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Prevalence and Factors Associated with Food Allergen Sensitization Detected by Skin Prick Testing in Congolese Children with Atopic Dermatitis: A Cross-Sectional Study of 102 Patients at the North Kivu Provincial Hospital, 2025

Pascaline Ngolo Masudi, Dermatologist and Venereologist
Dermatology Department, Provincial Hospital of North Kivu, DRC
Seudjip Nono, Associate Professor
Dermatology Department, University Clinics of Kinshasa, DRC
Pierre Kitha Bitingo, Assistant Professor
Internal Medicine Department, University of Lubumbashi (UNILU), DRC
Louis Kyembwa Mwindulwa, Assistant Professor
Pediatrics Department, University of Goma (UNIGOM), DRC
Desire Ndayazi Byemero, Associate Professor
Surgery Department, University of Goma (UNIGOM), DRC
Stanis Wembonyama Okitotsho, Full Professor
School of Public Health, University of Goma (UNIGOM), DRC

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Abstract

Background: Skin prick testing plays a key role in assessing allergic sensitization. However, its use remains limited in clinical practice in the Democratic Republic of Congo, particularly among children with atopic dermatitis. This study aimed to determine the prevalence of food allergen sensitization, as detected by skin prick testing, and to identify its associated factors among Congolese children with atopic dermatitis managed at the Provincial Hospital of North Kivu.

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Methods: A descriptive and analytical cross-sectional study was conducted, including 102 patients ranging in age from six months to fourteen years, all diagnosed with atopic dermatitis. Skin prick tests were performed in all participants to detect sensitization to food allergens. Testing was carried out using foods provided by parents or legal guardians that were suspected of being responsible for the observed dermatitis lesions. Data were recorded and analyzed using the Statistical Package for the Social Sciences (SPSS), version 27.

Results: Among the 102 patients, 36 were sensitized to at least one food allergen, corresponding to a prevalence of 35.3%. Cow's milk was the food most frequently suspected by parents to be responsible for atopic dermatitis lesions (53.9%). However, skin prick test results revealed a slightly different pattern, with sensitization most commonly observed to peanut (20.6%), African eggplant (16.7%), and cow's milk (13.7%). Univariate analysis demonstrated a statistically significant association between food sensitization detected by skin prick testing and age under five years ($p = 0.002$), male sex ($p < 0.001$), urban residence ($p = 0.004$), and severe atopic dermatitis ($p = 0.004$). Multivariate analysis showed that early onset of atopic dermatitis markedly increased the risk of food sensitization. The risk was particularly high when dermatitis began before three months of age (adjusted OR = 28.558; 95% CI: 3.851–211.771; $p = 0.001$), between three and six months (adjusted OR = 70.344; 95% CI: 3.018–1639.768; $p = 0.008$), or between six and nine months (adjusted OR = 43.591; 95% CI: 1.848–1028.250; $p = 0.019$). Conversely, early introduction of complementary feeding before six months of age was associated with a protective effect (OR = 0.041; 95% CI: 0.006–0.269; $p = 0.001$).

Conclusion: Congolese children with atopic dermatitis are frequently sensitized to certain food allergens, particularly peanut and African eggplant. This sensitization seems to be associated with multiple factors, including clinical characteristics as well as social and environmental determinants.

Keywords: Skin prick test; SCORAD; food allergens; atopic dermatitis; North Kivu

Introduction

Atopic dermatitis (AD) is a chronic dermatological disorder characterized by significant inflammation and intense pruritus, with a notably high prevalence among the pediatric population (Li et al., 2021). Some of the most reliable data on AD prevalence and trends come from the International Study of Asthma and Allergies in Childhood (ISAAC) (Muraro et al., 2014), which reported that over 20% of children are affected in certain countries, although prevalence varies widely worldwide. In the Democratic Republic of

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Congo (DRC), AD prevalence appears to be steadily increasing. A study conducted at the University Clinics of Kinshasa reported a hospital-based prevalence of 12.4% among children and adolescents aged 0–18 years (Seudjip et al., 2019).

AD exhibits considerable heterogeneity in severity, clinical manifestations, and disease course. Its pathophysiology is complex, involving interactions among multiple factors, including a dysfunctional skin barrier, immune system dysregulation, genetic predisposition, and filaggrin gene mutations (Mortz et al., 2021). Environmental factors such as ultraviolet radiation exposure, air pollution, domestic hygiene practices, and climatic variations also contribute significantly to the multidimensional profile of this condition (Boguniewicz et al., 2011).

Experimental studies using animal models suggest that environmental allergens, including food-derived proteins, may interact with the immune system via antigen-presenting cells in the superficial epidermal layer. This interaction can trigger immune sensitization, which may initiate or exacerbate clinical manifestations of AD (Christensen et al., 2023).

The prevalence of specific food allergens capable of triggering AD varies according to geographic region and dietary habits (Eller et al., 2009). European epidemiological data indicate that egg and cow's milk proteins are the predominant food allergens, exceeding other well-established allergens such as peanuts, tree nuts, sesame, fish, soy, and wheat gluten (Eller et al., 2009). In contrast, the specific food allergens that may trigger or aggravate AD in Congolese children remain poorly defined.

Diagnosis of food-induced AD relies on a combination of clinical observations and complementary biological tests. Among the tools used to detect IgE-mediated sensitization, skin prick testing (SPT) is generally performed first, as it is easy to administer, minimally traumatic for infants and children, less expensive than specific IgE (sIgE) serological tests, and provides rapid results to support the diagnosis of potential IgE-mediated food reactions (Caffarelli et al., 2010; Sampson et al., 1984 & Lipozenčic et al., 2010).

A positive SPT is defined as a wheal measuring ≥ 3 mm in diameter. This reaction reflects allergic sensitization, as determined by skin testing or measurement of specific IgE in blood samples. Upon subsequent exposure to the allergen, the body may manifest clinical symptoms (allergy) resulting from antigen–antibody interactions. Thus, allergy represents the clinical expression of pre-existing sensitization. (Lipozenčic et al., 2010)

Skin prick testing therefore plays a central role in assessing allergic sensitization. However, its use remains limited in medical practice in the Democratic Republic of Congo, particularly among children with AD. Accordingly, this study aimed to determine the prevalence and associated

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factors of food allergen sensitization detected by SPT among Congolese children with AD managed at the North Kivu Provincial Hospital.

Methods

Study Design and Setting

Between June and September 2025, we conducted a descriptive and analytical cross-sectional study to determine the prevalence and associated factors of food allergen sensitization in a cohort of Congolese children with atopic dermatitis (AD). Patients were recruited from the Dermatology Department of the North Kivu Provincial Hospital (HPNK) using a non-probabilistic sampling method.

Data Collection and Instrumentation

Sociodemographic and clinical information were collected via a structured questionnaire administered to the parents or legal guardians of the patients. Each patient underwent a comprehensive physical examination to document the clinical signs of AD. Seasonal periods during which patients experienced symptoms were also recorded systematically. The diagnosis of AD was confirmed by a qualified dermatologist (Ngolo M.P.) strictly according to the diagnostic criteria established by Hanifin and Rajka. Disease severity was assessed using the SCORAD index, interpreted as follows: a score <25 indicated mild AD, 25–50 indicated moderate AD, and >50 indicated severe AD.

Skin prick tests (SPTs) were performed in all patients to assess sensitization to food allergens. Testing utilized food items provided by the parents or legal guardians that were suspected to be associated with the observed lesions. Thirteen food items were identified as clinically suspected allergens and were included in the SPTs. Each patient underwent SPTs using the implicated food items provided by their parent or guardian.

This study was approved by the Health Research Ethics Committee of the Faculty of Medicine, University of Goma (Approval number: UNIGOM/CEM/008/2025), and the North Kivu Provincial Hospital in the DRC. Informed consent was obtained in writing from the parents or legal guardians of all participating children prior to performing the skin tests.

Skin Prick Test Procedure

In vivo diagnostic lancets (ALK Lancet) were used for all SPTs. Histamine served as the positive control, and physiological saline was used as the negative control to validate the results. Reactions were read at 10 minutes for histamine and 20 minutes for the food allergens. Tests were performed primarily on the anterior forearm in most children and on the back in some infants.

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The maximal and minimal diameters of each wheal were measured using a graduated millimeter ruler, and the mean of the two measurements was calculated. A wheal with a diameter ≥3 mm was considered a positive result, indicating clinically relevant allergic sensitization. Positive SPTs were interpreted as evidence of sensitization to the tested food allergens.

Inclusion and Exclusion Criteria

Inclusion Criteria: Patients aged six months to 14 years with a diagnosis of atopic dermatitis (AD) who had undergone standardized skin prick testing to assess their sensitization to food allergens were eligible

Exclusion Criteria: Patients receiving systemic or topical corticosteroids, antihistamines, or immunosuppressive agents at the time of the study were excluded. Patients with active skin lesions at the test site or whose parents/legal guardians did not provide written consent were also excluded.

Data Analysis

Data were entered and analyzed using the Statistical Package for the Social Sciences (SPSS), version 27. Microsoft Excel and Word 2007 were used to organize and present data in structured tables. Categorical variables were expressed as frequencies (n) and percentages (%), while continuous variables were described using means and ranges. Associations between demographic and clinical factors and food allergen sensitization, as determined by SPTs, were first evaluated using univariate analysis, followed by multivariate logistic regression. Odds ratios (ORs) with 95% confidence intervals (CIs) were reported, and statistical significance was set at $p < 0.05$.

Results

Demographic and Clinical Characteristics

The mean age of patients was 5.28 ± 4.53 years (range: 6 months–14 years). Males accounted for 52.4% of the sample, with a male-to-female ratio of 1.1. Most patients (79.2%) resided in urban areas at the time of data collection. Clinical manifestations of atopic dermatitis were more common during the dry season, affecting 56.4% of patients. Early introduction of complementary feeding (before six months of age) was reported in 56.4% of patients, and 31.7% developed atopic dermatitis before three months of age.

Skin Prick Test Results and Foods Suspected by Parents or Legal Guardians

Among the 102 patients, 36 (35.3%) exhibited sensitization to at least one food allergen. Cow's milk and African eggplant were the foods most frequently suspected by parents as triggers of atopic dermatitis lesions,

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reported in 53.9% and 50.0% of cases, respectively, followed by egg (48.0%), meat (43.1%), and peanut (42.2%).

Sensitization detected by skin prick testing was most common to peanut (20.6%), African eggplant (16.7%), and cow's milk (13.7%) (Table I).

Table I: Food Skin Prick Test Results

Food Allergens Tested by SPT	**Positive SPT ≥ 3 mm**		**Negative SPT < 3 mm**		**Not tested**	
	n	%	n	%	n	%
Peanut	21/102	20.6	22/102	21.6	59/102	57.8
African eggplant	17/102	16.7	34/102	33.3	51/102	50.0
Cow's milk	14/102	13.7	28/102	27.5	60/102	58.8
Egg	13/102	12.7	29/102	28.4	60/102	58.8
Meat	13/102	12.7	28/102	27.5	61/102	59.8
Wheat	10/102	9.8	38/102	37.3	54/102	52.9
Fish	9/102	8.8	34/102	33.3	59/102	57.8
Potato	7/102	6.9	36/102	35.3	59/102	57.8
Cassava leaves	4/102	3.9	23/102	22.5	75/102	73.5
Beans	3/102	2.9	22/102	21.6	77/102	75.5
Sweet potato leaves	3/102	2.9	27/102	26.5	72/102	70.6
Okra	2/102	2.0	16/102	15.7	84/102	82.4
Palm oil	2/102	2.0	16/102	15.7	84/102	82.4

Univariate Analysis of Sociodemographic and Clinical Factors Associated with Food Allergen Sensitization

Univariate analysis revealed a statistically significant association between sensitization to at least one food allergen detected by skin prick testing and several factors, including age under five years ($p = 0.002$), male sex ($p < 0.001$), urban residence ($p = 0.004$), severe atopic dermatitis ($p = 0.004$), introduction of complementary feeding ($p = 0.008$), the presence of severe atopic dermatitis ($p = 0.004$), and early onset of atopic dermatitis (< 3 months) ($p = 0.001$) (Table II).

Table II: Univariate analysis of sociodemographic and clinical factors associated with food allergen sensitization detected by skin prick testing

Demographic and Clinical Characteristics	Skin Prick -Test				p-value
	Positive to at least one food		Negative		
	n	%	n	%	
AGE GROUP	**n=36**	**%**	**n= 66**		0.002
6 months–5 years	31/36	86.1	25/66	37.9	
6–10 years	3/36	8.3	24/66	36.4	
11–14 years	2/36	5.6	17/66	25.8	
SEX	**n=36**	**%**	**n= 66**		<0.001
Male	21/36	58.3	28/66	42.4	
Female	15/36	41.7	38/66	57.6	
AREA OF RESIDENCE	**n=36**	**%**	**n= 66**		0.004
Urban	35/36	97.2	46/66	69.7	

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Rural	0/36	0.0	9/66	13.6	
Other areas	1/36	2.8	11/66	16.7	
PARENTAL OCCUPATION	**n=36**	**%**	**n= 66**		0.142
Employed	30/36	83.3	24/66	36.4	
Unemployed	6/36	16.7	42/66	64.9	
SEASON OF CONSULTATION	**n=36**	**%**	**n= 66**		0.261
Dry season	23/36	63.9	35/66	53.0	
Rainy season	13/36	36.1	31/66	47.0	
PERSONAL OR FAMILY HISTORY OF ATOPY	**n=36**	**%**	**n= 66**		0.204
Yes	13/36	36.1	33/66	50.0	
No	23/36	63.9	33/66	50.0	
SEVERITY OF AD	**n=36**	**%**	**n= 66**		0.004
Severe	20/36	55.6	10/66	15.2	
Non-severe	16/36	44.4	56/66	84.8	
INTRODUCTION OF COMPLEMENTARY FEEDING	**n=36**	**%**	**n= 66**		0.008
< 6 months	6/36	16.7	39/66	59.0	
≥ 6 months	30/36	83.3	27/66	41.0	
ONSET OF AD	**n=36**	**%**	**n= 66**		0.001
< 3 months	27/36	75.0	23/66	34.8	
3-6 months	6/36	16.7	21/66	31.8	
6-9 months	2/36	5.6	17/66	25.8	
> 9 months	1/36	2.8	5/66	7.6	
HISTORY OF DEWORMING	**n=36**	**%**	**n= 66**		0.079
Recent	20/36	55.6	48/66	72.7	
Past	16/36	44.4	18/66	27.3	
Other areas of residence included Bukavu, Beni, Uvira, and surrounding localities.					

Multivariate Logistic Regression Analysis of Sociodemographic and Clinical Factors Associated with Food Allergen Sensitization Detected by Skin Prick Testing

Multivariate logistic regression analysis demonstrated that the early onset of atopic dermatitis significantly increased the risk of food sensitization detected by skin prick testing. The risk was particularly elevated when dermatitis began before three months of age (adjusted OR = 28.558; 95% CI: 3.851–211.771; p = 0.001), between three and six months (adjusted OR = 70.344; 95% CI: 3.018–1639.768; p = 0.008), or between six and nine months (adjusted OR = 43.591; 95% CI: 1.848–1028.250; p = 0.019).

Conversely, the early introduction of complementary feeding before six months of age appeared to have a protective effect against food allergen sensitization (OR = 0.041; 95% CI: 0.006–0.269; p = 0.001).

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Table III: Multivariate Logistic Regression Analysis of Sociodemographic and Clinical Factors Associated with Food Allergen Sensitization Detected by Skin Prick Testing

	Skin Prick -Test				
	Positive to at least one food (%)	**Negative (%)**	**aOR**	**CI 95%**	**p-value**
AGE GROUP					
6 months-5years	86.1	37.9	1.456	[0.082-25.853]	0.798
6-10 Years	8.3	36.4	12.956	[0.325-516.359]	0.173
11-14 Years	5.6	25.8	1.000		*
SEX					
Male	58.3	42.4	0.201	[0.033-1.226]	0.082
Female	41.7	57.6	1.000		*
AREA OF RESIDENCE					
Urban	97.2	69.7	0.121	[0.008-1.757]	0.122
Rural	0.0	13.6	1.24	[0.063-2.461]	0.999
Others areas	2.8	16.7	1.000		*
INTRODUCTION OF COMPLEMENTARY FEEDING					
< 6 months	16.7	59.0	0.041	[0.006-0.269]	**0.001**
≥ 6 months	83.3	41.0	1.000		*
ONSET OF AD					
< 3 months	75.0	34.8	28.558	[3.851-211.771]	**0.001**
3-6 months	16,7	31.8	70.344	[3.018-1639.768]	**0.008**
6-9 months	5.6	25.8	43.591	[1.848-1028.250]	**0.019**
> 9 months	2.8	7.6	1.000		*
SEVERITY OF AD					
Severe	55.6	72.7	0.192	[0.031-1.203]	0.078
Non-severe	44.4	27.3	1.000		*

Abbreviations: AD, atopic dermatitis; aOR, adjusted odds ratio; CI, confidence interval; * reference category.

Discussion

The present study, which aimed to determine food allergen sensitization using skin prick testing, extends beyond a purely therapeutic perspective. A review of the current scientific literature reveals a paucity of studies addressing food allergen sensitization in sub-Saharan Africa. Among the limited investigations conducted in this region, our study, based on skin prick testing, demonstrated a lower prevalence than that previously reported in Mali (Teclessou et al., 2018).

Cow's milk was identified by most parents as the food most frequently implicated in triggering atopic dermatitis. Similar observations have been reported in other studies, notably those conducted by Angela Chang et al. in China (Chang et al.,2016).

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Regarding the sensitization profile identified by skin prick testing, our findings are consistent with reports from other sub-Saharan African countries, where peanut appears to be the principal allergen (Teclessou et al., 2018 & Agodokpessi et al., 2018). This pattern contrasts with European data, which emphasizes the predominance of cow's milk. Although methodological differences may partly explain this discrepancy, regional dietary habits and culinary practices likely also influence the occurrence of these sensitizations.

With respect to eggplant and atopic dermatitis, scientific evidence supporting a direct association remains limited. However, some studies have reported links between eggplant consumption and dermatologic manifestations, particularly allergic contact dermatitis and lichenoid reactions. These findings are supported by investigations conducted by Kabashima K and al. in Japan and Palla S and al. in India (Kabashima et al., 2004 & Palla et al., 2020).

In children younger than 5 years, the risk of developing food allergen sensitization appears to be higher. The sensitization observed in this age group may be explained by two major factors: impaired skin barrier integrity and immaturity of the immune system (Scott et al., 2020). These findings are consistent with those of previous studies, including those conducted by Scott H. Sicherer et al. in New York and Gabet Stephan in France (Scott et al., 2020 & Gabet, 2017).

Male sex was identified as a significant risk factor for food allergen sensitization. Our observations are consistent with previous studies reporting a higher prevalence of food allergen sensitization among males younger than 15 years with atopic dermatitis (Chen et al., 2008 & Elbany et al., 2025).

This sex-related difference is primarily attributed to hormonal variations, particularly testosterone, estrogens, and progesterone (Elbany et al., 2025). Testosterone exerts anti-inflammatory effects and modulates immune responses. In contrast, estrogens and progesterone stimulate immune cells and may exacerbate inflammatory processes. Before puberty, boys have relatively low testosterone levels, which may increase susceptibility to allergen sensitization and allergic reactions (Chen et al., 2008 & Elbany et al., 2025).

Epidemiological studies indicate that the prevalence of food allergen sensitization detected by skin prick testing is significantly higher in urban than in rural settings. The precise mechanisms through which urbanization influences allergen sensitization, particularly among children with atopic dermatitis, remain poorly understood. However, in the context of our study, this sensitization may plausibly be associated with several urban environmental factors, particularly dietary habits (Xin et al., 2023).

Dietary patterns in urban areas show a progressive convergence toward Western dietary models, characterized by increased consumption of

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industrially processed foods. These foods are typically rich in sodium, nitrites, processed culinary ingredients, and microbial fermentation products (Matthias et al., 2019). The work of Yajia Li et al. identified sodium as a potential mechanistic link between processed food consumption and atopic dermatitis (Yajia et al., 2021).

Among the patients examined, a significant association was observed between the severity of atopic dermatitis and the presence of food allergen sensitization detected by skin prick testing. These findings are consistent with those reported in the existing scientific literature (Čelakovská et al., 2016).

A significant association was observed between the early onset of atopic dermatitis and an increased risk of food allergen sensitization. Our analysis demonstrates that children who develop atopic dermatitis early in life are more likely to develop food allergen sensitization, as assessed by skin prick testing, compared with those whose atopic dermatitis occurs later. Similar findings have been reported by other investigators, notably Martin et al., who identified an 11-fold increased risk of food allergen sensitization among children with atopic dermatitis (Martin et al., 2015)

Consistent with the existing scientific literature, early complementary feeding, defined as introduction before 6 months of age, was identified as a protective factor against food allergen sensitization detected by skin prick testing. Studies by Brough and Prescott highlight the potential beneficial effect of early complementary feeding on the maturation of the mucosal immune system (Brough et al., 2020 & Prescott et al., 2008). This process promotes the development of a complex network of immune tolerance mechanisms that may attenuate the inflammatory cascade leading to allergen sensitization and the development of atopic dermatitis in early childhood (Brough et al., 2020 & Prescott et al., 2008).

Study Limitations

The present study has several limitations. First, the low statistical power resulting from the small sample size and the self-selective nature of participant recruitment limits the generalizability of the findings. Second, the calculation of the optimal sample size was not feasible due to logistical constraints, particularly limited time, financial resources, and participant availability. Finally, the progressive Westernization of dietary patterns observed in Africa restricted the exploration of a broader spectrum of food allergens specific to the Democratic Republic of the Congo.

Conclusion

Cow’s milk was the food most frequently identified by parents as triggering atopic dermatitis. A high prevalence of food allergen sensitization, particularly to peanut and African eggplant, was observed among Congolese

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children with atopic dermatitis. Moreover, significant associations were identified between food allergen sensitization and several sociodemographic and clinical factors, including age under 1 year, male sex, urban residence, and severe atopic dermatitis. The risk of sensitization was higher among patients with early-onset atopic dermatitis. In contrast, early complementary feeding (before 6 months of age) was identified as a protective factor against food allergen sensitization.

Identification of potential food allergens is essential for the development of targeted and individualized therapeutic strategies, thereby avoiding empirical and potentially ineffective dietary restrictions. Large-scale multicenter studies based on skin prick testing are warranted to better characterize potential triggers of atopic dermatitis across different provinces of the Democratic Republic of the Congo.

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Data Availability: All data are included in the content of the paper.

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Declaration for Human Participants: This study has been approved by the Health Research Ethics Committee of the Faculty of Medicine, University of Goma (Approval number: UNIGOM/CEM/008/2025), and the North Kivu Provincial Hospital in the DRC. The study was conducted in accordance with the principles of the Declaration of Helsinki.

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