

SEROPREVALENCE OF CELIAC DISEASE IN CHILDREN WITH TYPE 1 DIABETES
MELLITUS SCREENED BY ANTI-TISSUE TRANSGLUTAMINASE ANTIBODY IN
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ABSTRACT

Background: Celiac disease (CD) is an autoimmune disorder that occurs more frequently among patients with type 1 diabetes mellitus (T1DM). Because many affected children are asymptomatic, serological screening is important for early detection. **Objective:** To determine the seroprevalence of CD among children with T1DM in Karbala using anti-tissue transglutaminase (anti-tTG) antibodies and to identify associated clinical factors. **Patients and Methods:** This prospective study included children with T1DM attending the diabetic clinic at Karbala Pediatric Teaching Hospital from July 2014 to January 2015. All participants underwent serological screening for CD using serum anti-tTG antibodies. Demographic, clinical, anthropometric, and laboratory characteristics were evaluated. **Results:** Ninety-seven children with T1DM were enrolled, with a mean age of 10.5 years (range: 2–16 years). Anti-tTG antibodies were positive in 13 patients, yielding a seroprevalence of 13.4%. Seropositive patients had significantly lower HbA1c and hemoglobin levels ($p=0.03$ and $p=0.01$, respectively). Gastrointestinal symptoms, particularly chronic diarrhea, were significantly more frequent among seropositive children ($p=0.001$), as were other autoimmune diseases ($p=0.03$). No significant associations were observed with demographic or anthropometric characteristics, infant feeding pattern, or timing of gluten introduction. **Conclusion:** CD seropositivity was relatively common among children with T1DM. Routine serological screening using anti-tTG antibodies may facilitate early identification of CD in this high-risk population.

KEYWORDS: Seroprevalence, Celiac, Children, Type 1 Diabetes Mellitus, Anti-Tissue Transglutaminase, antibody.

INTRODUCTION

Type 1 diabetes mellitus (T1DM) is a chronic autoimmune disorder characterized by immune-mediated destruction of pancreatic β -cells, resulting in absolute insulin deficiency and lifelong dependence on exogenous insulin. Celiac disease (CD) is another immune-mediated disorder in which ingestion of gluten from wheat, barley, and rye induces small-intestinal inflammation in genetically susceptible individuals. Both diseases have a strong genetic background and are among the most common autoimmune disorders encountered during childhood.^[1] The association between T1DM and CD has been well established. Children with T1DM have a substantially greater prevalence of CD than the general

pediatric population, with reported rates varying considerably according to ethnicity, geographical region, screening strategy, and diagnostic criteria. Biopsy-confirmed CD among children with T1DM has been reported to range from approximately 2.4% to 16.4%.^[1] Previous Iraqi studies conducted in Baghdad reported prevalence rates ranging from 8.6% to 11.6% among children with T1DM.^[2,3] This increased occurrence is largely explained by the shared genetic susceptibility of the two conditions. T1DM and CD are strongly associated with human leukocyte antigen (HLA) class II genotypes, particularly HLA-DQ2 and HLA-DQ8. These genotypes are highly prevalent among individuals with CD and are also major genetic determinants of

susceptibility to T1DM.^[4] Several non-HLA susceptibility loci are also shared between the two diseases, supporting the concept of overlapping autoimmune mechanisms.^[1] Environmental factors, including gluten exposure, gastrointestinal infections, intestinal microbiota, and infant-feeding practices, have also been investigated as potential contributors to the development of autoimmunity, although their precise roles remain controversial.^[5,6] Recognition of CD in children with T1DM can be challenging because many affected patients have silent or subclinical disease. Classical manifestations such as chronic diarrhea, abdominal distension, weight loss, and growth failure may be absent. Some patients instead present with nonspecific or extra-intestinal manifestations, including iron-deficiency anemia, impaired growth, reduced bone mineral density, or unexplained changes in glycemic control.^[7-9] Consequently, relying exclusively on clinical symptoms may result in delayed or missed diagnosis. Serological screening has therefore become an important approach for detecting CD in high-risk populations. Anti-tissue transglutaminase (anti-tTG) antibodies provide high sensitivity and specificity and are widely used as the initial screening test for CD.^[10,11] Early identification is important because untreated disease may contribute to nutritional deficiencies, impaired growth, skeletal complications, and other autoimmune manifestations. Therefore, the present study aimed to determine the seroprevalence of celiac disease using anti-tTG antibodies among children with T1DM attending the diabetic clinic at Karbala Pediatric Teaching Hospital and to examine the demographic, clinical, and laboratory factors associated with positive celiac serology.

PATIENTS AND METHODS

A prospective study was conducted at the diabetic outpatient clinic of Karbala Pediatric Teaching Hospital from July 2014 to January 2015. The study included 97 children with previously diagnosed type 1 diabetes mellitus (T1DM), aged 2–16 years. The participants comprised 48 males and 49 females. All patients were receiving human insulin therapy. After obtaining oral consent from the children and/or their parents, participants underwent detailed history taking and physical examination. Data were collected using a structured questionnaire that included age, sex, age at

diabetes onset, duration of diabetes, gastrointestinal symptoms suggestive of celiac disease, associated autoimmune diseases, and family history of T1DM or other autoimmune disorders. Infant-feeding practices, duration of breastfeeding, and age at introduction of gluten-containing foods were also recorded. Medical records were reviewed for information regarding diabetes follow-up, dietary compliance, glucose monitoring, and previous laboratory investigations. Weight and height were measured, and anthropometric indices were plotted on appropriate growth charts. Weight and height Z-scores and body mass index (BMI) were calculated. Venous blood samples were collected from all participants. Hemoglobin and glycated hemoglobin (HbA1c) were measured using an automated CELL-DYN Ruby Hematology Analyzer and BIO-RAD D-10 system, respectively. Serum samples were separated by centrifugation and stored at -20°C until analysis. Celiac serological screening was performed by measuring anti-tissue transglutaminase IgA and IgG (anti-tTG) antibodies using commercial ELISA kits. An anti-tTG level <20 U/mL was considered negative, while ≥ 20 U/mL was considered positive. Patients with positive celiac serology were referred for gastroenterological evaluation. Data were analyzed using SPSS version 15.0. Continuous variables were summarized using means and standard deviations, while categorical variables were presented as frequencies and percentages. Independent-samples Student's *t*-test, chi-square test, and Fisher's exact test were applied as appropriate. A *p*-value <0.05 was considered statistically significant.

RESULTS

Among the 97 children with T1DM, 48 (49.5%) were males and 49 (50.5%) were females. Their mean age was 10.5 ± 3.8 years, mean duration of diabetes was 2.8 ± 2.8 years, and mean age at T1DM diagnosis was 7.6 ± 3.3 years. Anti-tTG IgA was positive in 13 (13.4%) patients, including 8 males (61.5%) and 5 females (38.5%). There was no significant association between sex and celiac seropositivity ($p=0.350$). Furthermore, males and females did not differ significantly in age ($p=0.677$), duration of T1DM ($p=0.844$), or age at T1DM diagnosis ($p=0.569$), as in table 1.

Table 1: Demographic characteristics and celiac screening results among children with type 1 diabetes mellitus (N=97).

Characteristic	Male (n=48)	Female (n=49)	Total (N=97)	P-value
Celiac screen, n (%)				0.350
Negative anti-tTG IgA	40 (47.6%)*	44 (52.4%)*	84 (86.6%)	
Positive anti-tTG IgA	8 (61.5%)*	5 (38.5%)*	13 (13.4%)	
Age (years), mean $\pm$ SD	10.4 ± 3.5	10.7 ± 4.0	10.5 ± 3.8	0.677
Duration of T1DM (years), mean $\pm$ SD	2.9 ± 3.3	2.8 ± 2.2	2.8 ± 2.8	0.844
Age at T1DM diagnosis (years), mean $\pm$ SD	7.4 ± 3.2	7.8 ± 3.5	7.6 ± 3.3	0.569

* Percentages for anti-tTG categories are calculated within each screening-result group, as presented in the original Table 1.

There were no significant differences between anti-tTG-positive and anti-tTG-negative children in age, age at onset of T1DM, duration of diabetes, or anthropometric Z-scores. However, seropositive children had significantly lower mean HbA1c ($9.36 \pm 2.9\%$ vs $11.08 \pm 2.7\%$, $p=0.0394$) and hemoglobin levels (11.2 ± 1.7 vs 12.3 ± 1.2 g/dL, $p=0.0122$). Chronic diarrhea was significantly more frequent among seropositive children (38.4% vs 7.1% , $p=0.0012$), whereas constipation and

abdominal distension were not significantly associated with celiac seropositivity. Parental consanguinity was more frequent among seropositive children (76.9% vs 54.8%), but the association was not statistically significant (Fisher's exact $p=0.2267$). Similarly, the timing of gluten introduction before or after 6 months of age was not significantly associated with celiac screening results (Fisher's exact $p=0.417$), as in table 2.

Table 2: Demographic, anthropometric, clinical, and selected risk-factor characteristics according to celiac screening results.

Characteristic	All (N=97)	Anti-tTG negative (n=84)	Anti-tTG positive (n=13)	P-value
Demographic and anthropometric characteristics				
Age (years), mean $\pm$ SD	10.5 ± 3.8	10.5 ± 3.8	10.5 ± 3.7	0.9998
Age at onset of T1DM (years), mean $\pm$ SD	7.6 ± 3.3	7.6 ± 3.4	7.2 ± 2.8	0.6827
Duration of DM (years), mean $\pm$ SD	2.8 ± 2.8	2.7 ± 2.8	3.2 ± 2.8	0.5744
Height-for-age Z-score, mean $\pm$ SD	-1.0 ± 1.3	-0.9 ± 1.2	-1.5 ± 1.6	0.1468
Weight-for-age Z-score, mean $\pm$ SD	-1.0 ± 1.4	-0.9 ± 1.4	-1.4 ± 1.2	0.2372
BMI-for-age Z-score, mean $\pm$ SD	-0.7 ± 2.4	-0.6 ± 2.5	-1.3 ± 2.2	0.3337
Clinical characteristics				
HbA1c (%), mean $\pm$ SD	10.85 ± 2.8	11.08 ± 2.7	9.36 ± 2.9	0.0394
Hemoglobin (g/dL), mean $\pm$ SD	12.1 ± 1.3	12.3 ± 1.2	11.2 ± 1.7	0.0122
Constipation, n (%)	8 (8.2)	5 (5.8)	3 (23.0)	0.072
Chronic diarrhea, n (%)	11 (11.3)	6 (7.1)	5 (38.4)	0.0012
Abdominal distension, n (%)	20 (20.6)	16 (19.0)	4 (30.7)	0.470
Parental consanguinity				
Consanguineous, n (%)	56 (57.7)	46 (54.8)	10 (76.9)	0.2267*
Not consanguineous, n (%)	41 (42.3)	38 (45.2)	3 (23.1)	
Age at introduction of gluten				
Before 6 months, n (%)	15 (15.5)	12 (80.0)†	3 (20.0)†	0.417*
After 6 months, n (%)	82 (84.5)	72 (88.0)†	10 (12.0)†	

* Fisher's exact test. † Percentages are within the age-at-gluten-introduction category, as reported in the original Table 7.

Among the study participants, breastfeeding was the predominant feeding practice during the first six months of life, reported in 69.1% of children, compared with 6.2% who received bottle feeding and 24.7% who received mixed feeding. When feeding practices were compared according to celiac serology, exclusive breastfeeding was slightly more common among children with negative anti-tTG results than among those with

positive results (70.2% vs. 61.5%). In contrast, bottle feeding was more frequent among anti-tTG-positive children compared with seronegative children (15.4% vs. 4.8%). However, the overall association between feeding pattern during the first six months of life and celiac seropositivity was not statistically significant ($p=0.334$). As in table 3.

Table 3: Type of feeding in the 1st 6months of life related to celiac screen result.

Anti-tTG, % within celiac screen result	Feeding history			Total
	Breast	Bottle	Mixed	
Negative	59(70.2%)	4(4.8%)	21(25%)	84
Positive	8(61.5%)	2(15.4%)	3(23.1%)	13
Total	67(69.1%)	6(6.2%)	24(24.7%)	97

The association is statistically not significant ($\chi^2=2.2, df=2, p\text{-value}=0.334$)

Among the 13 children with positive anti-tTG IgA, 8 (61.5%) were males and 5 (38.5%) were females. The mean age at detection of celiac disease autoimmunity

was 9.8 years, and the mean interval between T1DM diagnosis and CD detection was 2.6 years. The mean anti-tTG IgA level was 255.5 U/mL. Ten (76.9%) cases represented newly detected seropositivity, whereas three (23.1%) had been previously diagnosed with CD.

Gastrointestinal symptoms were present in 7 (53.8%) children, most commonly chronic diarrhea (38.5%), followed by abdominal distension (30.8%) and constipation (23.1%). As in table 4.

Table 4: Summary characteristics of children with positive anti-tTG IgA (n=13).

Characteristic	Summary
Age, years, mean $\pm$ SD	10.5 $\pm$ 3.7
Male, n (%)	8 (61.5)
Female, n (%)	5 (38.5)
Mean age at T1DM diagnosis, years	7.2
Mean age at CD diagnosis/anti-tTG detection, years	9.8
Mean interval between T1DM and CD detection, years	2.6
Newly detected CD seropositivity, n (%)	10 (76.9)
Previously diagnosed CD, n (%)	3 (23.1)
Anti-tTG IgA, U/mL, mean	255.5
Any gastrointestinal symptom, n (%)	7 (53.8)
Chronic diarrhea, n (%)	5 (38.5)
Abdominal distension, n (%)	4 (30.8)
Constipation, n (%)	3 (23.1)

The distribution of patients according to family history of T1DM and celiac disease (CD) showed no significant association with celiac seropositivity. Among anti-tTG-negative patients, 65% had no family history of either disease, compared with 77% of anti-tTG-positive patients. A family history of T1DM alone was more

frequent in the seronegative group than in the seropositive group (30% vs. 15%), whereas a family history of CD alone was slightly more frequent among seropositive patients. Overall, these differences were not statistically significant ($\chi^2 = 2.39$, $p = 0.495$). as in fig 1.

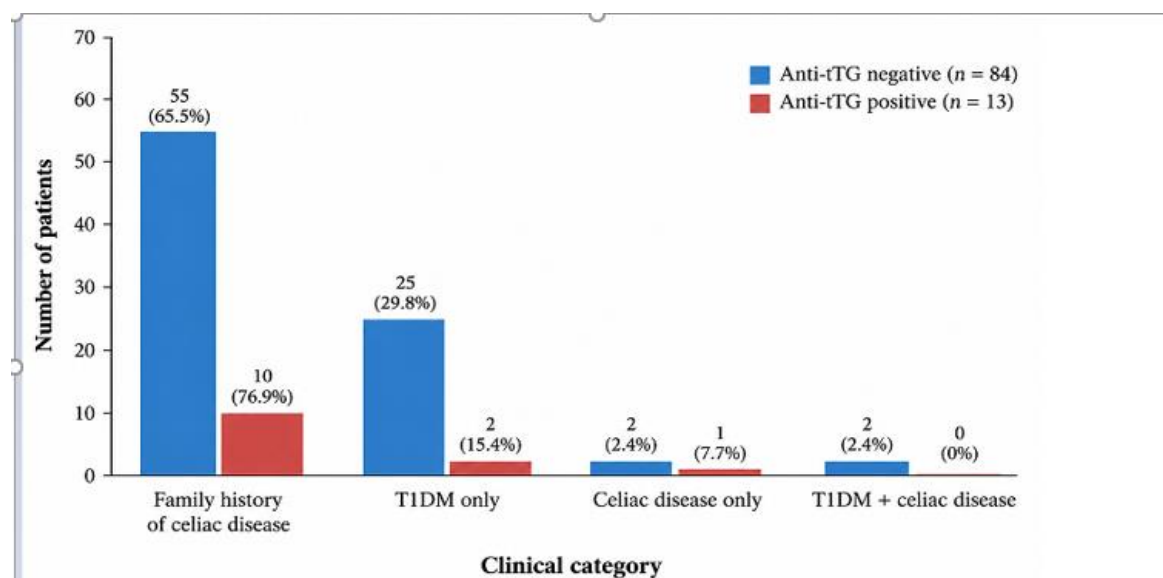


Fig 1: Distribution of the study group by their family history of T1DM, CD and the anti-tTGA result.

DISCUSSION

The present study demonstrated a celiac disease (CD) seroprevalence of 13.4% among children with type 1 diabetes mellitus (T1DM). This prevalence was higher than that reported in Iran by Fallahi et al. (6.25%)^[12] and Moayeri et al. (3.4%)^[13], but lower than findings from Saudi Arabia (20%)^[14] and Turkey (20.8%).^[15] It was comparable to reports from Algeria (13.7%).^[16] Considerable international variation has also been reported, ranging from 2.4% in Finland to 21.3% in Libya.^[17,18] Such differences may reflect variations in screening methods, sample characteristics, genetic susceptibility, and environmental exposures. Although

males represented 61.5% of seropositive patients, the association between sex and anti-tTG positivity was not significant. This differs from the female predominance reported in several studies^[12,19], although Araújo et al. similarly found no significant sex association.^[20] Age, age at T1DM diagnosis, duration of diabetes, and anthropometric indices were also comparable between seropositive and seronegative groups. Similar findings were reported by Al-Hussaini et al.^[14], Saadah et al.^[21] Approximately 77% of seropositive patients developed celiac autoantibodies within four years of T1DM onset, supporting evidence that most CD diagnoses occur during the early years following diabetes diagnosis.^[22]

Interestingly, seropositive children had significantly lower HbA1c levels than seronegative children (9.3% vs. 11.1%). This may reflect impaired nutrient absorption and recurrent hypoglycemia associated with subclinical CD. Similar observations were reported by Picarelli et al.^[23], although Al-Hussaini et al. found no significant difference.^[14] Hemoglobin was also significantly lower among seropositive children (11.2 vs. 12.3 g/dL, $p=0.012$), potentially reflecting micronutrient malabsorption, particularly iron, folate, and vitamin B12.^[21] Gastrointestinal manifestations were more frequent among seropositive patients. Chronic diarrhea showed a particularly strong association with positive anti-tTG ($p=0.0012$), whereas abdominal distension and constipation were not significantly associated. Diarrhea has similarly been reported as an important manifestation among T1DM patients with CD.^[24] Nevertheless, many affected children may remain asymptomatic or have only subtle manifestations, emphasizing the importance of screening rather than relying exclusively on gastrointestinal symptoms.^[2,14] Neither family history nor parental consanguinity was significantly associated with celiac seropositivity, although familial clustering of CD has been documented elsewhere.^[25] Similarly, feeding pattern during the first six months was not associated with celiac autoimmunity ($p=0.334$), consistent with Vriezinga et al.^[26] and Lionetti et al.^[27], but differing from Ivarsson et al.^[28] The timing of gluten introduction, whether before or after six months, was also unrelated to seropositivity, consistent with previous finding^[26], although Norris et al. reported different results.^[6] Overall, these findings support the strong underlying genetic relationship between T1DM and CD and reinforce the value of routine anti-tTG screening in children with T1DM, including those without typical gastrointestinal manifestations.

CONCLUSION

Celiac disease seroprevalence among children with T1DM was 13.4%. Most seropositive cases were detected within four years of T1DM onset and had lower HbA1c levels. Neither feeding pattern during the first six months nor the timing of gluten introduction was associated with celiac seropositivity.

REFERENCES

1. Sud S, Marcon M, Assor E, Palmert MR, Daneman D, Mahmud FH. Celiac disease and pediatric type 1 diabetes: diagnostic and treatment dilemmas. *Int J Pediatr Endocrinol*, 2010; 2010: 161285.
2. Abduljabbar HA, Matloub HY, Yassin BAG. Prevalence of celiac disease in type 1 diabetes mellitus in children and adolescents attending Children Welfare Teaching Hospital. *J Fac Med Baghdad*, 2012; 54(1): 28–32.
3. Obaid A, Kubba R, Zaidan K, Al Hergani M. The detection of silent celiac disease in patients with type 1 diabetes mellitus by the use of anti-tissue transglutaminase antibodies. *Al-Kindy Col Med J*, 2012; 8(2): 131–5.
4. Bao F, Yu L, Babu S, et al. One third of HLA DQ2 homozygous patients with type 1 diabetes express celiac disease-associated transglutaminase autoantibodies. *J Autoimmun*. 1999; 13(1): 143–8.
5. Fasano A, Catassi C. Celiac disease. *N Engl J Med*, 2012; 367(25): 2419–26.
6. Norris JM, Barriga K, Hoffenberg EJ, et al. Risk of celiac disease autoimmunity and timing of gluten introduction in the diet of infants at increased risk of disease. *JAMA*, 2005; 293(19): 2343–51.
7. Freemark M, Levitsky LL. Screening for celiac disease in children with type 1 diabetes: two views of the controversy. *Diabetes Care*, 2003; 26(6): 1932–9.
8. Cohn A, Sofia AM, Kupfer SS. Type 1 diabetes and celiac disease: clinical overlap and new insights into disease pathogenesis. *Curr Diab Rep*, 2014; 14(8): 517.
9. Freemark M, Litton J, Becker D, Treem W. The effect of subclinical celiac disease on bone mineral density in children with type 1 diabetes [abstract]. Presented at: Annual Meeting of the Pediatric Academic Societies; 2003; Seattle, WA.
10. Mahmud FH, Murray JA, Kudva YC, et al. Celiac disease in type 1 diabetes mellitus in a North American community: prevalence, serologic screening, and clinical features. *Mayo Clin Proc*, 2005; 80(11): 1429–34.
11. Schyum AC, Rumessen JJ. Serological testing for celiac disease in adults. *United European Gastroenterol J*, 2013; 1(5): 319–25.
12. Fallahi GH, Ahmadian JH, Rabbani A, Yousefnezhad A, Rezaei N. Screening for celiac disease in diabetic children from Iran. *Indian Pediatr*, 2010; 47(3): 268–70.
13. Moayeri H, Bahremand SH. Prevalence of celiac disease in children and adolescents with type 1 diabetes mellitus. *Med J Islam Repub Iran*, 2004; 18(1): 39–43.
14. Al-Hussaini A, Sulaiman N, Al-Zahrani M, Alenizi A, El Haj I. High prevalence of celiac disease among Saudi children with type 1 diabetes: a prospective cross-sectional study. *BMC Gastroenterol*, 2012; 12: 180.
15. Sari S, Yeşilkaya E, Eğriş O, Bideci A, Cinaz P, Dalgic B. Prevalence of celiac disease in Turkish children with type 1 diabetes mellitus and their non-diabetic first-degree relatives. *Turk J Gastroenterol*, 2010; 21(1): 34–8.
16. Boudraa G, Hachelaf W, Benbouabdellah M, Belkadi M, Benmansour FZ, Touhami M. Prevalence of coeliac disease in diabetic children and their first-degree relatives in West Algeria: screening with serological markers. *Acta Paediatr*. 1996; 85(Suppl 412): 58–60.
17. Arató A, Körner A, Veres G, Dezsöfi A, Ujpál I, Madácsy L. Frequency of coeliac disease in Hungarian children with type 1 diabetes mellitus. *Eur J Pediatr*, 2003; 162(1): 1–5.

18. Schober E, Bittmann B, Granditsch G, et al. Screening by anti-endomysium antibody for celiac disease in diabetic children and adolescents in Austria. *J Pediatr Gastroenterol Nutr*, 2000; 30(4): 391–6.
19. Shahbazkhani B, Faezi T, Akbari MR, et al. Coeliac disease in Iranian type I diabetic patients. *Dig Liver Dis*, 2004; 36(3): 191–4.
20. Araújo J, Silva GAPD, Melo FMD. Serum prevalence of celiac disease in children and adolescents with type 1 diabetes mellitus. *J Pediatr (Rio J)*, 2006; 82(3): 210–4.
21. Saadah OI, Al-Agha AE, Al Nahdi HM, et al. Prevalence of celiac disease in children with type 1 diabetes mellitus screened by anti-tissue transglutaminase antibody from Western Saudi Arabia. *Saudi Med J*, 2012; 33(5): 541–6.
22. Cerutti F, Bruno G, Chiarelli F, Lorini R, Meschi F, Sacchetti C. Younger age at onset and sex predict celiac disease in children and adolescents with type 1 diabetes: an Italian multicenter study. *Diabetes Care*, 2004; 27(6): 1294–8.
23. Picarelli A, Di Tola M, Sabbatella L, et al. Type 1 diabetes mellitus and celiac disease: endothelial dysfunction. *Acta Diabetol*, 2013; 50(4): 497–503.
24. Saadah OI, Zacharin M, O'Callaghan A, Oliver MR, Catto-Smith AG. Effect of gluten-free diet and adherence on growth and diabetic control in diabetics with coeliac disease. *Arch Dis Child*, 2004; 89(9): 871–6.
25. Al-Sinani S, Sharef SW, Al-Yaarubi S, Al-Zakwani I, Al-Naamani K, Al-Hajri A, et al. Prevalence of celiac disease in Omani children with type 1 diabetes mellitus: a cross-sectional study. *Oman Med J*, 2013; 28(4): 260–3.
26. Vriezinga SL, Auricchio R, Bravi E, et al. Randomized feeding intervention in infants at high risk for celiac disease. *N Engl J Med*, 2014; 371(14): 1304–15.
27. Lionetti E, Castellaneta S, Francavilla R, et al. Introduction of gluten, HLA status, and the risk of celiac disease in children. *N Engl J Med*, 2014; 371(14): 1295–303.
28. Ivarsson A, Myléus A, Norström F, et al. Prevalence of childhood celiac disease and changes in infant feeding. *Pediatrics*, 2013; 131(3): e687–94.