 to 125 mg/dL indicates prediabetes, and 126 mg/dL or higher indicates diabetes.			
2. Normal range for post-prandial blood sugar is below 140 mg/dL. If between 140 and 199 mg/dL, it indicates that prediabetes.			
3. Normal range for HbA1c is below 5.7% is normal, between 5.7 and 6.4% indicates prediabetes, and 6.5% or higher indicates diabetes.			
4. Mild DKA is characterized by a venous pH of <7.3, moderate (pH of <7.2) and in severe (pH is <7.1)			
Causes			
1. Causes of ketoacidosis is high insulin dose			
2. The primary cause of DKA is absolute or relative insulin deficiency			
3. The child is dehydrated or has not been eating enough carbohydrates lead to DKA			
4. Acute Illness when his or her body experiences higher levels of stress lead to DKA			
Symptoms and signs			
1. High blood sugar levels cause your child to urinate more than usual			
2. The child may feel dehydrated and thirstier than usual			
3. Abdominal colic			
4. Repeated vomiting			
5. Loss of weight			
6. Acetone-odor or breath			
7. Cold skin			
8. Disturbed consciousness			
9. Muscle weakness			
Interventional awareness			
1. The hospital is the place for management of ketoacidosis			
2. Lab investigations for ketoacidosis is assessment of blood glucose level, serum potassium level and ketonuria			

3. Steps for management of ketoacidosis are Hospitalization, Insulin administration and Intravenous fluids			
4. Administering the proper dose of insulin to prevent complication			
5. Blood sugar monitoring to prevent complication			
Complications			
1. Severe dehydration			
2. Coma			
3. Brain edema			
4. Retinopathy			
5. Neuropathy			
Avoid complications			
1. Healthy food, exercise and proper treatment			
2. Daily blood sugar monitoring			
3. Proper insulin dose administration			
4. Assessment of Ketones in urine			
5. Going to the hospital in case of uncontrolled			

الجزء الاول/ الخصائص الديموغرافية للام

1- العمر ☐ سنة

2- المستوى التعليمي

لا تقرأ ولا تكتب ☐ ابتدائية ☐ متوسطة ☐ اعدادية ☐ دبلوم ☐ بكالوريوس ☐

3- العمل

موظفة ☐ لا تعمل ☐ اعمال حرة ☐

4- الدخل الشهري

يكفي ☐ يكفي نوعا ما ☐ لا يكفي ☐

الجزء الثاني/ خصائص الاطفال المصابين بمرض السكري النوع الاول

1- العمر ☐

2- الجنس

ذكر ☐ انثى ☐

3- فترة الاصابة بالمرض

3-1 سنوات ☐ 4 سنوات او اكثر ☐

4- الرقود في المستشفى بسبب مضاعفات في اخر سنة

مرة واحدة ☐ عدة مرات ☐

الجزء الثالث/ استبانة لتقييم معارف ووعي الامهات اتجاه الحامض الكيتونى السكري لاطفال السكري النوع الاول

عناصر المعرفة العامة	اعرف	غير متأكد	لا اعرف
المعدل الطبيعي			
1. المعدل الطبيعي لسكر الدم الصائم99 مجم / ديسيلتر، 100 إلى 125 مجم / ديسيلتر يشير إلى مقدمات السكري ، و 126 مجم / ديسيلتر أو أعلى يشير إلى مرض السكري.			
2. المعدل الطبيعي لسكر الدم بعد الأكل أقل من 140 مجم / ديسيلتر. إذا كان بين 140 و 199 مجم / ديسيلتر ، فهذا يشير إلى أن مقدمات السكري.			
3. المعدل الطبيعي لمعدل السكر التراكمي أقل من 5.7٪ طبيعي ، بين 5.7 و 6.4٪ يشير إلى مقدمات السكري ، و 6.5٪ أو أعلى يشير إلى مرض السكري.			
4. المستوى الخفيف من الحمض الكيتوني بدرجة حموضة أقل من 7.3 ، ومتوسط (درجة حموضة أقل من 7.2) وفي الحالات الشديدة (درجة الحموضة أقل من 7.1)			
الاسباب			
1. أسباب الحماض الكيتوني هي جرعة الأنسولين العالي			
2. السبب الرئيسي للحماض الكيتوني السكري هو نقص الأنسولين المطلق أو النسبي			
3. إصابة الطفل بالجفاف أو عدم تناول ما يكفي من الكربوهيدرات يؤدي إلى DKA			
4. المرض الحاد عندما يعاني جسده من مستويات أعلى من التوتر يؤدي إلى DKA			
ظهور أعراض وعلامات			
1. ارتفاع مستويات السكر في الدم ، مما يؤدي إلى تبول طفلك أكثر من المعتاد			
2. قد يشعر الطفل بالجفاف والعطش أكثر من المعتاد			
3. المغص البطني			
4. التقيء المتكرر			
5. فقدان الوزن			
6. رائحة الأسيتون			

7. برودة الجلد			
8. اضطرابات في الوعي			
9. ضعف العضلات			
الوعي التداخلي			
1. المستشفى هو المكان المناسب لإدارة الحماض الكيتوني .			
2. الفحوصات المختبرية للحماض الكيتوني هي تقييم مستوى الجلوكوز في الدم ومستوى البوتاسيوم في الدم والبيلة الكيتونية			
3. الاستشفاء وإعطاء الأنسولين والسوائل الوريدية			
4. إدارة الجرعة المناسبة من الأنسولين لمنع المضاعفات			
5. مراقبة نسبة السكر في الدم لمنع المضاعفات			
المضاعفات			
1. الجفاف الحاد			
2. الاغماء			
3. وذمة الدماغ			
4. اعتلال الشبكية			
5. تلف الاعصاب			
تجنب المضاعفات			
1. ممارسة الرياضة والعلاج المناسب			
2. مراقبة سكر الدم اليومي			
3. اعطاء الجرعة المناسبة من الانسولين			
4. تقييم نسبة الكيتونات في الادرار			
5. الذهاب الى المستشفى في حالة عد السيطرة على نسبة السكر.			

Appendix G

Research publication approval

Medical Journal of Babylon

Open access and peer reviewed international journal

The journal is indexed in DOAJ, EBSCO, Scimago Journal Ranking, SCOPUS

Website: https://www.mocjbabylon.org , E-mail: WKHLRPMedknow_editorial@wolterskluwer.com

Editor-in-Chief: Mufeed J. Ewadh **Publisher:** Wolters Kluwer Medknow, **FISSN:** 2317-6768

Indexed by Scopus

Acceptance of article for publication in Medical Journal of Babylon

Dear Dr. Date: 17-07-2023

Ali Kareem Jawad and Salma Kadhim Jihad

I am pleased to inform you that your manuscript (MJBL_761_23) titled as:

Knowledge and Awareness of Mothers Regarding Diabetic Ketoacidosis among Type-1 Diabetic Children

has been accepted for publication in Medical Journal of Babylon.

We have received the payment for publication. So, you will receive the galley proof within 4-5 weeks. You must have to solve the query if we point out any in the galley proof.

After correction of galley proof, your article will be published online at https://www.medjbabylon.org

Best Regards

Prof. Mufeed J. Ewadh
Editor-in-Chief-MJBL

Corresponding author: Ali Jawad, College of Nursing, Community Health Nursing, University of Babylon
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الخلاصة

الخلفية العلمية: الحماض الكيتوني السكري هو أحد المضاعفات الحادة والخطيرة والمهددة للحياة لارتفاع السكر في الدم والحماض الكيتوني. ويحدث عندما يمنع نقص الأنسولين المطلق أو النسبي قدرة الجلوكوز على دخول الخلايا لاستخدامه كوقود استقلابي. ونتيجة لذلك، يقوم الكبد بتحطيم الدهون بسرعة إلى كيتونات لاستخدامها كمصدر للطاقة.

منهجية البحث: تهدف الدراسة إلى تقييم معرفة ووعي الأمهات فيما يتعلق بالحماض الكيتوني السكري بين الأطفال المصابين بالسكري من النوع الأول. أجريت الدراسة الوصفية من الفترة من 15 تشرين الثاني 2022 إلى 19 نيسان 2023 في مركز مستشفى مرجان التعليمي للسكري والغدد الصماء في مدينة الحلة، على عينة غير احتمالية (عمدية) مكونة من (150) أم لأطفال مصابين بداء السكري من النوع الأول.

نتائج الدراسة: (64.7%) من الأمهات عبرن عن ضعف المعرفة بالحماض الكيتوني السكري عند الأطفال كما وصفه بمتوسط إجمالي منخفض و(51.3%) من الأمهات عبرن عن وعي عادل بالحماض الكيتوني السكري عند الأطفال كما وصفه بمتوسط إجمالي معتدل .

الاستنتاج: معرفة الأم تظهر ضعف المستوى والوعي العادل تجاه الحماض الكيتوني السكري لدى الأمهات فيما يتعلق بالحماض الكيتوني السكري لدى الأطفال المصابين بداء السكري من النوع الأول. توجد علاقة بين معرفة ووعي الأمهات بشأن الحماض الكيتوني السكري لدى الأطفال المصابين بداء السكري من النوع الأول.

لا توجد فروق ذات دلالة إحصائية في معرفة الأم فيما يتعلق بمهنتها، والدخل الشهري، وفيما يتعلق بعمرها وجنس الطفل.

التوصيات: ينبغي توفير التثقيف الصحي لأمهات الأطفال. [يجب تحقيقه بشكل صحيح بطريقة منظمة بناءً على مخطط عام يجب أن يتضمن التثقيف في بداية العلاج ثم تكراره بناءً على تقييم سنوي.

وزارة التعليم العالي والبحث العلمي

جامعة بابل

كلية التمريض

معارف ووعي الأمهات حول الحماض الكيتوني السكري بين الأطفال المصابين بمرض السكري من النوع الأول

رسالة تقدم بها

علي كريم جواد

الى فرع

تمريض صحة المجتمع_ كلية التمريض _جامعة بابل

كجزء من متطلبات نيل درجة الماجستير في علوم التمريض

اشراف

أ.د. سلمى جهاد كاظم

أكتوبر 2023م

ربيع الاول 1445 هـ