

Effect of Nursing Intervention on Metabolic Control among Adolescents with Type 1 Diabetes Mellitus

Ragaa Nader Mohamed¹, Hala Mostafa El-Hady Hashim², and Ebtisam Mohamed Abd Elaal³.

(1) B.Sc., in Nursing science, (2005), Ain Shams University, Nursing Inspector, Kotor Health Administration, Gharbia Governorate, (2) Professor of Community Medicine and Public Health, Faculty of Medicine, Benha University, and (3) Professor of Community Health Nursing, Faculty of Nursing, Benha University, Egypt.

Abstract

Background: Type 1 diabetes mellitus is a metabolic disease characterized by a deficiency in pancreatic beta cells and insulin. It has a significant impact on biological, psychological, and social health of adolescents. **Aim of study:** Was to evaluate the effect of nursing intervention on metabolic control among adolescents with Type 1 diabetes mellitus. Research design: A quasi-experimental research design was used in this study. **Setting:** The study was conducted at Pediatric Endocrinology Outpatient Clinic in Benha University Hospital. **Sample:** A purposive sample included 100 adolescents with Type 1 diabetes mellitus attending Pediatric Endocrinology Outpatient Clinic for follow up. **Tools:** Two tools were used to conduct this study. **Tool I:** A structured interviewing questionnaire which included 4 parts: **A):** Personal characteristics of adolescents with Type 1 diabetes mellitus. **B):** Medical history of adolescents with T1DM. **C):** Anthropometrics and blood measurement. **D):** Knowledge of adolescents regarding T1DM, metabolic control and physical activity. **Tool II:** The diabetes self-management measure practices. **Results:** 45% of the studied adolescents were diagnosed through symptoms, and 20% discovered after complications. Additionally, 84% and 79% of studied adolescents had good knowledge about diabetes and metabolic control post-intervention increased from 47% and 37% pre-intervention. A significant difference of the studied adolescents regarding blood glucose level measurement pre and post nursing intervention ($P \leq 0.001$). Also, there was a strong positive correlation between total knowledge and self-management practices post-intervention ($p \leq 0.001$). **Conclusion:** Implementation of the nursing intervention was effective in improving adolescents' knowledge and practices regarding T1DM and metabolic control. **Recommendation:** Continuous implementation of structured nursing interventions is essential for enhancing diabetes-related knowledge and self-care practices among adolescents with Type 1 Diabetes Mellitus Type 1 diabetes mellitus, promoting optimal metabolic and glycemic control, and minimizing the risk of diabetes-related complications.

Keywords: Adolescents, Metabolic control, Type 1 Diabetes mellitus

Introduction

Adolescence is the transition period from childhood to adulthood, when growth and development accelerate, and changes occur. The management of diabetes in the teenage age group presents a more complex set of challenges given the variety of physiological, social and emotional changes that occur between childhood and adulthood, including

puberty, peer pressure, the desire to be normal, identity formation and social relationships. Although adolescents can manage Type 1 Diabetes Mellitus (T1DM) independently, appropriate parental involvement in the care of adolescents with diabetes is important. As parental monitoring increases in the care of adolescents with

diabetes, adolescents adapt better and have better metabolic control (**Öztaş et al., 2025**).

Type 1 diabetes mellitus is a metabolic disease characterized by a deficiency in pancreatic beta cells and insulin. This condition leads to significant biological, psychological, and social impacts for individuals. Adolescents with T1DM face the risk of severe acute and chronic complications. The incidence of T1DM is increasing among children and adolescents, leading to a growing number of individuals transitioning from childhood or adolescence to adulthood with diabetes. This transition presents additional challenges in managing the disease and maintaining optimal health (**Santa Cruz et al., 2025**).

Type 1 diabetes mellitus is a growing global health concern, affecting more than 1.2 million children and adolescents under 20 years old, with 108 thousand new diagnoses annually. This lifelong condition requires continuous management, frequent review, and adjustment of insulin therapy. Adolescents must develop skills in acceptance, coping, self-management, integration, and adjustment to live well with T1DM, adapting their daily lives accordingly (**Harazneh et al., 2024**).

Treating T1DM involves comprehensive care to maintain blood glucose levels within a target range and prevent complications. Essential management strategies include lifelong insulin therapy, cautious exercise, carbohydrate counting, and regular blood glucose monitoring. The treatment plan must be tailored to adolescents' needs, considering various factors such as age, lifestyle, and cultural influences. Additionally, family support and education play crucial roles in helping children and adolescents adhere to their treatment plans, dietary recommendations, and daily physical activity. Effective treatment of T1DM requires a

collaborative approach involving healthcare providers, patients, and their families to achieve optimal health outcomes (**Alzawahreh & Ozturk, 2024**).

Metabolic control is crucial in managing T1DM, as it directly impacts the risk of complications associated with the disease. Proper metabolic control helps to reduce glycated hemoglobin (HbA1c) levels, which is the gold standard for assessing glycemic control. Advanced diabetes technologies, such as Continuous Glucose Monitoring (CGM) and continuous subcutaneous insulin infusion, have significantly improved metabolic control by reducing HbA1c, minimizing hypoglycemia and micro and macro complications. However, challenges like incorrect carbohydrate counting, physical inactivity, and insulin resistance in T1DM patients can hinder achieving optimal metabolic control (**Mazzotta et al., 2024**).

Type 1 diabetes mellitus can lead to significant complications if not properly managed. Elevated blood glucose levels can cause acute issues like hypoglycemia and diabetic ketoacidosis, as well as chronic complications affecting both small and large blood vessels. Microangiopathy, such as retinopathy, nephropathy, and neuropathy, can result in blindness, renal failure, and nerve damage, respectively. Macroangiopathy can lead to cardiovascular diseases, including heart attacks and strokes. Additionally, T1DM increases the risk of skin complications, hypoglycemia unawareness, and psychosocial issues, such as diabulimia. Achieving optimal metabolic control is essential to minimize these complications and improve the overall quality of life for adolescents with T1DM (**Dong et al., 2024**).

Community Health Nurse (CHN) plays a pivotal role in managing diabetes, particularly for adolescents. CHN provides critical

education on self-management techniques, helping young adolescents and their families develop knowledge, confidence, and problem-solving skills. CHN offers ongoing, individualized education tailored to age, life stage, and diagnosis, ensuring effective diabetes management. Also, stay updated on the latest insulin therapy theories and diabetic devices, improving nursing care and encouraging self-sufficiency in at-home care. By promoting modern diabetes treatments and emphasizing diet, lifestyle changes, and technological training, CHN enhances health outcomes and minimizes complications for young adolescents with diabetes (Alzawahreh & Ozturk, 2024).

Significance of the study:

Global studies have demonstrated that the prevalence of T1DM has been steadily rising at a rate of 2-5%. Furthermore, the incidence of T1DM in the United States is roughly 1 in 300 among individuals who are 18 years old. Among the global rankings for diabetes prevalence, six nations in the Middle East and north Africa area are included in the top 10. The nations mentioned are Bahrain, Egypt, Kuwait, Oman, Saudi Arabia, and the United Arab Emirates. Egypt makes the highest contribution to the overall number of estimated childhoods T1DM cases among Eastern Mediterranean and Middle Eastern countries, accounting for around 25% of the region's total. The prevalence ranges from 1/100000 annually in Pakistan to 8/100000 annually in Egypt among children under 15 years of age (Alzawahry & Awwad, 2024).

Aim of the study

The aim of the present study was to evaluate the effect of nursing intervention on metabolic control among adolescents with T1DM.

Research hypothesis: Nursing intervention was improved knowledge, practices and metabolic control of adolescents with T1DM.

Subjects and Method

Research design:

A quasi-experimental research design was utilized to conduct this study.

Settings:

The study was conducted at Pediatric Endocrinology Outpatient Clinics in Banha University hospital.

Sampling:

A purposive sample was used in this study. The sample involved 100 adolescents with T1DM from the previously mentioned setting who attended the Pediatric Endocrinology outpatient clinics for follow-up. According to the following criteria:

-Aged 10-19 years.

-Newly diagnosed with T1DM.

-Exclusion criteria: -had other chronic diseases.

Tools of data collection:

Two tools were used in this study:

Tool I: A structured interviewing questionnaire: It consisted of four parts:

First part: It was concerned with personal characteristics of the adolescents with type1 diabetes, it included 5 closed ended questions; (age, sex, educational level, place of residence and adolescents' ranking).

The second part: It was concerned with the medical and family history of adolescents with T1DM involved in the study. It included 7 closed ended questions (how long adolescents had T1DM, how it was discovered, any of family members have T1DM, how long have adolescents been using insulin treatment, type of insulin used, how often do adolescents visit doctor for follow-up, and have adolescents ever been hospitalized for type 1 diabetes).

The third part: It was concerned with anthropometrics and blood measurement of adolescents with T1DM involved in the study. It included 6 open questions about (weight, height, BMI, last fasting blood sugar reading,

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last postprandial blood sugar reading two hours after eating, and last Hemoglobin A1C reading).

Fourth part: A- It was concerned with knowledge of adolescents regarding type 1 diabetes mellitus. It included 13 closed ended questions about type 1 diabetes (meaning, risk factors, signs and symptoms, the most common age for diagnosis, complications, prevention, the main goal of controlling blood glucose levels during sick days, ways to control blood glucose levels during sick days, meaning of hypoglycemia, signs and symptoms of hypoglycemia, causes of hypoglycemia, 15-15 rule for hypoglycemia management and the best example of 15 grams of carbohydrates.).

B1- It was concerned with knowledge of adolescents regarding metabolic control. It included 25 closed ended questions (HbA1C meaning, the hemoglobin A1C level that is considered good control of blood glucose level, blood glucose levels measurements timing, counting carbohydrates in daily meals, components of healthy food choices, know any applications that help count carbohydrates, the main goal of counting carbohydrates in a meal for type 1 diabetics, the importance of carbohydrates, types of carbohydrates, sources of carbohydrates, ways to maintain blood sugar levels, the insulin carb ratio meaning, ways to calculate the amount of carbohydrates, glycemic index meaning, the importance of the glycemic index for type 1 diabetics, the insulin sensitivity factor meaning, the importance of the insulin sensitivity factor for type 1 diabetics, the corrective dose of insulin for type 1 diabetics, the healthy choice for breakfast for a teenager with type 1 diabetes, the best choice for a healthy snack between meals, the choice that is considered an unhealthy lunch for a teenager with diabetes,

the healthy choice for drinks, the estimated amount of carbohydrates in a breakfast consisting of 2 slices of bread, 2 boiled eggs, a cucumber, and a cup of milk, the estimated amount of carbohydrates in a meal consisting of a cup of rice, a cup of cooked Molokai, a green salad, and a grilled chicken breast and source of knowledge).

B2- It was concerned with adolescents' knowledge regarding the importance of physical activity and its relationship with type 1 diabetes mellitus. It included 5 closed ended questions about (the effect of physical activity on blood sugar levels, the physical activity that can be practiced by adolescents, the recommended daily time of physical activity, the precautions that must be followed before practicing physical activity, and the benefit of maintaining a healthy weight).

Scoring system:

The scoring system for adolescents' total knowledge regarding type 1 diabetes and metabolic control was calculated by assigning a score of 1 for each correct answer and 0 for each incorrect answer, with a total knowledge score of 44 points. Based on the percentage of correct responses, the total knowledge score was categorized into three levels:

- Good knowledge: 33 points or above ($\geq 75\%$).
- Average knowledge: 22 to < 32 points (50% to < 75%).
- Poor knowledge: below 22 points (< 50%).

Tool II: Assessing the practice through; The Diabetes Self-Management measures (SEDM) are self-report practices adopted from (Mulvaney et al., 2014). It was divided into 4 categories: nutrition, control of blood glucose levels, physical activity and weight control and medical management). These categories consisted of 20 items as follows:

1. Nutrition which included 5 items (count the amount of carbohydrates in meals, keep

eating plan when sick, choose different foods and stick to eating plan when adolescent away from home, adjust eating plan when adolescent get more physically active, and adjust insulin doses to match the amount of carbohydrates adolescent eat).

2. Control of blood glucose levels which included 4 items (check blood sugar as recommended by doctor, lower blood sugar when sugar level is too high, raise blood sugar when sugar level is too low and use glucose readings to adjust insulin doses and meals).

3. Physical activity and weight control which included 5 items (check blood sugar before and after exercise, adjust meals or insulin doses before exercise to avoid lows or highs, control weight and keep it within the ideal weight range, do enough physical activity such as walking, aerobic exercise, and stretching, and do more physical activity if the doctor advises it).

4. Medical management which included 6 items (examine feet for cuts and blisters, visit doctor four times a year to monitor diabetes, take medication as prescribed by the doctor, inject insulin correctly in the right places, commit to take insulin doses at the specified times, and adjust insulin based on the sugar level and the amount of carbohydrates).

Scoring system:

The scoring system is graded according to the questionnaire. The scoring system for adolescent diabetes self-management measure practices was calculated as 2 scores for always, and 1 score for sometimes while, 0 for never. For each area of practices, the score of the questions was summed up and the total divided by the number of the questions, which converted into a percent score. The total practices scores = 40 points which further categorized: Satisfactory → if the score of the total reported practice was $\geq 75\%$ (≥ 30

points) unsatisfactory if it was $< 75\%$ (< 30 points).

Content validity:

The tools validity was done by five members of Faculty's Staff Nursing-Benha University Experts from the Community Health Nursing Specialties who reviewed the tools for clarity, relevance, comprehensiveness, applicability and easiness for implementation and according to their opinion minor modifications were carried out.

Reliability:

Reliability was done by Cronbach's Alpha coefficient test that was developed by Lee Cronbach in 1951 which revealed that each of the three tools consisted of relatively homogeneous items as indicated by the moderate to high reliability of each tool. The internal consistency of knowledge was 0.781 and practice was 0.842

Ethical consideration:

Approval and informed consent were obtained from Research Ethical Committee (Code: EC.CHN.P-112) at Faculty of Nursing Banha University to conduct the study, oral and written consent from all study participants was obtained after explaining the purpose of the study to gain their trust and cooperation. Each adolescent had a choice to continue or withdraw from study. Privacy and confidentiality were assured. Ethics, values, culture, and beliefs were respected. The data collected was stored in a confidential manner.

Pilot study:

The pilot study was carried out in the beginning of April 2024 to ascertain the clarity and applicability of the study tools representing 10% (10 adolescents) of total study participants 100 adolescents with T1DM. It had also served in estimating the time needed for filling the questionnaires. It ranged between 30-45 minutes to assess knowledge and practices of adolescents regarding T1DM and metabolic control. No

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modification was done, so the pilot study included in the study main subjects.

Nursing intervention included four phases:

Based on the results obtained from the interviewing questionnaire and observational checklists, as well as literature review, the nursing intervention developed by researchers. It was implemented immediately after pre-test. The researchers implemented the nursing intervention through 4 phases as the following:

(I) preparatory and Assessment phase:

The studied adolescents were interviewed during the assessment phase to obtain baseline data. The researchers greeted each adolescent, addressed the objectives, timeline, and activities of the study. The investigator were available one day every week (Thursdays) from 9.00 am to 1.00 pm. The researchers met the adolescents at the waiting area in Endocrinology Outpatient Clinic. The data collecting tools filled during this phase (pretest. The studied adolescents were asked to complete the questionnaire to assess their knowledge and practices), the average time needed for filling the sheet was around 30-45 minutes for each adolescent. The researchers assessed knowledge regarding T1DM, metabolic control and importance of physical activity. Each adolescent was observed individually during their actual practice to evaluate their practice exactly using an observational checklist. The average number of adolescents interviewed per day was 3-4 per day.

(II) Planning phase:

The researchers designed the nursing intervention in simple Arabic language as indicated in the assessment phase and considering the relevant literature. Researchers design the booklet, confirmed the number of sessions, contents, the various teaching methods, and the media to be used

based on adolescents levels of understanding. The goals and objectives were created as following:

General objectives:

The general objective of nursing intervention was knowledge, practices will improved and metabolic control among adolescents with T1DM after nursing intervention implementation

Specific objectives:

After the completion of the nursing intervention, the studied adolescents should be able to:

A-Acquire knowledge about Type 1 Diabetes Overview, Carbohydrate counting.

B- Performing skills:

Glucose monitoring, Insulin therapy (types, storage, injection technique, site rotation), Meal planning, Foot Care Daily Practice.

(III) Implementation phase:

The nursing intervention for adolescents with T1DM was implemented during the phase. It included (6) scheduled sessions. Each session provided for the small group of adolescents, which included 3-4 adolescents, lasted between 30 and 45 minutes. The all groups of studied adolescents received the same sessions. Additionally, several teaching methods, including lectures supported with video, group discussions, demonstration, re-demonstration were employed. On the first day of the nursing intervention, all study adolescents received different teaching media, included role play, educational booklet, and colored posters. A brief overview to the nursing intervention and its aim was done at the beginning of the first session. Every session started with a brief orientation of the prior one. The implementation phase took nearly 4 months. The nursing intervention was implemented through the program sessions, each session started by a summary of the previous one and objectives of the new

session. Total number of sessions for the studied adolescents was 6 sessions, 2 sessions for theoretical part and 4 sessions for practical part as the following:

Theoretical part for studied adolescents included two sessions as the following:

-Session (1): Understanding Type 1 Diabetes.
-Session (2): short-term complications Management.

The practical part for studied adolescents included two sessions as the following:

-Session (3): Self-Management Skills regarding glucose monitoring & insulin therapy.
-Session (4): Understanding carbohydrates.
-Session (5): Foot Care Daily Practice.
-Session (6): Adolescents' coping skills with type1 Diabetes.

(IV) Evaluation phase:

After implementation of the nursing intervention the researchers applied the post-test immediately after implementation of the nursing intervention using the same tools of pretest aiming to evaluate the efficacy of nursing intervention. The researchers compares the change in the adolescents' knowledge, practices and metabolic control immediately.

Administrative Approval:

An official letter was obtained from the Dean of Faculty of Nursing concerned the title, objectives, tools, and the study technique was illustrated to gain their cooperation which is needed to allow the researcher to meet the adolescents with T1DM chosen hospital.

Statistical analysis:

All data collected were organized, tabulated and analyzed by using the Statistical Package for Social Science (SPSS) version 21, which was used frequencies and percentages for qualitative descriptive data, while chi-square coefficient χ^2 was used for relation and correlation tests, mean and standard deviation was used for quantitative

data and the Spearman correlation test (r) was employed to assess the relations among the total scores of knowledge and attitudes.

The associations between items were considered as the following: (P-value)

- Highly statistically significant $P < 0.001^{**}$
- Statistically significant $P < 0.05^*$
- Not significant $P > 0.05$

Results

Table (1): Illustrates that; 29% of the studied adolescents were aged from 12 to less than 14 years old with mean age 13.24 ± 4.11 . Regarding to sex; 53% of the studied adolescent were females, 48% of them had secondary education, 53% of them were living in urban areas, and 52% of them had first ranking between their siblings.

Table (2): Shows that; 41% of the studied adolescents had T1DM from one to two years, 45% of them discovered T1DM through the symptoms and signs of the disease, 52% of them didn't have family history of T1DM, 44% of them used insulin treatment since less than 6 months, 35% of them used intermediate-acting insulin, 44% of them visited their doctors every three months for follow-up, and 37% of them hospitalized for T1DM due to very high blood sugar.

Table (3): Illustrates that; there was highly statistically significant difference of the studied adolescents regarding blood glucose level measurement pre and post nursing intervention ($P \leq 0.001$). Moreover, mean $\pm$ SD of the studied adolescents' last fasting blood sugar reading was 195.53 ± 64.202 pre nursing intervention compared to 130.02 ± 39.592 post nursing intervention, mean $\pm$ SD of the studied adolescents' last postprandial blood sugar reading two hours after eating was 208.32 ± 55.841 pre nursing intervention compared to 174.95 ± 26.175 post nursing intervention, while mean $\pm$ SD of the studied adolescents' last Hemoglobin A1C reading was 9.479 ± 1.6063 pre nursing intervention

compared to 8.042 ± 1.3134 post nursing intervention.

Figure (1): This figure illustrates that; 42% of the studied adolescents had good total knowledge level pre nursing intervention which increased to 82% post nursing intervention and 33% of the studied adolescents had average total knowledge level pre nursing intervention which decreased to 12% post nursing intervention, while 25% of the studied adolescents had poor total knowledge level pre nursing intervention which decreased to 6% post nursing intervention.

Figure (2) This figure illustrates that 47% of the studied adolescents had satisfactory total practices level pre nursing intervention regarding metabolic control which increased to 82% post nursing intervention, while 53% of the studied adolescents had unsatisfactory total practices level pre nursing intervention which decreased to 18% post nursing intervention. **Table (4):** Illustrates that; there were highly positive correlation between total knowledge and total practices regarding metabolic control post nursing intervention ($P \leq 0.001$), while there was positive correlation between total knowledge and total practices regarding metabolic control pre nursing intervention ($P < 0.05$).

Table (1): Personal characteristics of studied adolescents (n=100).

Personal characteristics	No.	%
Age/years:		
10 < 12 years	5	5.0
12 < 14 years	29	29.0
14 < 16 years	18	18.0
16 < 18 years	24	24.0
≥ 18 years	24	24.0
Min-Max	10-18	
Mean±SD	13.24±4.11	
Sex:		
Male	47	47.0
Female	53	53.0
Educational level:		
Primary education	29	29.0
Preparatory education	23	23.0
Secondary education	48	48.0
Place of residence:		
Rural	47	47.0
Urban	53	53.0
Adolescents' ranking:		
First	52	52.0
Middle	36	36.0
Last	12	12.0

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Table (2): Medical and family history of studied adolescents with T1DM (n=100).

Medical and family history	No.	%
How long have adolescent had type 1 diabetes:		
Less than a year.	39	39.0
From one to two years.	41	41.0
More than two years.	20	20.0
How was type 1 diabetes discovered:		
During some tests and medical examinations.	35	35.0
Through the symptoms and signs of the disease.	45	45.0
When the complications suddenly occur.	20	20.0
Any of family members have type 1 diabetes:		
Yes	48	48.0
No	52	52.0
How long have adolescent been using insulin treatment:		
Less than 6 months.	44	44.0
From 6 months to one year.	33	33.0
More than one year.	19	19.0
From 1 to 3 years.	4	4.0
Type of insulin used:		
Rapid-acting insulin.	29	29.0
Intermediate-acting insulin.	35	35.0
Long-acting insulin.	12	12.0
Rapid and long-acting insulin.	18	18.0
I don't know.	6	6.0
How often do adolescent visit doctor for follow-up:		
Once a month.	10	10.0
Every three months.	44	44.0
Every six months.	31	31.0
I don't follow up regularly.	15	15.0
Have adolescent ever been hospitalized for type 1 diabetes:		
Yes, due to very high blood sugar.	37	37.0
Yes, due to very low blood sugar.	29	29.0
No, I have never been hospitalized for diabetes.	34	34.0

Table (3): Mean and stander deviation of the studied adolescents regarding blood glucose level measurements pre and post nursing intervention (n=100).

Blood glucose level measurement	Pre nursing intervention			Post nursing intervention			t test	p-value
	Min.	Max.	Mean $\pm$ SD	Min.	Max.	Mean $\pm$ SD		
Last fasting blood sugar reading.	140	423	195.53 $\pm$ 64.202	75	290	130.02 $\pm$ 39.592	9.05	.000**
Last postprandial blood sugar reading two hours after eating.	142	453	208.32 $\pm$ 55.841	98	255	174.95 $\pm$ 26.175	5.25	.000**
Last Hemoglobin A1C reading.	7.0	14.0	9.479 $\pm$ 1.6063	5.7	12.2	8.042 $\pm$ 1.3134	7.99	.000**

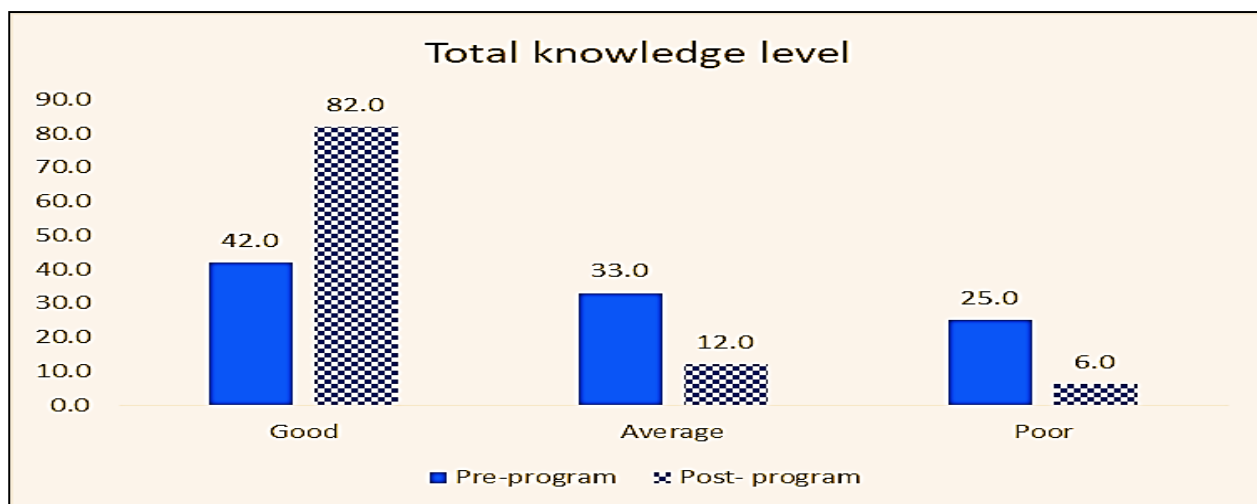


Figure (1): Percentage distribution of studied adolescents regarding their total knowledge levels pre and post nursing intervention (n=100).

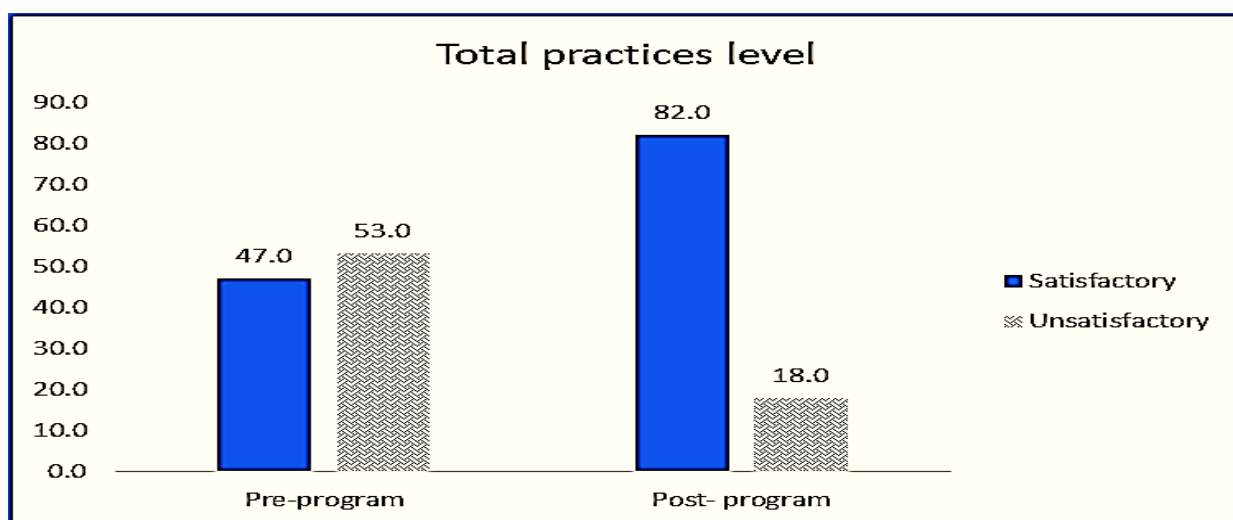


Figure (2): Percentage distribution of the studied adolescents regarding total practices' levels pre and post nursing intervention regarding metabolic control (n=100).

Table (4): Correlation between total knowledge and total practices regarding metabolic control pre and post nursing intervention, (n=100).

Items	Total Knowledge			
	Pre nursing intervention		Post nursing intervention	
	r.	p-value	r.	p-value
Total practices	.108	.020*	.845	.000**

Discussion

Management of Type 1 Diabetes Mellitus (T1DM) requires a comprehensive and proactive approach aimed at minimizing

complications, enhancing recovery, reducing blood glucose levels, and achieving optimal HbA1c outcomes. According to the guidelines established by the International Society for

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Pediatric and Adolescent Diabetes (ISPAD), maintaining HbA1c levels below 7% is a key target. This is achieved through an integrated strategy involving effective insulin administration, balanced nutrition, regular physical activity, structured diabetes education, and consistent self-monitoring of blood glucose throughout the critical stages of childhood and adolescence (**Ispriantari et al., 2023**).

Regarding to personal characteristics; Nearly one-third of the participants were in the age group of 12 to less than 14 years, with a mean age of 13.24 ± 4.11 years, indicating that most of the adolescents were in early to mid-adolescence critical developmental stage where self-care behaviors and health habits start to become more established. Female participants slightly outnumbered males, accounting for 53% of the total sample.

In terms of educational background, nearly half of the adolescents were enrolled in secondary education, which may positively influence their ability to understand diabetes-related health education and self-management strategies. Regarding residence, 53% of the adolescents lived in urban areas, potentially indicating better access to healthcare resources, diabetes education, and support services compared to their rural counterparts. Additionally, more than half of the participants (52%) were first in birth order among their siblings.

Overall, these characteristics provide valuable context for interpreting the outcomes of the study, as age, gender, education, residence, and family structure are important factors that can influence adolescents' knowledge, and practice to manage Type 1 Diabetes mellitus.

According to medical and family history of studied adolescents, the current study demonstrated that; slightly less than two fifth 39%, had type

1 diabetes for less than year. This finding was congruent with **Abraham et al., (2023)**, who studied “Glycemic control and associated factors among children and adolescents with T1DM, in southwest Ethiopia”, $n=158$, and found that 27.8% of participants had diabetes for less than year. This might be due to that a significant portion of the adolescents may have been recently diagnosed with T1DM, which is why they have had the condition for less than a year.

Concerning medical and family history of studied adolescents, the current study demonstrated that; more than half of them didn't have family history of type 1 diabetes and more than one third of them hospitalized for T1DM due to very high blood sugar. These result findings were incongruent with **Bekele et al., (2022)**, who studied “Health-related quality-of-Life and associated factors among children and adolescents with T1DM: A cross-sectional study, in Ethiopia”, $n=379$, and found that 22.7% children and adolescents had a family history of diabetes and 28.5% children and adolescents had a history of admission at health facilities in the last 6 months. This might be due to type 1 diabetes mellitus is influenced by a combination of genetic and other factors, such as viral infections, environmental triggers, and immune system abnormalities, which contribute to the development of T1DM in adolescents without a family history of the condition.

According to medical and family history of studied adolescents, the current study demonstrated that; more than third 34% of studied adolescents are never hospitalized for diabetes. This finding was in the same line with **Gürkan et al., (2019)**, who studied “Effects of a home-based nursing intervention program among adolescents with T1DM, in Turkey”, $n=36$, and found that 33% of studied

population never hospitalized last year for diabetes complications. This might be due to many adolescents with type 1 diabetes may manage their condition effectively through outpatient care, regular follow-ups, and adherence to treatment plans, reducing the need for hospitalization.

Regarding blood glucose level measurements, the present study reported that; mean of the studied adolescents' last haemoglobin A1C reading was 9.479 ± 1.6063 pre nursing intervention. This finding was in the same line with **Abdel Mordy et al., (2023)**, who studied "Assessment of carbohydrate content estimation among adolescents with type 1 diabetes and their glycemic control, in Egypt", $n=81$, and demonstrated that mean of the studied adolescents' last hemoglobin A1C reading was 9.7 ± 2.343 . This might be due to adolescents may struggle with adhering to their insulin regimen and other diabetes management practices, leading to higher A1C levels.

Concerning adolescents' total knowledge level, the present study illustrated that, a substantial improvement in adolescents' total knowledge levels following the implementation of the nursing intervention program. Prior to the intervention, less than half (42%) of the participants exhibited a good level of knowledge regarding diabetes care, while a considerable proportion (33%) had an average level and one-quarter (25%) demonstrated poor knowledge. After the nursing intervention, the proportion of adolescents with good knowledge nearly doubled to 82%, accompanied by a marked decline in both average (12%) and poor (6%) knowledge levels. This significant improvement indicates the effectiveness of the nursing intervention in enhancing adolescents' understanding of diabetes management.

As regard to adolescents' total practices level pre nursing intervention, the present study illustrated that; less than half 47% of the studied adolescents had satisfactory total practices level, while more than half 53% of the studied adolescents had unsatisfactory total practices level. This result was strongly agreed with **ElSayed et al., (2023)**, who studied "American Diabetes Association. Children and adolescents: Standards of Care in Diabetes-2023" and revealed that; the majority of the participants had satisfactory total practices level about diabetes. From investigator point of view, adolescents may have had ongoing follow-up with healthcare providers, reinforcing the importance of continuous self-management and offering support in addressing any challenges, leading to improved practice adherence.

Considering correlation between total knowledge and total practices regarding metabolic control, the present study showed that; there was a highly positive correlation between total knowledge and total practices regarding metabolic control post nursing intervention ($P \leq 0.001$), while there was a positive correlation between total knowledge and total practices regarding metabolic control pre nursing intervention ($P < 0.05$). This finding was consistent with **Al-Mutawaa et al. (2022)**, who revealed that; there was highly positive correlation between total knowledge and total practices regarding metabolic control post nursing intervention ($P \leq 0.001$).

On the other hand, these findings were inconsistent with **Thirunavukkarasu et al. (2021)** who studied "Knowledge, attitudes, and practices towards diabetic retinopathy among primary care physicians of Saudi Arabia: a multi-centre cross-sectional study, in Saudi Arabia", $n=274$, and showed that; there was no positive correlation between total knowledge and total practices regarding

metabolic. From investigator point of view, with improved knowledge, adolescents likely felt more empowered to take control of their health. Understanding the importance of maintaining balanced blood glucose levels, managing insulin injections, and adhering to dietary guidelines encouraged them to take more consistent and effective actions toward achieving metabolic control.

Conclusion

Implementation of the nursing intervention proved to be effective in improving adolescents' knowledge regarding T1DM and metabolic control. Majority of the studied adolescents had good total knowledge level about diabetes post nursing intervention and more than three quarters of them had had good total knowledge level about metabolic control post nursing intervention. Moreover, majority of studied adolescents had satisfactory total practices level post nursing intervention regarding metabolic control. Additionally, there were highly positive correlation between total knowledge and total practices regarding metabolic control post nursing intervention, while there was positive correlation between total knowledge and total practices regarding metabolic control pre nursing intervention.

Recommendations

- Continuous ongoing educational programs for adolescents with T1DM that should cover diabetes management, the importance of metabolic control, and the use of new technologies like continuous glucose monitoring and insulin pumps.
- Develop a dedicated online platform for adolescents with T1DM to enhance communication and provide direct access to the healthcare team for inquiries and support.
- Integrate diabetes education into school health curricula to raise awareness and support students with T1DM in managing

their condition effectively within the school environment.

- Foster community partnerships with local health clubs and recreational centers to provide adolescents with T1DM access to safe physical activity programs, and ongoing lifestyle support.

- Further research with larger, diverse populations to validate the effectiveness of nursing interventions and develop more tailored strategies for different adolescent groups.

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تأثير التدخل التمريضي على التحكم الأيضي لدى المراهقين المصابين بداء السكري من النوع الأول

رجاء نادر محمد، هالة مصطفى الهادي هاشم، وابتسام محمد عبد العال

داء السكري من النوع الأول هو مرض أيضي يتميز بنقص في خلايا بيتا البنكرياسية والأنسولين. وله تأثير كبير على الصحة البيولوجية والنفسية والاجتماعية للمراهقين لذلك هدفت هذه الدراسة إلى تقييم تأثير التدخل التمريضي على التحكم في التمثيل الغذائي بين المراهقين المصابين بداء السكري من النوع الأول. تم استخدام تصميم بحث شبه تجريبي في هذه الدراسة. أجريت الدراسة في العيادة الخارجية لأمراض الغدد الصماء للأطفال في مستشفى جامعة بنها، وشملت العينة الهادفة ١٠٠ مراهق مصاب بداء السكري من النوع الأول يراجعون العيادة الخارجية لأمراض الغدد الصماء للأطفال للمتابعة. وقد كشفت النتائج أن معرفة وممارسات المراهقين بمرض السكري والتحكم الأيضي ازدادت إلى ٨٤٪ و ٧٩٪ بعد التدخل، مقارنةً بـ ٤٧٪ و ٣٧٪ قبل التدخل. وُجد فرق كبير بين المراهقين المدروسين فيما يتعلق بقياس مستوى سكر الدم قبل وبعد التدخل التمريضي، كما وُجد ارتباط إيجابي قوي بين المعرفة الكلية وممارسات الإدارة الذاتية بعد التدخل. وقد أسفرت النتائج أن تطبيق التدخل التمريضي فعالاً في تحسين معرفة المراهقين وممارساتهم فيما يتعلق بمرض السكري من النوع الأول والتحكم الأيضي. وقد أوصت الدراسة إلى أن التنفيذ المستمر للتدخلات التمريضية المنظمة أمرًا ضروريًا لتعزيز المعرفة المتعلقة بمرض السكري وممارسات الرعاية الذاتية بين المراهقين المصابين بمرض السكري من النوع الأول، وتعزيز التحكم الأمثل في التمثيل الغذائي ونسبة السكر في الدم، وتقليل مخاطر المضاعفات المرتبطة بمرض السكري.