Comparative study of clinical and metabolic characteristics of children with type 1 diabetes and celiac disease before and after gluten-free diet

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Abstract

1. Introduction: Celiac disease (CD) is considered one of the well-known accompanying diseases of type 1 diabetes mellitus (T1DM) in the children. Although the children with T1DM and CD may be asymptomatic and be diagnosed only by screening experiments, the subsequent complications of this disease can affect the child's growth and metabolic status.

2. Implementation method: A case-control study was performed on 35 affected children to compare the clinical and metabolic characteristics of children under 18 years old infected with T1DM and CD. After diagnosis, children with celiac disease were treated with a gluten-free diet (GFD). Patients were under follow-up, the measurement of anthropometric indicators, and metabolic status consecutively up to one year, at 3, 6, and 12 months after diagnosis.

3. Results: 20 patients with T1DM and CD as a case group and 15 patients with T1DM as a control group was studied among a total of 35 eligible patients. There was no significant difference between two groups in terms of age, gender, height, weight, and BMI of the patients, in the incidence of hypoglycemia, DKA, and HbA1c levels ($P<0.05$); however, the increase in the average of weight and height of the patients during follow-up period was statistically significant in comparison with before treatment with GFD ($p<0.001$). Gastrointestinal symptoms were seen only in the group of patients infected with celiac disease and T1DM (case group), 62.5% of patients ($p<0.001$) at the beginning of diagnosis.

4. Conclusion: In general, this study concluded that GFD could be effective on the anthropometric indicators of patients with T1DM and CD, but it does not seem to affect the metabolic status of these patients compared to those infected with T1DM.

5. Keywords: celiac disease, type 1 diabetes mellitus, children

Introduction

Celiac disease is a type of enteropathy of the autoimmune origin that leads to chronic intestinal inflammation and is caused by increased sensitivity to gluten protein, a protein in rye wheat or barley (1). Nowadays, it is possible to find patients who have classic symptoms, even silent, and non-classical cases, using sensitive and specific serological tests and access to endoscopic procedures (2).

Studies show that people with Type 1 Diabetes mellitus are at a greater risk of causing celiac disease (3). The accompaniment of these two diseases is 5-7 times more prevalent than only celiac disease (4). Genetic predisposition, younger age, the onset of type 1 diabetes, and earlier supply of gluten in the infant's diet are probably related to the increased risk of causing celiac disease in people with diabetes mellitus (5, 6). In many children's diabetes clinics today, screening evaluation is performed to investigate celiac disease using routine serological tests or in cases of strong suspicion of illness; if the serological tests are positive and changes are observed in the biopsy of the patient's small intestine, the diagnosis of celiac disease is proposed (4).The studies conducted on the follow-up (short-term and long-term) of patients accompanied by two diseases, celiac disease, and diabetes mellitus, are limited. Some studies show that children with two simultaneous diseases grow less than children infected with only diabetes and may show a greater reduction in their growth parameters (7, 8). Studies show that the destruction of the small intestine causes malabsorption of nutrients in people infected with diabetes mellitus and undiagnosed celiac disease; consequently, it causes a decrease in hemoglobin A1c and insulin requirement and an increase in

hypoglycemic episodes(9, 10). However, some other studies reported no difference in HbA1c levels and hypoglycemic episodes count (7, 11, 12).

In a retrospect study that was done on 68 children infected with type 1 diabetes and celiac disease in comparison with 131 children with only type 1 diabetes, celiac disease was diagnosed among 5.5% of patients and of course, no significant differences were observed in hypoglycemic attacks and diabetic ketoacidosis between the control and case groups. The results of this study showed that diabetic and celiac patients treated with gluten-free diet have the same growth and metabolism as children without celiac disease. Moreover, in another study that was performed on 21 children with type 1 diabetes and celiac disease in comparison with 42 children of the control group, growth criteria, HbA1c, and insulin requirement were measured during diagnosis and 12 months later, and it was shown that Gluten-free diet had significant changes on the body mass index in children, although these changes were not observed in the control group (11).

According a few studies on the accompaniment of celiac disease and type 1 diabetes in children, this study aimed to survey the clinical and metabolic parameters in children with celiac disease and type 1 diabetes and compare it with the group of children with type 1 diabetes during one year.

Research background

So far, many studies were done on the metabolic effects of these two diseases on each other in the world in terms of the known accompaniment of celiac and type 1 diabetes diseases in children, on the one hand, the high prevalence of these two diseases, and the upward trend of their incidence rates. Studies are inconclusive in the field of anthropometric variables in children and adolescents with T1DM and celiac disease; some reports reported no difference between height and weight (151) and some others showed a decrease in standard deviation score (SDS) of weight (14), some in BMI-SDS (13, 15) and some also reported a decrease in SDS of height (4, 15).

Some studies have reported lower values of HbA1c level in patients with celiac disease (153, 156), while some studies found no difference among these values (13, 14, 17).

Rami et al. studied 98 diabetic children infected with silent celiac disease in a study who were recognized using EMA following that using biopsy in screening to investigate the clinical and metabolic characteristics of diabetic children with diagnosed celiac disease in screening which was done multi-centrally and was published in 2015. This study considered two control groups: age matching and diabetes onset age, which were negative in terms of EMA. The variables of height, weight, HbA1c, insulin dose, and acute complications investigated in this study was recorded for at least one year of follow-up. The average of age for diabetes was about 6.5 years, whose celiac disease was diagnosed at an average of 5.3 years after the diagnosis of diabetes (at an average of 10 years old). After the diagnosis of celiac disease, the patients were observed for an average of 3,3 years. The biopsies of 74 individuals revealed full or almost total mucosal atrophy. In this investigation, there was no change in HbA1c level, acute complications of diabetes, insulin dosage, BMI, or height between the case and control groups. They had a lower BMI than their control group in the girls' group. But, its remarkable finding was the cessation of weight gain in boys with celiac disease compared to their control group. This study concluded that silent celiac disease had no clear effect on the metabolic control of patients, but it negatively affected weight gain

Research method

All recognized children with celiac disease and type 1 diabetes mellitus were considered as the case group, children with only diabetes mellitus type 1 (age and gender matching) were considered for the control group. Our inclusion criteria were children under 18 years old referring to Hazrat Ali Asghar's endocrine patients' clinic with the simultaneous diagnosis of celiac disease and diabetes, as well as children infected with type 1 diabetes. Patients were followed up duration every 3 months to one year and included. Exclusion criteria included the patients who had previously been infected with other chronic diseases, Down syndrome, and other types of diabetes disease.

Regarding the number of referring patients with T1DM is limited and the limitation of simultaneous diagnosis of diabetes and celiac, all diagnosed children with 2 diseases were evaluated during the study. Diagnosed children with 2 diseases were considered as a case group, and children with diabetes only were considered as control. The sampling method was easy and accessible.

All children with the simultaneous diagnosis of celiac disease and diabetes who were regularly referred to the endocrine and gastrointestinal clinic were included. According to the limitation of the simultaneous diagnosis of two diseases, two cases of children infected with T1DM randomly and consecutively (age, gender matching, and duration of diabetes) were considered the control group, per patient who had both diseases. The sampling was easy and accessible. The cases were included in the study after explaining the conditions of study, completing the informed consent form, and having the inclusion criteria,

People were referred routinely every 3 months during a year. Diagnosis of celiac in patients with positive serology and pathological results was according to Marsh's classification (18). All diagnosed patients with celiac were treated with a gluten-free diet. TTG-IgA antibody level was checked during diagnosis and one year later.

The patients' information were recorded every 3 months in the consecutive evaluation, which includes anthropometric information of weight, height-age, diabetes onset age, duration of diabetes, presence of gastrointestinal symptoms, onset of puberty, blood sugar level, HbA1C level, insulin requirement - recording of hypoglycemic episodes or DKA, and TTG-IgA values. Then clinical and laboratory criteria were compared among the patients with the simultaneous diagnosis of celiac and diabetes and only diabetes. The information were collected and entered into SPSS statistical software and the data was analyzed at the end of the study. Data analysis was done by SPSS version 25. Descriptive statistics, including mean and standard deviation, as well as percentage frequency, were used to describe the data. Moreover, chi-square test and independent t-test were used to analyze the data. A significance level was considered 0.05.

 Findings

This study was a case-control which was done in Zahedan city to compare the clinical and metabolic characteristics of children with type 1 diabetes mellitus and celiac simultaneously   on children with celiac disease and type 1 diabetes mellitus as the case group and children with only diabetes mellitus as a control group before and after a gluten-free diet.

The patients under 18 years old referring to the endocrine and gastrointestinal clinic of Hazar Ali Asghar Hospital were included in the study if they had the conditions to study, and were followed up every three months within one year. Diagnosed celiac patients were treated with a gluten-free diet and anthropometric indicators and clinical characteristics of celiac disease and type 1 diabetes were consecutively measured every three months.

In general, 35 eligible patients were investigated in this project, of which 20 patients with a simultaneous diagnosis of celiac and type 1 diabetes as a case group and 15 patients with a diagnosis of only type 1 diabetes as a control group were studied. 11 patients (55%) were male, and 9 patients (45%) were female in the case group and 7 patients (46.7%) were male and 8 patients (53.3%) were female in the control group. The average of disease onset age was 9.9 ± 3.92 years old in case group' patients and 8.8 ± 3.96 years old in the control group (Table 1).

Table 1: Mean and standard deviation of onset age (based on the year) in the case and control group patients

Maximum	Minimum	Standard deviation	Mean		
15	3	3/92	9/9	Case group	Age
13	2	3/96	8/8	Control group	

The first purpose: determining and comparingof the age distribution of children infected with diabetes and celiac in comparison with children infected with only diabetes

The average of age was 11.8 ± 3.99 years old in the case group and 9.8 ± 3.96 years old in the control group at the time of patients' refer. The age distribution of patients did not follow the normal distribution, as a result, the non-parametric test was used to compare the age difference between two groups which there was no statistically significant   difference among the patients' age in the two groups (P>0.05) (Table 2).

Table 2: Age characteristic of patients in the case and control groups (based on the year)

The P value for the test	Maximum	Minimum	Median	Standard deviation	Mean		
0/099	16	5	12/5	3/99	11/8	Case group	Age

14	1/5	10	3/96	9/8	Control group

The second purpose: determining and comparing of the gender, weight, height, and BMI of children infected with diabetes and celiac in comparison with children infected with only diabetes

11 patients (55%) were male, and 9 patients (45%) were female among the 20 patients of the case group in the present study. Moreover, 7 patients (46.7%) were male and 8 patients (53.3%) were female in the control group. There was no significant difference between two groups in terms of gender (P>0.05) (Table 3).

Moreover, the average of patients' weight was 30.5 ± 14.04, 33.4 ± 14.1, and 35.7 ± 13.08 kg in the case group, respectively, before 6 months and 12 months after the gluten-free diet and was 28 ± 16.59, 30.8 ± 16.40, and 33.6 ± 16.78 kg in the control group, respectively, 6 and 12 months after follow-up at the time of entering the study.

The average of patient's height was 129.65 ± 21.68, 132 ± 21.76, 135.10 ± 20.83 cm in the case group, respectively, before 6 months and 12 months after the gluten-free diet and was 121.93 ± 22.41, 125.66 ± 24.12, and 129.46 ± 24.38 cm in the control group, respectively, at 6 and 12 months later at the time of entering the study.

There was no statistically significant difference between the two groups in terms of the patient's height (P>0.0) (Table 5).

The average of BMI was17.27, 18.40, and 19.02 kg/m2 in the case group, respectively, before 6 months and 12 months after the gluten-free diet in the patients of this study and was 17.81, 18.69 and 19.36 kg/m2 in the control group, respectively , 6 and 12 months after that at the time of entering the study.

There was no statistically significant difference between the BMI of the two groups at the similar times (P<0.05, Table 6).

Table 3: Frequency distribution of the two studied groups based on the gender

P-value	مجموع		Gender				
			Female		Male		
	Percentage	Frequency	Percentage	Frequency	Percentage	Frequency	
0/44	% 100	20	% 45	9	% 55	11	Case	Group
	% 100	15	% 53/3	8	% 46/7	7	Control	

Table 4: Weight indicators (kilograms) in the case and control groups at the time of diagnosis, 6 and 12 months later

p value	Minimum	Maximum	Median	Standard deviation	Mean			
0/26	12/5	61	25	14/04	30/57	Case	At the time of diagnosis	Weight
	10	78	22	16/59	28	Control		
0/38	13	61	29	14/10	33/47	Case	6 months later	
	10	79	27	16/40	30/8	Control		

pvalue	Minimum	Maximum	Median	Standard deviation	Mean		
0/35	14	61	34	13/08	35/73	Case	12 months later
	13	82	29	16/78	33/6	Control	

Table 5: Height indicators (cm) in the case and control groups at the time of diagnosis, 6 and 12 months later

pvalue	Minimum	Maximum	Median	Standard deviation	Mean			
0/17	94	159	132	21/68	129/65	Case	At the time of diagnosis	Height
	83	151	128	22/41	121/93	Control		
0/36	96	160	134/5	21/76	132	Case	6 months later	
	86	157	131	24/12	125/66	Control		
0/47	98	161	138	20/83	135/10	Case	12 months later	
	91	162	137	24/38	129/46	Control		

Table 6: Kg/m2 indicators (BMI) in the case and control groups at the time of diagnosis, 6 and 12 months later

p value	Minimum	Maximum	Standard deviation	Mean			
0/75	13/10	28/23	4/12	17/27	Case	At the time of diagnosis	BMI
	12/24	35/13	5/81	17/81	Control		
0/86	13/54	28/23	3/98	18/40	Case	6 months later	
	12/62	34/65	5/52	18/69	Control		
0/83	12/94	30/16	3/97	19/02	Case	12 months later	

14/7	33/69	5/19	19/36	Control		

4-4- The third purpose: determining and comparing of the anthropometric characteristics of children infected with celiac and diabetes before and after one year of the gluten-free diet (0, 6 and 12 months after diagnosis)

Analysis of Variance for duplicate data was used to compare the anthropometric characteristics of children with celiac and type 1 diabetes before 6 months and 12 months after the gluten-free diet regarding the normality of data distribution. First, the equality of dependent variable covariances (weight and height) was investigated by Mauchly's Sphericity test for one-factor analysis of variance with repeated measurements.

The data did not reject the assumption of covariances' homogeneity regarding the significance level of Mauchly's Sphericity; consequently, analysis of variance was used (W=0.297, $\chi2$ (2) =19.43, p<0.001 for weight). The difference between the average of patients' weight before 6 months and 12 months after the diagnosis and gluten-free diet was statistically significant (F(1.17, 19.96) = 21.31, p < 0.001) (Table 7 and graph 1).

The data did not question the assumption of covariances' homogeneity about height regarding calculated significance level for the Mauchly's Sphericity and, as a result, analysis of variance was used (05.0<$\chi2$ (2) =14.87, p, 0395 =W). Moreover, there was a significant difference between the average of patients' height in the above time periods (F (2,34) =44.52, p<0.001 (Table 8 and graph2).

Table 7: Comparing of weight (kg) in the case group at the time of diagnosis, 6 and 12 months later

95 % Confidence Interval		Standard deviation	Mean	
Upper limit	lower limit			
38/8	24/7	3/34	31/8	At the time of diagnosis	Weight
40/4	26/4	3/32	33/4	6 months later
42/6	29/2	3/16	35/9	12 months later
40/6	26/8	3/25	33/74	Total

Graph 1: Comparing of weight averages (kg) in the case groupat the time of diagnosis, 6 and 12 months later
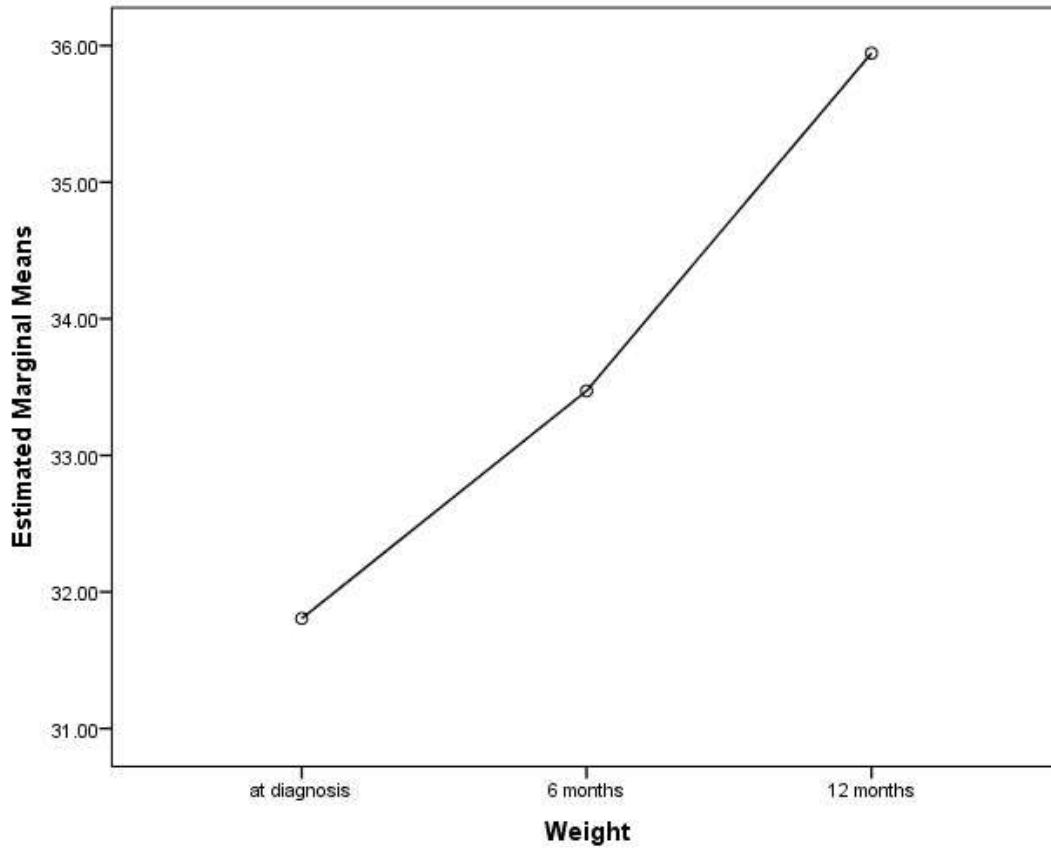

Table 8: Comparing of height (cm) in the case group at the time of diagnosis, 6 and 12 months later

95 % Confidence Interval		Standard deviation	Mean		
Upper limit	lower limit				
141/93	120/18	5/15	131/05	At the time of diagnosis	Height
142/8	121/17	5/13	132	6 months later	
145/8	124/5	5/05	135/16	12 months later	
143/5	121/96	5/10	132/74	Total	

Graph 2: Comparison of height averages (cm) in the case groupat the time of diagnosis, 6 and 12 months later
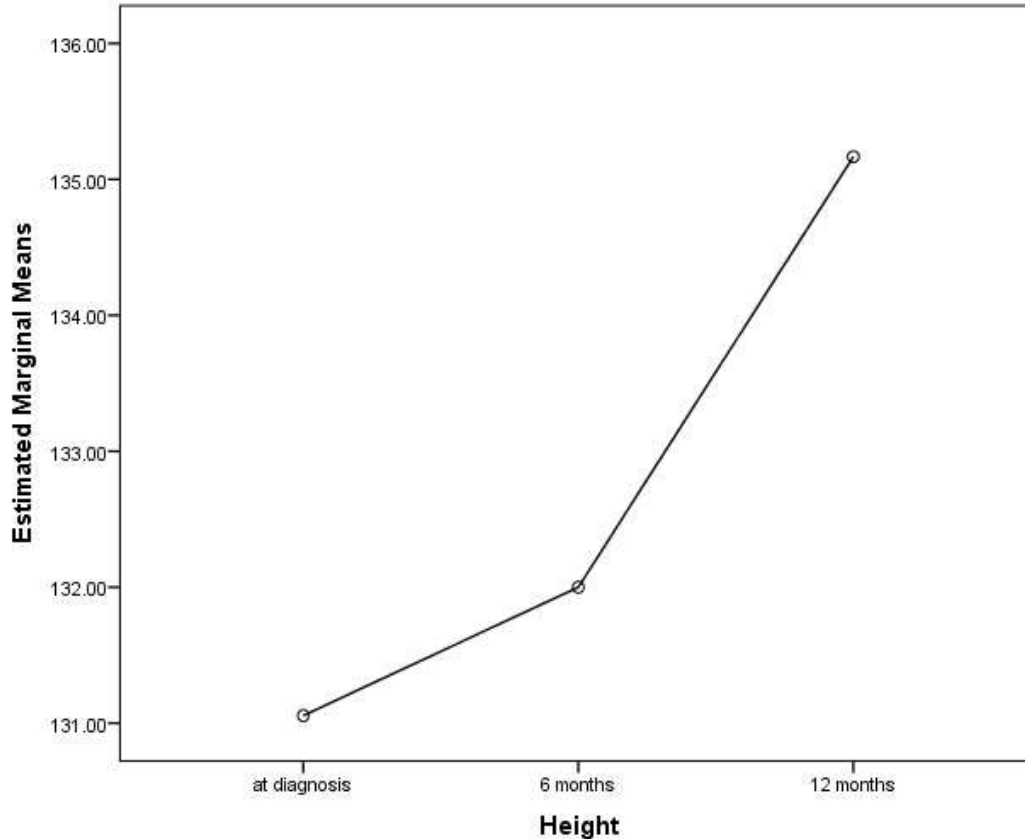
5-4- The fourth purpose: determining and comparing of HbA1c in children infected with celiac and diabetes with only diabetes before treatment and during the follow-up(at the time of diagnosis and one year later)
In our study, the average of hemoglobin A1c was 11.02% and 7.27%% in the case group, respectively, at the time of diagnosis and one year later which was 11.53% and 8.02% in the control group, respectively, at the time of diagnosis and one year later.
There was no statistically significant difference between two groups in terms of HbA1c at the time of diagnosis and one year later (T=0.51, df=32, p>0.05 and T=1.7, df=30, p>0.05 respectively, table 9).

Table 9: HbA1c indicators (%)in the case and control groups at the time of diagnosis, 6 and 12 months later

p-value	Minimum	Maximum	Standard deviation	Mean			
0/6	6/3	18/5	3/17	11/02	Case	At the time of diagnosis	HbA1c
	8/5	19/3	2/59	11/53	Control		
0/09	6/2	9/9	0/92	7/27	Case	12 months later	

5/8	11	1/48	8/02	Control	

4-6- The fifth purpose: determining and comparing of the insulin requirement[1] in children infected with celiac and diabetes with only diabetes before and after treatment

19 patients (95%) required insulin, and only one patient (0.5%) did not require insulin at the beginning of the control group study. Moreover, the whole 15 patients required insulin in the case group. The whole patients required insulin in two groups after 6 months. However, 12 months after the beginning the study and prescribing a gluten-free diet for the case group, 18 patients (90%) required insulin in the case group and 13 patients (86.7%) required insulin in the control group, and 2 patients (10%) did not require insulin in the case group and 2 patients (12.3%) did not require insulin in the control group. There was no significant difference between two groups in terms of the insulin requirement at the beginning of diagnosis, 6 and 12 months after diagnosis (P>0.05) (Table 10).

Table 10: Comparing of insulin requirementin the case and control groups at the time of diagnosis, 6 and 12 months later

p-value	Insulin requirement								
	Total		Does not require		Requires			
	Percentage	Count	Percentage	Count	Percentage	Count		
0/57	% 100	20	% 5	1	% 95	19	Case	At the time of diagnosis
	% 100	15	% 0	0	% 100	15	Control	
-	% 100	20	0	0	% 100	20	Case	6 months later
	% 100	15	0	0	% 100	15	Control	
0/58	% 100	20	% 10	2	% 90	18	Case	12 months later
	% 100	15	% 13/3	2	% 86/7	13	Control	

7-4- The sixth purpose: determining and comparing of the incidence of hypoglycemic episodes in children infected with celiac and diabetes with only diabetes before treatment

4 patients (21.1%) in the case group and 6 patients (40%) in the control group had suffered from hypoglycemic episodes before starting the treatment (there was no information about one patient of the case group). However, there was no significant difference between the case and control groups in terms of the incidence of hypoglycemic episodes (P>0.05) (Table 11).

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[1]نیاز به انسولین

Table 11: Comparison of hypoglycemic episodes in the case and control groups

p-value	Hypoglycemic episodes (before treatment)						
	Total		Does not have		Has		
	Percentage	Count	Percentage	Count	Percentage	Count	
0/2	% 100	19	% 78/9	15	% 21/1	4	Case
	% 100	15	% 60	9	% 40	6	Control

4-8- The seventh purpose: determining and comparing of HbA1C in childreninfected with celiac and diabetes with only diabetes before treatment

The average of hemoglobin A1c was 11.02% in the case groupand was 11.53% in the control group before treatment. There was no statistically significant difference between the two groups in terms of HbA1c at the time of diagnosis (t=0.05, p>0.51) (Table 12).

Table 12: HbA1c% indicators in the case and control groupsat the time of diagnosis

p-value	Minimum	Maximum	Standard deviation	Mean			
0/6	6/3	18/5	3/17	11/02	Case	At the time of diagnosis	HbA1c
	8/5	19/3	2/59	11/53	Control		

4-9- The eighth purpose: determining and comparing of DKA in children infected with celiac and diabetes with only diabetes before treatment

6 patients (31.6%) in the case group and 5 patients (33.3%) in the control group had suffered from DKA complications before starting the treatment (there was no information about one patient of the case group). But, the difference between two groups was not statistically significant in terms of the incidence of DKA before treatment (P<0.05) (Table 13).

Table 13: Comparing of the DKA incidence in the case and control groups before starting the treatment

p-value	DKA						
	Total		Does not have		Has		
	Percentage	Count	Percentage	Count	Percentage	Count	
0/6	% 100	19	% 68/4	13	% 31/6	6	Case

	% 100	15	% 66/7	10	% 33/3	5	Control

10-4- The ninth purpose: examination of gastrointestinal symptoms[2] before gluten-free diet in the case group of children infected with celiac and diabetes with only diabetes before treatment

10 patients among 16 patients (62.5%) had suffered from gastrointestinal symptoms in the case group, while none of the patients had gastrointestinal symptoms in the control group. The difference between two groups was statistically significant in terms of the gastrointestinal symptoms before starting the gluten-free diet (P<0.001)(Table 14).

Table 14: Comparing of the gastrointestinal symptomsincidence in the case and control groups before starting the treatment

p-value	Gastrointestinal symptoms						
	Total		Does not have		Has		
	Percentage	Count	Percentage	Count	Percentage	Count	
>0/001	% 100	19	% 37/5	6	62%/5	10	Case
	% 100	15	% 100	15	% 0	0	Control

6. Discussion

The accompaniment of celiac disease and type 1 diabetes mellitus (T1DM) is well known. Children with T1DM and celiac disease may be asymptomatic, and their disease is diagnosed only in screening.

Although these children may be asymptomatic at the time of diagnosis, malabsorption and growth failures in the future are considered complications of celiac disease in these patients (13, 19).

Studies in the field of anthropometric indicators in children and adolescents infected with T1DM and celiac disease simultaneously have often been contradictory; Some studies have reported no differences in weight and height indicators, and some others showed a decrease in the standard deviation score (SDS) of weight, SDS of body mass index (BMI), and SDS of height (4, 13, 16, 20).

The impact of celiac disease on the patients' metabolic control has always been discussed. Some studies have reported the hemoglobin A1c level in celiac patients, while others have not shown any difference (10, 12, 14, 16, 17).Various studies have reached the conclusion that weight and BMI of patients infected with celiac disease and T1DM increase after prescribing a gluten-free diet (4, 12, 13, 21, 22). Moreover, these studies concluded that the hypoglycemic episodes count has decreased in these patients and also gluten-free diet causes improvement of diabetes control, particularly in the patients who had suffered from malabsorption (13).

Rami et al., in a multicenter study on 98 diabetic children whose celiac disease were diagnosed in screenings and had been confirmed by biopsy (silent celiac), showed that silent celiac disease does not impact the patients' metabolic control. However, its effects on weighing patients are obvious even in the short term, and a gluten-free diet can have impressive effects on the weight and BMI of these patients (13).

In a study that was performed by Saukkonen et al. on children with celiac and T1DM to investigate the effect of celiac disease on the growth, glycemic control and overall, general health of the patients, it was concluded that prescribing a gluten-free diet has not had a positive effect on the patients' glycemic control, but it was related to the increase in weight for the height of the patients. Moreover, this study reported that this increase in the weight of patients was inversely related to changes in HbA1c levels. Eventually, this study concluded that celiac disease is

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rarely accompanied with symptoms of malnutrition in children and adolescents infected with T1DM and prescribing a gluten-free diet can cause an improvement of weighing in these patients (14).

Furthermore, Goh et al.'s study in 2010 had similar results to the results of the previous study (15).

A recent study of Creanza et al. showed that long-term treatment with a gluten-free diet does not cause deterioration of glycemic control in patients infected with celiac disease and T1DM simultaneously (16).

A case-control study for surveying the life quality and glycemic control was done by Pham-short et al. on 35 young patients with T1DM and celiac disease (cases) and 35 patients with only T1DM (control) and was published in 2016, concluded that patients with celiac and T1DM who have not had properly adhered to the gluten-free diet had a lower life quality and poorer glycemic control (17), but a study that was done in 2017 did not show any difference in life quality and nutritional status between celiac and T1DM patients simultaneously and celiac and T1DM alone patients as control groups (18).

In our study which was performed on 20 patients with celiac disease and T1DM simultaneously and 15 patients with T1DM, no significant difference was observed in terms of anthropometric indicators, HbA1c, and insulin requirement between two groups at similar follow-up times (at the time of diagnosis, 6 and 12 months later) before and after prescribing a gluten-free diet. However, the difference among the anthropometric indicators was obvious in the control group (celiac disease + T1DM) before and after prescribing a gluten-free diet and it caused an increase in the average of height and weight indicators in this group.

5-1 Conclusion

In general, there was no difference between age and gender, as well as anthropometric indicators, including height, weight, and BMI of patients in the two studied groups. Furthermore, no difference was observed between two groups in the incidence of hypoglycemic episodes, DKA and HbA1c levels. Gastrointestinal symptoms were observed only in the group of patients with celiac disease and T1DM (case group) at the beginning of diagnosis.

The present study concluded that prescribing a gluten-free diet has been obvious on the anthropometric indicators in the case group (celiac disease + T1DM) and has caused an increase in the height and weight of the patients after prescribing a gluten-free diet in comparison with before treatment. Besides there was no difference between two groups in terms of HbA1c and insulin requirement at the time of diagnosis and up to one year follow-up period.

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