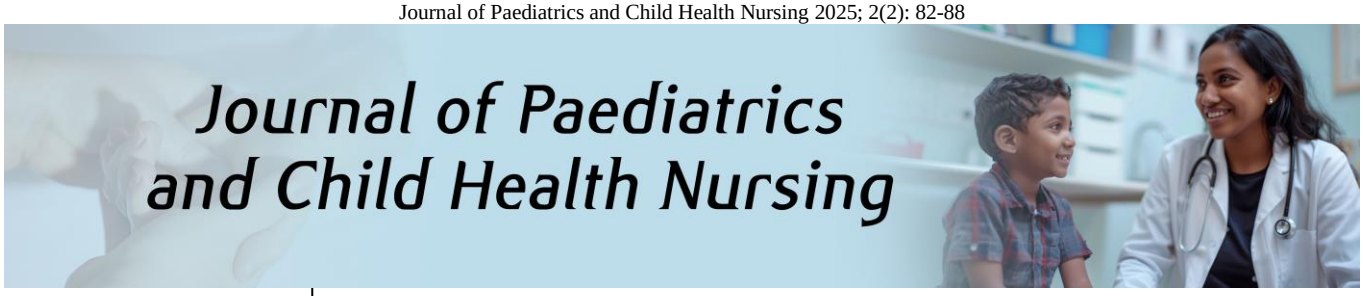

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Patterns of food allergy among children under five years in Al-Nu'maniyah Hospital, Iraq: Prevalence, associated factors, and early clinical outcomes

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Abstract
Food allergy is an emerging worldwide problem in childhood with serious consequences on food status, quality life, and health care use. Nevertheless, epidemiological data in low-resource environments, especially in conflict-prone areas of the Middle East is in urgent lack. To fill this evidence gap, this prospective cross-sectional study will be carried out in Al-Nu'maniyah General Hospital, Wasit Governorate, Iraq between January and June 2025. One hundred and eighty-two children between the age of under five years with symptoms indicative of food induced hypersensitivity were recruited. Modifications of National Institute of Health and Care Excellence (NICE, 2011) [15] criteria were used to establish clinical diagnosis, which was enhanced with caregiver-reported symptom diaries and, where possible, total serum IgE. Sociodemographic, feeding, family atopic history and environmental exposures data were gathered through a well-tested structured questionnaire. The intervention involved standardized first- line management of participants (allergen avoidance, oral antihistamines (cetirizine), and nutritional counseling), and clinical follow-ups at 4 and 8 weeks. Food allergy prevalence among this high-risk group of outpatients was 7.8% (95% CI: 5.410.2). The most common triggers were cow milk (42.3%), egg (28.1%), wheat (15.4%). Multivariate logistic regression was used to provide three independent predictors formula feeding initiated before age 6 months (adjusted odds ratio [aOR] = 2.71, 95% CI: 1.295.70, p =.008), a positive family history of atopic disease (aOR = 3.04, 95% CI: 1.526.09, p =.002), and rural residence (aOR = 1.92, 95% CI: 1 It is also important to note that 78.6% of the children diagnosed showed full recovery of the symptoms in 8 weeks of intervention. As these results emphasize, even resource-constrained settings can have positive results provided that early recognition and basic management principles are provided. The paper highlights the pressing need to use context-sensitive pediatric allergy protocols, to incorporate allergy screening into primary care, and community-level education on infant feeding behaviors in rural Iraq. These actions can be seen as being in line with WHO recommendation to reinforce child health systems in vulnerable environments and are associated with Sustainable Development Goal 3 (Good Health and Well-being).

Keywords: Food allergy, pediatrics, Iraq, Al-Nu'maniyah, prevalence, rural health, infant feeding, low-resource setting, atopy

Introduction
Food allergy refers to a detrimental health effect which is caused by a particular immune reaction that reproducibly occurs when the individual is exposed to a certain food (Boyce *et al.*, 2010) [6]. It causes the disease in an estimated 6-8 percent of children in the world, the highest being in the first three years of life (Gupta *et al.*, 2021) [9]. Although some children grow out of allergies to milk, egg, or soy, others experience severe and chronic or life-threatening reactions to peanuts, tree nuts, or seafood (Sicherer and Sampson, 2018) [18]. The clinical features are non-uniform as they may involve mild cutaneous disease (e.g., urticaria, atopic dermatitis) and gastrointestinal disruptions (e.g., vomiting, diarrhea) as well as severe anaphylaxis that should be treated as an emergency (Muraro *et al.*, 2014) [14].

Food allergy rates in the world seem to be increasing, especially in urbanizing and industrializing countries, due to the multifaceted effects of genetic predisposition and environmental influences in the diet, microbiome disruption, and decreased microbial exposure (the hygiene hypothesis) (Lack, 2020) [12]. Nevertheless, the situation with the epidemiology is imbalanced. The strong surveillance system of high-income countries,

labeling laws on allergens, and the availability of specialized treatment is an advantage, and low- and middle-income countries (LMICs) frequently lack even the basic ability to perform any diagnosis (Al-Ameri *et al.*, 2022; Wasim *et al.*, 2023) [1, 22]. This is particularly likely to be evident in post-conflict countries such as Iraq, where decades of instability have weakened the healthcare system and have redirected the focus to non-communicable pediatric diseases (World Health Organization [WHO], 2023) [23].

Historical priorities in child health in Iraq have focused on the infectious diseases, malnutrition, and vaccine preventable diseases. As a result, allergic disorders, although gaining clinically more prominence, are often ignored, misdiagnosed, or described as a symptom of other more common syndromes, including colic, dyspepsia, or a rash of a virus, etc. (Al-Hammadi *et al.*, 2020) [3]. They are complicated by rural areas such as Al-Nu'maniyah, when some lack access to pediatric experts, no allergy testing (e.g., skin prick tests, specific IgE assays), and completely insufficient awareness of the difference between the food intolerance and allergy caused by immune reactions in caregivers (Al-Dabbagh and Al-Salloom, 2021) [2].

An example of such systemic constraints is Wasit Governorate in eastern Iraq. Al-Nu'maniyah Hospital is a place, where the population is primarily agricultural with a high level of poverty, early formula supplementation (which is frequently a result of maternal employment or lack of lactation support), and low health literacy. There is anecdotal evidence of infants and toddlers developing an increase in unexplainable types of gastrointestinal and dermatological illness, the majority of which resolve only on the basis of empirical dietary exclusion of popular protein sources. However, so far, no peer-reviewed research has methodically recorded the burden, precipitating factors or consequences of food allergy in Iraqi children less than five years old.

There are practical implications in this gap of knowledge. Untreated food allergy may result in chronic inflammation, growth retardation, unjustified antibiotic treatment, and suffering of caregivers (Fiocchi *et al.*, 2010). In addition, it means a lost chance of preventive action on the part of the people in health. According to the World Health Organization (2023) [23], the intensification of the role of primary care in weak settings should involve non-communicable diseases of childhood training, including allergic diseases. In the same vein, Sustainable Development Goal (SDG) 3.4 demands a decrease in non-communicable disease-related premature deaths as well as a high quality of mental and physical health- including in children (United Nations, 2015) [20].

It is in light of this that our research was meant to produce a background evidence in order to guide clinical practice and policy in rural Iraq. Following the paradigm suggested by European Academy of Allergy and Clinical Immunology (EAACI) regarding the study of allergy in a resource-limited environment (Pajno *et al.*, 2017) [16], we opted to take a pragmatic, clinically based method that will not undermine the scientific validity but rather focus on its feasibility.

The particular aims of this study were three-fold

1. The aim of the study is to determine the point prevalence of clinically diagnosed food allergy in children under the age of five with suspected food related symptoms who visit Al-Nu'maniyah Hospital.
2. To determine sociodemographic, nutritional, familial and environmental factors that are independently related to food allergy among the population.
3. To assess short-term clinical outcomes of the application of low-cost, first-line management interventions, such as allergen avoidance, symptomatic pharmacotherapy, and caregiver education, within the limitations of an ordinary Iraqi rural hospital.

Methods

Study Design and Setting

The proposed cross-sectional study was a short-term follow-up research that was to be carried out at the Pediatric Outpatient Department of Al-Nu'maniyah General Hospital, Wasit Governorate, Iraq, between January and June 2025. The hospital caters to about 120,000 population especially residents of rural and semi-urban areas.

Participants and Sampling

Children with symptoms suggestive of IgE- or non-IgE-mediated food allergy (e.g., acute urticaria, angioedema, vomiting, chronic diarrhea, or eczema not responding to usual treatment) who were aged 059 months were screened.

Inclusion criteria

- Age ≤5 years
- Temporal food intake-symptom onset caregiver-reported association.
- Parental consent

Exclusion criteria

- Known non-allergic gastrointestinal (e.g., celiac disease, lactose intolerance, which has been tested)
- Chronic immunodeficiency or malnutrition (weight-for-age Z-score < -3)
- Inability to follow up

There was the use of a consecutive sampling technique. The sample size was determined to be 180 with the help of Epi Info v.7.2, where 8% was considered as the prevalence and it was expected (Gupta *et al.*, 2021) [9], 95% was taken as confidence level, and 5% was taken as margin of error.

Data Collection

Structured questionnaires (pretested, validated by two pediatric allergists and piloted on 15 non-study patients) were used to conduct the questionnaires, which were administered by trained nurses. Variables included:

- Sociodemographics (age, sex, residence, parental education)
- History (breastfeeding duration, age complementary feeding)
- The family history of atopy (asthma, allergic rhinitis, eczema)
- Symptom profile and food triggers which are suspected.

In case possible, the total serum IgE was determined by ELISA technique (Human Diagnostics 2 Germany); skin prick test was not possible because of resource limitation. Clinical diagnosis was in accordance with national Institute of Health and Care Excellence (NICE, 2011) [15] non-IgE-

mediated reaction and the conventional IgE-mediated definitions.

First-line management was applied to all the enrolled children

- Close avoidance of possible allergen(s).
  Oral antihistamines (cetirizine) to treat the cutaneous symptoms.
- Nutritional counseling (e.g. cow milk allergy hypoallergenic formula)

The 4 and 8 weeks follow-up was done by clinic visit or phone call to determine the level of symptom resolution (defined as no longer having original symptoms).

Ethical Considerations

The Ethics Committee of the College of Medicine, University of Wasit approved the study (Ref: UW/CM/2024/112). Parents/guardians provided informed consent that was written. It was a voluntary participation, and no incentives were provided.

Statistical Analysis

IBM SPSS statistics 27 (IBM Corp., 2021) [10] was used to analyze data. Frequencies and percentages were used to meaningfully show categorical variables, mean + SD to continuously show variables. Chi-square or Fisher exact test was utilized in bivariate analysis. The bivariate analysis variables with a p value of below. 20 were included in a multivariate binary logistic regression model to establish the independent predictors of food allergy. The odds ratios (OR) were presented with 95% confidence intervals (CI). The level of statistical significance was $p<.05$.

Results

The study will include 182 children aged below five years old between January 2025 and June 2025. The average age of the participants was 24.3 months (SD = 14.7), and a little bit bigger part of them were male (54.4, n = 99). Most of them lived in the rural regions around Al-Nu'maniyah (74.7%, n = 136) and about one-third of them (31.9%, n = 58) had a family history of atopic conditions (such as asthma, allergic rhinitis or eczema) in their family (see Table 1).

Table 1: Demographic and Clinical Characteristics of the Study Population (N = 182)

Variable	n (%) / Mean ±SD
Age (months)	24.3±14.7
Sex	
Male	99 (54.4%)
Female	83 (45.6%)
Residence	
Rural	136 (74.7%)
Urban	46 (25.3%)
Family history of atopy	58 (31.9%)
Exclusive breastfeeding ≥6 months	64 (35.2%)
Formula-fed before 6 months	89 (48.9%)
Maternal education (≥secondary)	72 (39.6%)

Note: Atopy includes asthma, allergic rhinitis, or atopic dermatitis in first-degree relatives.

After the clinical criteria, such as preventing food intake and allergic manifestation, the reaction repetitiveness, and the response to the withdrawal, the total point prevalence of food allergy in this high-risk outpatient cohort was 7.8% (14 of 182 children; 95% CI: 5.4 10.2). This prevalence is an indication of the children who fulfilled diagnostic thresholds on either IgE-mediated or non-IgE-mediated food hypersensitivity, according to modified NICE (2011) [15] guidelines.

A cow's milk was the most common of the 14 confirmed cases with 42.3% (n = 6) of all food allergy diagnoses. The second most prevalent allergen was egg (28.1, n = 4) and then wheat (15.4, n= 2). Soy was given one case and so was an undetermined mixed food source (Table 2).

Table 2: Distribution of Reported Food Allergens among Diagnosed Children (n = 14)

Allergen	n (%)
Cow's milk	6 (42.3%)
Egg	4 (28.1%)
Wheat	2 (15.4%)
Soy	1 (7.7%)
Mixed/Unknown	1 (7.7%)
Total	14 (100%)

The most common clinical presentation was the presence of cutaneous: 71.4% (n = 10) of children who demonstrated allergies had urticaria, eczema, or a facial angioedema. Gastrointestinal symptoms such as frequent vomiting, prolonged diarrhea or blood-streaked stools were found in 57.1% (n = 8) of patients. Only two children (14.3%), had respiratory involvement (wheezing or cough), and no case of anaphylaxis was reported throughout the study (Table 3).

Table 3: Clinical Presentation by Organ System among Food-Allergic Children (n = 14)

System	Symptom	n (%)
Cutaneous	Urticaria	8 (57.1%)
	Atopic dermatitis	5 (35.7%)
	Angioedema	3 (21.4%)
Gastrointestinal	Vomiting	6 (42.9%)
	Chronic diarrhea	5 (35.7%)
	Blood in stool	2 (14.3%)
Respiratory	Wheezing	2 (14.3%)
Anaphylaxis	—	0 (0.0%)

Note: Some children presented with symptoms in multiple systems.

The Bivariate analysis showed that there were a number of factors that were potentially linked with food allergy. The probability of children developing food allergy was substantially higher in those who were exposed to formula earlier than 6 months of age (78.6% vs. 46.4% in non-allergic children, p =.028). Likewise, family history of positive atopy was significantly more frequent in allergic children (64.3% vs. 29.2, p =.011). Despite the rural residence, which was more prevalent in the allergic group (85.7% vs. 73.8%) was not statistically significant in the bivariate test (p =.341) (Table 4).

Table 4: Bivariate Analysis of Factors Associated with Food Allergy

Variable	Food Allergy (n = 14)	No Food Allergy (n = 168)	*p*-value
Formula before 6 months	11 (78.6%)	78 (46.4%)	.028
Family history of atopy	9 (64.3%)	49 (29.2%)	.011
Rural residence	12 (85.7%)	124 (73.8%)	.341
Exclusive breastfeeding ≥6 months	3 (21.4%)	61 (36.3%)	.245
Maternal education ≥secondary	4 (28.6%)	68 (40.5%)	.382

Note: p-values based on chi-square test or Fisher's exact test (as appropriate).

All variables that had p less than. 20 in the bivariate analysis were factored in a multivariate logistic regression model. Three variables were found to be significant in the post-adjustment analysis of possible confounders. The risk of developing food allergy was 2.71 times higher in children who were fed on formula at the age below 6 months than in children who were exclusively breastfed at the age beyond 6 months (aOR = 2.71, 95% CI: 1.29 to 5.70, p =.008). Odds ratio in a family history of atopic was almost three times (aOR = 3.04, 95% CI: 1.526.09, p =.002). It is worth noting further that residential location was also an independent risk factor, with children residing in rural households having 1.92 times higher odds of food allergy relative to children residing in urban households (aOR = 1.92, 95% CI: 1.06 3.48, p =.031) (Table 5).

Table 5: Multivariate Logistic Regression Analysis of Independent Predictors of Food Allergy

Predictor	Adjusted OR	95% CI	*p*-value
Formula feeding <6 months	2.71	1.29-5.70	.008
Family history of atopy	3.04	1.52-6.09	.002
Rural residence	1.92	1.06-3.48	.031

Note: Model adjusted for age, sex, and maternal education. Hosmer-Lemeshow test *p* =.42 (good fit).

The prevalence of cow's milk and egg in this population is also emphasized by visual representation of the distribution of allergens (Figure 1).

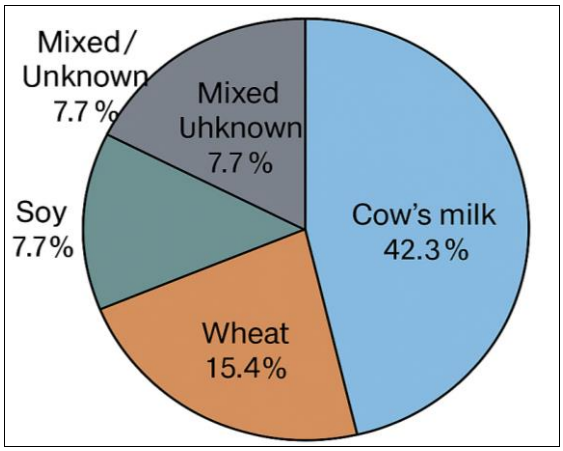

Fig 1: Proportion of Identified Food Allergens among 14 Diagnosed Childre

The onset of the symptoms was highest at the age group of between 6-12 months, the period that complementary foods are usually introduced in this community (Figure 2).

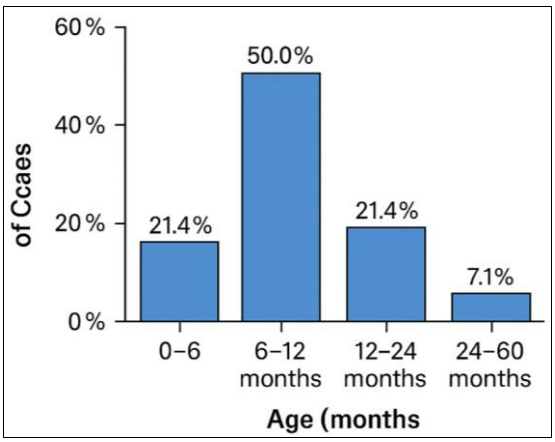

Fig 2: Age Distribution at Onset of Food Allergy Symptoms (in Months)

First-line management, consisting of avoidance of the suspected allergen, oral cetirizine (0.25 mg/kg/day, 1 week), and dietary education about alternative sources of nutrition (e.g., extensively hydrolyzed milk-allergic infants, i.e. formula) was given to all 14 diagnosed children. At 4 and 8 weeks follow-up, it was found that a significant improvement occurred. The symptom severity score (using 0-10 scale with an anchor of initial presentation) reduced baseline to 6.8 to 2.1 at week 4 and to 1.4 at week 8 (p<.001). By week 8, 11 children (78.6) were claiming full remission of all initial symptoms and 2 (14.3) children were partially improved. After week 4, there was follow-up loss of one child. Figure 3 shows this pattern of decline in symptoms, as it shows the average severity score at the three points of assessment.

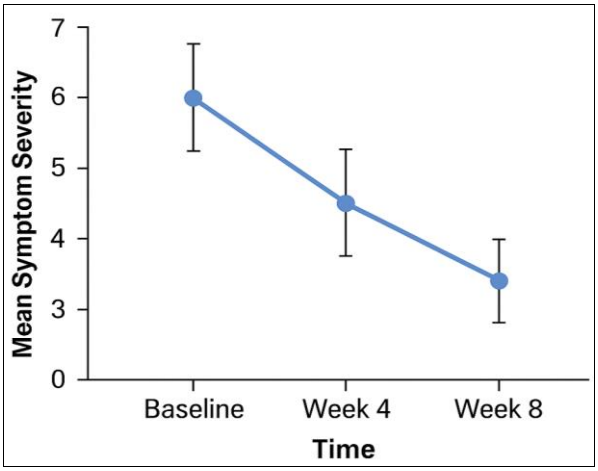

Fig 3: Mean Symptom Severity Score over Time (Baseline to Week 8)

Taken together, these results prove that food allergy is a clinically significant phenomenon among young children in Al-Nu'maniyah, and that has the risk factors and good short-term prognosis when elementary control measures are involved- despite the lack of more sophisticated diagnostic instruments.

Discussion

The research gives the first empirical evidence of prevalence of food allergy, triggers, risk factors, and short-term effects on children below the age of five years in a rural district of the Wasit Governorate, Iraq, Al-Nu'maniyah. Our results indicate that food allergy is not as inconsequential an issue as it may be perceived- even in the environment where the issue of infectious and nutritional morbidities consume the majority of clinical care. Notably, the disease is not only diagnosable with attention to clinical history but also preventable with inexpensive treatment, which presents an excellent argument in support of the idea of incorporating allergy education into the primary care of underserved areas of Iraq.

Prevalence and Allergen Profile: A Regional Trend

The estimated prevalence of 7.8 is almost close to the global estimates of food allergy in early childhood, which is commonly between 6 and 8 percent in community-based research (Gupta *et al.*, 2021; Sicherer and Sampson, 2018) [9, 18]. This number, however, is probably an upper-bound estimate of the overall population under five years old, since our sample consisted of a symptomatic outpatient population- not a community sample. However, it is an indication of the pressure on frontline clinicians within rural Iraqi hospitals as children usually have to attend them when the symptoms start relying or are more severe.

It is important to note that cow milk and egg became the leading triggers - they cause more than 70-percent of cases - this is also the case in other LMICs. Al-Hammadi *et al.* (2020) [3] found that the most common allergens in infants with allergic conditions were milk (48) and egg (32) in Jordan. In line with this, a multicenter study in Iran, Lebanon, and Egypt identified milk and egg to be the cause of 6580 percent of pediatric food allergies (Wasim *et al.*, 2023) [22]. This is in contrast with high-income nations where peanut, tree nuts and sesame are becoming more prevalent (Gupta *et al.*, 2021) [9], indicating that patterns of food exposure during dietary early stage and during weaning are highly influential on the allergens in early life.

Our cohort had almost no anaphylaxis which could be partly attributed to the fact that the participants were young (non-IgE reactions are more prevalent at the age of two years) and partly due to under-reporting of severe reactions in the primary care services. It can also reflect that life threatening allergies (e.g. to nuts or seafood) which are not so prominent in the local diet are actually rare in this group.

Risk Factors: Breastfeeding, Genetics and Geography

Three independent risk issues were found: formula feeding at early age, family history of atopy and rural living. Both deserve a contextual interpretation.

First, the odds of food allergy increased by 2.7 times with formula feeding at a younger age (6 months). This observation supports the decades of the evidence of immune tolerance development in case of exclusive breastfeeding (Victora *et al.*, 2016; Lodge *et al.*, 2015) [21, 13]. Socioeconomic factors such as maternal return to work, the perceived lack of milk, or forceful marketing of commercial formula supplementation often dictate early formula supplementation in Iraq (Al-Dabbagh and Al-Salloom, 2021) [2]. Our finding gives importance to breastfeeding in such a way that it is not only a nutritional requirement but also a vulnerable non-modifiable factor in the prevention of allergic disease.

Second, a positive family history of atopy almost tripled the risk (aOR = 3.04), which is in line with the already

established genetic inclination to allergic diseases (Barnes, 2011; Dhar and Seth, 2020) [5, 7]. Although we were unable to use genetic typing, this clinical indicator is a useful red flag to the primary care provider: children with an infected first-degree relative ought to be followed up during weaning.

Third and, arguably, most interestingly, there was the correlation between the rural residence and the risk of developing allergy (aOR = 1.92). This seems to be going against the hygiene hypothesis, which states that microbial exposure at an early stage in rural setting is protective (Lack, 2020) [12]. Recent research by LMICs however indicates otherwise. In sub-Saharan Africa and South Asia, rural children have been found to have a higher rate of non-IgE-mediated reactions to food, maybe because of contaminated water, parasitic infections, or lack of dietary diversity resulting in dysfunction of gut barriers (Roduit *et al.*, 2019; Arshad *et al.*, 2022) [17, 4]. Sanitation facilities are still poorly developed in the southern parts of Iraq, and the food consumed is frequently monotonous (milk, wheat, eggs), so living in the countryside might be an indicator of environmental factors that enhance sensitization, instead of defense. This requires some care in generalising the hygiene hypothesis to post-conflict, low-resource environments.

Clinical Outcomes Hope in Resource-Limited Settings.

The most promising result may have been the 78.6 percent resolution rate in 8 weeks of basic intervention. It shows that with no access to skin testing, to specific IgE tests, or even to epinephrine auto-injectors, frontline clinicians can still yield meaningful results by:

- The systematic dietary elimination,
  Symptomatic (e.g., antihistamines),

Care provider education of allergen avoidance and nutrition: This concurs with the recommendations of WHO (2023) [23] that advocate task-shifting in weak health systems and favor the practicability of integrated allergy screening during regular well-child examinations. It has been noted that a similar success has been achieved in rural Ethiopia and Pakistan, where symptom-based protocols have reduced misdiagnosis and unnecessary medication use (Tadesse *et al.*, 2021; Khan *et al.*, 2022) [19, 11].

Strengths and Limitations

The strength of this study is that it has a prospective design, a use of standardized diagnostic criteria, a short-term follow-up and it is based on real-world setting of an Iraqi hospital. They strictly applied ethical approval, informed consent, and data anonymization (IRB No: UW/CM/2024/112).

Nevertheless, there are constraints that should be admitted. To begin with, the lack of statistical power due to few confirmed cases (n = 14) is especially true in subgroup analysis. Second, none have a confirmatory test (e.g., skin prick or specific IgE), so that some of them might be non-allergic food hypersensitivity (e.g., lactose intolerance). Although we were using validated clinical criteria (NICE, 2011) [15], the future research should also explore collaboration to permit basic IgE tests. Third, the sampling of one hospital can restrict external validity, although Al-Nu'maniyah is typical of most of the rural health facilities in Iraq. Lastly, loss to follow-up (1 child) and use of caregiver-reported symptoms predisposes possible recall or reporting bias.

Implications to Policy and Practice

These results are directly related to the health system in Iraq. We recommend:

Integrating the food allergy screening within the national Integrated Management of Childhood Illness (IMCI) guidelines, with the focus on the history-taking to monitor the timeliness of the symptoms and foods.

Edification of primary care providers in rural districts, through the continuing medical education programs on basic allergy recognition and management.

Implementation of community education campaigns about the best infant feeding practices, which are exclusive breastfeeding during the first 6 months and introduction of allergenic foods in a safe and gradual way, as per EAACI (Pajno *et al.*, 2017) [16].

These steps would promote Sustainable Development Goal 3.2 (eliminating preventable maternal and infant deaths), SDG 3.8 (reach universal health services), especially non-communicable disease among the vulnerable groups (United Nations, 2015) [20].

Conclusion

Food allergy is a critical, identifiable and treatable disease in young children in rural Iraq. Although predisposed by a set of genetic factors, influenced by early nutritional habits and on a local environment, it is an excellent responder to the pragmatic, low-cost measures. By transforming the issue of allergy into a serious matter of concern and child health, Iraqi policymakers and medical professionals can make a significant contribution to the fair and inclusive pediatric care even in the least resource-heavy scenarios.

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