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ORIGINAL ARTICLE

Prevalence and Determinants of Food Allergy in Children Attending Aswan University Hospital

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ABSTRACT

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Introduction: Food allergy (FA) is a growing public health issue, particularly in children, with an estimated prevalence surpassing 10% in industrialized nations. This study aimed to evaluate the prevalence, clinical presentation, and diagnostic findings of FA among children attending the pediatric gastroenterology clinic at Aswan University Hospital. **Patients and Methods:** This observational, cross-sectional study included 300 children aged 1–15 years who presented with gastrointestinal complaints at the pediatric gastroenterology clinic of Aswan University Hospital from September 2023 to September 2024. **Results:** The study included 300 children aged 1–15 years with gastrointestinal complaints, half of whom were diagnosed with FA. The most common diagnoses were Celiac disease (51.3%), IgE-mediated allergies (40.7%), and less frequently CMPA (6.0%) and FPIES (2.0%). Clinical symptoms included runny nose (60.7%), diarrhea (51.0%), bloody stools (51.0%), and failure to thrive (46.3%). Laboratory testing revealed elevated eosinophils (mean 10.42%) and total IgE levels (mean 147.21 IU/mL). Skin prick tests (SPT) and specific IgE (SIgE) tests identified common allergens such as peanuts (44.1%), fish (32.2%), and eggs (27.1%). Oral food challenge (OFC) confirmed food sensitivities in 35.3% of the cases, with fish, eggs, and peanuts being the most reactive allergens. Additionally, 51.3% of patients tested positive for tTG-IgA, confirming Celiac disease. **Conclusion:** food allergies are common in pediatric GIT complaints, with Celiac disease and IgE-mediated allergies being the most prevalent. Diagnostic tests like SPT, IgE, OFC, and tTG-IgA are crucial for accurate diagnosis

INTRODUCTION:

An immune-mediated hypersensitivity reaction to particular proteins in food is known as a food allergy (FA), and it has grown to be a major global public health concern. It is defined by an aberrant immune system reaction to typically innocuous dietary proteins, which can result in a variety of clinical symptoms affecting the skin, respiratory tract, cardiovascular system, and gastrointestinal (GI) system. With estimates indicating that 6–8% of children worldwide suffer from FA, the frequency of food allergies has been gradually rising, especially in developed nations

[1]. This pattern has also been observed in developing countries, where the prevalence of food allergies has increased throughout the previous two to three decades **[2].**

Cow's milk, eggs, peanuts, tree nuts, soy, wheat, fish, and shellfish are the most common allergens in children, making up over 90% of food allergy cases **[3].** IgE-mediated allergy reactions are the most common among these; they usually happen minutes to hours after eating and can cause severe anaphylactic events. Conversely, food allergies that are not mediated by IgE, such coeliac disease, have delayed symptoms that typically impact the gastrointestinal tract and are less likely to cause life-threatening reactions right away **[4].**

Food allergies have a substantial influence on the quality of life for impacted children and their families and have been connected in recent years to a number of chronic illnesses, including as asthma, allergic rhinitis, and atopic dermatitis **[5].** Clinical history, certain diagnostic techniques including skin prick tests (SPT), serum IgE testing, and, occasionally, oral food challenges (OFC) are used to diagnose FA **[6].**

However, it is challenging to determine the extent of the issue and put into practice efficient public health measures due to the dearth of trustworthy data about the incidence and diagnosis of food allergies in developing nations, including Egypt **[7].** The purpose of this study is to investigate the frequency, clinical manifestations, and diagnostic results of food allergies in a group of kids who come to Aswan University Hospital with gastrointestinal issues.

PATIENTS AND METHODS

This research was an observational, cross-sectional study was conducted in the pediatric gastroenterology clinic of Aswan University Hospital involving 300 children who attended Aswan University Hospital from September 2023 to September 2024.

Inclusion criteria:

- Children ages between 1 and 15 years attending the Git clinic with a complain suspicious to food allergy

Exclusion criteria:

- Children older than 15 years old and those below 1 year
- Children with history of anaphylactic shock due to other causes than food allergy
- Other causes of wheezy chest.
- Other causes of failure to thrive.
- Other causes of diarrhea.
- Other causes of regurge.
- Other causes of rash.
- Children with cyclic vomiting.
- Functional dyspepsia.
- Local causes of rectal bleeding.

Ethical and legal considerations:

Ethical committee approval was obtained, and written consent was signed from all cases before participation in this study.

Sample size:

Epi Info STATCALC (statistical calculator) was used to calculate the sample size by considering the following assumptions:

95% confidence level and 5% marginal error and assumed prevalence of food allergy reported in up to 10 % of <15 years children **(Yousif et al., 2021).** Accordingly, the sample size required will be 142. We raised the sample size to 300 children to get more informative results.

The following simple formula was used for calculating the adequate sample size:

$$n = \frac{Z^2 p(1-p)}{d^2}$$

where n is the sample size, Z is the standard normal variant (at 5% type 1 error (P<0.05) it is 1.96,

P (expected proportion in population based on previous studies) =10%,

d (absolute error or precision) =0.05

the level of confidence usually aimed for is 95%

Statistical Analysis

Data were gathered, refined, encoded, and input into the Statistical Package for Social Sciences (IBM SPSS) version 20. Qualitative data were expressed as numbers and percentages, but quantitative data were reported as means, standard deviations, and ranges when their distribution was shown to be parametric.

The comparison of two groups with qualitative data was conducted using the Chi-square test; the Fisher exact test was employed when the predicted count in any cell was less than 5.

An independent t-test was employed to compare two independent groups with quantitative data and parametric distribution.

The confidence interval was set to 95% and the margin of error accepted was set to 5%. So, the p-value was considered significant as the following:

P > 0.05 = non-significant (NS).

P < 0.05 = significant (S).

P < 0.001 = highly significant (HS).

Intervention (s):
Every patient who was enrolled underwent the following tests:

- Thorough medical history and methodical assessment: concentrating on the type of allergy, possible triggers, symptoms and when they appear, severity and treatment of the allergic condition, reproducibility, and known risk factors like physical activity, non-steroidal anti-inflammatory drugs, family history, and coexisting conditions.

- Organized questions: IgE-mediated allergy symptoms will be categorised into the following groups using questions aimed at the study population: In addition to pollen allergy hay fever, PFAS is characterised by oral cavity-specific pruritus and oedema; urticaria/angioedema; allergic rhinitis/asthma; gastrointestinal (GIT) symptoms such as nausea, vomiting, abdominal pain, and diarrhoea after eating; atopic eczema/dermatitis; and food-induced anaphylaxis.
- Food diary: After consuming the problematic food, patients were advised to keep a food journal in which they recorded their daily nutritional intake and reported any allergic reactions.
- Food sensitisation assessment Prick-prick tests (PPT) and SPT: The patient's history guided the choice of food for the prick-prick test. A tiny amount of the food ingredient was administered to the skin after a lancet was put into a succulent part of the fruit or vegetable. The prick-prick test involved inserting the lancet through the epidermis at a 45-degree angle. Using sterile saline, beans and wheat were ground into a paste, the tip of the lancet was then dipped in the paste, and a tiny bit was applied to the skin before the lancet was used to puncture it **[8].** Histamine dihydrochloride (10 mg/ml) and standardised saline solution were used as positive and negative controls in the skin prick test. The European Academy of Allergy and Clinical Immunology's (EAACI) recommendations were followed in the test's administration and analysis **[6].**

When the skin prick test was not appropriate or possible, such as in patients with severe asthma, severe skin allergies, or those who refused the test, the sIgE was used to measure sIgE levels against particular food allergens. An immunoblot approach intended for the semi-quantitative evaluation of circulating allergen-specific immunoglobulin E in human serum was used to determine the concentration of sIgE. The manufacturer's guidelines were followed for interpreting the results.

Verification of food allergies mediated by Ig-E:

- Diets that eliminate:

The foods to avoid were determined based on the history, SPT, and sIgE. Over the course of two to four weeks, the results of the diagnostic elimination diet should be carefully monitored and evaluated for every food item eliminated. A food allergy will be highly suspected if the exclusion diet significantly reduces symptoms. A food allergy to the omitted products is unlikely if the exclusion diet does not significantly relieve symptoms; instead, pancreatic insufficiency, mastocytosis, carbohydrate malabsorption, or cancers may be considered.

- Test of oral food challenge (OFC):

When the diagnosis was in doubt, an open OFC test was performed on sensitised individuals to confirm it. The EAACI guidelines [9] shall be followed when conducting the examination. Before going to OFC, the likely food was removed. The patient must be in good health on the day of the test; long-term allergic diseases such asthma, atopic dermatitis (eczema), and allergic rhinitis (hay fever) should be properly treated to prevent interfering with the interpretation of symptoms. Furthermore, as antihistamines might mask moderate early symptoms, they must be stopped before the oral meal challenge. There will be emergency treatments available, such as inhaled bronchodilators, antihistamines, or adrenaline. At intervals of 20 to 25 minutes, patients received

increasing amounts of the suspicious food. Until the patient reached the normal consumption level, the dosage was gradually doubled.

RESULTS:

The study included 300 children who came to Gastroenterology unit due to any GIT complain, half of them diagnosed with food allergy, there were 91 male and 59 female, the ages ranged from 1 to 15 years (mean 7.11 years) and the mean weight were 19.81 ± 8.22, 44 patients had family history and 63 patients had Consanguinity as shown in fig (1).

As regards the diagnosis of food allergy, there were 77 (51.3%) patients with Celiac, 61 (40.7%) patients with IgE Mediated, 9 (6.0%) patients with CMPA, and 3 (2.0%) patients with Fpies as shown in (2).

Regarding the Clinical Presentation results, there were 91 (60.7%) patients with runny nose , 76 (51.0%) patients with diarrhea , 76 (51.0%) patients with bloody stool, 69 (46.3%) patients with failure to thrive, 63 (42.3%) patients with abdominal distension, 41 (27.5%) patients with vomiting, 39 (26.0%) patients with wheezy chest , 39 (26.0%) patients with swelling edematous lip, 36 (24.0%) patients with urticaria, 35 (23.5%) patients with dysphagia, 28 (18.7%) patients with eczema and 23 (15.3%) patients with nonspecific GIT Symptoms as shown in (3).

Fig (1): detection of food allergy among study children.

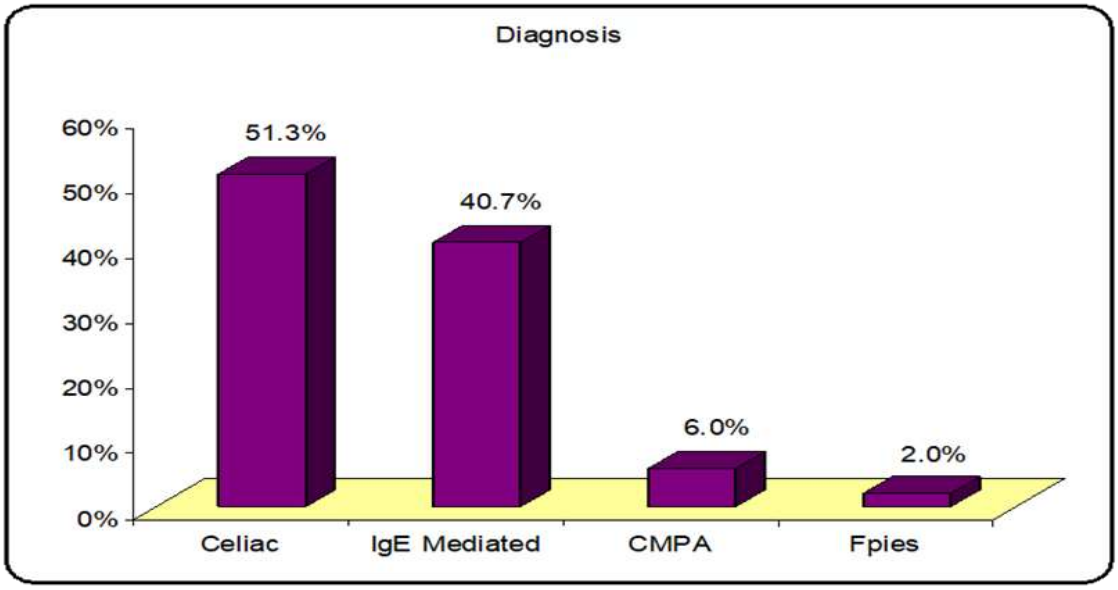

Fig (2): Distribution of the studied cases according to Diagnosis.

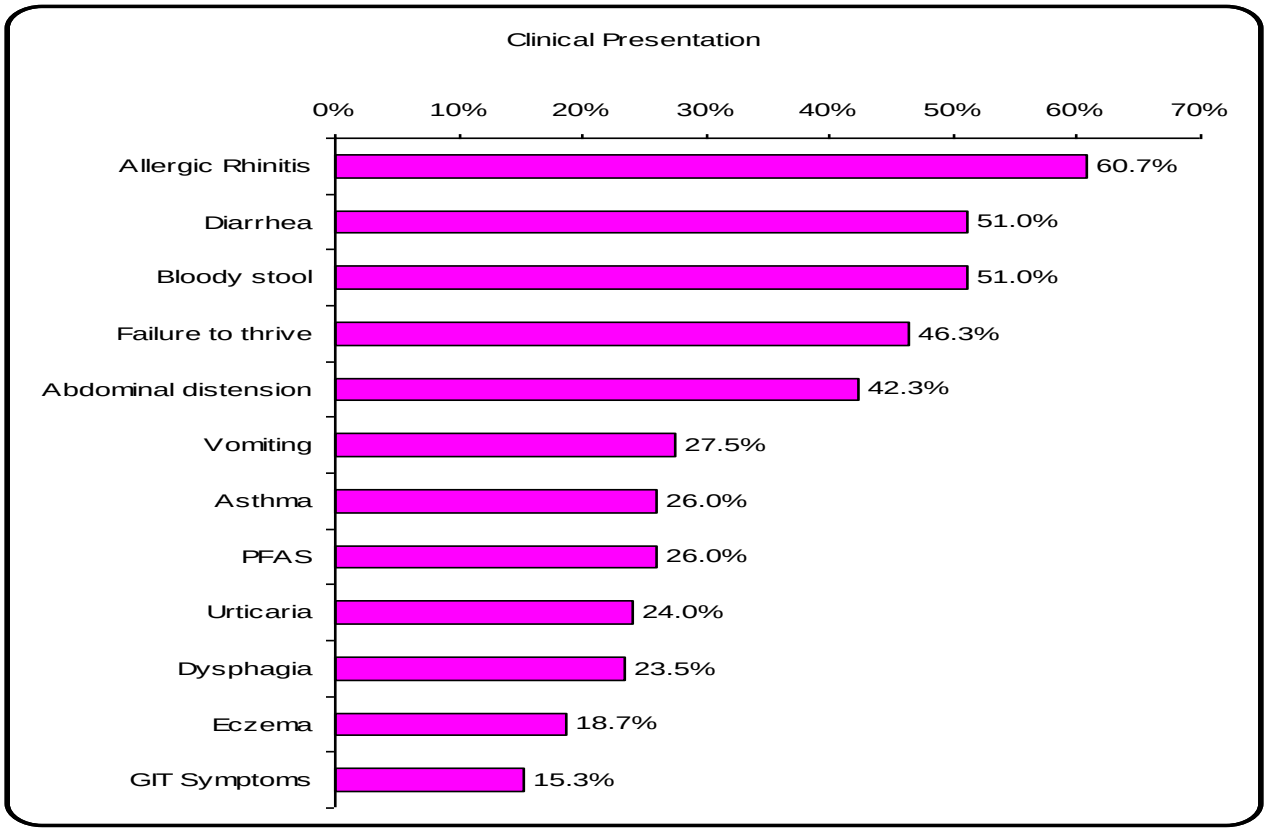

Fig (3): Distribution of the studied cases according to Clinical Presentation.

All patients evaluated by CBC, skin prick test (SPT), serum IgE , Oral food challenge test (OFC) , and tTG-IgA , the results are shown in table (1) , (2) ,(3), (4) and (5).

Table (1): Distribution of the studied cases according to HB % (g/dI), Platelets count, WBCs count, Eosinophil %, and Total (IgE (IU/mI)

	No.= 150	
	Mean ± SD	**Range**
HB % (g/dI)	12.20 ± 1.44	7.5 – 16.3
Platelets count	292.46 ± 40.68	242 – 420
WBCs count	7.94 ± 1.93	3.3 – 11.5
Eosinophil %	10.42 ± 6.52	2.1 – 75
Total (IgE (IU/mI)	147.21 ± 51.13	57 – 256
	No	89 (59.3%)
	Yes	61 (40.7%)

As illustrated in table (1) the Mean HB % (g/dI) Was 12.20 ± 1.44, the Platelets count ranged from 242 to 420 with a mean of 292.46 ± 40.68, The Mean WBCs count Was 7.94 ± 1.93, the Eosinophil % ranged from 2.1 to 75 with mean 10.42 ± 6.52 and the Total (IgE (IU/mI) ranged from 57 to 256 with mean 147.21 ± 51.13.

Table (2): Distribution of the studied cases according to SPT

No.= 150		**No.**	**%**
SPT	No	91	60.7%
	Yes	59	39.3%
Peanut		26	44.07%
Fish		15	25.4%
Egg		14	23.7%
Strawberry		14	23.7%
Cow’s Milk		10	16.9%

As illustrated in table (2), out of the 150 allergic patients enrolled, 59 (39.3%) were found to have evidence of SPT sensitization to one or more food allergens. Out of the 59 patients with SPT evidence for food sensitization, 26 (44.07%) were Peanut, 15 (25.4%) were Fish, 14 (23.7%) were Egg, 14 (23.7%) were Strawberry, and 10 (16.9%) were Cow’s Milk allergy.

Table (3): Distribution of the studied cases according to SIgE

No.= 150		**No.**	**%**
SIgE	No	91	60.7%
	Yes	59	39.3%
Peanut		26	44.1%
Fish		19	32.2%
Egg		16	27.1%
Strawberry		14	23.7%
Cow's Milk		9	15.3%

As illustrated in table (3) out of the 150 allergic patients enrolled, 59 (39.3%) were found to have evidence of SIgE sensitization to one or more food allergens, Out of the 59 patients with SPT evidence for food sensitization: 26 (44.1%) were Peanut, 19 (32.2%) were Fish, 16 (27.1%) were Egg, 14 (23.7%) were Strawberry and 9 (15.3%) were Cow's Milk.

Table (4): Distribution of the studied cases according to OFC

No.= 150		**No.**	**%**
OFC	No	97	64.7%
	Yes	53	35.3%
Fish		23	43.4%
Egg		14	26.4%
Peanut		16	30.2%

As illustrated in table (4) out of the 150 allergic patients enrolled, 53 (35.3%) were found to have evidence of OFC sensitization to one or more food allergens, out of the 53 patients with OFC evidence for food sensitization: 23 (43.4%) were Fish, 14 (26.4%) were Egg, and 16 (30.2%) were Peanut.

Table (5): Distribution of the studied cases according to tTG-IgA

tTG-IgA	**No.**	**%**
Positive	77	51.3%
Negative	73	48.7%

As illustrated in table (5) shows there were 77 (51.3%) Patients with positive tTG-IgA and 73 (48.7%) Patients with negative tTG-IgA.

Some patients had combined factors: positive SPT sensitization to more than single food element, evidence of sIgE sensitization to more than one food allergen, & evidence of OFC sensitization to two or more food allergen.

DISCUSSION:

The purpose of this observational cross-sectional study was to determine how common food allergies were among children under 15 who were seen at Aswan University Hospital. SPT, CBC, sIgE evaluations, total Ig-E levels, and tTG-IgA tests were all part of the protocol, along with OFC.

Similar to the findings of **Yousif et al., (2021)** at Ain Shams University Hospitals in Egypt (45%) [10] and **Abdallah et al., (2020).** at Assiut University Children's Hospital in Egypt (47%) [11], the current study found that 50% of preschool-aged children had food allergies. These results are noticeably greater than those between Bahraini school-age children (15.5%) that **AbdulAal and Alalwan (2023)** were reported **[12].**

According to the age and gender distribution of the examined cases, the current study found that the prevalence of allergy was higher in boys than in girls, with 91 males (60.7%) and 59 females (39.3%) having ages ranging from 1 to 15 years (mean 7.11 years). This result is comparable to that of **Shaker et al.,(2017),** who determined that 59% of children with food allergies were male and that the average age of these children was 10.8 years (range: 5 to 18 years) **[13].** In comparison to a study by **Al-Hammadi et al., (2011) ,**in Asia, which found that 20% of children with food allergies had a positive family history **[14],** and a study by **Beck et al.,(2016),** which found that 71.1% of allergic children had a family history of allergy **[15],** the current study revealed that 44 out of 150 allergic children (29.3%) had a positive family history. Regarding how the cases that were evaluated were distributed according to their clinical presentation. There were 91 (60.7%) patients with runny nose, 39 (26.0%) with wheezy chest, 39 (26.0%) with PFAS, 36 (24.0%) with urticaria, 28 (18.7%) with eczema, and 23 (15.3%) with non-specific GIT symptoms, according to the current study's estimation of the clinical presentation results. This result is in line with **El-Shabrawy et al., (2021)** whose findings that among children, 13 (16.6%) had pollen-food allergy syndrome, 31 (39.7%) had runny nose, and 41 (52.5%) had urticaria **[16].** However, this data runs counter to the findings of **Jasielska et al.,(2023),** who determined that among patients with food allergies, 23 had atopic dermatitis (51%), 18 had gastrointestinal pain (40%), 7 had constipation (15.5%), and 4 had diarrhoea (8.8%). Only one patient, who had a wheezy chest, had bronchial asthma (2.2%). Overall, symptoms from multiple systems were reported by 42% of FA patients **[17].**

The studied cases were distributed according to total IgE (IU/mI), eosinophil percentage, platelet count, WBC count, and HB% (g/dI). WBC count was 7.94 ± 1.93, Eosinophil% ranged from 2.1 to 75 with a mean of 10.42 ± 6.52, Total IgE (IU/mI) ranged from 57 to 256 with a mean of 147.21 ± 51.13, total HB% (g/dI) ranged from 242 to 420 with a mean of 292.46 ± 40.68 *109/l, and the mean HB% (g/dI) was 12.20 ± 1.44. This result is consistent. While the mean WBC count was greater than ours (10.42 *109/l), **Eliseeva et al.,(2020)** who found that the mean haemoglobin level among food-allergic children in Russia was 13.50 gm/dl, and the platelet counts varied from 273.87 to 315.20 *109/l with a mean of 294.54 *109/l **[18].**

Of the 150 allergic patients who were involved in the current study, 59 (39.3%) showed signs of SPT sensitisation to one or more food allergens, such as 10 (16.9%) cow's milk, 26 (44.07%) peanuts, 15 (25.4%) fish, 14 (23.7%) eggs, and 14 (23.7%) strawberries. These results are in line with those of **El-Shabrawy et al.,(2021),** who found that the most prevalent allergies among youngsters were strawberry (17; 21.79 **[16]**, fish (29; 37%), peanut (31; 39.7%), and egg (18; 23%).

However, according to **Jasielska et al.,(2023),** 82% of all children with allergies had a hen's egg allergy, 40% had a cow's milk allergy, 8.8% had a pig allergy, and 6.6% had a wheat and rye allergy. Nine (47.3%) of the FA1 patients had a cow's milk allergy, while 17 (89.4%) had a hen's egg allergy. The most common allergy in the FA2 group was to eggs, which affected 21 patients (80.7%), followed by cow's milk or its antigens, which affected 9 patients (34.6%). Soy, milk, and eggs were the most severe allergy classifications **[17].**

Out of the 150 allergic patients who were involved in the current investigation, 59 (39.3%) showed signs of SIgE sensitisation to one or more food allergens. Nine (6.0%) were cow's milk, 19 (12.7%) were fish, 16 (10.7%) were eggs, 14 (9.3%) were strawberries, and 26 (17.3%) were peanuts out of the 59 patients having SPT evidence for food sensitisation. **Abu-Dayyeh et al.,(2020).** found that 25% of patients were sensitised to one or more food allergies, which is in contrast to this result. Cow milk (11.2%), pistachios (4.9%), soybeans (4.6%), cherries (4.4%), and oranges (4.4%) were the foods against which S-IgE was most commonly detected. In contrast to other top hits, the distribution of Pistachio's s-IgE classes shifted away from weak class 1 and towards higher IgE classes. Age-group differences in food allergy sensitisation were observed: children and adults were more susceptible to fruits than to milk, whereas newborns were more sensitive to milk, tree nuts, and eggs **[19].**

Out of the 150 allergic patients that were recruited, 53 (35.3%) demonstrated indications of OFC sensitisation to one or more food allergens, according to the current study's analysis of the cases investigated by OFC. These results were less than those of a study by **DunnGalvin et al., (2010).** in Ireland, which found that 42 (51.2%) of the 82 children who had an OFC test **[20]** were positive, and a study by **Soller et al.,(2014).** in Ireland, which found that 25 (46.3%) of the 54 children who had a food challenge were positive **[21].**

According to the results of the current study, 77 patients (51.3%) had positive tTG-IgA and 73 patients (48.7%) had negative tTG-IgA. **Hussain et al.,(2014)** who found that 52 (85.24%) of the 61 people with IgA levels higher than 10 u/ml had a positive (>30 u/ml) anti-tissue transglutaminase antibody titer, with a mean value of 42.67+-7.60 U/ml **[22].** This finding is in contrast to their findings.

CONCLUSION:

This study of 300 children with gastrointestinal complaints found that 50% were diagnosed with food allergies, most commonly Celiac disease (51.3%) and IgE-mediated allergies (40.7%). Common symptoms included runny nose, diarrhea, bloody stools, and failure to thrive.

Laboratory tests revealed elevated eosinophils and identified food sensitivities through skin prick tests (39.3%) and serum IgE (39.3%). Oral food challenge confirmed allergies in 35.3% of cases, and Celiac disease was diagnosed in 51.3% with positive tTG-IgA.

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