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ORIGINAL RESEARCH ARTICLE

Two Decades of Food Allergen Sensitization in Palestine

A Retrospective Analysis of 1,849 Specific-IgE Test Records from a Multi-Branch Diagnostic Laboratory Network, 2004-2026

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STUDY PERIOD Oct 2004 - May 2026	RECORDS ANALYZED 1,849 patients	GOVERNORATES 11 (West Bank)
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ABSTRACT

Background. Food allergy is a rising global health concern, yet epidemiologic data from Palestine and the wider Levant remain scarce. We characterized food allergen sensitization using two decades of laboratory records from a multi-branch diagnostic network serving the West Bank.

Methods. We retrospectively analyzed 1,849 specific-IgE (sIgE) test records (October 2004 - May 2026) from patients referred for food allergy evaluation across 11 governorates. Up to 62 food allergens were assessed per patient with a panel-based sIgE immunoassay. Heterogeneous legacy results were harmonized to a 0-VI class scale; sensitization was defined as sIgE $\geq$ 0.35 kU/L. Rates were compared by age, sex, governorate and calendar year using the chi-square test and logistic and linear models.

Results. Overall, 737 of 1,849 individuals (39.9%; 95% CI 37.7-42.1) were sensitized to at least one food and 27.6% were polysensitized ($\geq$ 2 foods). The leading sensitizing foods were shellfish mix (19.2%), cow milk (16.7%), almond (13.0%), cashew (11.4%) and peanut (11.3%). Sensitization peaked in early childhood (50.9% at 1-5 years) and fell with age (28.4% beyond 40 years; $p < 0.001$). Males were sensitized far more often than females (47.1% vs 32.8%; odds ratio 1.82, 95% CI 1.51-2.20; $p < 0.001$), a gap present in every age stratum. Dairy and egg dominated in infancy whereas shellfish predominated in adults. Sensitization varied between governorates (27.8-50.0%) but not significantly ($p = 0.281$). The annual positivity rate declined by ~ 1.7 percentage points per year from 2013 ($p < 0.001$) as testing volume rose sharply.

Conclusions. This is, to our knowledge, the largest analysis of food allergen sensitization reported from Palestine. It reveals a substantial sensitization burden with a pronounced male predominance and early-childhood peak, a shellfish- and dairy-dominated allergen profile, and a falling positivity rate consistent with broadening, less-selective testing. The results offer a reference baseline for allergy services and underscore the need for population-based confirmation.

Keywords. food allergy; sensitization; specific IgE; Palestine; epidemiology; shellfish; cow milk; pediatric allergy; Levant.

1 INTRODUCTION

Food allergy has emerged as a defining chronic condition of the modern era. After the first wave of the allergy epidemic - asthma and allergic rhinitis - a "second wave" dominated by IgE-mediated food allergy has been documented across industrialized and, increasingly, transitioning economies [1, 2]. Conservative estimates place the burden of IgE-mediated food allergy at roughly 4-7% of children and 1-2% of adults [3], with sensitization (the presence of allergen-specific IgE) several times more common still. Beyond the risk of anaphylaxis, food allergy imposes a considerable toll on nutrition, growth, household economics and quality of life [4].

A central distinction frames any laboratory-based study of this kind. **Sensitization** denotes the immunologic presence of specific IgE (sIgE) against an allergen and is detected by serologic assays or skin testing; **clinical food allergy** additionally requires reproducible symptoms on exposure [5, 6]. Many sensitized individuals tolerate the implicated food, so sIgE positivity consistently exceeds the prevalence of confirmed allergy [5]. Nonetheless, the sIgE profile of a population is informative in its own right: it mirrors local diet, food-processing practices, environmental exposure and cross-reactivity, and it is the day-to-day evidence base on which clinicians act. Allergen hierarchies accordingly differ markedly between regions - peanut and tree nuts dominate North American series, whereas wheat, sesame and shellfish feature more prominently across parts of Asia and the Middle East [3].

For the Eastern Mediterranean, and for Palestine in particular, the evidence base is thin. The most directly comparable regional study, a retrospective analysis of 3,463 referred patients in neighboring Jordan, found that about one quarter were sensitized to at least one food, with a male excess and a childhood peak [7]. Work from Lebanon has estimated self-reported food allergy at 4.1% in children and 3.2% in adults [8] and has highlighted sesame as a regionally distinctive allergen - the so-called "Middle Eastern peanut" [9]. Within Palestine itself, published allergy research has concentrated almost entirely on allergic rhinitis among university students; the food allergen sensitization profile of the population has, to our knowledge, never been described at scale.

This gap is consequential. The West Bank is home to more than three million people, served by a maturing network of diagnostic laboratories, yet allergy services operate without local reference data on which foods matter most, in whom, and where. Diagnostic panels, dietary counseling and procurement decisions are therefore guided largely by data imported from dissimilar populations. A long-running laboratory archive offers a pragmatic way to begin closing this gap.

We therefore interrogated two decades of food allergen sIgE testing from Medicare Laboratories, a multi-branch diagnostic network operating across the West Bank. Our objectives were five-fold: (i) to quantify the overall burden of food sensitization and polysensitization; (ii) to rank the responsible allergens and describe the quantitative severity of responses; (iii) to characterize variation by age and sex; (iv) to map differences across the 11 governorates; and (v) to examine temporal trends in testing and positivity from 2004 to 2026.

2 MATERIALS AND METHODS

2.1 Study design and setting

We conducted a retrospective, cross-sectional analysis of routinely collected diagnostic data from Medicare Laboratories, a private multi-branch clinical laboratory network operating across the West

Bank, Palestine. The archive comprises records from more than thirty laboratory collection points (branch codes such as MN, MR, MH and MS) distributed across 11 governorates. All food allergen specific-IgE (sIgE) test records available in the consolidated archive, spanning October 2004 to May 2026, were eligible for inclusion.

2.2 Study population

The analysis dataset comprised 1,849 sIgE testing episodes from patients referred by their physicians for evaluation of suspected food allergy. Each record carried a branch identifier, an anonymized sample identifier, the collection date, the patient age and sex, the governorate of the requesting site, and the panel result. It is important to emphasize that this is a **clinically referred sample** - individuals investigated because allergy was suspected - and not a random sample of the general population; sensitization rates reported here therefore describe the tested population and are expected to exceed community prevalence.

2.3 Laboratory testing

Specific IgE was measured with a commercial multiparameter panel immunoassay. Three request types were present in the archive: a standard 35-item food allergen panel (the most frequently ordered), a broader food allergen panel, and a pediatric panel that supplements common foods with inhalant allergens. After harmonization (Section 2.4), the dataset covered up to 62 distinct food allergen specificities and 11 inhalant specificities per patient. Each allergen result was reported as a quantitative sIgE concentration in kU/L and/or as a semi-quantitative reactivity class.

2.4 Data harmonization and classification

Because the archive accumulated over 22 years under evolving laboratory information systems, considerable nomenclature drift was present: a single allergen frequently appeared under several column labels (for example "Egg white", "Egg White" and "Eggwhite"; or "Cow milk", "Cow Milk" and "Milk"). All 117 result fields were mapped to a controlled vocabulary of 62 canonical food allergens and 11 inhalant allergens. Where a patient held more than one result for the same canonical allergen, the most reactive value was retained.

Result values were equally heterogeneous, mixing numeric kU/L concentrations, class strings (for example "Class II" or "Positive (class 3)") and qualitative terms ("Negative", "Positive"). Every cell was parsed programmatically to a unified sIgE class using the conventional concentration cut-offs shown in Box 1 [5]. Explicit class strings were mapped directly; qualitative positives lacking a concentration were retained as positive but left unclassified for the severity analysis.

sIgE class	Concentration (kU/L)	Interpretation
0	< 0.35	Negative / not sensitized
I	0.35 - 0.69	Very low - sensitization, often without symptoms
II	0.70 - 3.49	Low-level sensitization
III	3.50 - 17.49	Moderate sensitization
IV	17.50 - 49.99	High sensitization
V	50.0 - 99.99	Very high sensitization

VI	≥ 100	Extremely high sensitization
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Box 1. Specific-IgE class scale applied to harmonize two decades of heterogeneous laboratory results. Sensitization was defined as sIgE ≥ 0.35 kU/L (Class I or above); moderate-to-high responses as Class III or above.

2.5 Definitions and outcomes

An individual was classified as **sensitized** to a given allergen when sIgE was ≥ 0.35 kU/L. A patient was **food-sensitized** if positive to at least one food, **monosensitized** if positive to exactly one and **polysensitized** if positive to two or more. Responses of Class III or above were designated **moderate-to-high**. Ages recorded in days were converted to years, and implausible values were reconciled; patients were grouped as < 1 , 1-5, 6-12, 13-18, 19-40 and > 40 years. Geographic analysis used the governorate of the requesting site.

2.6 Statistical analysis

For each allergen, the sensitization rate was the number of positive individuals divided by the number tested for that allergen; denominators differ between allergens because panels evolved over time. Binomial 95% confidence intervals (CIs) were calculated by the Wilson score method. Categorical comparisons used the Pearson chi-square test; the effect of sex was additionally expressed as an odds ratio (OR) with a 95% CI, and examined within each age stratum to assess confounding. Temporal trend was assessed by linear regression of the annual sensitization rate across 2013-2026 (years with ≥ 40 records). Allergens tested in fewer than 200 individuals were excluded from the main ranking. Two-sided p-values below 0.05 were considered significant. Analyses were performed in Python 3 using the pandas and SciPy libraries.

2.7 Ethical considerations

The study analyzed anonymized secondary data generated in the course of routine clinical care; no patient was contacted and no intervention was undertaken. No directly identifying information was extracted from the archive. The work was conducted in accordance with the principles of the Declaration of Helsinki and was reviewed and approved by the management of Medicare Laboratories as a service evaluation of de-identified records, for which individual informed consent was not applicable.

3 RESULTS

Key findings at a glance

- Two in every five referred individuals (**39.9%**) were sensitized to at least one food; most of them were sensitized to several.
- Shellfish and cow milk were the leading sensitizing foods, followed by tree nuts, peanut and sesame.
- Food sensitization peaked in early childhood (**50.9%** at 1-5 years) and declined steadily into older adulthood.
- Boys and men were about **1.8 times** more likely to be sensitized than girls and women - a gap seen in every age group.
- The dominant allergens shifted across the life course: dairy and egg in infancy, shellfish and tree nuts in adulthood.
- Positivity rates fell over the study period as testing expanded to a broader, less pre-selected population.

3.1 Characteristics of the study population

The dataset comprised 1,849 food allergen sIgE testing episodes collected between October 2004 and May 2026 (Table 1). The sex distribution was almost exactly balanced - 941 females (50.9%) and 908 males (49.1%) - but the cohort was young: the median age was 19 years and nearly half of all individuals (48.3%) were children under 18. Testing was geographically wide, covering all 11 West Bank governorates, although volume was concentrated in the major population centers of Ramallah, Nablus, Jenin, Tulkarem and Hebron. In total the archive contained 54,555 individual food allergen results.

Characteristic	Value
Study period	October 2004 - May 2026
Testing episodes analyzed	1,849
Female : Male	941 (50.9%) : 908 (49.1%)
Age, median (mean)	19 years (21.5 years)
Children (< 18 years)	892 (48.3%)
Age groups <1 / 1-5 / 6-12 yr	87 / 560 / 182
Age groups 13-18 / 19-40 / >40 yr	82 / 587 / 348
Governorates represented	11 (West Bank)
Highest-volume governorates	Ramallah 672 - Nablus 444 - Jenin 176
Food allergen specificities	up to 62 per patient (harmonized)
Total food allergen results	54,555
Predominant request	35-item food allergen panel

Table 1. Characteristics of the 1,849 food allergen specific-IgE testing episodes analyzed from the Medicare Laboratories archive, West Bank, Palestine.

3.2 Overall food sensitization and polysensitization

Of the 1,849 individuals tested, **737 (39.9%; 95% CI 37.7-42.1) were sensitized to at least one food allergen.** Sensitization was rarely confined to a single food: 510 individuals (27.6% of the cohort) were polysensitized to two or more foods, while only 227 (12.3%) were monosensitized. Among sensitized individuals, polysensitization was thus the rule rather than the exception, accounting for 69.2% of all positive patients, who carried a mean of 5.3 positive food specificities each. Across the whole archive, 3,876 individual food results were positive. This pattern - broad, multi-allergen reactivity - is a recurring theme of the analyses that follow and is consistent with extensive IgE cross-reactivity between botanically or biologically related foods.

3.3 The food allergen hierarchy

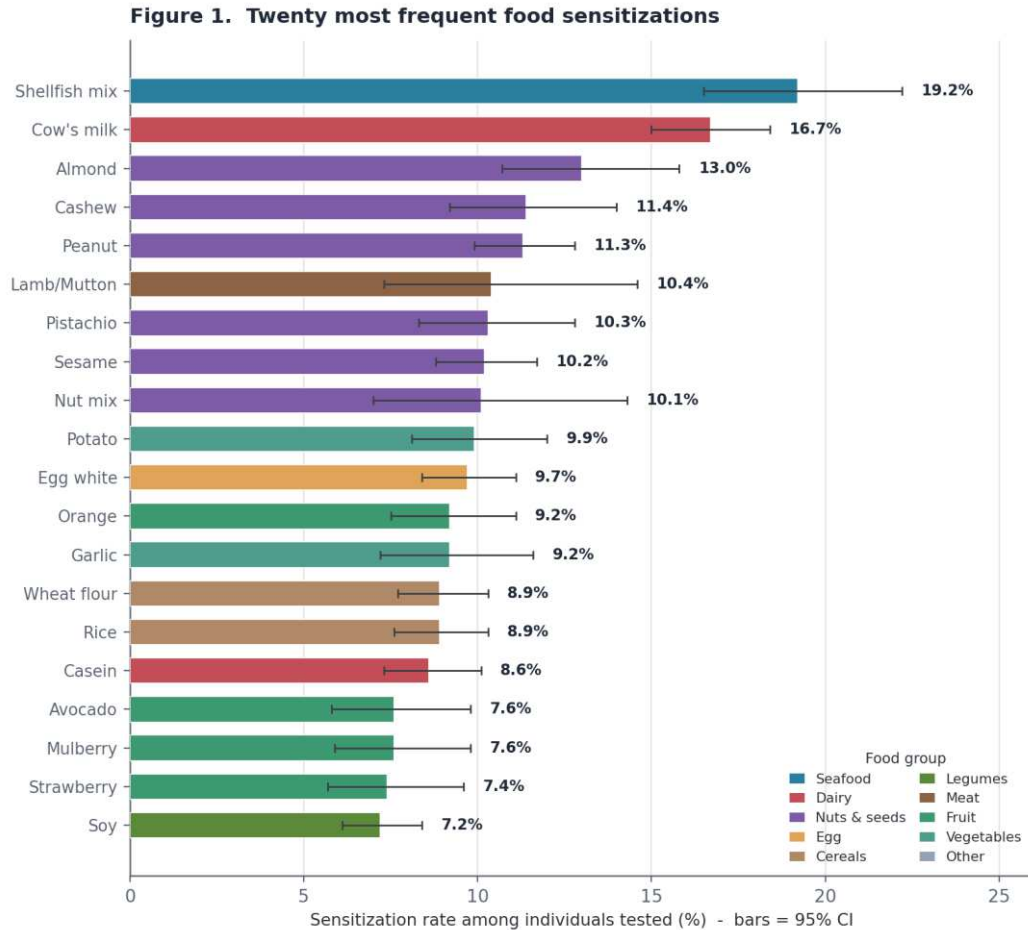


Figure 1. The twenty most frequent food sensitizations, expressed as the percentage of tested individuals with specific IgE ≥ 0.35 kU/L. Bars are colored by food group; horizontal lines show 95% confidence intervals.

A clear hierarchy emerged (Figure 1, Table 2). **Shellfish mix was the single most frequent sensitizing food (19.2%; 95% CI 16.5-22.2)**, followed by cow milk (16.7%). Tree nuts featured strongly and repeatedly - almond (13.0%), cashew (11.4%), pistachio (10.3%) and a combined nut mix (10.1%) - as did peanut (11.3%) and sesame (10.2%), the latter a regionally characteristic allergen. Staple cereals also ranked highly, with wheat flour and rice each sensitizing close to 9% of those tested. Egg white (9.7%), the dairy fraction casein (8.6%) and several common fruits and vegetables completed the upper tier. The breadth of this hierarchy - spanning seafood, dairy, nuts, seeds, cereals, fruits and vegetables - underlines how widely distributed food sensitization was in this referred population.

#	Allergen	Food group	Tested	Sensitized, n (%)	95% CI	$\geq$ CI. III
1	Shellfish mix	Seafood	714	137 (19.2%)	16.5-22.2	36%
2	Cow's milk	Dairy	1,849	308 (16.7%)	15.0-18.4	30%
3	Almond	Tree nut	675	88 (13.0%)	10.7-15.8	25%
4	Cashew	Tree nut	674	77 (11.4%)	9.2-14.0	35%
5	Peanut	Peanut	1,848	208 (11.3%)	9.9-12.8	30%

6	Lamb/Mutton	Meat	270	28 (10.4%)	7.3-14.6	7%
7	Pistachio	Tree nut	696	72 (10.3%)	8.3-12.8	39%
8	Sesame	Seed	1,658	169 (10.2%)	8.8-11.7	28%
9	Nut mix	Tree nut	268	27 (10.1%)	7.0-14.3	15%
10	Potato	Vegetable	907	90 (9.9%)	8.1-12.0	32%
11	Egg white	Egg	1,849	179 (9.7%)	8.4-11.1	25%
12	Orange	Fruit	981	90 (9.2%)	7.5-11.1	28%
13	Garlic	Vegetable	674	62 (9.2%)	7.2-11.6	31%
14	Wheat flour	Cereal	1,834	163 (8.9%)	7.7-10.3	20%
15	Rice	Cereal	1,739	154 (8.9%)	7.6-10.3	25%
16	Casein	Dairy	1,581	136 (8.6%)	7.3-10.1	35%
17	Avocado	Fruit	674	51 (7.6%)	5.8-9.8	24%
18	Mulberry	Fruit	696	53 (7.6%)	5.9-9.8	26%
19	Strawberry	Fruit	715	53 (7.4%)	5.7-9.6	28%
20	Soy	Legume	1,827	131 (7.2%)	6.1-8.4	16%
21	Goat milk	Dairy	674	48 (7.1%)	5.4-9.3	31%
22	Maize	Cereal	942	67 (7.1%)	5.6-8.9	21%
23	String beans	Legume	686	48 (7.0%)	5.3-9.2	25%
24	Pumpkin seed	Seed	697	48 (6.9%)	5.2-9.0	25%
25	Pea	Legume	674	45 (6.7%)	5.0-8.8	33%

Table 2. The 25 leading food allergens ranked by sensitization rate among individuals tested. ">= Cl. III" is the proportion of positive results reaching moderate-to-high titer (Class III or above), an indicator of response intensity.

3.4 Quantitative severity of sensitization

Figure 6. Quantitative severity of specific-IgE responses

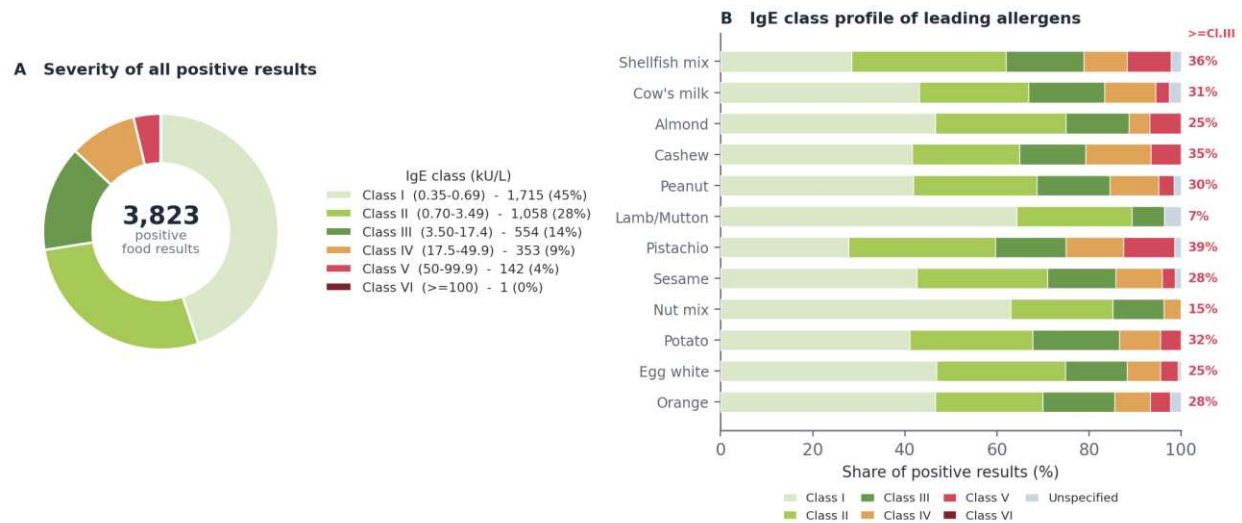


Figure 6. Quantitative severity of positive food results. (A) Distribution of all 3,823 classified positive results across IgE classes I-VI. (B) The IgE class profile of the twelve leading allergens; red figures give the percentage of positives reaching Class III or above.

Most positive results were of low titer, but a substantial minority were not. Of the 3,876 positive food results, 44% fell in Class I and 27% in Class II, whereas **27% reached Class III or above - the moderate-to-high range** more often associated with clinical reactivity (Figure 6A). The intensity of response varied by allergen (Figure 6B). Nut and dairy allergens were not merely common but frequently high-titer: around 39% of positive pistachio results, 35% of cashew, 36% of shellfish and 35% of casein results reached Class III or above. By contrast, cereal and staple-vegetable sensitizations were more often low-grade. This severity gradient matters clinically, because higher sIgE titers are associated with a greater probability of genuine, and sometimes severe, clinical allergy.

3.5 Food sensitization across the life course

Figure 2. Food sensitization across the life course

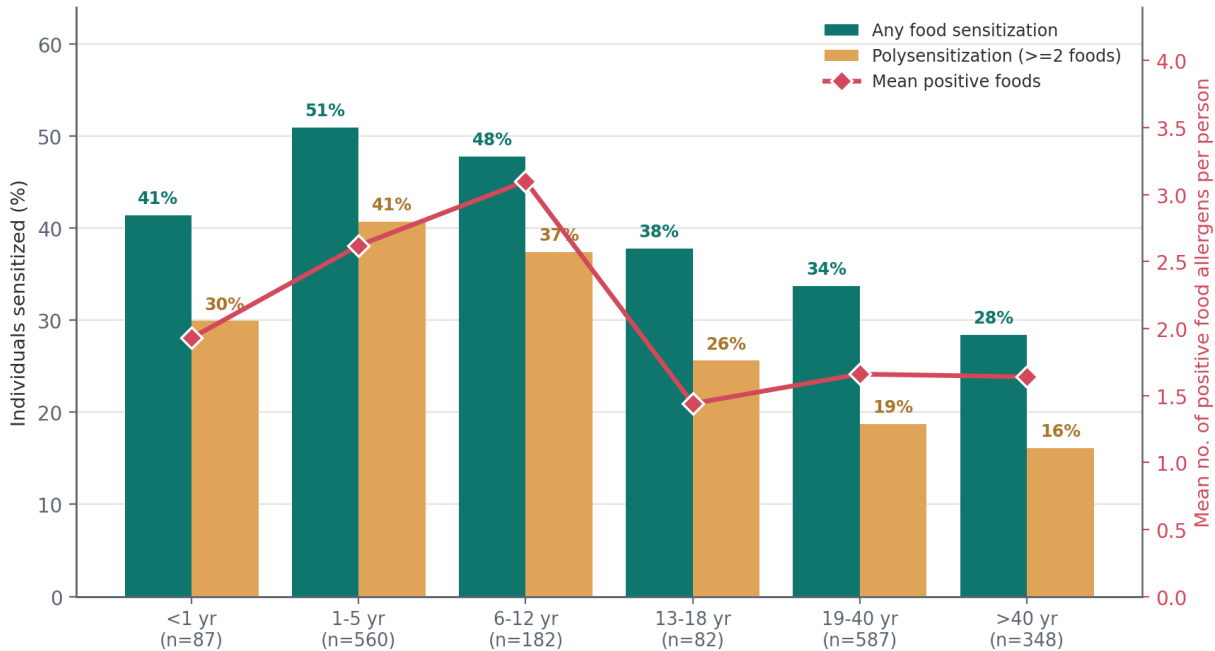


Figure 2. Food sensitization by age group. Bars show the percentage of individuals sensitized to any food and to two or more foods (polysensitization); the red line shows the mean number of positive food allergens per person.

Age was a powerful determinant of sensitization (Figure 2, Table 3; chi-square = 61.6, $p < 0.001$). Sensitization was already common in infancy (41.4% below one year), **peaked in early childhood at 50.9% among children aged 1–5 years**, and then declined consistently with each successive age band, reaching 28.4% beyond the age of 40. Pooled across the age boundary, children under 18 were considerably more often sensitized than adults (48.8% vs 31.6%; $p < 0.001$). The mean number of positive foods told a parallel story, rising to a maximum of 3.1 in the 6–12-year group before falling in adolescents and adults, and polysensitization was likewise concentrated in the youngest children (40.7% of those aged 1–5 years).

The **identity** of the dominant allergens also shifted with age. Among young children (under 6 years) the leading sensitizers were the classic foods of infancy — cow milk (33.5% of those tested), egg white (18.2%) and wheat (9.3%). Among adults the picture inverted: cow milk sensitization fell to 4.8% while shellfish rose to become the most common sensitizing food at 20.2%. This transition is the serologic signature of the natural history of food allergy, in which most milk and egg sensitization is outgrown while seafood and tree-nut sensitization tends to persist or emerge later.

Age group	n	Any sensitization, % (95% CI)	Poly-sensitized %	Mean +ve foods	Leading food allergen
<1 yr	87	41.4 (31.6–51.9)	29.9	1.93	Cow's milk (24%)
1-5 yr	560	50.9 (46.8–55.0)	40.7	2.62	Cow's milk (35%)
6-12 yr	182	47.8 (40.7–55.0)	37.4	3.10	Shellfish mix (22%)
13-18 yr	82	37.8 (28.1–48.6)	25.6	1.44	Shellfish mix (19%)

19-40 yr	587	33.7 (30.0–37.7)	18.7	1.66	Shellfish mix (21%)
>40 yr	348	28.4 (24.0–33.4)	16.1	1.64	Shellfish mix (19%)

Table 3. Food sensitization by age group, showing the childhood peak and the gradual decline through adult life. The leading allergen is the most frequent whole-food sensitizer within each age band.

3.6 Sex differences in food sensitization

Figure 3. Sex differences in food sensitization

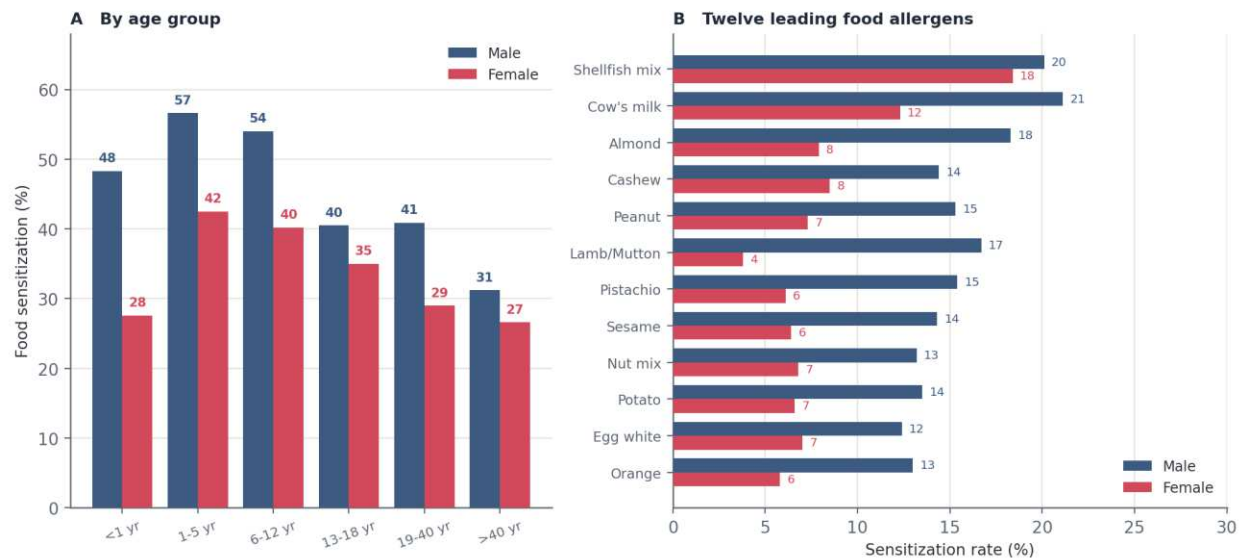


Figure 3. Sex differences in food sensitization. (A) Sensitization rate in males and females within each age group. (B) Male and female sensitization rates for the twelve leading food allergens.

One of the most striking findings of the study was a pronounced sex disparity. **Males were sensitized far more often than females — 47.1% versus 32.8% —** corresponding to an odds ratio of 1.82 (95% CI 1.51–2.20; chi-square = 38.8, $p < 0.001$). The male excess was not a statistical artifact of age: when the cohort was divided into age strata, males showed higher sensitization in every single band, from infancy (48.3% vs 27.6%) through early childhood (56.6% vs 42.5%) to adults over 40 (31.2% vs 26.6%) (Figure 3A). Males were also more often polysensitized (34.5% vs 20.9%) and carried nearly twice as many positive food specificities on average (2.8 vs 1.5). The disparity extended across essentially the entire allergen hierarchy (Figure 3B): for almost every leading food, the male rate exceeded the female rate, with the gap widest for cow milk, almond and the meats.

Part of this signal reflects who is brought for testing — boys accounted for 58.6% of all pediatric testing episodes, against only 40.3% of adult episodes — so the cohort over-represents young, frequently sensitized boys. Crucially, however, the persistence of a male excess *within* every age stratum indicates a genuine biological component, consistent with the well-documented male predominance of childhood atopy.

3.7 Geographic variation across governorates

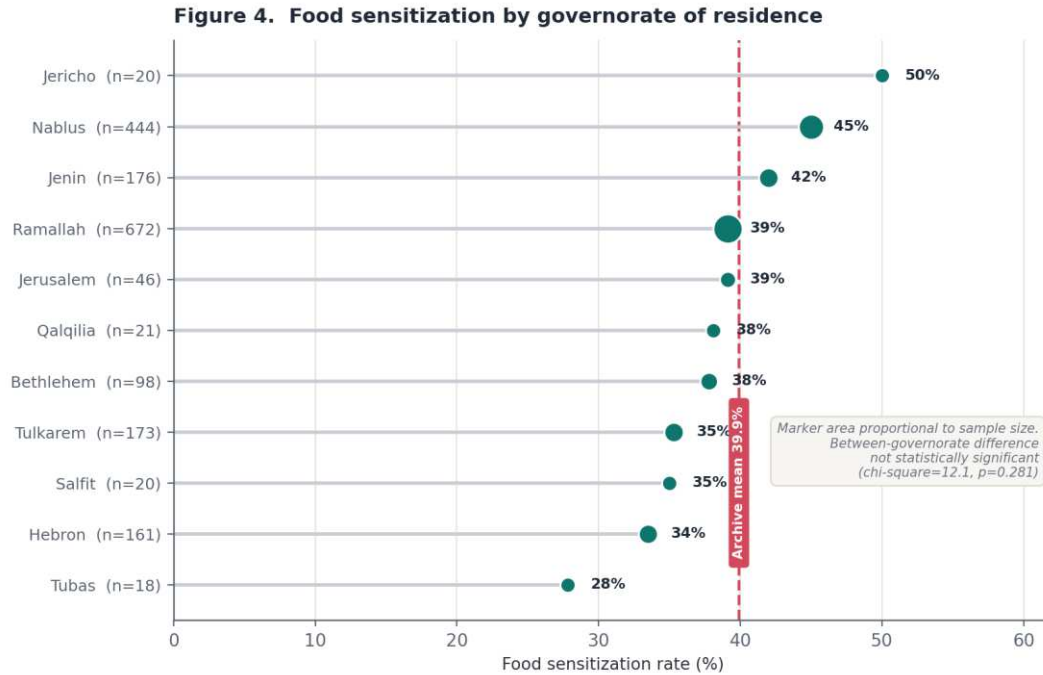


Figure 4. Food sensitization rate by governorate of residence. Marker area is proportional to the number tested; the dashed line marks the archive-wide mean of 39.9%.

Sensitization rates differed numerically across the 11 governorates, ranging from 27.8% in Tubas to 50.0% in Jericho, with Nablus (45.0%) and Jenin (42.0%) also above the archive mean and Hebron (33.5%) and Tulkarem (35.3%) below it (Figure 4, Table 4). However, **this geographic variation was not statistically significant** (chi-square = 12.1, p = 0.281), and the most extreme values came from governorates with very small samples — Jericho, Salfit and Tubas each contributed fewer than 25 records. The one large high-rate center, Nablus, also had by far the youngest tested population (median age 7 years), so its elevated rate is most plausibly explained by age structure rather than by a distinct local exposure. Taken together, the data give no firm evidence of true between-governorate differences in food sensitization; differences in the age mix of those referred for testing appear sufficient to account for what is seen.

Governorate	n	Any sensitization, % (95% CI)	Polysensitized %	Median age (yr)
Jericho	20	50.0 (29.9–70.1)	45.0	8
Nablus	444	45.0 (40.5–49.7)	32.9	7
Jenin	176	42.0 (35.0–49.4)	27.8	20
Jerusalem	46	39.1 (26.4–53.5)	28.3	24
Ramallah	672	39.1 (35.5–42.9)	25.6	24
Qalqilia	21	38.1 (20.8–59.1)	28.6	20
Bethlehem	98	37.8 (28.8–47.6)	28.6	12
Tulkarem	173	35.3 (28.5–42.6)	25.4	24

Salfit	20	35.0 (18.1–56.7)	30.0	4
Hebron	161	33.5 (26.7–41.1)	20.5	17
Tubas	18	27.8 (12.5–50.9)	22.2	8

Table 4. Food sensitization by governorate, ordered from highest to lowest rate. The between-governorate difference was not statistically significant ($\chi^2 = 12.1$, $p = 0.281$).

3.8 Temporal trends, 2004–2026

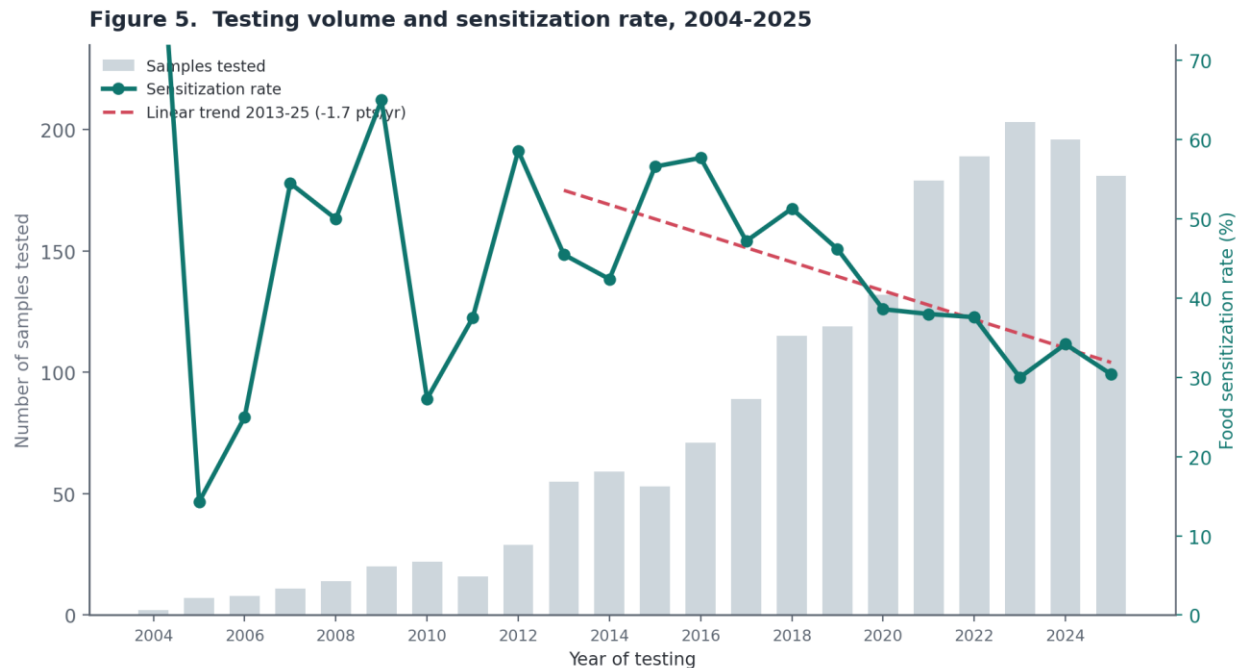


Figure 5. Annual testing volume (gray bars) and food sensitization rate (teal line) from 2004 to 2025. The dashed line is the fitted linear trend in sensitization rate from 2013 onward.

Testing activity grew dramatically over the study period (Figure 5). In the late 2000s the laboratory recorded only a handful of food allergen panels each year; by 2021–2025 annual volume had risen to roughly 180–200. Against this expansion, the sensitization rate moved in the opposite direction. From a peak above 55% in the mid-2010s, the annual positivity rate fell to around 30–34% in the most recent years — **a statistically significant linear decline of approximately 1.7 percentage points per year from 2013 onward ($p < 0.001$, $R\text{-squared} = 0.62$)**. The inverse relationship between rising volume and falling positivity is the expected consequence of broadening access: as allergy testing became more routine and was extended to a wider, less strongly pre-selected population, the proportion returning a positive result inevitably diminished. The trend is therefore best read as evidence of changing test utilization rather than of a genuine decline in the underlying burden of food allergy.

3.9 Inhalant allergen sensitization (secondary panel)

A subset of patients tested on the pediatric panel was additionally assessed for common inhalant allergens (Table 5). Within this smaller group, animal danders were the leading aeroallergens — dog (15.7%) and cat (13.7%) — followed by house dust mites (9.6–11.2%) and, at lower frequency, molds and pollens. A cross-reactive carbohydrate determinant (CCD) marker was positive in 6.5% of those

tested, a reminder that some plant- and venom-related positives in panel assays reflect cross-reactive glycan epitopes rather than clinically relevant sensitization. These inhalant figures should be read with caution given the small denominators, but they confirm that atopic sensitization in this population is not limited to foods.

Inhalant allergen	Category	Tested	Sensitized
Dog dander	Animal dander	197	15.7%
Cat dander	Animal dander	197	13.7%
House dust mite (<i>D. pteronyssinus</i>)	House dust mite	197	11.2%
House dust mite (<i>D. farinae</i>)	House dust mite	197	9.6%
<i>Alternaria alternata</i>	Mold	197	8.1%
CCD marker	Cross-reactive marker	1,424	6.5%
Grass mix	Pollen	197	5.1%
Birch pollen	Pollen	197	3.0%
Mugwort pollen	Pollen	101	2.0%
<i>Aspergillus fumigatus</i>	Mold	101	2.0%
<i>Cladosporium herbarum</i>	Mold	101	1.0%

Table 5. *Inhalant (aeroallergen) sensitization among patients assessed on the pediatric panel. Denominators are small and rates should be interpreted as indicative only.*

4 DISCUSSION

4.1 Principal findings

This analysis of 1,849 specific-IgE testing episodes is, to our knowledge, the largest description of food allergen sensitization yet reported from Palestine. Four results stand out. First, the sensitization burden among referred patients was substantial: two in five were sensitized to at least one food, and most of those were polysensitized. Second, the allergen hierarchy was led by shellfish and cow milk, with tree nuts, peanut and sesame close behind - a profile that is recognizably Levantine rather than North American. Third, sensitization followed a clear life-course pattern, peaking in early childhood and declining with age, while the dominant allergens shifted from dairy and egg in infancy to shellfish in adulthood. Fourth, a robust male predominance ran through every age group. Geographic differences, by contrast, were not statistically significant, and the falling positivity rate over time is best explained by the broadening of testing rather than by any real change in disease frequency. Throughout, the findings should be read as a description of *sensitization* in a clinically referred population - not as estimates of clinical food allergy prevalence in the wider Palestinian population.

4.2 The allergen hierarchy in regional context

The overall sensitization rate of 39.9% is higher than the approximately 25% reported in the most directly comparable regional study, a retrospective laboratory series of 3,463 referred patients in neighboring Jordan [7], and higher than the 21% positive specific-IgE rate described in a Lebanese series of suspected food-allergic patients [9]. The difference is unlikely to indicate a uniquely allergic

population. The most parsimonious explanation is methodologic: a broad, panel-based assay testing up to 62 food specificities per patient mechanically increases the chance that at least one result is positive, compared with narrower or more targeted testing. Referral thresholds and panel composition, rather than biology, plausibly account for much of the gap.

The composition of the hierarchy is more informative than its absolute height. Cow milk was a leading allergen here just as it was in Jordan and Lebanon [7, 8], confirming dairy as the cornerstone food allergen of early life across the Levant. The prominence of sesame - sensitizing one in ten of those tested - echoes the regional observation that sesame is, in effect, the "Middle Eastern peanut" [9], reflecting its heavy use in tahini, halva and bread. The single most distinctive feature of our data, however, was that **shellfish topped the hierarchy**. Shellfish allergy is characteristically an allergy of older children and adults, and its leading position here is consistent both with the seafood content of the Eastern Mediterranean diet and with extensive cross-reactivity: the major shellfish allergen tropomyosin is homologous to the tropomyosin of house dust mite [10], which was itself a frequent sensitizer in the pediatric panel. A proportion of shellfish positivity may therefore represent serologic cross-reactivity rather than independent clinical seafood allergy - a distinction that only clinical correlation can resolve.

4.3 Age and the natural history of food allergy

The age pattern recapitulates, in cross-section, the natural history of food allergy. Sensitization peaked at 50.9% in children aged 1-5 years and the largest mean number of positive foods occurred at 6-12 years, after which both measures declined. The accompanying shift in allergen identity - cow milk sensitization falling from 33.5% in young children to 4.8% in adults, while shellfish rose to first place in adulthood - is the serologic counterpart of two well-established clinical phenomena: the frequent resolution ("outgrowing") of milk and egg allergy during childhood, and the later onset and greater persistence of seafood and tree-nut allergy [11]. That children under 18 were significantly more often sensitized than adults (48.8% vs 31.6%) is concordant with the Jordanian findings [7] and with the global literature, and is consistent with prioritization of pediatric surveillance and intervention efforts in this population.

4.4 The male predominance

A consistent excess of sensitization in males is one of the most reproducible observations in pediatric allergy [12], and it was clearly present here, with an odds ratio of 1.82. Importantly, the excess persisted within every age stratum, including infancy, which argues against it being purely an artifact of who is referred. A biological contribution is therefore likely, in keeping with the recognized male predominance of early-life atopy that tends to attenuate, and in some conditions reverse, after puberty [13]. At the same time, an ascertainment component cannot be dismissed: boys made up nearly three-fifths of pediatric testing episodes, so the cohort structurally over-samples the most sensitization-prone group. The Jordanian series likewise reported higher odds of positivity in males [7], suggesting that the pattern is regionally consistent. The practical implication is that boys presenting with suggestive symptoms carry a higher pre-test probability of sensitization - not necessarily of clinical food allergy, which still requires clinical confirmation.

4.5 Temporal trend and geographic findings

The 22-year span allowed an unusual view of how testing itself has evolved. Volume rose by more than an order of magnitude, while the positivity rate fell significantly, by roughly 1.7 percentage points per year from 2013. We interpret this inverse relationship as a maturation effect rather than a true

epidemiologic decline. In the early years, when testing was scarce, only patients with a high prior probability of allergy were investigated, yielding high positivity; as testing became routine and accessible, it was extended to milder and more uncertain presentations, diluting the positive fraction. A genuine fall in food allergy would run counter to essentially all international data, against which food sensitization has remained stable or risen [14], and is not a credible reading of these numbers. Similarly, although crude sensitization rates differed between governorates, the variation was not statistically significant and was confounded by differences in the age mix of those tested - most visibly in Nablus, whose high rate accompanied the youngest patient population. We therefore caution against interpreting the geographic figures as evidence of local environmental effects.

4.6 Implications for clinical practice and policy

Several practical implications follow, while keeping firmly in mind that the data describe sensitization in a referred population rather than clinical food allergy at population scale. Diagnostic panels offered in Palestine should be anchored to the locally observed hierarchy - shellfish, dairy (including casein), egg, tree nuts, peanut, sesame and the staple cereals - rather than imported uncritically from Western templates. Results should always be reported with their quantitative class, because the 27% of positives reaching Class III or above carry a materially higher probability of clinical reactivity than low-titer positives [5]. Above all, a positive sIgE result is a starting point, not a diagnosis: wherever feasible it should be interpreted against the clinical history and, for consequential decisions such as dietary elimination, confirmed by supervised oral food challenge in line with international guidelines [15, 16]. The data also support a wider case for structured allergy services, trained personnel, and a national food allergy registry to convert routine laboratory activity into actionable public-health intelligence.

Implications for practice

- Build local sIgE panels around the observed hierarchy: shellfish, dairy, egg, tree nuts, peanut, sesame and cereals.
- Always report the quantitative IgE class - titer predicts the likelihood of true clinical allergy.
- Treat a positive sIgE as a sensitization result, not a diagnosis; confirm with clinical history and, where possible, oral food challenge.
- Prioritize pediatric surveillance, where sensitization and polysensitization are concentrated.
- Establish a national allergy registry to track the true clinical burden over time.

5 STRENGTHS AND LIMITATIONS

The principal strength of this study is its scale and reach: 1,849 individuals, more than 54,000 individual allergen results, two decades of continuous data and coverage of all 11 West Bank governorates make it the most comprehensive food allergy dataset assembled for this population. The availability of quantitative IgE titers, rather than positive/negative results alone, additionally allowed the severity of responses to be characterized.

These strengths are balanced by several important limitations, which we present in order of significance. **First and most fundamental, the study measures specific-IgE sensitization, not clinical food allergy.** No symptom data and no oral food challenges were available; in published

cohorts, oral food challenge confirms IgE-mediated allergy in only a fraction of sensitized individuals - often half or fewer. The figures reported here therefore certainly overestimate the prevalence of true, symptomatic food allergy, and **should not be read as estimates of clinical food allergy prevalence in the Palestinian population**. Any practical use must be coupled with clinical assessment. **Second**, the cohort is a clinically referred sample, not a community sample; selection bias precludes any estimate of population prevalence and the findings generalize only to patients sent for testing. **Third**, the analysis rests on retrospective, routinely collected data: two decades of nomenclature drift required extensive harmonization, a small fraction of qualitative results could not be assigned a class, and testing denominators varied between allergens as panels evolved. **Fourth**, records represent testing episodes; although identifiers were anonymized, repeat testing of the same individual cannot be wholly excluded. **Fifth**, the assay platform and panel composition are likely to have changed across 22 years, which - together with shifting referral patterns - contributes to the observed temporal trend. **Sixth**, geographic attribution used the governorate of the requesting laboratory site, which may not coincide exactly with the patient residence. **Finally**, no information was available on symptoms, comorbid atopic disease, diet, family history or socioeconomic status, and cross-reactive carbohydrate determinants may inflate some plant-derived positives. The results should therefore be read as a description of the sensitization landscape, and as a hypothesis-generating baseline, rather than as definitive prevalence estimates.

6 CONCLUSION

Two decades of laboratory data reveal a substantial and structured burden of food allergen sensitization among Palestinians referred for allergy testing. Sensitization was common and usually multiple, concentrated in early childhood, consistently more frequent in males, and led by an allergen hierarchy - shellfish, dairy, tree nuts, peanut and sesame - that is distinctly regional. Apparent geographic differences dissolved on adjustment for who was tested, and the long-term fall in positivity reflects the welcome broadening of access to testing rather than any true decline in disease. Within the boundaries imposed by a retrospective, laboratory-based design, these findings give clinicians and laboratories in Palestine their first large-scale, locally grounded reference for the patterns of food allergen sensitization, and should now be tested and extended by population-based studies with clinical confirmation, by oral food challenge programs, and by a national allergy registry capable of turning routine diagnostic activity into lasting public-health knowledge.

7 ABBREVIATIONS

Abbreviation	Term
CCD	Cross-reactive carbohydrate determinant
CI	Confidence interval
HDM	House dust mite
IgE	Immunoglobulin E
IRC	Institutional Review Committee
sIgE	Allergen-specific immunoglobulin E
kU/L	Kilo-units per liter (unit of sIgE concentration)

OR	Odds ratio
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8 DECLARATIONS

Ethics approval and consent to participate

This study was reviewed and approved by the Medicare Laboratories Institutional Review Committee (Ramallah, West Bank, Palestine; approval reference MLIRC-FA-2026-01), the institutional ethics body responsible for oversight of all research and service-evaluation activity conducted within the Medicare Laboratories network. The Committee waived the requirement for individual informed consent to participate, because the study was a retrospective service evaluation of fully de-identified, routinely generated diagnostic laboratory data, with no patient contact and no individually identifiable information extracted from the archive. This approach is consistent with established Palestinian and international practice for the secondary use of anonymized laboratory records. The study was conducted in accordance with the principles of the Declaration of Helsinki.

Consent for publication

Not applicable. The manuscript reports aggregated, anonymized data only and contains no individually identifiable patient information, images, or other personal details from which any participant could be recognized.

Availability of data and materials

The minimal de-identified dataset supporting the conclusions of this article is held by Medicare Laboratories and is available from the corresponding author (Ibrahim Salhi; gmd@medicare.ps) on reasonable request, subject to a data-sharing agreement and to internal data-governance approval. Restrictions apply because the dataset comprises records originating from individual diagnostic testing within a private clinical laboratory and is therefore not publicly archived; requests are reviewed on a case-by-case basis to ensure that any onward use remains compatible with patient confidentiality and the terms under which the original samples were obtained.

Competing interests

The authors are affiliated with Medicare Laboratories, the institution whose archive was analyzed. The authors declare no other competing interests. No commercial sponsor had any role in the design, analysis or reporting of the study.

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Author contributions

I. Salhi conceived and supervised the study and curated the laboratory archive. A. Mazraawi and Z. Badran contributed to data curation and analysis. All three authors contributed to interpretation of the results, drafting and critical revision of the manuscript, and approved the final version. I. Salhi is the corresponding author.

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