

Study of Glycemic Control and Management of Children Suffering from Type 1 Diabetes Versus Type 2 Diabetes

Asmaa Shaban Mohammed*, Wafaa El-Sayed Ouda**, Eman Abd El-Fatah Ali***

B.Sc. Nursing, Fayoum University. Nursing Supervisor, Intensive Care Unit, Fayoum General Hospital*, Professor of Pediatric Nursing Department Faculty of Nursing-Ain Shams University**, Assist. Prof. of Pediatric Nursing Ain Shams University***

Abstract

Background: Diabetes mellitus is a worldwide epidemic affecting the health of millions of children. While type 1 diabetes is caused by autoimmune destruction of the insulin-producing beta cells of the pancreas, type 2 diabetes results from a combination of insulin resistance and beta cells insulin secretory defect. **Aim:** This study aimed to study of glycemic control and management in children suffering from type 1 diabetes versus type 2 diabetes. **Design:** A descriptive comparative study. **Sampling:** A purposive sample comprised of 160 children (130 children with type 1 Diabetes Mellitus and 30 children with type 2 Diabetes Mellitus) and their mothers. **Setting:** This study was conducted at Diabetic Outpatient Clinics in Children's Hospital affiliated to Health Insurance in Fayoum. **Tools of data collection:** included interviewing questionnaire was used to collect data about characteristics of the studied children and their mothers, knowledge of the studied children about diabetes mellitus, glycemic control and management of diabetes. **Results:** This study revealed that the mean age of studied children with type 1 diabetes was 11.2 ± 2.4 and 60% of them were males, about 89.2% of studied children had satisfactory knowledge about Diabetes mellitus, while the mean age of studied children with type 2 diabetes was 12.6 ± 3.5 and 60% of them were females, all of studied children with type 2 diabetes had satisfactory knowledge about Diabetes mellitus. 60% of the studied children with type 1 diabetes and 73.3% of the studied children with type 2 diabetes were awarded about glycemic control. **Conclusion:** Upon the findings of the current study, concluded that majority of children with type 1 diabetes had satisfied knowledge about glycemic control and management of diabetes. All children with type 1 diabetes have satisfied knowledge about glycemic control and management of diabetes. **Recommendation:** continuous health teaching to children with type 1 diabetes and type 2 diabetes and their mothers regarding diabetes and glycemic control.

Key words: Diabetes, Glycemic control, management of diabetes.

Introduction

Diabetes is a group of metabolic diseases characterized by a chronic hyper glycaemia condition resulting from defects in insulin secretion, insulin action, or both. The frequency of diabetes is rising around the world, and studies are showing children are at increasing risk of developing the disease. Hyperglycemia of diabetes is associated with long-term damage, dysfunction, and failure of different organs,

especially the eyes, kidneys, nerves, heart, and blood vessels (World Health Organization, 2019).

Diabetes mellitus caused by many factors as genetic syndromes, chemicals, medications, malnutrition, infections, or other illnesses, according to the current classification there are two major types include: type 1 diabetes and type 2 diabetes. The distinction between the two types has historically been based on age at onset,

degree of loss of β cell function, degree of insulin resistance, presence of diabetes-associated autoantibodies, and requirement for insulin treatment for survival (**Leslie, et al. 2016**).

Type 1 diabetes is one of the most common chronic diseases seen in childhood; it is an autoimmune disease in which the body's immune system attacks insulin-producing cells in the pancreas. As a result, the pancreas produces little or no insulin (**Lucier J & Weinstock PS, 2022**).

Type 2 diabetes: is a metabolic disorder that a result in hyperglycemia (high blood glucose levels) due to the pancreas usually produces some insulin, but either the amount produced is not enough for the body's needs, or the body's cells are resistant to it. Insulin resistance, or lack of sensitivity to insulin, happens primarily in fat, liver, and muscle cells (**Jensen, 2018**).

The insulin deficiency results in decreased insulin utilization and increased hepatic glucose production leading to hyperglycemia. In addition, there is an increased breakdown of adipose tissue leading to ketonemia and eventual Diabetic Ketoacidosis (DKA) (**American Diabetes Association, 2018**).

Glycemic control is an important part of diabetes management. It is a process of achieving an optimal blood glucose range. Strict glycemic control has been shown to reduce the long term complication of diabetes. However, achieving good glycemic control is challenging for children with diabetes especially in resource limited setting (**DiMeglio LA, et al., 2018**)

Treatment depends on many factors, such as the type of diabetes and the ability of pancreas to manufacture insulin and combination of the following: Continuous glucose monitoring (CGM), Insulin

therapy, Regular physical Exercise and Diet Regimen (**Wang et al., 2022**).

Management of diabetes concentrates on keeping blood sugar levels as close to normal. Children with type 1 diabetes require daily insulin treatment to control their blood glucose levels, insulin is commonly delivered with a syringe, insulin pen or insulin pump, regular blood glucose monitoring and a healthy lifestyle to manage their condition effectively (**Garvey, 2018**).

Education about components of management such as blood glucose monitoring, insulin replacement, diet, exercise, and problem solving strategies must be delivered to the diabetic children and their families for effective diabetes management. Education seems necessary both at diagnosis, where there is usually no knowledge base and diabetic children and their families are given the basic skills for controlling the disease and throughout the patient's lifetime, with ongoing attention to self-management skills, screening and prevention of complications (**Jameson JL, et al., 2022**)

Significance of the study:

Diabetes mellitus (DM) is one of the most common endocrine and metabolic conditions in childhood. Data from large epidemiological studies worldwide estimate that 355.900 new cases of children and adolescents are diagnosed with type 1 diabetes worldwide (**The National Diabetes Statistical, 2021**).

International Diabetic Federation estimate that 108.300 children under 15 years have type 1 diabetes, the number rising to 149.500 when the age range extends to less than 20 years (**International Diabetes Federation, 2022**).

The Centers for Disease Control and Prevention estimate that 23.000 children and

adolescent under 20 years have type 2 diabetes (**The National Diabetes Statistical, 2022**).

Incidence

Incidence of diabetic children in Egypt was 700,000 children. 175,000 children with type 1 diabetes (**World Health Organization, 2018**).

Incidence of type 1 diabetes, there are currently an estimated 1.1 million children and adolescents (<20 years) living with type 1 diabetes around the world, moreover over 132,000 children and adolescents are diagnosed with type 1 diabetes each year (**International Diabetic federation, 2018**).

Incidence of type 2 diabetes, there are currently an estimated 41.600 new cases of children and adolescents are diagnosed with type 2 diabetes worldwide (**International Diabetic Federation, 2021**).

Aim Of The Study:

This study aimed to study of glycemic control and management in children suffering from type 1 diabetes versus type 2 diabetes.

Research Questions:

There is different between glycemic control and management in children suffering from type 1 diabetes versus type 2 diabetes?

Subject and Methods

Research Design:

Descriptive design was used to achieve the aim of this study.

Study Settings:

This study was carried out at Diabetic Outpatient Clinics in Children's Hospital affiliated to Health Insurance at fayoum.

Subject:

Purposive sample was consisted of 130 children with type 1 diabetes and 30 children

with type 2 and their accompanying mothers who attended to the previously mentioned setting.

The inclusion criteria

Children with confirmed diagnosis of diabetes mellitus, children in the age group of 6-18 years and able to read and write

The Exclusion Criteria

Children suffering from other chronic diseases, mental or psychiatric illness.

Tools of Data Collection:

Data was collected through using the following tool:

I- A predesigned questionnaire sheet

It was written in simple Arabic language by the researcher after reviewing the related literature. It consisted of two parts

Part I: A: Characteristics of children including; age, gender, level of education, attendance to school, ranking and residence, past and present history of children regarding diabetes as duration of diabetes, detection of disease, onset of symptoms, duration between symptoms and diagnosis, family history, complication and management of diabetes.

B: Characteristics of children's mothers including; age, level of education and occupation.

Part II: Concerned with children's knowledge regarding diabetes mellitus, glycemic control and management of type 1 and type 2 diabetes as the following:

A: Children's knowledge regarding diabetes mellitus it was composed of (8) questions about definition, types, causes, normal value of blood glucose level, signs and symptoms of hypoglycemia, signs and symptoms of hyperglycemia, intervention of hypoglycemia and intervention of hyperglycemia.

B : Children's knowledge regarding glycemic control of type 1 and type 2 diabetes it was composed of (4) questions about: Definition of glycemic control, method of glycemic control, factors affecting glycemic control and parameter of glycemic control.

C: Children's knowledge regarding management of type 1 and type 2 diabetes including:

(a) Adherence to follow up: in outpatient clinic which composed of (6) questions about: place of follow up, compliance in diabetic management, previous hospitalization, causes of hospitalization, number of hospitalization and duration of hospitalization.

(b) Treatment regimen: which composed of (12) questions about action of insulin, nature of insulin, control of insulin dose, type of insulin, site of injection, change of site of injection, route of insulin injection, side effect of insulin, effect of oral medication, preparation of oral medication, regularity in time for oral medication and complication of oral medication.

(c)Adherence to diet regimen: which composed of (7) questions about: relation between food and glycemic control, type of food, follow prescribed diabetic food, foods avoided, number of meals in day, content of food and foods that affect blood glucose level.

(d)Adherence to exercise regimen: which composed of (7) questions about: adherence to practice exercises, causes of doesn't practice exercises, importance of exercise, frequency of practice exercises, type of exercises, taking juice before practice exercises and complications during practice exercises.

❖ Scoring system:

Total grades of children's knowledge was scored 44 grades that converted into percent and equal 100 %. The correct and complete answer was scored two grades, the correct and incomplete answer was scored one

grade and the incorrect and didn't know answer was scored zero. These scores were summed – up and converted into percent score.

The score ranged from the following:

- Score less than 60 grade referred to unsatisfactory level of knowledge.
- Score more than 60 grade or equal referred to satisfactory level of knowledge.

II-Operational Design:

The operational design includes preparatory phase, content validity and reliability, pilot study and field Work

Preparatory phase

During this phase, the study tool was prepared through reviewing the available local and international related literature to be oriented with the various aspects of the research problem

Content validity and Reliability

It was ascertained by a jury of three expertise from faculty pediatric nursing, to review the tool for clarity, relevance, comprehensiveness and applicability.

Reliability of tool were tested using Cronbach Alpha Test equal 0.737 for the questionnaire sheet.

Pilot study

It was carried out on 10% (13 children suffer from type 1 diabetes and 3 children suffer from type 2 diabetes) of the study subject in the previously mentioned setting, in order to test the applicability of the constructed tools and the clarity of the included questions related to children` knowledge regarding to glycemic control and management of diabetes. The pilot study has also served to estimate the time needed for each child to fill in the questions. According to the results of the pilot, very minor changes were required there for all children involved in the pilot study were included in the main study sample.

Field Work

The actual field work of the study was carried out from beginning of May up to the end of July 2022 (3 months) the researcher was available in the study setting every day to collect data. From Pediatric diabetic out-patient clinic of Health Insurance of children's hospital from 9 am to 2 pm. The children and their mothers were interviewed (for 30 minutes).

The researcher was introduced herself to the study subject and explained the purpose, important and aim of the study to all children before starting the data collection, each child was fill the questionnaire sheet individually for 30 minutes to identify level of knowledge about glycemic control and management of diabetes.

III-Administration Design:

Ethical approval was obtained from the Scientific Ethical Research Committee, Faculty of Nursing at Ain-Shams University before starting the study. An oral approval was obtained from children and their mothers prior to data collection. The researcher assured that anonymity and confidentiality would be guaranteed and the right to withdraw from the study at any time. Ethics, values, culture and beliefs were respected.

Ethical Considerations:

Ethical approval was obtained from the scientific ethical committee of Faculty of Nursing, Ain Shams University. the researcher was clarified the objective and aim of the study to the nurses included in the study before starting and oral approval was obtained from the nurses before inclusion in the study; a clear and simple explanation was given according to their level of understanding. They secured that all the gathered data was confidential and used for research purpose only. The researcher was assuring maintaining anonymity and confidentiality of subjects` data included in the study. The subjects were informed that they are allowed to choose to participate or not in the study and they have the right to withdrawal from the study at any time.

IV-Statistical Design:

Data collected from the studied sample were revised, coded and entered using computer. Data entry and statistical analysis were fulfilled using Statistical Package for Social Sciences (SPSS) software version 21. The obtained data was organized, tabulated, analyzed, and represented in the form of tables and figures as required. Data were presented using qualitative statistics in the form of frequencies, percentages, mean and stander deviation (SD) and chi square tests. So, the p-value was considered significant as the following:

- P-value <0.05 was considered significant
- P-value <0.001 was considered as highly significant
- P-value >0.05 was considered insignificant

The main findings of this study were summarizes as follows:

Table (1): as regards characteristics of the studied children, this table shows that 60 % of the studied children with type 1 diabetes are in the age category of $6 < 12$ years with the $\bar{X} \pm SD 11.2 \pm 2.4$ years, while 73.3% of the studied children with type 2 diabetes are in the age category of $12 \leq 18$ with the $\bar{X} \pm SD 12.6 \pm 3.5$ years. As regards gender of the studied children, it is clear that 60% are male and 60% are female in children with type 1 and type 2 diabetes respectively. In relation to level of education of the studied children, it is clear that almost half 47.7% & 46.7% have primary and preparatory education respectively.

In relation to attendance to school of the studied children, it is clear that 86.2% of the studied children with type 1 diabetes are regular, compared by all of the studied children with type 2 diabetes. As regards ranking of the studied children, it is clear that 38.5% of the studied children with type 1 diabetes are first, while 40% of the studied children with type 2 diabetes are first and second. 63.1% & 66.7% of the studied children with type 1 and type 2 diabetes are lived in urban area respectively.

Table (2): shows that 53.8% of mother's age of the studied children with type 1 diabetes are in the age group of 28 <38 years with $\bar{X} \pm SD$ 34.6±10.6 years, while 66.7% of mother's age of the studied children with type 2 diabetes are in the age group of 28 <38 years with $\bar{X} \pm SD$ 36.3±9.8 years. In relation to level of education of the studied children, it is clear 38.5% of mothers have university education, while 53.3% of mothers have secondary education. 55.4% of mothers of the studied children with type 1 diabetes are work, while 53.3% of mothers of the studied children with type 2 diabetes are house wife

Figure (1): shows that there is no statistical significant difference with p-value >0.05 as regards total knowledge levels as majority in both group have a satisfactory level of knowledge.

Table (3): reveals that there is statistical significant difference with p-value >0.05 between studied children's characteristics (age and gender) and their knowledge, where (P – value = 403 * and Chi= .854). There is no statistical significant difference with p-value >0.05 between studied children's level of education where (P – value = 403 * and Chi= .854).

Table (1): Distribution of studies children according to their characteristic. (n=160).

Characteristics	Type 1 diabetes n=130		Type 2 diabetes n=30	
	No.	%	No.	%
Age (Years)				
6<12	78	60	8	26.7
12≤18	52	40	22	73.3
$\bar{X} \pm SD$	11.2 ± 2.4		12.6±3.5	
Gender				
Male	78	60	12	40
Female	52	40	18	60
Level of education				
Primary	62	47.7	6	20
Preparatory	46	35.4	14	46.7
Secondary	22	16.9	10	33.3
Attendance to School				
Regular	112	86.2	30	100
Irregular	18	13.8	0	0
Ranking				
First	50	38.5	12	40
Second	42	32.3	12	40
Third	32	24.6	6	20
Fourth	6	4.6	0	0
Residence				
Urban	82	63.1	20	66.7
Rural	48	36.9	10	33.3

Table (2): Number and percentage distribution of the studied children's mothers according to their characteristics (n= 160).

Characteristic of diabetic children's mothers	Type 1diabetes n= 130		Type 2diabetes n= 30	
	No.	%	No.	%
Age				
18<28	10	7.7	6	20
28<38	70	53.8	20	66.7
38<48	38	29.2	4	13.3
≥48	12	9.2	0	0
$\bar{X} \pm SD$	34.6±10.6		36.3±9.8	
Level of education				
Illiterate	6	4.6	0	0
Primary	4	3.1	0	0
preparatory	22	16.9	6	20
Secondary	48	36.9	16	53.3
Faculty	50	38.5	8	26.7
Occupation				
Work	72	55.4	14	46.7
House wife	58	44.	16	53.3

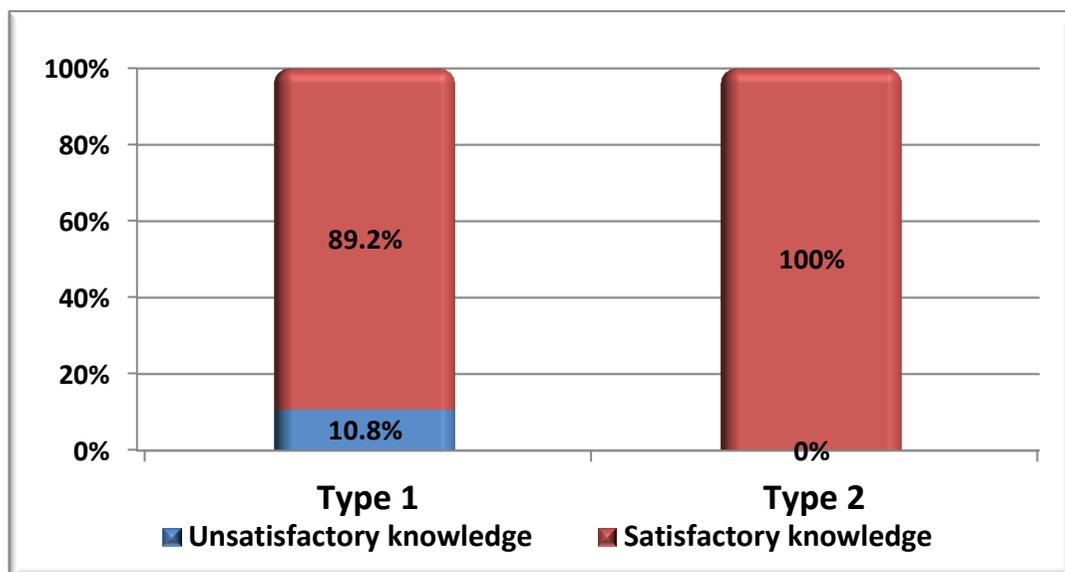


Figure (1): Percentage distribution of the studied children regarding to their total knowledge. (n=160).

Relation between variables of the study:**Table (3):** Relation between characteristics of studied children and their total knowledge (n=160).

Items	Type 1 diabetes				Type 2 diabetes				Chi – Square value	P – value
	Satisfactory		Unsatisfactory		Satisfactory		Unsatisfactory			
Age	NO.	%	NO.	%	NO.	%	NO.	%	.854	.403
6<12	68	58.6	10	71.4	8	26.7	0	0		
12≤18	48	41.4	4	28.6	22	73.3	0	0		
Gender									.854	.403
Male	68	58.6	10	71.4	12	40				
Female	48	41.4	4	28.6	18	60				
Level of education									3.892	.161
Primary	52	44.8	10	71.4	6	20				
Preparatory	44	37.9	2	14.3	14	46.7				
Secondary	20	17.2	2	14.3	10	33.3				
Attendance to school									11.070	.005
Regular	104	89.7	0	0	30	100				
Irregular	12	10.3	0	0	0	0				
Ranking									11.875	.038
First	50	43.1	0	0	12	40				
Second	34	29.3	8	57.1	12	40				
Third	26	22.4	6	42.9	6	20				
Fourth	6	5.2	0	0	0	0				
Residence									.237	.775
Urban	74	63.8	8	57.1	20	66.7				
Rural	42	36.2	6	42.9	10	33.3				

Discussion:

Concerning characteristics of studied children the results of the present study (Table 1), shows that, two third of the studied children were in the age category of 6<12 years with the mean age 13.01±2.4years, while more than two third of the studied children suffer from type 2 diabetes were in the age category of 12≤18 with the mean age 12.6±3.5 years. This finding is in agreement with **Ivan I Dedov, et al 2018** who carried out a study entitled — Diabetes mellitus in children and adolescent according to the Federal diabetes registry in the Russian Federation and found that peak incidence of type 2 diabetes mellitus increased between 15-

18 years ago. This finding is in agreement with **Ziegler and Bonifacio (2012)** who carried out a study entitled —Age-related Islet Autoantibody Incidence in Offspring of Children's With Type 1 Diabetes in Germany and found that the incidence of type 1 diabetes has its peak around puberty. Moreover, this finding supported with **Patterson et al. (2014)** who carried out a study entitled —Diabetes in the young -A global view and worldwide estimates of numbers of children with type 1 diabetes in Europe and found that the incidence of type 1 diabetes has its peak <15 years.

The results of the present study, (**table 1**) shows that, two third of the studied children with type 1 diabetes were males, while two third of the studied children with type 2 diabetes were females. This finding was not supported by **Omar et al. (2015)** who carried out a study entitled —Microalbuminuria and Glycated Hemoglobin in Children, with Type 1 Diabetes Mellitus at the Alexandria University Children's Hospital and found that the incidence of diabetes was females more than males. Moreover this finding is disagree with **Edan Siima Majaliwa, 2022** who carried out a study entitled —Survival of children and youth with type 1 diabetes mellitus in Tanzania and found that female more than male .As well as this finding is agree with **Beatriz Castillo Rodriguez, 2022** who carried out a study entitled — Characteristics of type 2 diabetes in female and male youth and found that females diagnosed with type 2 diabetes were younger and at a higher stage of pubertal development than males.

78.9% of the studied children were poor of glycemic control with HbA1c.

Concerning characteristics of the studied children's mothers, the results of the present study (**Table 2**), shows that, more than half of mother s' age of children suffer from type 1 diabetes were in the age category of 28<38 years and more than half of them working. This finding was not supported by **Hoda et al. (2022)** who carried out a study entitled — Effectiveness of an Evidence Based Insulin Injection Guidelines Application on Diabetic Children mothers Awareness about insulin injection: A quasi experimental study and reported that near half of mothers age ranged between 30 years and less than 40 years and more than half of them not working.

Concerning characteristics of the studied children's mothers, the results of the present study (**Table 2**), shows that, more than two third of mother s' age of the studied children suffer from type 2 diabetes were in the age category of 28<38 years and more than half of them doesn't work. This finding was not supported by **Rahman et al. (2021)** who carried out a study entitled — Awareness and Practice among Parents of Diabetic children and Adolescent and their Glycemic Status and

reported that less than half of mothers' age of the studied children suffer from type 2 diabetes were above 46 years and 80% of them doesn't work.

The results of the present study, (**Figure 1**) shows that, the majority of the studied children suffer from type 1 diabetes had satisfied knowledge about diabetes, glycemic control and management while all of the studied children suffer from type 2 diabetes had satisfied knowledge about diabetes, glycemic control and management. the finding of the current study reports that the majority of children with type 1 and type 2 had satisfactory knowledge about intervention of hyperglycemia . This finding was agree with **Nasaiba Ahmed,(2021)** , Who carried out a study entitled — Glycemic Control and Knowledge among Children and adolescents with Diabetes Mellitus: A Cross- Sectional Study and reported that majority of the studied children had good knowledge about diabetes and its management.

Concerning to total knowledge of the studied children. The finding of the current study, **Table (3)** reveals that, there were no statistical significance difference between age and their total knowledge. This finding was disagreeing with **Mohammad et al. (2012)** who stated in a study entitled —Predictors of Glycemic Control in Children with Type 1 Diabetes Mellitus in Assiut-Egypt that age was highly significant factor of glycemic control. Children with poor control had significantly higher mean of age than the group with good control and the degree of glycemic control among the different age groups revealed no statistically significant difference. Moreover, **Vanelli et al. (2005)** reported in a study entitled —Nationwide Cross Sectional Survey of Children and Adolescents with Diabetes in Italy that children and adolescents increasing age was associated with a higher mean HgA1c and a decreased likelihood of attaining HgA1c in the target range regardless of insulin regimen. The finding of the current study revealed that, there were no statistical significance difference between study children gender and their total knowledge. This result was in line with **Mohammad et al. (2012)**, who found that gender was not associated with glycemic control.

Concerning to the relation between studied subject according to their mean scores of knowledge and gender, no statistically significant difference was observed. This result (table, 3) is in an agree with **Chromas & Slany, (2011)**, who studied the relation between total knowledge and glycemic control and gender, mentioned that no difference between boys and girls.

Concerning study of children's knowledge about intervention of hyperglycemia, the finding of the current study reports that the majority of children with type 1 and type 2 had satisfactory knowledge about intervention of hyperglycemia. This finding was contrary with **Etta Chimbe Phiri, et., (2017)**, who carried out a study entitled — Patients Knowledge Assessment on Diabetes and Self – Care Practices Among Older Adolescent With Diabetes Mellitus in Malawi and reported that more than half of the studied children had inadequate knowledge on managing hyperglycemia and two third of the studied children were inappropriately doing self – monitoring of blood glucose level.

Conclusion:

Based on the present study findings it can be concluded that the majority of children with type 1 diabetes had satisfied knowledge about glycemic control and management of diabetes, while all children with type 2 diabetes had satisfied knowledge about glycemic control and management of diabetes.

Recommendations:

In the light of the finding of the present study, the following recommendations are suggested:

- Continuous health teaching to children with type 1 and type 2 and their mothers regarding diabetes and glycemic control to improve their adherence to diabetes management.
- Periodic and constant follow up is very important to discuss and facilitate any difficulties that may face the children suffering from diabetes.

- Psychological support, since emotional well-being is strongly associated with positive diabetes outcomes.

References:

- American Diabetes Association (2018):** Children and Adolescents: Standards of Medical Care in Diabetes –. *Diabetes Care*, 43 (Suppl. 1), S163-S182. doi:<https://doi.org/10.2337/dc20-S013>.
- Chromas J. & Slany J., (2011):** Quality of life of children, *Caslek ceson.* (150): 660-664, *Journal of Czech Physician.*
- DiMeglio, L.A., Acerini, C.L., Codner, E., Craig, M. E., Hofer, S. E., Pillay, K., & Maahs, D. M. (2018):** ISPAD Clinical Practice Consensus Guidelines 2018: Glycemic Control Targets and Glucose Monitoring for Children, Adolescents, and Young Adults with Diabetes. *Pediatr Diabetes.* Suppl 27:105-14.
- Edan Siim Majaliwa, Lind Minja, Joel Ndavongeie, Kaushik Ramaiva & Savoki G. Mfinanga (2022):** Survival of children and youth with type 1 diabetes mellitus in Tanzania *Pediatric Diabetes / Volume 23, Issue 8/ P. 1560- 1566.*
<https://doi.org/10.1111/pedi.13425>.
- Etta, Chimbe Phiri, Gladys Msiska, Lucy Ida, Kululanga & Balwani Chingatichefw Mbakaya (2017):** Patient's Knowledge Assessment on Diabetes and Self-Care Practices Among Older Adolescents with Type 1 Diabetes Mellitus in Malawi. *Eur Sci Journal, ESJ*, 13(33), 429.
- Hoda Mohamed Nafee, Eman Abd Elsamea Elguoshy, Hoda Ghareeb, Rehab Abd El Aziz El sayed Abd Aziz (2022):** Effectiveness of an Evidence Based Insulin Injection Guidelines Application on Diabetic children's Mothers Awareness about insulin injection: Thesis of Master Degree in Pediatric Nursing Faculty of Nursing Mansoura University.
- International Diabetic Federation (2019):** Global estimates of incidence of type 1 diabetes in children and adolescents: Results from the International Diabetes Federation

- Atlas. *Diabetes research and clinical practice*, 183, 109083.
- National Diabetes Statistics Report (2021):** Estimates of diabetes and its burden in the world.
<https://www.cdc.gov/diabetes/pdfs/data/statistics/national-diabetes-statistics-report.pdf>
- National Diabetes Statistics Report (2022):** Global estimates of incidence of type 2 diabetes in children and adolescents
<https://www.cdc.gov/diabetes/pdfs/data/statistics/national-diabetes-statistics-report.pdf>
- International Diabetes Federation (2018):** IDF Diabetes Atlas, 7th ed., Brussels Belgium: International Diabetes Federation; 220-223.
- International Diabetic Federation (2019):** Global estimates of incidence of type 1 diabetes in children and adolescents: Results from the International Diabetes Federation Atlas. *Diabetes research and clinical practice*, 183, 109083.
- International Diabetic Federation (2021):** Global estimates of incidence of type 2 diabetes in children and adolescents: Results from the International Diabetes Federation Atlas. *Diabetes research and clinical practice*, 163, 108083.
- International Diabetic Federation (2022):** Global estimates of incidence of type 1 diabetes in children and adolescents: Results from the International Diabetes Federation Atlas. *Diabetes research and clinical practice*, 183, 10908
- Ivan I Dedov, Marian V. Shestakova, Valentina A. Peterkova, Olga K. Vikulova & Anna V. Zheleznvakova (2018):** Diabetes mellitus in children and adolescent according to the Federal diabetes registry in the Russian Federation. *Diabetes mellitus* 20(6),932-402.
- Jameson, E. E., Elgersma, K., Martina, J. P., Currie, W. S., & Goldberg, D. E. (2022):** Diabetes mellitus : Diagnosis, classification and pathophysiology. In: Harrison Principles of Internal Medicine. 20th ed. *Biological Invasions*, 24(12), 3799-3815
- Jensen, E. T., & Dabelea, D. (2018):** Type 2 diabetes in youth: new lessons from the SEARCH study. *Current diabetes reports*, 18, 1-7.
- Kliegman, R., Stanton, B., Geme, J. & Schor, N. (2016):** Diabetes mellitus in children. In: Nelson Textbook of Pediatrics. 20th ed. Philadelphia, Pa..
<http://www.clinicalkey.com>.
- Leslie, R.D., Palmer, J., Schloot, N.C., & Lernmark, A. (2016):** Diabetes at the crossroads: relevance of disease classification to pathophysiology and treatment. *Diabetologia*. 2016;59:13–20. 4.
- Levitsky, L.L. (2016):** Epidemiology, presentation and diagnosis of type 1 diabetes mellitus in children and adolescents. <http://www.uptodate.com/home>.
- Lucier, J., & Weinstock, R.S. (2021):** Diabetes. *Diabetes Mellitus Type1*.
- Nosaiba Ahmed Hussein Abdelseed (2021):** Glycemic Control and Knowledge among Children and Adolescents with Diabetes Mellitus: Across- sectional Study. *Journal of Scientific Research in Medical and Biological Sciences* 2 (1), 1- 9, 2021.
- Mohammad, H., Farghaly, H., Metwalley, K., Monazea,E. and Abd El-Hafeez, H. (2012):** Predictors of glycemic control in children with Type 1 diabetes mellitus in Assiut-Egypt. *Indian J Endocrinol Metab*; 16(5): 796-802.
- Omar, M., Rezk, M., El-Kafoury, A. & Kandil, M. (2015):** Microalbuminuria and glyated hemoglobin in children with type 1 diabetes mellitus. *Alexandria J of Medicine*; 51(1): 83-88
- Ouda, W., Al-Rafay, S., Nasar-Eldin, A. & Kamal, S. (2016):** Stressors and Coping Pattern of Newly Versus Old Diagnosed Children with Type 1 Diabetes Mellitus: an Assessment Study. Thesis of Master Degree in Pediatric Nursing Faculty of Nursing Ain Shams University; 12.
- Patterson, C., Guariguata, L., Dahlquist, G., Soltész, G., Ogle, G. and Silink, M. (2014):** Diabetes in the young - A global view and worldwide estimates of numbers of children with type 1 diabetes. *Diabetes. Res Clin Pract*; 103:161–75

- Rehman F., Bedwora Z., Abdul B. & Homoida K. (2021):** Awareness and Practice among Parents of Diabetic children and Adolescent and their Glycemic Status; Biomed J Sci & Tech Res. Bjstr.ms.id. 006194. ISSN: 2574-1241- doi: 10.26717/BJSTR.2021.38.006194.
- Vanelli, M., Cerutti, F., Chiarelli, F., Lorini, R. and Meschi, F. (2005):** MCDC-Italy Group. Nationwide cross sectional survey of 3560 children and adolescents with diabetes in Italy. J Endocrinol Invest; 28: 692-9.
- Wang, M., Liang, Y., Chen, K., Wang, M., Long, X., Liu, H., ... & He, B. (2022):**The management of diabetes mellitus by mangiferin: advances and prospects. *Nanoscale*, 14(6), 2119-2135.
- World Health Organization (2018):** Estimates of incidence of type 1 diabetes in children and adolescents: Retrieved 24-8.
- Ziegler, A. & Bonifacio, E., Babydiab-Babydiet Study Group. (2012):** Age-related islet autoantibody incidence in offspring of children's with type 1 diabetes, the BABYDIAB-study Group Diabetologia; 55(7): 1937-4