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Food Insecurity Among Families of Children with Type 1 Diabetes Mellitus and Its Relation to Glycemic Control.

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A B S T R A C T

Background: Food insecurity, (FI) a significant public health issue, can have a serious detrimental effect on controlling diabetes. **Objective**: to assess the frequency of household FI in the type 1 diabetes mellitus (T1D) families attending the diabetes clinic and to determine the relation between FI and glycemic control among T1D children. **Methods**: A cross-sectional study was conducted in the period from November 2021 to October 2022 on 237 parents of TIDM children who come to receive periodic insulin therapy and routine checkups using a structured questionnaire consisting of three parts; socioeconomic level, medical history, and food security questionnaire. Body mass index (BMI) and Hemoglobin A1c levels were assessed in all children. **Results**: According to glycemic control, 50.6% had poor glycemic control and 59.6% of studied patients belonged to food insecure families. Low socioeconomic standard (SES), maternal basic education, secondary education, and comorbid celiac disease significantly increased risk of food insecurity by 5.308, 4.176 and 10.406 folds respectively. Comorbid celiac disease, thyroid diseases, low SES, low mother education, hospitalization in the last year, were significantly associated with poor glycemic control. Low BMI, obese, comorbid celiac disease, FI significantly increase risk of poor glycemic control by 12.349, 19.313, 6.39 and 2.353 folds respectively. CONCLUSION: Low SES, poor glycemic control, and lower maternal education were predictors of food insecure patients. FI prevailed in a larger percentage of studied patients, and it is independently associated with poor glycemic control in patients with T1DM.

INTRODUCTION

Food security is a condition in which everyone, at all times, and has physical, financial, and social access to an adequate supply of food that is safe, satisfies their nutritional needs, and provides the foods they prefer for an active and healthy existence.[1] Children from any community may experience food insecurity (FI), which is a condition in which availability of food is insufficient or uncertain. [2] FI is persistently more common in homes with diabetes patients than in those without the chronic illness, and it is more prominent in those with diabetic children. [3] Type 1 diabetes mellitus (T1DM) represents one of the commonest endocrine illnesses in children and teenagers. Around 3 percent of youngsters worldwide are thought to be affected.[4] T1DM is primarily a childhood and adolescent disease resulting from insufficient insulin synthesis and an increase in blood glucose as a result (i.e., hyperglycemia). [5] In 2019, there were 1,000,000 new cases of T1DM diagnosed each year in children and adolescents worldwide. The most affected regions

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are Europe, North America, and the Caribbean. Egypt, the most crowded Middle Eastern country, documented a smaller prevalence of T1DM than other Middle Eastern nations. [6] The number of new cases in Egypt is increasing gradually; in a retrospective study to determine T1DM prevalence in children and adolescents, it was discovered that the disease prevalence increased continuously from 1994 to 2011 to reach 26.8 per 100,000 people. [7]

Parents of chronically unwell children have additional difficulties, such as being able to pay for pricey medical equipment like glucometer test strips, insulin, and insulin pumps, all of which are necessary for patients to monitor their blood sugar levels more precisely. [8] One of the variables contributing to failed type 1 diabetes control is household FI. A T1DM patient is more likely to have poorer diabetes outcomes and poor glycemic control as a result. This could result in long-term repercussions like chronic renal disease, problems with one's eyesight, an increased danger of infection and perhaps death.[9] To improve patient outcomes for families with T1DM children, it is crucial that healthcare professionals comprehend these families' requirements and adjust their goals and educational materials accordingly.[10]

FI was linked to noticeably higher HbA1c levels, and this association was stronger in people with diabetes who had not yet been diagnosed. According to these findings, it may be necessary to increase the number of people who are screened for FI. To help people in better understanding their health risks and developing self-management objectives within the framework of their socioeconomic reality, diabetes screening is required in high-risk populations, such as people who are food insecure.[11] Clinicians who are aware of a family's FI status can make more sensible dietary recommendations, modify medication schedules, identify patients who are more likely to experience adverse FI-related health outcomes like asthma, depression, and obesity, and give detailed information on where to buy healthy food at reasonable prices.[12] The American Diabetic Association now suggests that healthcare professionals perform a FI assessment and use the results to modify their diabetes care. [13] The aim of this work was to assess frequency of household FI in the type 1 diabetes families attending diabetes clinic and to determine relation between FI and diabetic control among type 1 diabetic children in diabetes clinic, Egypt.

Research questions: What is the frequency of household food insecurity in the type 1 diabetes families attending Zagazig diabetes clinic, Egypt? Is there a relation between food insecurity and diabetic control among T1DM children in Zagazig diabetes clinic, Egypt?

METHODS

A cross sectional study was done at Zagazig University diabetes clinic, Egypt during period from start of November 2021 to end of October 2022. Before the interview, verbal consent was obtained from the study participants after they had been told of its nature and aim.

Caregivers of T1DM children who come to receive periodic insulin therapy and routine checkup were selected. All patient's and caregiver's information were kept private. Inclusion criteria entailed only caregivers of children suffering from type 1 DM, diagnosed more than 1 year.

Sample size: Estimation was done by assuming that prevalence of household food insecurity in T1DM families was (19.5%) according to Mendoza et al., 2018 study [14] and total population for 1 year "period of the study" is (1920), sample was (215) at 95% confidence level using open Epi software with 10% non-response, sample size was (237).

Sampling: Selection of sample done by systematic random technique, a represented sample was drowned from Caregivers of T1DM children who come to receive periodic insulin therapy and routine checkup at diabetes clinic, Egypt.

Data collection tool: Study tools and scoring done through structured Questionnaire consists of three parts: Part1: Assessment of socioeconomic level using Fahmy et al., 2015. [15] Socio-demographic score less than 40% (low), score 40%- less than 70% (middle) and score 70% and more (high). Part 2: Medical history: number of children suffering from type1 DM in family, medical history: duration, type of treatment, no of injections and other Comorbid disorders. Part3: Food security questionnaire (United States Department of Agriculture, 2012):[16] Household Food Security Survey Module: Six-Item Short Form for the last 12 months, starting in the current month of last year. The six questions concern having enough food or money to purchase food, being able to purchase a healthy diet, and disrupted eating habits (such as reducing meal sizes, missing meals, and going with no

food). Six questions were included: 1st: "The food that (I/we) bought just didn't last, and (I/we) didn't have money to get more." Was that often, sometimes, never true or do not know for (you/your household) in the last 12 months? 2nd: "(I/we) couldn't afford to eat balanced meals." Was that often, sometimes, never true or do not know for (you/your household) in the last 12 months? 3rd: In the last 12 months, since last (name of current month), did (you/you or other adults in your household) ever cut the size of your meals or skip meals because there wasn't enough money for food? The answer was either yes, no or do not know. 4th: [IF YES ABOVE, ASK] How often did this happen—almost every month, some months but not every month, in only 1 or 2 months or do not know? 5th: In the last 12 months, did you ever eat less than you felt you should because there wasn't enough money for food? The answer was either yes, no or do not know. 6th: In the last 12 months, were you every hungry but didn't eat because there wasn't enough. money for food? The answer was either yes, no or do not know.

Table 1: Scoring of food security questionnaire

Number of affirmatives	Scale score
0	NA
1	2.86
2	4.19
3	5.27
4	6.30
5	7.54
6	8.48

Scoring: Affirmative (yes) responses include "often" or "sometimes" on questions 1st and 2nd , as well as "yes" on 3rd , 5th , and 6th. Affirmative (yes) is the code used for the responses "almost every month" and "some months but not every month" on 4th one. The household's raw score on the scale is calculated as the sum of all affirmative answers to the six questions within the module as shown in Table 1. The following is the status of food security; High or marginal food security (raw score 1 may be regarded as marginal food security, but many families that would be classified as having marginal food security on the household or adult scale will have raw score 0 on the six-item scale). Low food security, raw score 2-4. Very low food security (raw score 5–6). "low food security" and "very low food security" are combined to form the term "food insecure."

***Tool validation*:** An expert translator translated the questionnaire from English to Arabic, followed by a back translation by another expert translator, and finally, a comparison between the original and the translation performed by a second bilingual expert was done to confirm validity. The questionnaire was evaluated by a panel of experts in community medicine department to assess the content validity of it. A pilot study was done on (24 Caregivers of Type 1 Diabetes children) 10 % of the sample size to test the possibility of the study, and the clarity of the study tools and to measure the time required to fill in every questionnaire. There was no change in the questionnaire, so they were included in the study. Regarding reliability Cronbach's Alpha was 0.87.

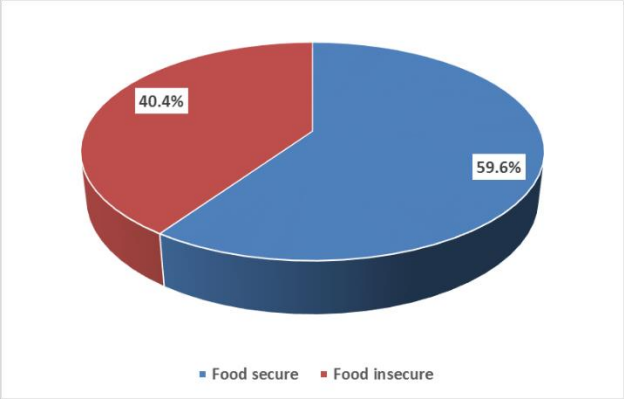

Figure 1: Pie chart showing distribution of patients according to food security

Clinical and laboratory examination: In light clothing and to the nearest 0.1 kg, weight was recorded. With a validated stadiometer, height was measured barefoot and reported to the nearest 0.1 cm. All the measurements were obtained by a single investigator. Body mass index (BMI) is a person's weight in kilograms divided by the square of height in meters. For children, BMI is age- and sex-specific and is often referred to as BMI-for-age. Body mass index-for-age percentiles for boys and girls were used. [17] BMI categories were Underweight if Less than the 5th percentile, Healthy Weight if between 5th percentile to less than the 85th percentile, Overweight if in between 85th to less than the 95th percentile and Obesity equal to or greater than the 95th percentile. We merged Overweight and Obesity in one category during statistically analysis. Hemoglobin A1c (HbA1c), (Reference range 4.0–6.0%) was done to all children included.

Table 2: Relation between food security and the studied variables

Variable	Total N=237	Insecure N=135 (%)	Secure N=102(%)	P
Sex:				
Male	122 (51.5)	76 (62.3)	46 (37.9)	0.088
Female	115 (48.5)	59 (51.3)	56 (48.7)	
SES:				
Low	117 (49.4)	87 (74.4)	30 (25.6)	
Middle	76 (32.1)	36 (47.3)	40 (52.7)	<0.001**
High	44 (18.5)	12 (27.3)	32 (72.7)	
Father education:				
Read and write	22 (9.3)	16 (72.7)	6 (27.3)	
Basic	46 (19.4)	23 (50)	23 (50.0)	
Secondary	79 (33.3)	55 (69.6)	24 (30.4)	0.015*
Intermediate	49 (20.7)	26 (53.1)	23 (46.9)	
High	41 (17.3)	15 (36.5)	26 (63.5)	
Mother education:				
Read and write	45 (19.0)	27 (60.0)	18 (4.0)	
Basic	36 (15.2)	26 (72.2)	10 (27.8)	
Secondary	50 (21.1)	39 (78.0)	11 (22.0)	0.002*
Intermediate	55 (23.2)	21 (38.2)	34 (61.8)	
High	51 (21.5)	22 (43.1)	29 (56.9)	
Father occupation:				
Worker	24 (10.1)	4 (3.0)	20 (19.6)	
Skilled worker	47 (19.8)	33 (24.4)	14 (13.7)	0.132
Free trade/Clerk	97 (40.9)	61 (45.2)	36 (35.3)	
Professional	69 (29.1)	37 (27.4)	32 (31.4)	
Mother occupation:				
Housewife	71 (30.0)	41 (16.7)	30 (83.3)	
Worker	8 (3.4)	4 (50.0)	4 (50.0)	
Skilled worker	37 (15.6)	31 (83.8)	6 (16.2)	0.141
Free trade/Clerk	59 (24.9)	31 (52.5)	28 (47.5)	
Professional	62 (26.2)	28 (45.2)	34 (54.8)	
BMI:				
Underweight	84 (35.4)	56 (66.7)	28 (33.3)	
Average	124 (52.3)	67 (54.0)	57 (46.0)	0.011*
Overweight and obese	29 (12.2)	12 (41.4)	17 (58.6)	
Seasonal variation				
First half	111 (46.8)	67 (60.4%)	44 (39.6)	0.321
Second half	126 (53.2)	68 (54%)	58 (46.0)	
Frequency of blood glucose monitoring:				
Frequent	180 (75.9)	107 (59.4)	73 (40.6)	0.17
Infrequent	57 (24.1)	28 (49.1)	29 (50.9)	
Hospitalization in last year	66 (27.8)	45 (68.2)	21 (31.8)	0.03*
Comorbid thyroid disorders	21 (8.9)	17 (81.0)	4 (199)	0.02*
Comorbid celiac disease	11 (4.6)	10 (90.9)	1 (9.1)	0.026*
	Median (IQR)	**Median (IQR)**	**Median (IQR)**	**P**
Age (year)	7.25 (4.91 – 9.5)	7.5(5.5 – 9.5)	6.5(4.75 – 10.06)	0.077
Disease duration (year)	2.5(1.59 – 6.5)	2.5(1.67 – 6.5)	2.5(1.5 – 6.19)	0.697
HbA1c (%)	9.44 ± 1.69	8.09 ± 1.36	7.27 ± 0.81	<0.001**
Good control	117 (49.4%)	56 (41.5%)	61 (59.8%)	0.005*
Poor control	120 (50.6%)	79 (58.5%)	41 (40.2%)	

** P <0.05 is statistically significant ** P ≤0.001 is statistically highly significant standard deviations.*

Statistical analysis: All statistical analysis of the data was carried out using SPSS (Statistical Package for the Social Sciences) version 26. Depending on the type of data, quantitative variables have been described using their median and interquartile range or means and standard deviation. Absolute frequencies of data were used to describe Categorical variables. When appropriate, the Fisher exact and chi square tests were

used to compare categorical variables. To compare ordinal data between two groups, chi square for trend test was performed. To validate presumptions for use in parametric tests, Kolmogorov-Smirnov (distributiontype) and Levene (homogeneity of variances) tests were utilized.

Table 3: Multivariate regression analysis of predictors of food insecurity

Variable	AOR	95% C.I.		P-value
		Lower	Upper	
High SES				<0.001**
Low SES	5.308	2.241	12.575	<0.001**
Middle SES	1.384	0.538	3.564	0.5
High maternal education				0.005*
Illiterate mother	1.659	0.648	4.246	0.291
Maternal basic education	2.652	0.964	7.296	0.059
Maternal secondary education	4.176	1.604	10.868	0.003*
Maternal intermediate education	0.783	0.337	1.817	0.569
Comorbid celiac disease	10.406	1.163	93.090	0.036*

*AOR= Adjusted odds ratio CI = Confidence interval *P <0.05 is statistically significant ** P≤0.001 is statistically highly significant*

Independent sample t test (for normally distributed data) and Mann Whitney test (for not normally distributed data) were applied to compare quantitative data between two groups. Using binary logistic regression, it was possible to pinpoint independent risk variables linked to certain health issues. P 0.05 was used as the statistical significance level. If p≤0.001, a highly significant difference was evident.

RESULTS

Baseline data of studied patients was described in Table 2. The age of patients ranged from 2.5 to (17 years and 11 months). Females represented 48.5%, 49.4% had low SES, 33.3% of fathers had secondary education, 21.1% of mothers had secondary education, 40.9% of fathers worked as free trades/clerks and 24.9% of mothers worked as free trades/clerks. According to frequency of blood glucose monitoring, 75.9% had frequent monitoring. About 28% had hospitalization in the last years. Disease duration ranged from 3 months to 15.5 years. According to glycemic control, 50.6% had poor glycemic control. About 60% of studied patients belonged to food insecure families as shown in Figure 1

Table 2 shows the predictors of FI**.** There is statistically significant relation between food security and all of SES, father education, mother education, body mass index, hospitalization in last year, comorbid thyroid diseases, celiac disease and glycemic control. Comorbid celiac disease, thyroid diseases, low SES, low father, mother education, hospitalization in the last year, comorbid celiac, thyroid disorders significantly associated with insecurity.

On doing multivariate regression analysis, Low SES, maternal basic education, secondary education and comorbid celiac disease significantly increased risk of FI by 5.308, 4.176 and 10.406 folds respectively. Middle SES and illiterate, basic educated mother non-significantly increased risk for food insecurity by 1.384, 1.659 and 2.652 folds respectively. Intermediate education non-significantly decreases risk (Table 3).

Table 4 shows the predictors of poor glycemic control. There is statistically significant relation between glycemic control and all of SES, mother education, body mass index, hospitalization in last year, comorbid thyroid diseases, and celiac disease. Comorbid celiac disease, thyroid diseases, low SES, low mother education, hospitalization in the last year, significantly associated with poor glycemic control.

On doing multivariate regression analysis, underweight, obese, comorbid celiac disease, food insecurity significantly increases risk of poor glycemic control by 12.349, 19.313, 6.39 and 2.353 folds respectively. Comorbid thyroid disease non-significantly increases risk for poor control by 3.758 folds [Table 5].

DISCUSSION

FI is characterized by a decline in the supply of nutritious and secure foods. Diabetes management

may be significantly harmed by food insecurity. Poor glycemic control in children can result in a variety of negative outcomes, including hypoglycemia and ketoacidosis, which can necessitate hospitalizations as well as a variety of chronic issues in later life.

Table 4: Relation between glycemic control and the studied variables

Variable	Total N=237(%)	Good control (≤7%) N=117 (%)	Poor control (>7%) N=120(%)	P
Sex:				
Male	122 (51.5)	61 (50.0)	61 (50.0)	0.841
Female	115 (48.5)	56 (48.7)	59 (51.3)	
SES:				
Low	117 (49.4)	46 (39.3)	71 (59.2)	
Middle	76 (32.1)	39 (51.3)	37 (48.7)	<0.001**
High	44 (18.5)	32 (27.4)	12 (10.0)	
Father education:				
Read and write	22 (9.3)	11 (50.0)	11 (50.0)	
Basic	46 (19.4)	22 (47.8)	24 (52.2)	
Secondary	79 (33.3)	32 (40.5)	47 (59.5)	0.07
Intermediate	49 (20.7)	23 (46.9)	26 (53.1)	
High	41 (17.3)	29 (70.7)	12 (29.3)	
Mother education:				
Read and write	45 (19.0)	17 (37.8)	28 (62.2)	
Basic	36 (15.2)	10 (27.8)	26 (72.2)	
Secondary	50 (21.1)	28 (56.0)	22 (44.0)	<0.001**
Intermediate	55 (23.2)	30 (54.5)	25 (45.5)	
High	51 (21.5)	32 (62.7)	19 (37.3)	
Father occupation:				
Worker	24 (10.1)	13 (54.2)	11 (45.8)	
Skilled worker	47 (19.8)	18 (38.3)	29 (61.7)	0.505
Free trade/Clerk	97 (40.9)	50 (51.5)	47 (48.5)	
Professional	69 (29.1)	36 (52.2)	33 (47.8)	
Mother occupation:				
Housewife	71 (30.0)	30 (42.2)	41 (57.8)	
Worker	8 (3.4)	2 (25.0)	6 (75.0)	
Skilled worker	37 (15.6)	20 (54.1)	17 (45.9)	0.063
Free trade/Clerk	59 (24.9)	29 (49.2)	30 (50.8)	
Professional	62 (26.2)	36 (58.1)	26 (41.9)	
BMI:				
Underweight	84 (35.4)	19 (22.6)	65 (77.4)	
Average	124 (52.3)	93 (75.0)	31 (25.0)	0.009*
Overweight and obese	29 (12.2)	5 (17.2)	24 (82.8)	
Frequency of blood glucose monitoring:				
Frequent	180 (75.9)	107 (59.4)	73 (40.6)	0.17
Infrequent	57 (24.1)	28 (49.1)	29 (50.9)	
Hospitalization in last year	66 (27.8)	24 (36.3)	42 (63.7)	0.013*
Comorbid thyroid disorders	21 (8.9)	4 (19.0)	17 (81.0)	0.004*
Comorbid celiac disease	11 (4.6)	2 (1.7)	9 (7.5)	0.034*
	Median (IQR)	**Median (IQR)**	**Median (IQR)**	**P**
Age (year)	7.25 (4.91 – 9.5)	6.67 (4.75 – 9.5)	7.33 (5.5 – 9.5)	0.117
Disease duration (year)	2.5 (1.59 – 6.5)	2.5 (1.59 – 6.08)	3.33 (1.54 – 6.5)	0.521

** P <0.05 is statistically significant ** P ≤0.001 is statistically highly significant*

In our study, about half of our participants had poor glycemic control. A higher rate was reported by another study in Saudi Arabia in 2013 among diabetic children in which 66.2% of the patients had very poor glycemic control.[18] The prevalence of food insecurity among patients in this study was about 60%. Lower prevalence was reported in a Canadian study in which they reported that FI prevalence among families of diabetic children was 40.9%.[12] An obvious explanation

Table 5: Binary regression analysis of predictors of poor control among studied patients:

Variable	AOR	95% C.I.		P-value
		Lower	Upper	
Food insecurity	2.353	1.187	4.663	0.014*
Comorbid thyroid	3.758	.974	14.507	0.055
Comorbid celiac disease	6.390	1.111	a36.756	0.038*
Average BMI				0.006*
Underweight	12.349	6.101	25.363	<0.001**
Overweight and obese	19.313	6.181	60.343	<0.001**

*AOR= Adjusted odds ratio CI = Confidence interval * P <0.05 is statistically significant ** P ≤0.001 is statistically highly significant*

to the significant rate of FI in our study is the difference in the socio-economic standard between Egypt and Canada. The higher rate of food insecurity among our patients in this study highlights the need of these families for support.

A study in USA in 2018 on children and adolescents, found that low SES rates were more in food insecure group than food secure group. [14] This was in agreement with our findings and can be explained by the fact that families with low SES facing economic problems due to costs of treatment and care of DM so they provide their families with low quality food which has high carbohydrate, and low protein, fruits and vegetables content.

We found that food insecure group were suffering poor glycemic control more than food secure group. This findings was in agreement with another study in USA in 2018 on children and adolescents who found that there was a significant relation between FI and poor glycemic control., and participants who reported food insecurity had mean HbA1c levels that were higher than participants who reported food security [14] This can be explained that FI compromising lack of balanced meals, cutting the amount of foods consumed, skipping meals or going without food for a long time can lead to poor glycemic control.

The report of Canadian Community Health Survey stated that lower parental educational levels significantly associated with food-insecure status. [19] Our results were in line with this report. it is also found that lower educational levels of parents were more among food insecure families, compared to food secure families and maternal secondary education level significantly increases risk of FI by 4.2 folds.

Canadian study-examining children with diabetes mellitus in 2011 found no association between BMI and food insecurity. [20] However, the current results were not in agreement with that study where we concluded that food insecure patients were suffering underweight more than food secure patients. This difference may be explained by that our study is carried out on greater sample size (237).

A Canadian study exploring food insecurity among young people with diabetes in 2011 and another study in USA examining associations between FI and health outcomes in young children reported that children from homes with food insecurity experience more health issues, including higher rates of hospitalization, than children from homes with food security.[20,21] This was in line with our findings; food insecure patients reported higher rates hospitalization in the last year more than food secure patients.

A study examining the link between adults' FI and a variety of chronic diseases in 2020 in USA, stated that FI was positively associated with a variety of chronic diseases [22] which agreed with our findings. This can be explained by that the higher rate of chronic diseases among food-insecure patients represents another burden on the outcomes for these families increasing their suffering from FI.

The current study revealed that FI significantly increases risk of poor glycemic control by 2.4 folds. Also, a study in 2019 demonstrated that poor glycemic control was linked to food insecurity.[23] Another study

in South Africa in 2021; found that food insecure group were over five times more likely to have poor glycemic control.[24] This may be explained by that many families who are food insecure alter the kinds and quantities of food they consume to reduce the cost of DM. They give their families less portions of milk, fruit, and vegetables while increasing their intake of simple carbohydrates.[25] However, further studying of mechanisms by which FI adversely affects glycemic control is still needed.

A study done in USA in 2020 in youth and young adults concluded that the odds of high-risk glycemic control among those within lower SES profile were greater than those in higher profile. 26 Also, many studies concluded that low SES was associated with poorer glycemic control among T1DM youth. [18, 27, 28] which agreed with our findings. This may be because families with high income can solve diabetes problems better, have less stress and better QOL. In Saudi Arabia, in 2022, a study was done to determine the variables that influence glycemic control in diabetic children; they did not find any association between glycemic control and parents' education.[29] However, our results were not consistent with this finding. This difference may be due to the smaller sample size of the Saudian study (n=171). In our study, we found that overweight and obesity significantly increased risk of poor glycemic control by 19 folds. A lower risk was reported by a Sweden study in 2013. They found that obesity significantly increased risk of poor glycemic control by 3.4 folds only.[30] This great variability may be due to age difference as they carried out their study on adults (18-59) years. An Iranian study in 2008 stated that autoimmune diseases including celiac and thyroid disease have a substantial link to type 1 diabetes.[31] In our study, there was a relation between glycemic control and, comorbid thyroid and celiac diseases. We found that celiac disease significantly increases risk of poor glycemic control by 6 folds. These patients may have a higher propensity to react against specific antigens, a genetic inability to tolerate some autoantigens, or certain common antigens found in the tissues of people predisposed to autoimmune diseases. These factors may account for the high prevalence of some autoimmune disorders in these patients. [32] Some of the limitations of this study included the cross-sectional design, the relatively small sample size, and depending on recalling not follow up. Yet, it had some strength points. To our knowledge, it is the first Egyptian study to address relation between food insecurity and glycemic control in diabetic patients and especially in type 1 diabetes mellitus. It acts as base for further research on this point.

CONCLUSIONS

Low Socioeconomic level, poor glycemic control, and lower maternal education were predictors of FI. Poor glycemic control was associated with extremities of BMI, comorbid celiac disease, FI. FI prevailed in larger percentage of studied patients, and it is independently associated with poor glycemic control among T1DM patients.

Recommendations: Food insecurity screening should be implemented as part of routine clinical practice and clinicians should assist families in resolving this problem to lessen its effects. Interventions to improve food insecurity among T1DM children may enhance their glycemic control and decrease health care utilization. Large scale multi-centric prospective studied to prove role of FI on glycemic control and randomized controlled trials to study effect on correction of food security on glycemic control.

Ethical Consideration: Approval of Institutional Review Board (IRB) of Zagazig University, Faculty of medicine was taken after revision of study protocol (ZU-IRB #10135). The study participants were told about description and intention of study and written consent was taken before the interview. All caregivers' and patient's data were private.

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REFERENCES

1. World Health Organization. The State of Food Security and Nutrition in the World 2021: Transforming food systems for food security, improved nutrition and affordable healthy diets for all. Food & Agriculture Org; 2021.

2. Hutchinson J, Tarasuk V. The relationship between diet quality and the severity of household food insecurity in Canada. Public Health Nutr 2022 Apr; 25(4):1013-1026.
3. American Diabetes Association. Standards of medical care in diabetes—2019 abridged for primary care providers. Clinical diabetes: a publication of the American Diabetes Association 37.1; 2019: 11.
4. Yang CC, Lin CH, Wang NK, Lai CC, Lo FS. Chang Gung Juvenile Diabetes Eye Study Group. Risk Factors Associated With the Development of Nephropathy 10 Years After Diagnosis in Taiwanese Children With Juvenile-Onset Type 1 Diabetes-A Cohort Study From the CGJDES. Front Endocrinol (Lausanne) 2018; 9:429.
5. Oram RA, Patel K, Hill A, Shields B, McDonald TJ, Jones A, et al. A Type 1 Diabetes Genetic Risk Score Can Aid Discrimination Between Type 1 and Type 2 Diabetes in Young Adults. Diabetes Care 2016; 39(3):337-44.
6. Alhazmi A, Sane F, Lazrek M, Nekoua MP, Badia-Boungou F, Engelmann I, Alidjinou EK, Hober D. Enteroviruses and Type 1 Diabetes Mellitus: An Overlooked Relationship in Some Regions. Microorganisms 2020; 8(10):1458.
7. El-Ziny MA, Salem NA, El-Hawary AK, Chalaby NM, Elsharkawy AA. Epidemiology of childhood type 1 diabetes mellitus in Nile Delta, northern Egypt - a retrospective study. J Clin Res Pediatr Endocrinol 2014; 6(1):9-15.
8. Thomas DM, Lipsky LM, Liu A, Nansel TR. Income Relates to Adherence in Youth with Type 1Diabetes through Parenting Constructs. Journal of developmental and behavioral pediatrics: JDBP 2018; 39(6):508-15.
9. Sutherland MW, Ma X, Reboussin BA, Mendoza JA, Bell BA, Kahkoska AR, et al. Socioeconomic position is associated with glycemic control in youth and young adults with type 1 diabetes. Pediatr Diabetes 2020; 21(8):1412-1420.
10. Morgan, Julianna. Effects of Socioeconomic Status on Glycemic Control in Children and Young Adults with Type 1 Diabetes. 2021.
11. Walker RJ, Garacci E, Ozieh M, Egede LE. Food insecurity and glycemic control in individuals with diagnosed and undiagnosed diabetes in the United States. Primary care diabetes 2021; 15(5):813-8.
12. Vitale M, Dorado L, Pais V, Sidani S, Gucciardi E. Food Insecurity Screening Among Families of Children With Diabetes. Diabetes spectrum: a publication of the American Diabetes Association 2019; 32(4):338-48.
13. Association AD. 1. Improving Care and Promoting Health in Populations: Standards of Medical Care in Diabetes—2020. Diabetes Care 2019; 43(Supplement_1):S7-S13. doi: 10.2337/dc20-S001.
14. Mendoza JA, Haaland W, D'Agostino RB, Martini L, Pihoker C, Frongillo EA, et al. Food insecurity is associated with high risk glycemic control and higher health care utilization among youth and young adults with type 1 diabetes. Diabetes Res Clin Pract 2018 Apr; 138:128-137.
15. Fahmy S, Nofal L, Shehata S, Elkady H, Ibrahim H. Updating indicators for scaling the socioeconomic level of families for health research. The Journal of the Egyptian Public Health Association 2015; 90:1-7.
16. United States Department of Agriculture .US Household food security survey module: six-item short form. US Department of Agriculture, Economic Research Service; 2012. Available from: https://www.ers.usda.gov/media/8282/short2012.pdf
17. https://www.cdc.gov/healthyweight/assessing/bmi/childrens_bmi/about_childrens_bmi.html
18. Al-Odayani AN, Alsharqi OZ, Ahmad AM, Khalaf Ahmad AM, Al-Borie HM, Qattan AM. Children's glycemic control: mother's knowledge and socioeconomic status. Glob J Health Sci 2013; 5:214–26.
19. Canadian Community Health Survey Cycle 2.2, Nutrition. Income-related household food security in Canada 2004 [homepage on the Internet]. [Cited 2023 Jan 10]. Available from: www.hc-sc.gc.ca/fn-an/surveill/nutrition/commun/index_e.html.
20. Marjerrison S, Cummings EA, Glanville NT, Kirk SFL, Ledwell M .Prevalence and associations of food insecurity in children with diabetes mellitus. J Pediat 2011; 158: 607–11.
21. Cook JT, Frank DA, Berkowitz C, Black MM, Casey PH, Cutts DB. Food insecurity is associated with adverse health outcomes among human infants and toddlers. J Nutr 2004; 134:1432-8.
22. Leunga CW, Kullgren JT, Malanic PE, Singerf DC, Kirche M, Solwaye E, et al. Food insecurity is associated with multiple chronic conditions and physical health status among older US adults. Preventive Medicine Reports 2020; 20:101-211.
23. Walker RJ, Campbell JA, Egede LE. Differential impact of food insecurity, distress, and stress on self-care behaviors and glycemic control using path analysis. J. Gen. Intern. Med 2019; 34: 2779–2785.
24. Nsimbo BA, Erumeda N, Pretorius D. Food insecurity and its impact on glycaemic control in diabetic patients attending Jabulani Dumani community health centre, Gauteng province, South Africa. Afr. J. Prim. Health Care Fam. Med. 2021; 13:e1–e6.
25. Kirkpatrick S, Tarasuk V. Food insecurity is associated with nutrient inadequacies among Canadian adults and adolescents. J Nutr. 2008; 138: 604-12.
26. Sutherland M, Ma X , Reboussin B, Mendoza J, Bell B,. Kahkoska A, Sauder K, Lawrence J, Pihoker C, Liese A. Socioeconomic position is associated with glycemic control in youth and young adults with type 1 diabetes
27. Borschuk AP, Everhart RS. Health disparities among youth with type 1 diabetes: A systematic review of the current literature. Fam Syst Health 2015; 33(3):297-313.
28. Piechowiak K, Zdunczyk B, Szypowska A. Environmental factors affecting management of type 1 diabetes in children below the age of 10. Pediat Endocrinol Diabet Metabol 2017; 23:23–9.
29. Al-Qahtani SM , Shati AA, Alqahtani YA, AlAsmari AA , Almahdi MA, Al Hassan AA , et al. Factors Affecting Glycemic Control among Saudi Children with Type 1 Diabetes Mellitus in Aseer Region, Southwestern. Saudi Arabia. Int. J. Environ. Res. Public Health 2022; 19: 11558.

30. Melin EO, Thunander M, Svensson R, Olsson ML, Thulesius HO. Depression, obesity, and smoking were independently associated with inadequate glycemic control in patients with type 1 diabetes. European Journal of Endocrinology 2013; 168: 861–869.
31. Sharifi F, Ghasemi L, Mousavinasab N. Thyroid function and anti-thyroid antibodies in Iranian patients with type 1 diabetes mellitus: Influences of age and sex. Iran J Allergy Asthma Immunol 2008; 7 (1):31-6.
32. Norden G, Jensen E, Stilbo I. B-cell function and islet cell and other organ-specific autoantibodies in relatives to insulin-dependent diabetic patients. Acta Med Scand 1983; 213 (3):199-203.

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