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Article

Assessing Preparedness and Preventive Measures for Managing Food Allergy and Anaphylaxis in Primary Schools of Rabigh, Saudi Arabia

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Abstract

Background and Aims: Anaphylaxis is a severe allergic reaction that can lead to life-threatening consequences. Despite growing awareness of food allergies, schools in Saudi Arabia remain underprepared to manage allergic reactions. This study aimed to evaluate the preparedness of primary schools in Rabigh, Saudi Arabia, in managing allergic reactions, with a focus on their policies and training practices to prevent food-related anaphylaxis. **Methods:** A cross-sectional survey was conducted involving 24 primary schools in Rabigh. An online questionnaire, previously validated for assessing school preparedness, was distributed to school administrators. The questionnaire covered preparedness to manage allergic reactions and existing protocols for allergy management. Data were analysed using IBM SPSS Statistics version 25 to determine the association between preparedness level and the presence of pupils with food allergies or anaphylaxis. **Results:** Nineteen schools (79%) completed the survey. Most schools (95%) had emergency communication systems, and 74% designated a staff member to manage allergic reactions. However, only 58% were aware of pupils with food allergies. Preventive measures such as food-handling guidance and a no-nut policy were present in most schools. Still, policies against food sharing and closer supervision of high-risk pupils were inconsistently implemented. A comparison between schools with and without pupils with allergies revealed that schools with such pupils were more likely to identify allergy risks and provide closer supervision during mealtimes ($p = 0.042$). **Conclusion:** Although some schools in the Rabigh region have implemented basic allergy emergency systems, significant gaps in preparedness remain, particularly in preventive measures and the supervision of high-risk pupils. The study highlights the need for standardized policies and regular training to enhance preparedness, especially in schools without known pupils with allergies, in order to ensure a safe educational environment.

Keywords: Anaphylaxis; preparedness of primary schools; cross-sectional survey; manage allergic reactions; pupils with allergies

1. Introduction

Anaphylaxis is a rapidly occurring, severe hypersensitivity reaction characterised by life-threatening upper airway obstruction and hypotension [1,2]. Globally, evidence indicates an increase in anaphylaxis rates, primarily driven by medications and food [3], with children and younger age

groups at significantly higher risk for hospitalisation and emergency department visits [4,5]. In Saudi Arabia, a cross-sectional study found that the prevalence of anaphylaxis among emergency department admissions was 0.00026%, with most cases occurring in children between the ages of 1 and 16 years (60.9%) [6]. The clinical manifestations of anaphylaxis typically include urticaria, angioedema, rash, tongue swelling, and cardiovascular collapse or respiratory obstruction, which can be fatal [7]. A study conducted in Riyadh, Saudi Arabia, revealed that the most common triggers for anaphylaxis were food and drug allergies, with urticarial and angioedema being the most prevalent manifestations [8].

Schools are required to provide a secure environment for children, especially those with special medical needs, such as allergies. Fatal anaphylaxis events in school settings are often linked to inadequate action plans that fail to prevent allergen exposure, as well as delays in administering epinephrine, the first-line treatment for anaphylaxis [9]. Nineteen percent of life-threatening allergic reactions that occur in school environments have been documented during field trips, at school playgrounds, or while travelling to and from schools [10]. Policies regarding food allergies and anaphylaxis in schools, as well as the governing laws for management, vary significantly between different countries and even among schools within the same country [11]. A survey conducted in 157 schools in Northwest England, UK, revealed that only 47% of respondents felt confident in their ability to manage anaphylaxis.

Furthermore, schools without Pupils with allergies were significantly less likely to have a standardised emergency protocol than those with Pupils with allergies ($p < 0.001$) [12]. Another study indicated that the preparedness of eleven primary schools in Cyprus did not meet safety standards, raising concerns about the readiness of school personnel to manage allergic reactions and administer epinephrine auto-injectors to children with food allergies [13]. These results highlight gaps in confidence and preparedness among school staff in handling anaphylaxis, revealing significant variations in policies and preparedness across different countries and schools while emphasising the need for standardised emergency protocols and proper training.

Several studies in Saudi Arabia have evaluated school staff's knowledge and attitudes toward food allergies and anaphylaxis. These studies revealed a significant lack of basic understanding regarding food allergies, recognising anaphylactic symptoms, and the necessary immediate actions, including using an epinephrine auto-injector [14–18]. To our knowledge, insufficient studies are focusing on the preparedness of schools in Saudi Arabia to address food allergies and anaphylaxis. Ensuring the safety of children with food allergies in schools is a crucial mission that must be strengthened in Saudi Arabia through educational interventions and well-implemented policies for severe allergic reactions. While awareness of food allergies and anaphylaxis management in schools has been increasing, challenges persist. There is a pressing need for nationwide regulations and required training for school staff on recognising and managing food allergies and anaphylactic emergencies.

Furthermore, cultural, religious, and logistical characteristics of the Saudi educational context, such as gender-segregated schools, lack of universal school meal programs, and variable access to epinephrine auto-injectors, may pose unique challenges compared to Western systems. These factors justify region-specific evaluations and interventions tailored to the Saudi setting. This study aimed to assess the preparedness of all primary schools in the Rabigh governorate to manage allergic reactions and effectively care for Pupils with anaphylaxis.

2. Materials and Methods

2.1. Participants and School Setting Context

Although individual-level pupil data were not collected, regional estimates from the Ministry of Education indicate that primary schools in Rabigh typically enrol 200–300 pupils each. Therefore, the practices assessed in this study are likely to affect approximately 4,000 to 6,000 pupils across the 24 participating schools.

All primary schools in Rabigh Governorate (n = 24), located in the western region of Saudi Arabia, were invited to participate in this study. At the time of the study, the most recent summary list of primary schools in Rabigh governorate was used to identify and invite them to participate in the survey. An online survey was created using Google Forms software and disseminated to the schools' administrations by a coordinator from the educational ministry. Special needs and private schools were excluded from the study.

In most Saudi public schools, including those in Rabigh, Pupils typically bring food from home in lunchboxes. There are no centralised school meal services. Regarding anaphylaxis management, pupils are generally not provided with or trained to carry epinephrine auto-injectors, and schools are not legally mandated to stock them. As such, emergency preparedness relies largely on staff awareness and general response protocols rather than pharmaceutical readiness.

2.2. Survey Distribution and Anonymity

The survey was distributed electronically via Google Forms through the regional coordinator from the Ministry of Education. The invitation included a cover letter explaining the study's purpose and the voluntary nature of participation. A follow-up reminder was sent to all 24 schools one week after the initial invitation to improve response rates. Responses were submitted anonymously; no identifying information about the schools or respondents was collected. This anonymity aimed to encourage honest feedback and reduce social desirability bias.

2.3. Questionnaire Design

A previously published and validated questionnaire assessed the school's preparedness [12]. The Arabic translation of the questionnaire was validated by two translators proficient in both languages and affiliated with health services. The assessment included the following: an online questionnaire assessed schools' preparedness to manage allergic reactions and their current measures to prevent them. This questionnaire consists of three sections: a) sociodemographic data, including age, gender, and job; b) understanding of the school: schools were asked to identify whether they have Pupils with allergies and if they receive training in allergy management; and c) current guidelines and protocols for managing severe allergic reactions in schools.

2.4. Statistical Analysis

Data were entered and analysed using SPSS version 25.0. All qualitative variables were presented as frequencies and percentages, while quantitative variables were expressed as means \pm standard deviations (SD). The chi-square test was applied to examine the association between school preparedness for managing and responding to allergic reactions and the school's preventive measures. The comparison of self-assessment knowledge scores between schools with and without allergic Pupils was conducted using the Mann-Whitney U test, depending on the normality of the data. A p -value of < 0.05 was considered statistically significant.

2.5. Ethical Approval

The Research Ethics Committee at King Abdulaziz University, Unit of Biomedical Ethics, with reference number 240-25, recommended approval of the project on 22 October 2024. The Research Ethics Committee (REC) is based on the Good Clinical Practice (GCP) Guidelines. We conducted this investigation in accordance with the ethical principles outlined in the Declaration of Helsinki.

3. Results

Nineteen schools completed the online questionnaire, with 11 (58%) female and 8 (42%) male schools. Most respondents were school directors (n = 8, 42%); others included teachers, health instructors, and instructors in safety and security. Regarding age distribution, the largest age group was 45–55 years, comprising eleven participants (58%), followed by the 35–44 age group, which

included seven respondents (37%). The results revealed that eight schools (42%) reported receiving training or courses on allergies, while the majority, 11 schools (58%), indicated they had not. Twelve schools (63%) reported having pupils with allergies or at risk of anaphylaxis.

3.1. School Preparedness for Allergy Emergencies and Preventative Measures:

3.1.1. Preparedness for Allergy Emergencies

The results revealed varying levels of school preparedness for allergy emergencies. Most schools (18, 94.74%) indicated that they have communication systems in place to manage emergencies, while only one school (5.26%) reported having no such systems. A majority (14, 73.68%) stated that a designated staff member manages allergic cases, whereas five participants (26.32%) indicated that no such designation exists. When asked about defining staff roles during an allergic emergency, half (10, 52.63%) confirmed this practice, eight (42.11%) reported no clear role definitions, and one (5.26%) was unsure. Additionally, 11 schools (57.89%) indicated that they are aware of Pupils with food allergies or anaphylaxis, while five (26.32%) reported they were not aware, and three (15.79%) were unsure. However, fewer schools (8, 42.11%) were prepared for allergic reactions in Pupils without a known history of allergies, with seven participants (36.84%) reporting no preparation and four (21.05%) being uncertain (**Error! Reference source not found.**).

3.1.2. Preventative Measures

More than half (58%, 11 schools) indicated that guidance is provided to staff handling food, while six (32%) stated there was no guidance, and two (11%) were unsure. Only six participants (32%) reported closer supervision of high-risk Pupils during mealtimes, compared to 10 (53%) who said no such supervision exists and three (16%) who were unsure. Similarly, policies against food sharing were inconsistent, with six respondents (32%) confirming their existence, seven (37%) indicating no policy, and six (32%) uncertain. A no-nut policy was more common, reported by 13 participants (68%), while six (32%) stated their schools lacked such a policy. Special supervision for high-risk Pupils on school buses was the least implemented measure, with only four respondents (21%) confirming its existence, 11 (58%) reporting no supervision, and four (21%) uncertain (**Error! Reference source not found.**).

Table 1. School preparedness for allergy emergencies and applied policies to prevent allergic reactions in schools.

Respondent's n (%)			
Has your school prepared for emergencies related to allergies?	Yes	No	I don't know
1-Developing communication systems within the school that are simple to follow in emergencies?	18 (95%)	1 (5%)	0 (0%)
2. Assign one staff member to manage pupils with allergies and non-allergic cases?	14 (74%)	5 (26%)	0 (0%)
3- Identifying the role of each school staff member in an allergy emergency.	10 (53%)	8 (42%)	1 (5%)
4-knowing the Pupils with food allergies or anaphylaxis	11 (58%)	5 (26%)	3 (16%)
5- Preparing for allergic reactions in children without a previous history of allergies?	8 (42%)	7 (37%)	4 (21%)
Preventive measures to prevent allergic reactions in schools			
	Yes	No	I don't know
6. Is there any guidance for staff on preventing food allergies when handling food?	11 (58%)	6 (32%)	2 (11%)
7. Are high-risk Pupils being supervised more closely during mealtimes?	6 (32%)	10 (53%)	3 (16%)
8. Is there a policy against sharing food among pupils at your school?	6 (32%)	7 (37%)	6 (32%)
9-.Does the school have a no-nut policy?	13 (68%)	6 (32%)	0 (0%)

10- Is there special supervision for high-risk Pupils on school buses?	4 (21%)	11 (58%)	4 (21%)
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Total study participants: 19. Data are displayed as numbers (%).

3.2. Comparison of Preparedness Levels and Preventive Measures Between Schools with and Without Pupils with Food Allergy

The comparison of preparedness measures between schools with and without Pupils identified as having food allergies. Most schools with Pupils who have allergies (92%) have developed simple communication systems for emergencies, while all schools without such cases (100%) have also done so, showing no significant difference ($p = 0.329$). In the context of managing instances of allergies, it was observed that 75% of schools accommodating pupils with allergies, as well as 71% of schools without such pupils, have adopted the measure of designating a staff member to address this issue. Notably, there exists no significant statistical difference between these two percentages ($p = 0.865$). The identification of staff roles during allergy emergencies was reported by 58% of schools with allergic Pupils and 29% of schools without, but this difference was not statistically significant ($p = 0.440$). Identifying Pupils with food allergies or anaphylaxis was universally implemented in schools with allergic Pupils (100%), while none of the schools without allergic reactions identified such Pupils, indicating a significant difference ($p = 0.000$). Finally, preparation for allergic reactions in children without a prior allergy history was reported by 42% of schools with allergic Pupils and 29% of schools without, showing no significant difference ($p = 0.844$).

Table 2. Comparison of preparedness Levels between schools with and without Pupils with food allergy.

Questions	Schools with Pupils Experiencing Allergic Reactions(n=12)	Schools without Pupils Experiencing Allergic Reactions(n=7)	Total	P-value
Developing communication systems within the school that are simple to follow in emergencies	11 (92%)	7 (100 %)	19	0.329 ^a
Assign one staff member to deal with allergic cases?	9 (75%)	5 (71 %)	14	0.865 ^b
Identifying the role of each school staff member in an allergy emergency?	7 (58%)	2 (29 %)	9	0.440 ^b
Knowing the Pupils with food allergies or anaphylaxis	12 (100%)	0 (0 %)	12	0.000^{b*}
Preparing for allergic reactions in children without a previous history of allergies?	5 (42%)	2 (29%)	7	0.844 ^b

^a Chi-square was used, and ^b Fisher Exact Test was used. Data are displayed as numbers (%). The value listed in bold indicates statistical significance ($*P\text{-value}<0.05$).

The comparison of preventive measures between schools with and without Pupils with a history of allergic reactions. Most schools with Pupils who have allergies (67%) provide guidance for staff on preventing food allergies, compared to 43% of schools without allergic Pupils; however, this difference is not statistically significant ($p = 0.666$). Half of the schools with Pupils who have allergies report closely supervising high-risk Pupils during mealtimes. In contrast, none of the schools without such Pupils implement this measure, showing a significant difference ($p = 0.042$). Regarding policies on food and utensil sharing, 42% of schools with Pupils who have allergies and 14% of schools without them reported having such a policy; however, this difference was not statistically significant ($p = 0.472$). A no-nut policy is present in 75% of schools with Pupils who have allergies and 57% of those without, again without a significant difference ($p = 0.617$). Finally, special supervision for high-risk Pupils on school buses is reported by 33% of schools with Pupils who have allergies. In contrast, none of the schools without such Pupils provide this supervision, although the difference was not statistically significant ($p = 0.421$) (Table 3).

Table 3. Comparison of preventive measures between schools with and without Pupils with allergic reactions.

Questions	Schools with Pupils Experiencing Allergic Reactions (n=12)	Schools without Pupils Experiencing Allergic Reactions (n=7)	Total	P-value
Is there guidance available for staff on preventing food allergies when handling food?	8(67%)	3(43%)	11(58%)	0.666 ^b
Are high-risk Pupils being supervised closely during mealtimes?	6(50 %)	0(0%)	6 (32%)	0.042 ^{b*}
Is there a policy against sharing food and utensils among Pupils at your school?	5(42%)	1(14%)	6 (32 %)	0.472 ^b
Do Pupils at your school have a no-nut policy?	9(75%)	4(57%)	13(68%)	0.617 ^b
Is there special supervision for high-risk Pupils on school buses?	4(33%)	0(0%)	4(21 %)	0.421 ^b

^a Chi-square was used, ^b Fisher's Exact Test was used. Data are displayed as numbers (%). The value listed in bold indicates statistical significance (**P-value*<0.05).

Regarding the use of an epinephrine auto-injector, 2 (17%) schools with known allergic students reported using it in an emergency, compared to 1 (14%) school that had not reported any allergic students. This difference was not statistically significant ($p = 0.890$). It is possible that the school without identified allergic students encountered an unexpected allergic reaction or had a student with an undiagnosed allergy at the time of the incident. The majority of schools in both groups, 10 (83%) with allergic students and 6 (86%) without, reported not using the auto-injector in an emergency.

3.3. Comparison of Preparedness Measures for Allergic Reactions: Trained vs. Untrained Schools

While trained schools ($n = 8$) showed slightly higher adherence to specific measures compared to untrained schools ($n = 11$), no statistically significant differences were found between the two groups. In terms of implementing preventive measures for allergic reactions, trained schools reported greater adherence to most preventive practices compared to untrained ones; however, none of the differences reached statistical significance (see supplementary materials **Error! Reference source not found.** and **Error! Reference source not found.**).

4. Discussion

This study provides an overview of school preparedness for managing Allergy emergencies and the policies in place to prevent such reactions. Most administrators from the 19 participating primary schools reported having basic emergency systems, such as designating staff members (74%) and establishing internal communication protocols (95%). Additionally, 58% of schools were aware of having pupils with food allergies or at risk of anaphylaxis. In comparison, 42% reported being prepared to manage reactions in pupils without a prior history of allergies. These findings suggest a foundational level of preparedness, which is encouraging. However, notable gaps persist,

particularly in defining staff roles during emergencies, as over a quarter of respondents were uncertain about specific responsibilities. This aligns with previous national studies, which have shown limited staff training and low availability of epinephrine auto-injectors in Saudi public schools [19,20]. Similar trends have been reported internationally; for example, fewer than half of UK schools have trained staff or on-site emergency medication [21].

While many schools have implemented core strategies to manage Allergy emergencies, inconsistencies remain in preventive practices, especially for unanticipated reactions. Although 58% of schools provided food-handling guidance, only 32% had policies against food sharing, and just 32% reported close supervision of high-risk pupils during mealtimes. Only 21% offered special supervision for pupils with allergies during transportation. These figures suggest that while general awareness exists, consistent policy enforcement is lacking. Preventive measures such as food-sharing restrictions and dedicated supervision are critical, particularly among younger pupils who may struggle to recognise or communicate symptoms. Clear, mandatory protocols across all schools could significantly enhance the safety and protection of pupils with allergies.

Notably, the presence of pupils with food allergies was associated with a more proactive approach to managing allergies. Schools with such pupils were more likely to identify at-risk individuals and provide closer supervision during mealtime. However, this reflects a reactive rather than a preventive mindset. Schools without known cases tended to lag in preparedness, which is concerning given the unpredictable nature of first-time allergic reactions. Moreover, the absence of significant differences in many preparedness measures between schools with and without pupils with allergies points to a broader issue of under-implementation, even where the need is apparent. This underscores the necessity for proactive, system-wide allergy risk management that is not contingent on current enrollment patterns.

Although schools with trained staff showed slightly higher adherence to preventive measures, these differences were not statistically significant, likely due to the small sample size. Nonetheless, the trend highlights the potential impact of staff education on preparedness. Regular, structured training programs, supported by clear institutional policies, could help ensure that all school personnel are equipped to respond confidently and effectively to an Allergy emergency.

None of the participating schools reported stocking generic (unassigned) epinephrine auto-injectors, which are considered essential for managing severe allergic reactions that occur unexpectedly. The cases of epinephrine use documented in this study were based on pupil-specific pens, rather than stock supplies. This reflects a gap in national policy, as schools in Saudi Arabia are currently not required or equipped to maintain spare auto-injectors. Given the unpredictable nature of first-time anaphylactic episodes, particularly in children without a known allergy, ensuring access to school-held, unassigned epinephrine devices should be considered a priority in future preparedness frameworks.

It is essential to emphasise that allergy management is not limited to rare anaphylactic events. Daily safety, inclusion, and emotional well-being are equally important. Pupils with food allergies often face stigma, anxiety, or social exclusion. Schools must therefore cultivate inclusive environments where affected pupils feel protected and accepted, not singled out or marginalised. This includes fostering open communication with families, normalising allergen safety measures, and integrating pupils with allergies into all aspects of school life.

Parental involvement plays a central role in effective allergy management. However, our study did not evaluate whether Rabigh schools maintain structured systems for parents to report food allergies. This is a notable gap. International studies suggest that failure to report allergies limits school readiness and puts pupils at risk. For instance, in Romania, only 52% of parents informed school personnel about their child's food allergy [22]. Similar underreporting has been observed in countries such as Mexico, Colombia, and El Salvador, where even medically confirmed cases frequently go unreported and epinephrine auto-injectors are rarely prescribed [23–26]. These global findings underscore the need for comprehensive school–parent communication systems that ensure early identification and planning.

Local epidemiological data would further contextualise school preparedness. Unfortunately, no population-based prevalence estimates are currently available for Rabigh. A national-level survey suggested that approximately 6–7% of children in Saudi Arabia have physician-diagnosed food allergies, though underdiagnoses is likely. Recent European data indicate that the pooled lifetime prevalence of self-reported food allergy in children has increased to nearly 20% [27], suggesting that this issue warrants ongoing attention in both high- and middle-income countries.

Saudi schools face unique logistical and cultural challenges compared to Western contexts. The reliance on home-packed meals (rather than standardised lunches), limited availability of epinephrine devices, and variations in staff training affect how policies are implemented. Religious norms and communication styles may also influence how allergy risks are disclosed and managed. Therefore, national policies must be tailored to local educational and social contexts. European and Middle Eastern guidelines, including those from the EAACI and Italian public health bodies, provide valuable models that could be adapted to Saudi Arabia's needs [27–29].

One limitation of this study is its focus on a single geographic region (Rabigh), which may limit the generalizability of findings. Additionally, although the survey was distributed anonymously through official Ministry of Education channels, reliance on self-report introduces the possibility of response bias or over-reporting. Lastly, the absence of data on structured parental reporting systems restricts our ability to assess preparedness pathways fully. Future research should include multi-regional sampling, direct observation of school practices, and triangulated input from parents and pupils to build a more comprehensive understanding of allergy preparedness.

5. Conclusion

In conclusion, while this study identified encouraging efforts such as no-nut policies and basic emergency protocols, overall preparedness to manage allergic reactions remains inconsistent. Significant gaps in role clarity, enforcement of preventive policies, and daily support structures indicate the need for a unified national strategy. Standardised policies, inclusive practices, and regular training should be implemented across all schools, ensuring that every pupil with allergies is safe, supported, and fully included in the school environment.

Supplementary Materials: The following supporting information can be downloaded at the website of this paper posted on Preprints.org. More information will be provided upon request.

Author Contributions: Conceptualization, N.F.; methodology, N.F., M.H., M.D., S.H., and A.A.; software, N.F.; validation, N.F., M.H., M.D., S.H., and A.A.; formal analysis, N.F.; investigation, N.F., M.H., M.D., S.H., and A.A.; resources, N.F.; data curation, N.F., M.H., M.D., S.H., and A.A.; writing—original draft preparation, S.H., and N.F.; writing review and editing, N.F. and S.H.; visualisation, N.F.; supervision, N.F.; project administration, M.H. All authors have read and agreed to the published version of the manuscript.

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Institutional Review Board Statement: On October 22, 2024, the Research Ethics Committee at King Abdulaziz University, Unit of Biomedical Ethics, with reference number 240-25, recommended granting permission to conduct the project. The Research Ethics Committee (REC) is based on the Good Clinical Practice (GCP) Guidelines. We conducted this investigation under the ethical principles outlined in the Declaration of Helsinki.

Informed Consent Statement: Schools in this study agreed to participate by voluntarily completing the survey. All collected data was kept completely confidential and used only for research purposes.

Data Availability Statement: Data will be provided upon request. For more information, contact M.H., the corresponding author.

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Conflicts of Interest: The authors declare that they have no conflicts of interest.

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