

Compliance with Therapeutic Regimen among Children having Type 1 Diabetes Mellitus

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Abstract:

Background: Type 1 diabetes mellitus (T1DM) is characterized by destruction of the pancreatic beta cell; this eventually leads to absolute insulin deficiency in the affected children. Optimal glucose control can be accomplished through compliance to the therapeutic regimen which includes insulin regimen, dietary regimen, exercise regimen, periodic check-up, periodic laboratory tests and foot care. The objective of this study was to evaluate the degree of compliance with the therapeutic regimen among children having Type 1 Diabetes Mellitus.

Methods: A descriptive research design was carried out at the Endocrine Clinic (EC) of Alexandria University Children's Hospital (AUCH). A convenient sample of 100 children aged from 5 to 16 years was selected. The sample population was free from any other diseases and was diagnosed with only T1DM for not less than 6 months before conducting the study. Children and their parents were interviewed individually using a structured interview schedule in order to obtain data about conformity to the therapeutic regimen. Children's anthropometrics were measured and compared to normal standards for age and gender. Results of glycosylated hemoglobin, fasting blood glucose and other investigations were obtained and compared to the typical range for children with T1DM of the same age group and gender.

The results: 54% of the studied children were poorly complying with their therapeutic regimen. Children with T1DM were 39%, 54%, 67%, 55% and 60% compliant to the medication regimen, dietary regimen, exercise regimen, periodic checkup and foot care, respectively. As for laboratory investigations, 73% of the total subjects had abnormal fasting blood glucose (≥ 126 mg/dl) and 74% had poorly controlled HbA1c ($\geq 8.5\%$). When comparing the total score of compliance with children's body mass index (BMI), 9.3% of children with poor compliance to their therapeutic regimen were underweight, 22.2% were overweight and 9.3% were obese.

Conclusion and recommendations: More than half of the studied children (54%) were poorly compliant with their total therapeutic regimen. Therefore, it was recommended to conduct a total rehabilitation program for children with T1DM that include educational, recreational and occupational activities.

Keywords: Compliance, Therapeutic Regimen, Children, Type 1 Diabetes Mellitus.

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I. Introduction

Type 1 Diabetes mellitus (T1DM) is the most common metabolic disease during childhood. Its onset occurs predominantly between the ages of 7 and 15⁽¹⁾. The International Diabetes Federation (IDF) 2017 reported that the number of children with T1DM was 1,106,500 children worldwide and around 132,600 cases are diagnosed with T1DM each year⁽²⁾.

In the early stages of T1DM, clinical manifestations appear with stressful situations such as infections and acute febrile illness. In later stages, progressive islets cells destruction produces more obvious manifestation which includes: polyuria, polydipsia, polyphagia, enuresis, irritability, unusual fatigue, weight loss, abdominal discomfort, nausea, increase refusal of food and fluids that ends in dehydration and malnutrition⁽³⁾.

Diagnosis of T1DM should be based on criteria that confirm the presence of the disease: apparent clinical manifestations of T1DM plus random blood glucose (RBG) ≥ 11.1 mmol/l (≥ 200 mg/dl), fasting blood glucose (FBG) ≥ 7.0 mmol/l (≥ 126 mg/dl) or two hours post prandial blood glucose ≥ 11.1 mmol/l (≥ 200 mg/dl) during an oral glucose tolerance test (OGTT) and glycated hemoglobin (HbA1c) $\geq 6.5\%$ ⁽⁴⁾.

Therapeutic management of a child with T1DM is an integrative approach involving the child, the family and the health professionals. It consists of medication regimen (mainly insulin replacement), dietary regimen, exercise regimen, periodic check-up, periodic laboratory tests and hygienic care^(5,6).

Compliance with the therapeutic regimen has a significant influence on the quality of metabolic control and the prognosis of T1DM. The extent to which patients are compliant with their T1DM management may increase their morbidity and mortality risks⁽⁷⁾. The child's compliance is a challenge because of inadequate knowledge that leads to significant increase in long-term complications⁽⁸⁾.

Pediatric nurses play a vital role in empowering children with T1DM to properly manage the disease through self-maintenance and improving the quality of life of those children through providing them and their families with the needed data and consultations⁽⁹⁾. They also have an important contribution in promoting compliance with the therapeutic regimen. The key to confirm the child's compliance is health education which is a major function provided by the nurse to enhance compliance⁽¹⁰⁾.

Aim of the study:

The aim of this study was to: Evaluate the degree of compliance with therapeutic regimens among children having Type 1 Diabetes Mellitus.

Research Question:

What is the level of compliance with therapeutic regimen among children having Type 1 Diabetes Mellitus?

II. Methodology

Study Design

A descriptive research design was employed.

Setting

The study was conducted at the Endocrine Clinic (EC) of the Alexandria University Children's Hospital (AUCH).

Subjects

A convenient sample of 100 children having T1DM was selected based on the following criteria:

1. Their age ranged from 6-15 years old.
2. They were free from other diseases.
3. They were diagnosed with T1DM for not less than six months before conducting the study.

Tools:

Three tools were used to collect the necessary data. Those tools were developed by the researchers after thorough review of literature⁽¹⁻³⁾.

Tool I: Compliance with Therapeutic Regimen among Children Having Type 1 Diabetes Mellitus Structured Interview Schedule

The structured interview schedule consisted of three parts:

Part 1: Socio-Demographic Data of Children with T1DM: It contained the Child's name, age, gender, educational level and residence.

Part 2: Medical History: It included data about the history of diabetes mellitus disease. This data included: duration of diabetes, type of insulin used, methods of insulin administration, performance of regular sport, duration of sport, whether the sport's coach had knowledge about the signs of hypoglycemia and its management, history about diabetes-related complications and the family history of diabetes mellitus.

Part 3: Compliance of Children having T1DM with their Therapeutic Regimen

The structured interview schedule was developed in a form of questions related to compliance to the therapeutic regimen. Three point Likert scale was used to assess the response to questions as follows: always done items were given a score (2), sometimes given a score (1) and never given a score (0). Compliance with therapeutic regimen was graded as Good, Fair and Poor. Items of this part of the tool involved the following:

- a) *Compliance to medication regimen:* it consisted of questions about commitment to taking insulin as directed by the diabetologist, discarding the remaining insulin dose in the bottle every month, storing insulin pen at room temperature, discarding vial of the insulin pen every month, taking insulin in the right sites, changing insulin injection sites daily, washing hands before preparing the medicine, rolling or running the sterile insulin vial between the palms of the hands until it becomes homogeneous and the deposit disappears, holding the skin with forefinger and thumb and holding the needle perpendicularly to inject at an angle of 90 degrees.
- b) *Compliance to dietary regimen:* it consisted of questions about following the diet prescribed by the diabetologist, taking three meals and two snacks between meals, avoiding taking high-sugar foods, taking food that contains complex carbohydrates, taking the appropriate amount of fiber foods, taking the appropriate amount of starchy foods at mealtimes and avoiding consuming foods that contain saturated fats.
- c) *Compliance to exercise:* it consisted of questions about regular exercising, knowing the importance of performing exercises to child with T1DM, engagement in daily activities, taking water during exercise practice or during activities of daily living, taking carbohydrates containing sugar during prolonged duration of sports activities (more than 30 minutes) or during activities of daily living.

d) *Compliance with Periodic checkups*: it consisted of questions about visiting the diabetic clinic every three months for follow-up, performing an ophthalmic examination annually after the fifth year of being diabetic and checking blood pressure annually.

e) *Compliance with periodic laboratory tests*: it consisted of questions about regular monitoring of fasting blood glucose and glycated hemoglobin (HbA1c) every three months.

f) *Compliance with foot care*: it consisted of questions about nail trimming style, wearing comfortable and closed shoes and avoiding walking barefoot.

Tool II: Anthropometric Measurements Sheet

The sheet listed the weight, height and body mass index (BMI) measurements. It also included weight and height standard deviation charts for age and gender.

Tool III: Laboratory Investigations Record

The record logged the results of fasting blood glucose and HbA1c as the main ones and if indicated other investigations were logged.

The scoring system of Compliance with Therapeutic Regimen among Children Having Type 1 Diabetes Mellitus Structured Interview Schedule

There were a total of 29 questions in the six main therapeutic regimens. They were divided as follows; medication regimen (10 questions), dietary regimen (6 questions), exercise regimen (5 questions), periodic check-up (3 questions), periodic laboratory tests (2 questions) and foot care (3 questions).

The responses to the questions of each regimen were summed up and the total was divided by the number of the questions, giving the score for the regimen. These scores were converted into percentage score and were interpreted as follows: children who achieved a score of 60 % or more were judged as having good compliance; those achieving a score between 50% to less than 60% were considered to have fair compliance; while others achieving a score below 50% were considered as having poor compliance⁽¹¹⁾.

Method

1. The agreement of Research Ethics' Committee of Alexandria Faculty of Nursing was obtained before beginning the research process.
2. An administrative approval for the collection of data was obtained from the responsible directors of the chosen settings after explaining the purpose of the study.
3. The tools were developed by the researchers after thorough review of the related literature.
4. The tools were tested for their content validity by 5 experts in the pediatric nursing field. Their validity was ($r = 0.960$).
5. The developed tools were also tested for their reliability by using Cronbach's Coefficient Alpha Test and the result was ($r = 0.827$) which reflected a high level of reliability.
6. A pilot study was carried out on 10 children with T1DM to test the feasibility of the research and the applicability of the tools. Those 10 children were not included in the study subjects.
7. Based on the feedback from the pilot study, the tools were accordingly modified. Some questions in part (3) of tool (I) were modified as they were not fully understood by the children and their parents. Those questions were related to taking food that contains complex carbohydrates, taking appropriate amounts of starchy foods, avoiding consuming foods that contain saturated fats and taking carbohydrates containing sugar during prolonged duration of sports activities (more than 30 minutes) or during excessive activity of daily living. Those questions were simplified to be more easily understood by the children and their parents.
8. Data was collected over a period of six months beginning on 18th January and ending on 14th June 2018.
9. Each child and/or his/her parents, depending on the age of the child, was interviewed individually to obtain the following data:
 - a. Socio-demographic characteristics of the child with T1DM using part (1) of tool (I).
 - b. Medical history of the disease. The history was compared with the data in the medical record of the child using part (2) of tool (I).
 - c. Answers to questions that reflect the items of compliance to the therapeutic regimen. Both the parent and the child were asked about the six components of compliance using part (3) of tool (I).
 - d. Each interview session lasted for approximately 15-20 minutes.
10. Anthropometric measurements, weight and height, were measured and compared to standard deviation charts for age and gender. BMI was calculated and was recorded using tool (II).
11. Laboratory investigations were obtained from medical records and recorded using tool (III).
12. Ethical Issues:

- a. Written informed consent was obtained from the diabetic children's parents after explaining the aim and method of the study.
- b. Parents have the right to either refuse or participate in the study and they have the right to withdraw at any time.
- c. Child's privacy and confidentiality of the collected data were maintained throughout the implementation of the study.

Statistical Analysis

1. Collected data was revised, coded and transformed into a specially designed format to be suitable for computer feeding. Following data entry, checking and verification processes were carried out to discover and correct any errors that might have taken place during data entry.
2. Data was analyzed using IBM SPSS (Statistical Package for Social Sciences) version 16 on a personal computer.
3. The significance of the obtained results was judged at the 5% level.
4. The tests used for data analysis were:
 - a. *Chi-square test*: Used for categorical variables to test the association between the variables.
 - b. *Fisher's Exact or Monte Carlo tests*: Used to test the association between the variables of chi-square when more than 20% of the cells have expected count of less than 5.
 - c. *Cronbach's Alpha*: Used for Reliability Statistics.

III. Results

Table (1) shows the compliance of children with T1DM to their medication regimen. It shows that 59% of children were always taking insulin as directed by the diabetologist. As for children taking insulin by syringe, 61.5% of them discarded the remaining doses in insulin vial every month. Regarding children taking insulin by pen, 64.9% of them were always discarding the pen every month. It is also shown that 49%, 57% and 62% never took insulin in correct place, changed insulin injection site nor washed hands before preparing the insulin, respectively.

Concerning children taking premixed insulin (n=15), 80% of them were always rolling the sterile insulin vial before aspirating the dose. With regards to injecting insulin using the proper technique, 85% of children were always injecting insulin at an angle of 90 degrees.

Table (1): Compliance of Children with T1DM to their Medication Regimen

Compliance to medication regimen	Never		Sometimes		Always	
	No.	%	No.	%	No.	%
Take insulin as directed by diabetologist (n=100)	19	19	22	22	59	59
Take insulin through the syringe (n= 26)						
• get rid of insulin remaining dose in bottle every month	16	61.5	8	30.8	2	7.7
Use the insulin pen (n= 74)						
• Storage of insulin pen at room temperature	28	37.8	7	9.5	39	52.7
• Discard vial of the pen every month	12	16.2	14	18.9	48	64.9
Take insulin in correct places (n=100)	49	49	16	16	35	35.0
Change insulin injection sites (n=100)	57	57	23	23	20	20
Wash hands before preparing insulin (n=100)	62	62	20	20	18	18
Premixed insulin: (n=15)						
• Roll the sterile insulin vial	1	6.7	2	13.3	12	80
Inject insulin with right way (n=100)						
• Holding the skin	63	63	19	19	18	18
• injections at angle of 90 degrees	11	11	4	4	85	85

Table (2) shows compliance of children with T1DM to their dietary regimen. With regards to following the prescribed diet, 65% of children with T1DM never followed their medically prescribed diet. As for distribution of food intake, 52% of studied children were never taking three meals and snacks in between. In relation to taking high-sugar foods, 53% of them were did not avoid taking high-sugar foods.

The subjects complied to taking complex carbohydrates and fiber food with a percentage of 54% and 66% respectively. In regards to starchy foods, 40% of children never consumed appropriate intake of starchy foods. In regards to foods containing saturated fat, 43% of children reported that they never took foods that contained saturated fat.

Table (2): Compliance of Children with T1DM to Dietary Regimen (n=100)

Compliance to dietary regimen	Never	Sometimes	Always	Total %
	%	%	%	
Follow prescribed diet	65	15	20	100
Take three meals and snacks	52	32	16	100
Avoid taking high-sugar foods	53	25	22	100
Take the complex carbohydrates	9	37	54	100
Take fiber foods	7	27	66	100
Take appropriate starchy foods	40	35	25	100
Avoid taking foods that contain saturated fat	43	38	19	100

Table (3) shows compliance of the subjects to their exercise regimen. It can be noted that 65% of the subjects were never regularly exercising and 80% of them did not know the importance of exercising for children with T1DM. It was also observed that 79% of those children were always engaged in daily activities, 57% of them were never drinking water during exercise or activity and 40% of them were always taking carbohydrates containing sugar during heavy exercise.

Table (3): Compliance of Children with T1DM to Exercise Regimen (n=100)

Compliance to Exercise	Never	Sometimes	Always	Total %
	%	%	%	
Regularly perform exercise	65	8	27	100
Know important of perform Exercise	80	3	17	100
Engage in daily activities	6	15	79	100
Take a water during exercise or activity	57	30	13	100
Take carbohydrates from sugar during heavy exercise	33	27	40	100

Table (4) shows the compliance of the subjects to their periodic check-ups. It can be noted that 70% of those children were compliant in regularly visiting the diabetic clinic. On the other hand, 58% of them never went for ophthalmic examination and 70% of them never checked their blood pressure.

Table (4): Compliance of Children with T1DM to Periodic Check-ups (n=100)

Compliance to Periodic check-up	Never	Sometimes	Always	Total %
	%	%	%	
Regularly visit diabetic clinic	18	12	70	100
Regularly going for ophthalmic examination	58	6	36	100
Regularly check blood pressure	70	15	15	100

Table (5) shows the compliance of the subjects to performing their basic periodic laboratory tests. It shows that 59% and 62% of the subjects regularly monitored FBG and regularly checked HbA1c, respectively.

Table (5): Compliance of Children with T1DM to Basic Periodic Laboratory Tests (n=100)

Compliance to basic periodic laboratory tests	Never	Sometimes	Always	Total %
	%	%	%	
Regularly monitor FBG	19	22	59	100
Regularly check HbA1c	22	16	62	100

Table (6) shows the compliance of the subjects to foot care. It shows that 41% of them never cut their nails in a straight fashion and 67% never wore comfortable and closed shoes while 40% of always avoided walking barefoot.

Table (6): Compliance of Children with T1DM to Compliance to Foot Care (n=100)

Compliance to Foot Care	Never	Sometimes	Always	Total %
	%	%	%	
Cut nails in straight fashion	41	31	28	100
Wear comfortable and closed shoes	67	18	15	100
Avoid walking barefoot	37	23	40	100

Figure (1) portrays the distribution of children with T1DM in relation to total compliance score. It shows that 54% of those children poorly complied with their therapeutic regimen.

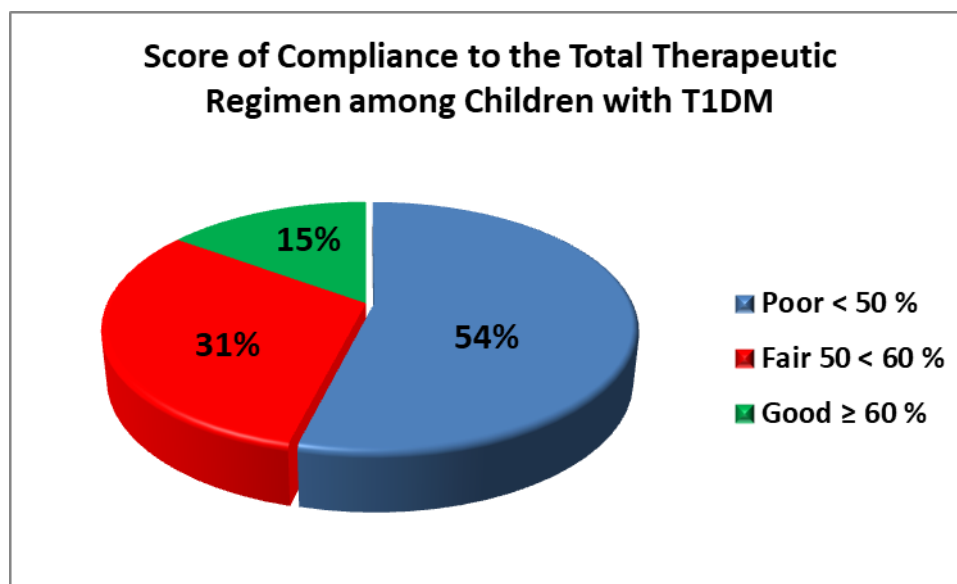


Figure (1): Distribution of children with T1DM in relation to the total compliance score

Table (7) shows the distribution of children with T1DM according to their anthropometric measurements. As for children’s weight; it is observed that 2% were below average weight for age and gender and 9% were above average weight for age and gender. It is also delineated that 10% of those children were above average height for their age and gender and 14% were below average height for their age and gender. It is noted that 40% of the children deviated from average BMI for their age and gender: 11%, 20% and 9% were underweight, overweight and obese, respectively.

Table (7): Distribution of children with T1DM to their anthropometric measurements (n=100)

Physical Measurements	%
Average weight for age and gender	
• Average weight(3 rd to 97 th percentile)	89
• Below average weight(less than 3 rd percentile)	2
• Above average weight(more than 97 th percentile)	9
Average height for age and gender	
• Average height(3 rd to 97 th percentile)	76
• Below average height(less than 3 rd percentile)	14
• Above average height(more than 97 th percentile)	10
BMI for age and gender	
• Underweight(less than 5 th percentiles)	11
• Normal weight(less than 85 th percentiles)	60
• Overweight(less than 95 th percentiles)	20
• Obese(more than 95 th percentiles)	9

Table (8) shows the distribution of the subjects according to the results of their laboratory investigations. It is clear that 73% had abnormal fasting blood glucose result (≥ 126 mg/ dl), 74% of them had poorly controlled

HBA_{1C} result ($\geq 8.5\%$). As for microalbuminuria, 32% of the children who underwent this test (number = 56) had abnormal result (> 20 mg / dl).

Table (8): Distribution of children with T1DM according to their laboratory investigations

Lab. Investigations	No.	%	Total %
Fasting blood sugar (n=100)			
Normal(<126mg/ dl)	27	27	100
Abnormal(≥ 126 mg/ dl)	73	73	
HBA_{1C} (n=100)			
Good control (<7.5%)	8	8	100
Fair control (7.5-<8.5%)	18	18	
Poor control ($\geq 8.5\%$)	74	74	
Microalbuminuria (n=56)			
Normal(<20 mg/ dl)	38	68	56
Abnormal (>20 mg/ dl)	18	32	

Table (9) clarifies the relationship between the overall compliance of children with T1DM and their BMI according to percentile chart for age and gendgender. It shows that 45.5% of underweight children (n=11), 60% of overweight children (n= 20) and 55.5% of obese children (n=9) scored "Poor" on compliance with their therapeutic regimen. These results show no statistical significance between BMI and compliance with the T1DM therapeutic regimen (Mc P =0.976).

Table (9): Relationship between Overall Compliance of Children with T1DM and their BMI according to percentile chart for age and gender

Child's Compliance to Therapeutic Regimen	BMI according to percentile								Total	Significance			
	Under weight n=11		Normal weight n=60		Overweight n=20		Obese n=9						
	No.	%	No.	%	No.	%	No.	%					
Overall compliance	•	Poor <50%	5	45.5	32	53.3	12	60.0	5	55.5	54	54%	Mc P =0.976
	•	Fair 50 - <60%	4	36.4	20	33.3	5	25.0	2	22.2	31	31%	
	•	Good $\geq 60\%$	2	18.2	8	13.3	3	15.0	2	22.2	15	15	

χ^2 : Chi square test ^{MC}P: Monte Carlo *Significant at P ≤ 0.05

Table (10) reveals the relationship between the overall compliance of the subjects with the therapeutic regimen and their laboratory investigations. It is observed that 74.1% with abnormal fasting blood glucose result had poor compliance with their therapeutic regimen and 55.4% with poor control HBA_{1C} result had poor compliance to their therapeutic regimen. It is also noted that 33.3% with abnormal microalbuminuria results had poor compliance to their therapeutic regimen. There were no statistically significant differences for FBG, HBA_{1C} and Microalbuminuria, respectively (P = 0.444, 0.268 and 0.726) (P= 0.444, 0.268 and 0.726).

Table (10): Relationship between Compliance of Children with T1DM to the Therapeutic Regimen and their Laboratory Investigations

Children's Laboratory Investigations	Compliance of Children						Total	Significance	
	Poor(n=54)		Fair(n=31)		Good(n=15)				
	No.	%	No.	%	No.	%			
Fasting blood sugar (n=100)								$\chi^2= 1.625$ P= 0.444	
• Normal <126	14	25.9	57	22.6	6	40.0	27		27
• Abnormal ≥ 126	40	74.1	24	77.4	9	60.0	73	73.0%	
HBA_{1C}(n=100)								Mc P = 0.268	
• Good control <7.5%	3	37.5	5	62.5	0	0.00	8		8.0
• Fair control 7.5-<8.5%	10	55.5	6	33.3	2	11.1	18		18.0
• Poor control >8.5%	41	55.4	20	27.0	13	17.6	74	74.0	

Microalbuminuria (n=56)									Mc P = 0.726
• Normal <20 mg/ dl	20	66.7	14	73.7	4	57.1	38	67.9	
• Abnormal >20 mg/ dl	10	33.3	5	26.3	3	42.9	18	32.1	

χ²: Chi square test ^{MC}P: Monte Carlo *Significant at P≤0.05

IV. Discussion

Insulin therapy is the mainstay in the management of T1DM⁽¹²⁾. The results of the present study showed that 39% of children had poor compliance to insulin regimen (Table 1). This finding could be justified by lack of information of children and their parent about medication storage which affects the viability of insulin, right area of insulin administration which affects insulin absorption, ignorance of side-effects of unchanged injection site which leads to lipodystrophy. The finding is congruent with Gomes and Negrato (2016)⁽¹²⁾ who performed a study about adherence to insulin therapeutic regimen in patients with type 1 diabetes. They reported that 48.0% were minimally adherent to their insulin therapeutic regimen.

Diet plays an essential role in the management of children with T1DM⁽¹³⁾. The current study found that 54% of children were poorly compliant to the dietary regimen (Table 2). This could be justified by peer-related factors and lack of knowledge specific to diabetes dietary regimen problems such as: parents' inability to control sugar intake of their children (children prefer high sugar foods and fast food rather than green vegetable, especially among peers). This finding was in line with Patton (2011)⁽¹³⁾ who conducted a study about adherence to diet in youth with T1DM. He concluded that many youth with T1DM struggled with adherence and did not meet dietary guidelines for their disease.

Physical activity is imperative in the self-management of T1DM. Regular exercise is the best way of maintaining weight, decreasing insulin resistance, improving insulin sensitivity and decreasing daily need for exogenous insulin⁽¹⁴⁾. The present study found that 67% of studied children had poor compliance to exercise regimen (table 3). This finding could be justified by lack of information about the importance of regular exercise, fear of hypoglycemia during exercise, and lack of parental support and encouragement to participate in sport or physical activity. Similar findings were reported by Jegdic, et. al (2013)⁽¹⁴⁾ who carried out a study about physical fitness in children with T1DM, measured through six-minute walk test. They reported that children with T1DM were less physically fit than their matched healthy controls.

Periodic check-ups are an extremely important part of diabetes care. They help to check the disease's prognosis, follow growth and development of those children, check regimen, detect early signs of complication and deal with them⁽¹⁵⁾. The findings of the current study showed that 55% of studied children were poorly compliant to periodic check-up (Table 4) and 58% of them had never performed ophthalmic examination (Table 4). These findings could be justified by lack of awareness of the dangers of the diabetes-related complications, the distance between the places of follow-up and home and lack of awareness of the importance of follow-up of children. These findings were supported by Ibraheem, et. al (2014)⁽¹⁵⁾. They reported that 40.3% of children with T1DM were not having an eye examination.

One of the key dimensions of health care quality and improved T1DM management is compliance with the total therapeutic regimen provided by health care professional⁽¹⁶⁾. The current study found that 54% of the subjects poorly complied with their overall therapeutic regimen (Figure 1). This finding could be justified by lack of education of diabetic care and children's self-care practice, financially related factor and lack of social support, lack of school support, lack of adequate health insurance which leads to increased occurrence of acute complication due to an imbalance between carbohydrate intake and insulin levels, not taking snacks in between meals, insufficient or excessive insulin treatment and feeling difference from his/ her peers. These findings are consistent with Kyokunzire and Matovu (2018)⁽¹⁶⁾ who published a study about factors associated with adherence to diabetes care recommendations among children and adolescents with T1DM. They reported that there was an overall poor adherence to diabetes care recommendations among T1DM children and adolescents in this population.

Overweight and obesity in children with T1DM are now prevalent and accounts for significant health consequences⁽¹¹⁾. The same trend was observed in the present study. 40% of the subjects deviated from normal average BMI for age and gender (Table 7). This finding could be justified by lack of information about the consequences of overweight and obesity on cardiovascular complications. This finding is congruent with Minges, et. Al (2013)⁽¹⁷⁾ who conducted a study about overweight and obesity in Youth with T1DM. They reported that there is high prevalence of overweight and obesity among youth with T1DM.

The emerging treatments and technologies in T1DM were designed to enhance glycated hemoglobin (HbA1c) and reduce progression of diabetes-related complications⁽¹⁸⁾. The present study found that 74% of the studied sample had poorly controlled HBA1C (Table 8). The relationship showed that 55.4% with poor control HBA1C result had poor compliance to their therapeutic regimen (Table 10). These findings could be justified by

poor compliance to dietary and insulin regimen (Tables 1&2). These findings were congruent with Andrade, et. al (2017) ⁽¹⁹⁾ as they reported that poor glycaemic control, which is common among Brazilian patients with DM1, is associated with lower education, self-perception of insufficient adherence to diet and insulin and inadequate monitoring of HbA1C levels. This finding was also supported by Viana, et.al (2016) ⁽²⁰⁾ who reported that improved adherence to diabetes care treatment modestly reduced HbA1c in patients with T1DM.

Regular screening for microalbuminuria is highly recommended for the early detection of diabetic nephropathy⁽²¹⁾. The findings of the current study showed that 73% of the subjects who underwent microalbuminuria test had abnormal results (Table 8) and 72.5% with abnormal microalbuminuria results had poor compliance to their therapeutic regimen (Table 10). These findings could be justified by poor compliance to therapeutic regimen and poor diabetic control which lead to nephro-vascular changes that can occur as early as 2.5 to 3 years after diagnosis ⁽⁵⁾. These findings were supported by Al-Eisa, et. al (2017)⁽²²⁾ and Daniels, et al. (2013)⁽²³⁾. Both researches reported that, good glycemic control is beneficial in preventing diabetic nephropathy.

VI. Conclusion

Based on the results of the current study it can be concluded that:

Compliance with the total therapeutic regimen among children having type 1 diabetes mellitus was poor in more than half of the studied subject. Compliance with the exercise regimen scored the lowest among the six therapeutic regimens. More than one-third of the subjects have deviated from average body mass index for age and gender and more than two thirds had poor results of glycated hemoglobin.

V. Recommendations

According to the results and conclusions driven from the current study, the following recommendations are suggested:

1. More pediatric health facilities should be established to reduce the travelling distance of children with T1DM and their parents, so that they could follow the established visit schedule.
2. A total rehabilitative program should be conducted for children with T1DM. This program should include educational, recreational and occupational activities.
3. Camps for children with T1DM are very beneficial to decrease the feelings of isolation and the “ I am the only one who is different” perception.
4. Promoting diabetes support groups through the internet.
5. Social, school, peer and family support is mandatory for engaging children with T1DM in the routine of therapeutic regimen.
6. Health teaching through printed materials should be available in the pediatric diabetic clinics.

Further studies:

Further multi-center research should be performed prospectively on larger study samples in this area to identify factors affecting the level of compliance with therapeutic regimen among children having T1DM, reasons for poor compliance to therapeutic regimen so that appropriate interventions can be instituted to improve compliance and ultimately prevent complications from the disease.

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