

Assessment of Diabetic Children's Problems Related to Insulin Injection

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Abstract

Background: Diabetes mellitus is one of the most common chronic disorders in the world. **This study aimed to** assess the diabetic children's problems related to insulin injection. **Study Design:** A descriptive design was conducted at diabetic outpatient clinic/children's hospital affiliated to Ain Shams University Hospitals. **Study subjects:** A purposive sample of 100 diabetic children from both genders and aged from 6-18 years (accompanying mothers were interviewed when necessary). **Data collection tools:** I. Structured interviewing questionnaire to gather data concerning characteristics of the studied diabetic children and their parents, medical history, follow up and self care, children's knowledge regarding diabetes and the problems related to insulin injection. II. Observational checklist of insulin injection to assess the studied children's reported practice of insulin injection. **Results:** The study revealed that, more than half of the studied children had unsatisfactory total knowledge regarding type 1 diabetes and insulin injection and more than half of them had moderate problems related to insulin injection, also more than half of the children practiced insulin injection correctly and there was highly statistical significant difference between problems related to insulin injection and children's total knowledge related to diabetes and practice of insulin injection. **Conclusion:** The study concluded that, most of the studied diabetic children had moderate and mild problems related to insulin injection. The study revealed an inadequate knowledge related to diabetes and insulin treatment. **Recommendations:** The study recommended continuous health education for the diabetic children and their parents regarding insulin injection technique, dose calculation, possible complications, injection problems and its management.

Keywords: Knowledge, practice, diabetic children's problems, insulin injection problems, nursing.

Introduction:

There are 425 million people have diabetes in the world and more than 39 million people in the Middle East and North Africa region. While in Egypt there are more than 8 million cases of diabetes (**International Diabetes Federation, 2018**).

Approximately 1 in every 400 to 600 children has T1DM. In Egypt, T1DM incidence and prevalence were found to show an increase over the past 18 years. The incidence and prevalence were higher in females and more cases were found to originate from rural areas (**El Ziny et al., 2017**).

Insulin injection treatment may cause many problems to diabetic children and their families. Some of the problems

could be related to difficulty of insulin injection preparation, wrong insulin injection practice, high cost and unavailability of insulin and its supplies, or psychological problems such as embarrassment of taking insulin in public places, fear of needle pain. Children also may suffer from dermatological side effects of insulin injection such as liph hypertrophy or lipoatrophy (Neu et al., 2015).

Aim of the study:

This study aimed to assess diabetic children's problems related to insulin injection.

Research Questions:

1: What are diabetic children's problems related to insulin injection?

2: Is there a relationship between diabetic children's characteristics and problems related to insulin injection?

Subjects and Methods:

Research Design:

A descriptive design was used to achieve the aim of this study.

Setting:

The study was conducted at the diabetic outpatient clinic/children's hospital affiliated to Ain Shams University hospitals.

Sample and Subjects:

A purposive sample of 100 diabetic children were involved in this study representing 10% of the total attendance of children which was 1055 child during

2017-2018, from both genders (their accompanying mothers were interviewed when necessary) with the following inclusive criteria:

-Children aged from 6-18 years.

Tools of Data Collection:

Tool I: Structured Interviewing Questionnaire:

It was designed by the researcher after reviewing the relevant literature and was written in a simple Arabic language. The tool included the following parts:

Part I: characteristics of the studied diabetic children and their parents.

Part II: Medical history, follow up and diabetes self care practices.

Part III: Assessment of children's knowledge regarding diabetes and the problems related to insulin injection.

• Scoring System of Knowledge:

This part consisted of 21 questions (21 points) each question had 4 or more responses. The correct answer scored 1. The incorrect or incomplete answer scored zero. The response (do not know) was considered as an incorrect answer during collecting the total answers scores and was given zero. According to children's responses, the total knowledge satisfaction level was categorized into two categories; satisfactory level for 50% or more of the total correct answers and unsatisfactory level for less than 50% of the total correct answers.

• Scoring System of Problems:

This part consisted of closed ended 24 questions with responses that ranged

from 0 (Never) to 4 (all times) representing the intensity of the problems and yes/no questions concerned with psychological problems, school problems and side effects related to insulin injection. The responses were given (1) for (yes) answer and (zero) for (No) answer. According to children's responses their total insulin related problems were categorized into three categories; less than 50% had mild problems, 50 to $\geq 75\%$ had moderate problems and $>75\%$ had severe problems.

Tool II: Observational Checklist for Reported Practice of Insulin Injection: It was adopted from **American Association of Diabetes Educators, (2017)** to assess the studied children's reported practice regarding their insulin injection.

• Scoring System of observational checklist:

The checklist included 10 steps that. The children responses were given score 1 for correctly done and zero for not correctly done. According to the children's practice scores the total practice was classified into less than 60% (Not correctly done) and more than 60% (Correctly done).

Content Validity and Reliability:

Validity of the designed structured interviewing questionnaire was evaluated by 5 expertise in the pediatric nursing in Faculty of Nursing Ain shams University, for content clarity and objectivity. The reliability coefficient for the study tool was calculated using the correlation coefficient Cronbach's alpha test (0.82 to .099) that is statistically accepted as a very high coefficient.

Pilot Study:

A pilot study was carried out on September 2017, included 10% of the expected total study subjects. It was conducted to evaluate the applicability, clarity, efficiency and time required to fulfill the tools. Subjects who shared in the pilot study were excluded later from the study sample due to modifications in the data collection tools.

Field of Work:

- The data collection process started on the first of October 2017 till the end of May 2018. This was conducted within 2 days weekly (Tuesday and Wednesday) from 9 Am to 12 Pm.

- The researcher conducted the study in the diabetes outpatient clinic/ children's hospital affiliated to Ain Shams University hospitals. The researcher started the data collection by introducing herself to the parent (mothers) and their diabetic children, and gave them an explanation about the aim of the research and its expected outcomes. The researcher interviewed each study subject to fill the study tools. The time needed for completing one questionnaire was about 15-20 minutes.

Ethical Considerations:

Official approval was obtained from Research Ethics Committee in Faculty of Nursing, Ain Shams University to conduct the current study. Verbal approval was obtained from each child's accompanied parents before their inclusion in the study with assuring for their anonymity and confidentiality.

Statistical Design:

The collected data was organized, scored, tabulated and analyzed using the statistical package for social sciences, version 20.0 (SPSS Inc., Chicago, Illinois, USA) as:

- Quantitative data were expressed as mean \pm standard deviation $\bar{X} \pm SD$.

- Qualitative data were expressed as frequency and percentage.

The following statistical tests were used:

- Number, percentage distribution, and mean.

- Standard deviation (S.D) (for variable age).

- Chi-square (X^2) test of significance was used in order to compare proportions between two qualitative parameters.

Results:

Table (1): Regarding the characteristics of the studied children's parents the mean age of the studied mothers was 35.69 ± 7.49 , and less than half (43%) of them had secondary education. 57% of the mothers were not working. The mean age of the studied fathers was 40.64 ± 6.93 , less than half (46%) of the studied fathers had bachelor degree. All of the fathers (100%) were working.

In relation to family history, the present study revealed that less than half of the studied children (47%) had positive family history of diabetes.

Table (2): Regarding the studied children's characteristics it was found that, the mean age of the studied children was 10.65 ± 4.76 and more than half (62%) of them were males. 54% of the studied children were ranked as the first child in their family, and less than half (47%) of the studied children were in primary school.

Regarding the problems of insulin injection administration. Unavailability of insulin was found to represent a problem to 57% of the studied diabetic children. While high cost of insulin represented a problem to 81% of them and 65% had problem of not changing the needle with every dose.

Regarding the side effects and complications of insulin, 75% of the studied children had skin inflammation at site of injection and 67% of them had redness and hematomas at site of injection. 66% of them had lipohypertrophy. Also 76% of the studied children complained of pain at injection site.

Fig (1): Regarding the total problems related to insulin injection, 59% of the studied children were found to have moderate problems, 33% of them had mild problems and 8% had severe problems

Fig (2): Regarding the total reported practice of insulin injection, it was found that 58% of the studied children practiced the injection correctly while 42% of them didn't practice correctly.

Table (3): This study showed that, there was a positive relation between the studied children's total problems related to insulin injection and their medical history. There was highly statistically significant difference between the studied children total problems of insulin injection and

their follow up and diabetes self-care practices. There was also a statistically significant difference between the studied children total practice and their characteristics ($p < 0.05$).

Table (4): It was found that there was highly statistically significant difference between the studied children's total problems of insulin injection with total knowledge about diabetes ($P < 0.001$).

Table (5): The study also revealed that, there was statistically significant difference between the studied children's total problems of insulin injection and total reported practice of injection ($P < 0.05$).

Table (6): There was negative correlation and significant relation between total score of problems of insulin injection and both of total knowledge and total reported practice.

Table (1): Distribution of diabetic children's parents according to their characteristics (n=100).

Characteristics of Parents	Mother		Fathers	
	No.	%	No.	%
Age (years)				
20≤30	10	10	6	6
30≤40	77	77	46	46
40≤50	13	13	48	48
$\bar{X} \pm SD$	35.69±7.49		40.64±6.93	
Educational level				
Illiterate	9	9	6	6
Read and write	6	6	0	0
Primary	0	0	3	3
Secondary	43	43	45	45
Bachelor	42	42	46	46
Occupation				
Work	43	43	100	100
No work	57	57	0	0

Table (2): Distribution of the studied diabetic children according to their characteristics (n=100).

Characteristics of children	No.	%
Age (years)		
6<9	34	34
9<12	29	29
12<15	28	28
15≤18	9	9
$\bar{X}\pm SD$	10.65±4.76	
Gender		
Male	62	62
Female	38	38
Rank of the child		
First	54	54
Second	33	33
Third	9	9
Fourth	4	4
Educational level		
Illiterate	3	3
Read and write	32	32
Primary school	47	47
Preparatory school	12	12
Secondary school	6	6

Table (3): Relation between the studied children's total problems related to insulin injection and their medical history (n=100).

Medical History	Total Problems						X ²	p-value
	Mild Problems (n=33)		Moderate problems (n=59)		Sever problems (n=8)			
	No.	%	No.	%	No.	%		
Duration of disease (years)								
<1	7	21.2	8	13.6	1	12.5	9.154	0.047 *
1<3	19	57.6	31	52.5	1	12.5		
3≤6	7	21.2	20	33.9	6	75.0		
Onset of diabetes								
Suddenly	4	12.1	0	0.0	3	37.5	18.952	<0.001 **
Signs & symptoms	24	72.7	51	86.4	3	37.5		
Diabetes related complications	5	15.2	8	13.6	2	25.0		

Table (4): Relation between the studied diabetic children's total problems of insulin injection and their total knowledge regarding diabetes and insulin injection (n=100).

Total knowledge	Mild Problems		Total Problems Moderate problems		Severe problems		Chi-square test	
	No.	%	No.	%	No.	%	x2	p-value
Satisfied (n=40)	24	72.7	16	27.1	0	0.0		
Unsatisfied (n=60)	9	27.3	43	72.9	8	100.0	24.14	<0.001*
Total (n=100)	33	100.0	59	100.0	8	100.0	0	*

Table (5): Relation between the studied diabetic children's total problems of insulin injection and their total reported practice of insulin injection (n=100).

Total practice	Mild Problems		Total Problems Moderate problems		Severe problems		Chi-square test	
	No.	%	No.	%	No.	%	x2	p-value
Done (n=58)	25	75.8%	33	55.9%	0	0.0%		
Not Done (n=42)	8	24.2%	26	44.1%	8	100.0%	15.423	0.004*
Total (n=100)	33	100.0%	59	100.0%	8	100.0%		

Table (6): Correlation between total score of knowledge regarding diabetes and insulin, total score of problems related to insulin injection and total score of reported practice of insulin injection.

Item		Total score of knowledge	Total score of problems	Total score of reported practice
Total score of knowledge	rs		-0.356	0.270
	p-value		0.004*	0.021*
Total score of problems	rs	-0.356		-0.378
	p-value	0.004*		0.012*
Total score of reported practice	rs	0.270	-0.378	
	p-value	0.021*	0.012*	

Fig (1):Percentage distribution of the studied children according to their total problems related to insulin injection (n=100).

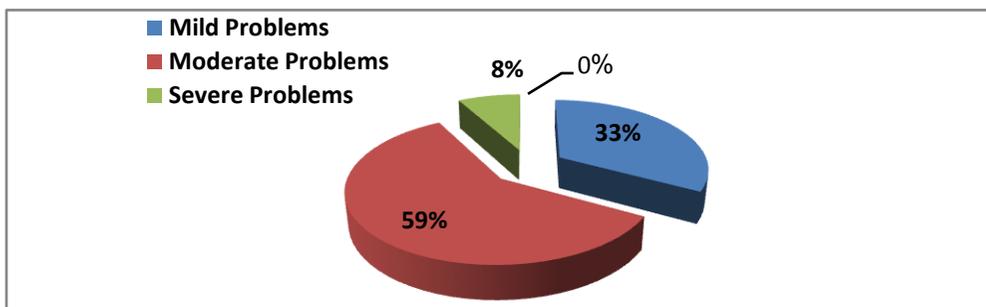
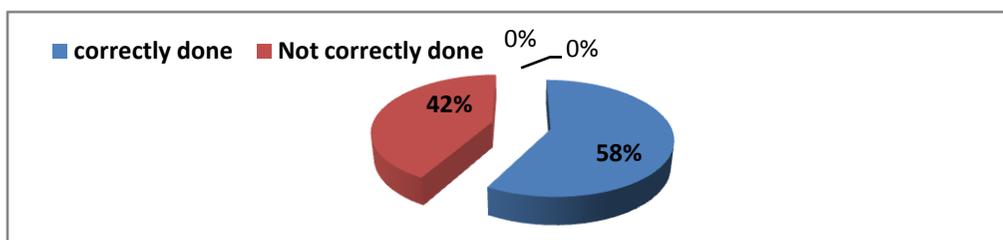


Fig (2): Percentage distribution of the studied children according to their total reported practice (n=100).



Discussion:

Regarding the characteristics of the studied children's parents, the present study revealed that more than three quarters (77%) of the studied children's mothers were between the age of $30 \leq 40$ years with $\bar{X} \pm SD$ 35.69 ± 7.49 , and less than half of the fathers (48%) were between the age of $40 \leq 50$ with $\bar{X} \pm SD$ 40.64 ± 6.93 . This result was in an agreement with **Helgeson et al., (2012)** who reported that, the studied parents' range of age was 27–56 years with $\bar{X} \pm SD$ 43 years.

Regarding the studied children's and parents' place of residence, the study illustrated that more than three quarters of them (76%) came from rural areas. This may be due to lack of health care in hospitals of rural areas which makes families seek medical care in the university hospital in Cairo.

In relation to family history, the present study revealed that less than half of the studied children (47%) had positive family history of diabetes. This finding was in an accordance with a study carried out by **Parkkola et al., (2013)** who mentioned that almost one quarter of the studied children had first degree and second degree relatives with type1 diabetes. In the researcher's opinion, this finding was expected as the risk of having type1 diabetes is increased in children with positive family history.

Regarding the studied children's characteristics, the current findings revealed that more than one third of the studied children (34%) were between the age of $6 < 9$ years with $\bar{X} \pm SD$ 10.65 ± 4.76 . This finding was in the same context of a study by **Landau et al., (2013)** who found out that more than half of the studied children's ages were < 12 years, and the study of **Alshourbagy et al., (2015)** found that there was increased incidence of diabetes in children at age group of 11-14

years. In researcher's point of view, it is an expected result as children between the age of ten to nineteen are at risk to develop diabetes more than younger children.

Regarding the studied diabetic children's medical history, it was found that more than three quarters of the studied children (78%) discovered the disease from the signs and symptoms of diabetes. This finding was in accordance with a study carried out by **Alshourbagy et al., (2015)** who mentioned that, the majority of the studied children discovered the disease from symptoms of polyuria, polydipsia and loss of weight.

In relation to the studied children's follow up and diabetes self care practices, the current study revealed that, less than three quarters of them (70%) were committed with diabetes follow up in the university hospital. More than one third of the studied children (38%) were not compliant with monitoring glucose in urine. Less than half of the studied children (46%) were compliant with monitoring blood glucose and more than half of the studied children (51%) made blood glucose test only twice a day. These results agreed with study of **Miller et al., (2013)**, who revealed that children at age of 6 to younger than 13 were more compliant to monitoring blood glucose than older children at age of 13 to 18 years, the younger children also made the tests more frequently than older children. This could be due to preschoolers and school age children are exposed to junk food and other inappropriate snacks when they are at school or daycare centers which lead to in compliance with diabetic diet.

In particular to the studied children's total knowledge about diabetes, this study revealed that more than half of

the studied children had unsatisfied level of knowledge regarding the diabetes and insulin. This result agreed with **Johnson et al., (2015)** who found that more than half of the studied children had poor knowledge regarding the disease of diabetes. **Wysocki et al., (2011)** also reported that most of the studied children and parents had poor knowledge regarding the complications of type 1 diabetes. On the other hand, this finding of the current study was not in accordance with the study reported by **O'Neil et al., (2015)**, who found that almost three quarters of the studied children responded correctly to questions regarding knowledge about diabetes.

Regarding to total problems related to insulin injection, this study revealed that more than half of the studied children suffered from moderate problems related to insulin injection while the minority of them suffered from severe problems. These results were in an accordance with **Davies et al., (2013)**, who mentioned that most of studied children had problems of high cost of the insulin, insulin pens, syringes and monitoring tests, which affected the compliance to insulin therapy especially in children who lack health insurance coverage.

Shashank et al., (2008), also reported that, lack of health education about insulin regimens and hypoglycemia caused a problem for most of the studied children and their caregivers. In researcher's opinion the low economic status and high cost of insulin, pens and glucose test strips in addition to lack of health education regarding the disease and insulin injection are leading reasons for noncompliance and other problems of insulin injection.

As regards to the studied children's psychological and school problems related to insulin injection. It was found that one quarter of the studied children were embarrassed of injecting insulin in public or at school. This finding was supported in study by **Peyrot et al., (2015)**, who mentioned that more than one third of the studied patients reported that they were embarrassed of using insulin injection in public. In the researcher's opinion, lack of understanding from diabetic children's peers and teachers in schools in addition to the psychological burden of the disease lead to feelings of embarrassment regarding insulin injection in public.

Regarding the studied children's problems related to insulin injection side effects and complications, it was observed that, less than half of the studied children had hypoglycemia from insulin overdose. This result was almost similar to study of **Barnard et al., (2010)**, who stated that half of the studied children had episodes of hypoglycemia 2-3 time per week. The present study showed that, three quarters of the studied children suffered from skin inflammation at the site of injection and more than half of them suffered from erythema and hematoma at injection site. These findings were supported by **Van Munster et al., (2014)**, who found that almost one third of the studied children had erythema and skin inflammation at injection sites. In relation to the problems of lipohypertrophy and lipoatrophy, the current study showed that, more than half of the studied children had lipohypertrophy at sites of injection, while one quarter of them had lipoatrophy. These findings were agreed with the study by **Tsadik et al., (2018)**, who mentioned that, more than one third of the studied children had

lipohypertrophy and almost one quarter of them also had lipoatrophy.

Gentile et al., (2018) also reported that almost half of the studied children had lipohypertrophy and few children had lipoatrophy. In researcher's opinion, dermatological problems are caused by wrong technique of insulin injection, repeated injection in the same site, reuse of needles/lancets and not cleaning the skin before injection.

As regards to the studied children's total reported practice of insulin injection, the current study showed that more than half of the studied children done the right steps of self administration of insulin. This result was supported by **Ali & Fashafsheh, (2014)**, who reported that the studied children had average score regarding insulin injection technique. This result could be due to repeated injection by the children and guidance by the parents during injection.

On the other hand the result of the current study was in contrast with **Ahmed, (2012)** who mentioned that more than half of the studied children had poor practice of insulin self administration with a lot of mistakes of injection.

As regards to relation between the studied children's total problems of insulin injection and their characteristics, there was highly statistically significant relation between the studied children gender and total problems ($P < 0.001$), where females were noticed to have severe problems compared to male children. There was also significant relation between total problems and age and educational level.

These findings were in agreement with **Peyrot et al., (2015)**, who reported that there was significant positive

association between gender and problems of insulin injection, females are more vulnerable to problems such as embarrassment, missing injections, pain and also found positive association with age. In the researcher's opinion the young children's limited cognitive ability to cope with daily demands of diabetes management may lead to aggression, resistance to blood glucose monitoring, skipping insulin injections and refusal of changing injection sites.

There was also a relation between studied children's total problems and medical history, duration of the disease. These findings agreed with **Omar et al., (2011)** and **Jin et al., (2010)**, they found that children with long duration of disease had dermatological problems of insulin injection and they had economical problems due to lack of insurance coverage. There was also a significant relation between studied children's total problems and follow up and diabetes self-care practices as found by **Streisand & Monaghan, (2014)** who mentioned that, children and parents who realize the importance of regular follow up face less problems and complications of the disease and accept insulin therapy as potentially beneficial comparing to those who don't make regular follow up. From the researcher's opinion, diabetic children/parents who commit to regular monitoring of blood glucose are able to discover early signs of diabetes complications problems of insulin injection such as skin problems, hypoglycemia that needs adjustment of insulin dose and food intake, they are also able to enhance insulin injection technique to avoid injection practice related problems.

It was found that there was highly statistically significant relation between the studied children's total problems of

insulin injection with total knowledge about diabetes ($p < 0.001$). This result was in the same line with **Phiri et al., (2017)**, who found that there was positive correlation between knowledge about diabetes and the correct practice of insulin injection, as the knowledge improved the practice of the children became better. In the researcher's point of view, satisfactory knowledge about diabetes and the right practice of insulin injection contribute to decreased severity of the problems and complications related to insulin injection.

The present study revealed that, there was statistically significant relation between the studied children total problems with total practice, with p-value (0.004). This finding was compatible with **Van Munster et al., (2014)** and **Patton, (2011)**.

Conclusion and Recommendations

On the light of the findings of the present study, it was concluded that:

Most of the studied diabetic children had moderate and mild problems related to insulin injection such as; administration problems, psychological and dermatological side effects. The study revealed that, there was a significant relation between diabetic children's insulin injection related problems and their characteristics, their knowledge related to diabetes and practice of insulin injection .

The findings of the present study suggest the following recommendations:

1- Early detection of problems and complications related to insulin injection to enhance the diabetic children's

compliance to insulin treatment and glycemic control.

2- Continuous health education for the diabetic children and their parents regarding insulin injection technique, dose calculation, possible complications, injection problems and its management.

3- Emphasize the role of nursing staff in outpatient diabetes clinics to educate and support the diabetic children and their families in insulin management therapy and its related problems.

4- Financial support for the diabetic children and their families regarding insulin and its supplies.

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Conflict of interest

No

References:

- Ali, I. Sayej, S. & Fashafsheh, H. (2014):** Evaluating self-care practices of children with type1 diabetes mellitus in northern west bank: A controlled randomized study utilizing oremself care theory. *Journal of Education and Practice*. 5(11), p 53:63.
- Al shourbagy, O .Masia, F. Al nagar, R. Karam, M. (2015):** A descriptive study of diabetes mellitus among school children attending health insurance clinic. 8(68), p 312:314.
- Ahmed, E. (2012):** Knowledge, attitude and practices among diabetic children and their relation to glycemic control, [online]. Faculty of Medicine. University of Khartoum. 2(3), p 23. Available from: <http://khartoumspace.uofk.edu/bitstream/handle/123456789/7483/KNOWLEDGE%20ATTITUDE%20AND%20PRACTICES.pdf?sequence=1>. [Access date 1-12-2018].
- Barnard, K. Thomas, S. Royle, P. Noyes, K. & Waugh, N. (2010):** Fear of hypoglycaemia in parents of young children with type1 diabetes: a systematic review. *BMC Pediatrics*. 10(1), 50.
- Davies, J. Gagliardino, J. Gray, J. Khunti, K. Mohan, V. & Hughes, R. (2013):** Real world factors affecting adherence to insulin therapy in patients with type1 or type2 diabetes mellitus: a systematic review. *Diabetic Medicine*. 30(5), 512- 524.
- De Coninck, C. Frid, A. Gaspar, R. Hicks, D. Hirsch, L. Kreugel, G. & Strauss, K. (2010):** Results and analysis of the 2008–2009 insulin injection technique questionnaire survey. *Journal of Diabetes*. 2(3), 168:179.
- Gentile, S. Strollo, F. Della Corte, T. Marino, G. & Guarino, G. (2018):** Skin complications of insulin injections: a case presentation and a possible explanation of hypoglycaemia. *Diabetes research and clinical practice*. 138, 284:287.
- Helgeson, V. S. Becker, D. Escobar, O. & Siminerio, L. (2012):** Families of children with diabetes: Implications of parent stress for parent and child health. *Journal of pediatric psychology*. 37(4), 467:478.
- International Diabetes Federation. (2018):** Diabetes facts and figures. [online]. Available from: <https://www.idf.org/our->

- network/regions members/middle-east-and-north-africa/members/34-egypt.html. [Accessed on 22-9-2018].
- Jin, J. Sklar, E. Oh, S. & Li C. (2010):** Factors affecting therapeutic compliance: a review from the patient's perspective. *Therapeutics and Clinical Risk Management*. 4(1), 269.
- Johnson, B. Pollak, T. Silverstein, H. Rosenbloom, A. L. Spillar, R. McCallum, M. & Harkavy, J. (2015):** Cognitive and behavioral knowledge about insulin-dependent diabetes among children and parents. *Pediatrics*. 69(6), 708:713.
- Landau, Z. Lebenthal, Y. Boaz, M. & Pinhas-Hamiel, O. (2013):** Observational study of diabetes management in type1 diabetic school-age children during holiday versus school days. *Journal of Pediatric Endocrinology and Metabolism*. 26(11), 83:86.
- Miller, M. Beck, W. Bergenstal, M. Goland, S. Haller, J. McGill, B. & T1D Exchange Clinic Network. (2013):** Evidence of a strong association between frequency of self monitoring of blood glucose and hemoglobin A1c levels in T1D exchange clinic registry participants. [online]. *Diabetes Care*. DC_121770.DOI: 10.2337/dc12-1770 Available from: <http://care.diabetesjournals.org/content/early/2013/01/29/dc12-1770.short>. [Accessed on 23-10-2018].
- Neu, A. Lange, K. Barrett, T. Cameron, F. Dorchy, H. Hoey, H. & De Beaufort, C. (2015):** Classifying insulin regimens—difficulties and proposal for comprehensive new definitions. *Pediatric diabetes*. 16(6), 402:406.
- O'Neil, J. Jonnalagadda, S. Hopkins, L. & Kicklighter, R. (2015):** Quality of life and diabetes knowledge of young persons with type1 diabetes: Influence of treatment modalities and demographics. *Journal of the American Dietetic Association*. 105(1), 85:91.
- Omar, A. El-Kafoury, A. & El-Araby, I. (2011):** Lipohypertrophy in children and adolescents with type1 diabetes and the associated factors. *BMC Research Notes*. 4(1), 290.
- Parkkola, A. Härkönen, T. Ryhänen, J. Ilonen, J. Knip, M. & Finnish Pediatric Diabetes Register. (2013):** Extended family history of type1 diabetes and phenotype and genotype of newly diagnosed children. *Diabetes Care*. 36(2), 348:354.
- Patton, R. (2011):** Adherence to diet in youth with type1 Diabetes. *Journal of the American diabetes association*. 111(4), 550:555.
- Peyrot, M. Barnett, H. Meneghini, F. & Schumm-Draeger, M. (2015):** Insulin adherence behaviors and barriers in the multinational global attitudes of patients and physicians in insulin therapy study. *Diabetic Medicine*. 29(5): 682:689.
- Phiri, C. Msiska, G. Kululanga, I. & Mbakaya, C. (2017):** Patient's knowledge assessment on diabetes and self care practices among older adolescents with type1 diabetes mellitus in Malawi. *European Scientific Journal*. 13(33), 55.

- Shashank, J. Das, K. Vijay, J. & Mohan, V. (2008):** Challenges in diabetes care in india: Sheer numbers, lack of awareness and inadequate control. Journal of Association of Physicians of India. 56(6), 443:450.
- Streisand, R. & Monaghan, M. (2014):** Young children with type1 diabetes: challenges, research, and future directions. Current Diabetes Reports. 14(9), 520.
- Tsadik, A. Atey, T. M. Nedi, T. Fantahun, B. & Feyissa, M. (2018):** Effect of insulin-induced lipodystrophy on glycemic control among children and adolescents with diabetes in TikurAnbessa specialized hospital, Addis Ababa, Ethiopia. Journal of Diabetes Research. 25(5), 120
- Van Munster, E. Van de Sande, C. Voorhoeve, G. & van Alfen-van der Velden, A. (2014):** Dermatological complications of insulin therapy in children with type1 diabetes. European Diabetes Nursing. 11(3), 79:84.
- Wysocki, T. Lochrie, A. Antal, H. & Buckloh, M. (2011):** Youth and parent knowledge and communication about major complications of type1 diabetes: Associations with diabetes outcomes. Diabetes Care. 15(20), 154:179.