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Public Awareness and Perception of Gluten Allergy in the Northern Border Region of Saudi Arabia: A Cross-Sectional Study

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Abstract: **Background:** Gluten allergy (GA) is described in this study as a gluten-related condition associated with immune-mediated responses following gluten ingestion in susceptible individuals. It is estimated to affect around 1% of the global population and may present at any stage of life. This study aimed to evaluate public awareness and perception of GA among adults in Arar City, the capital of the Northern Border region of Saudi Arabia. **Methods:** A cross-sectional descriptive survey was conducted between March and August 2025. Data were collected using a structured questionnaire developed from previously published studies, translated and pilot-tested for clarity. The survey was distributed online through social media platforms and included items on sociodemographic characteristics, knowledge of symptoms, risk factors, complications, and perceived social impact of GA. **Results:** A total of 400 participants completed the survey (mean age 32.4±11.7 years). The sample was predominantly young, female, and university educated. Overall, 74.2% of participants had heard of GA. However, knowledge gaps were evident, as only 47.3% recognized that GA affects the small intestine. While 70% correctly indicated the need for a special diet, misconceptions about symptoms and disease characteristics were common. Fatigue (61%) and abdominal distension (56.2%) were the most frequently identified symptoms. Rheumatoid arthritis was the most commonly reported associated risk factor (83.2%), and malnutrition (50.5%) was the most recognized complication. Regarding social impact, 60.4% of participants believed that individuals with GA experience hesitation when eating outside the home, and 49.5% reported difficulty in accessing gluten-free products. **Conclusion:** Although general awareness of GA was relatively high, detailed understanding of its clinical features and complications remains limited among the studied population. These findings highlight the need for targeted public health education and improved community awareness to support early recognition and better management of gluten-related conditions.

Key Words: Gluten Allergy, Awareness, Perception, Symptoms, Risk Factors, Saudi Arabia

INTRODUCTION

Gluten allergy (GA), as described in this study, refers to a gluten-related condition characterized by an immune-mediated response triggered by the ingestion of gluten-containing cereals such as wheat [1]. Gluten is a complex protein composed mainly of gliadin and glutenin, which are widely consumed as part of daily diets across the world. In susceptible individuals, the immune system may react abnormally to these proteins, leading to intestinal inflammation and mucosal damage [2,3]. As a result, affected individuals may develop a range of gastrointestinal and extraintestinal manifestations. At present, the only effective management strategy remains strict and lifelong adherence to a gluten-free diet [1].

The clinical presentation of GA varies widely and may include chronic diarrhea or constipation, abdominal distension, nausea, vomiting, weight loss, delayed growth, and iron deficiency anemia [4]. The condition can affect individuals at any age, although it is more frequently diagnosed in children and is reported to be more common among females than males [5]. Globally, the prevalence of GA is estimated to be around 1–1.4%, although variations exist across regions and populations [5]. Several international initiatives have been implemented to improve

the quality of life for individuals living with GA. These include nutritional education programs, improved food labeling systems, and the introduction of gluten-free product certification, all of which aim to support safer dietary choices and enhance food accessibility [6,7].

Epidemiological data indicate that the prevalence of GA varies considerably between countries. A systematic review reported prevalence rates ranging from 0.14% to 3.2% among adults, with some of the highest rates observed in Saudi Arabia [8]. Among children, the estimated prevalence ranges from 0.6% to 1.5%, with peak diagnosis commonly occurring in early childhood [8]. Similarly, a European meta-analysis reported undiagnosed cases ranging from 0.1% to 3.3%, highlighting the presence of a substantial hidden burden of disease [9].

In Saudi Arabia, available evidence suggests a relatively higher prevalence compared with several other regions [10]. Studies conducted in different parts of the country have reported varying rates, including 1.5% among schoolchildren in Riyadh [11]. and approximately 3% in the Eastern Province [12]. Furthermore, higher prevalence has been observed among specific high-risk groups; for example, one study reported a prevalence of 14.6% among individuals with type 1 diabetes [13]. Comparable findings have also been reported in neighbouring countries, such as the United Arab Emirates (2.7%) [14]. and Bahrain, although with lower reported rates.

Despite increasing recognition of GA, awareness within the general population remains inconsistent. Previous studies in Saudi Arabia have demonstrated moderate to high levels of general awareness; however, important gaps persist in understanding symptoms, risk factors, and long-term complications [15,16]. Many individuals remain undiagnosed, partly due to limited public knowledge and the variable nature of clinical presentation [8].

Understanding public perception of GA is essential, as awareness plays a key role in early recognition, appropriate dietary adherence, and overall disease management [17]. Factors such as gender, psychological well-being, social support, and beliefs about the chronic nature of the condition can significantly influence compliance with a gluten-free diet and long-term outcomes [18].

Although several studies have explored awareness of GA in different regions of Saudi Arabia, there is limited data from the Northern Border region, particularly Arar City. Given potential regional differences in education, healthcare access, and food availability, assessing local perceptions is important for developing targeted health education strategies. Therefore, this study aimed to evaluate the perception of GA among adults in Arar City, with a focus on knowledge of symptoms, risk factors, complications, and the perceived impact of the condition on social life.

METHODS

Study Design and Setting

This study employed a cross-sectional descriptive survey design targeting the adult population of Arar City, the capital of the Northern Border region of Saudi Arabia. Data were collected over a six-month period from March 1 to August 30, 2025.

Study Population and Sample Size

The study included individuals aged 18 years and above who were residing in Arar City and agreed to participate. The required sample size was calculated using Epi Info software (version 7.2.4.0), assuming a 50% expected prevalence of awareness, a 95% confidence level, a margin of error of 5%, and a study power of 80%. The minimum calculated sample size was 384 participants; this was increased to 400 to account for potential incomplete responses.

Sampling Technique and Recruitment

Participants were recruited using a convenience sampling approach through online distribution of the questionnaire via commonly used social media platforms, including Snapchat, WhatsApp, and Facebook. The survey link was shared widely to reach the general adult population. Participation was voluntary, and informed consent was obtained electronically through a separate introductory page before accessing the questionnaire. It is acknowledged that this recruitment approach may favor younger, more educated, and digitally active individuals.

Data Collection Tool

Data were collected using a structured, self-administered questionnaire developed after a comprehensive review of relevant literature [11, 19–22]. The original questionnaire was prepared in English, translated into Arabic, and then back-translated into English by a bilingual expert to ensure linguistic consistency.

To establish content validity, the questionnaire was reviewed and approved by two internal medicine consultants. A pilot study was conducted on 20 participants to assess clarity, comprehensibility, and time required for completion. No major modifications were necessary, and pilot data were excluded from the final analysis.
The questionnaire consisted of four main sections:

- **Sociodemographic Characteristics:** (age, gender, education, and income)
- **Perception and Knowledge of GA**: including general awareness and symptoms
- **Awareness of Risk Factors and Complications:** associated with GA
- **Perceived social impact of GA**, including challenges related to daily life and food access

Although the questionnaire was developed carefully and pilot-tested, no formal reliability testing (e.g., internal consistency measures) was performed.

Data Collection Procedure

The questionnaire was distributed electronically, and responses were collected anonymously. Participants were

able to complete the survey at their convenience. Measures to restrict participation to one response per individual were applied through the survey platform settings where possible; however, complete control over duplicate submissions could not be guaranteed.

Statistical Analysis

Data were entered and analyzed using SPSS software (IBM SPSS Statistics for Windows, Version 27.0, Armonk, NY, USA). Categorical variables were presented as frequencies and percentages, while continuous variables were summarized using means and standard deviations. Associations between categorical variables were assessed using Pearson's Chi-square (χ^2) test. All statistical tests were two-tailed, and a p-value of ≤0.05 was considered statistically significant.

Inclusion and Exclusion Criteria

Individuals aged 18 years and above who were willing to participate were included in the study. Those younger than 18 years or who declined to provide consent were excluded.

Ethical Considerations

Ethical approval was obtained from the Local Bioethical Committee of Northern Border University (Approval No. HAP-09-A-043; Decision No. 31-25-H; dated 17/03/2025). Participation was voluntary, and informed consent was obtained electronically prior to data collection. All responses were collected anonymously, and confidentiality of participants' information was maintained throughout the study.

RESULTS

Table 1 shows the demographic characteristics of the study participants. A total of 400 individuals were enrolled, with a mean age of 32.4±11.7 years. Over half were under 30 years old, female, and university educated. Approximately two-thirds (67.8%) of participants reported having sufficient income. Around three-quarters (74.2%) had heard of a gluten allergy, 16.8% had a family history of gluten allergy, and slightly more than three-quarters (76%) stated that gluten is present in wheat.

Table 2 summarizes the participants' perspectives on GA. Less than half (47.3%) of the respondents acknowledged that GA affects the small intestine, more than two-thirds (70%) claimed that patients with GA must adhere to a particular diet, and around one-sixth stated that persons with GA can consume gluten-containing items such as bread if there are no symptoms.

Fatigue was the most often reported GA symptom (61%), followed by abdominal distention (56.2%), diarrhea with an unpleasant odor (36.5%), and stress and depression (40.2%). Neuropathy (34%), and only a small minority of subjects (16.8%) claimed that GA can develop without symptoms.

Table 1: Sociodemographic Characteristics of the Studied Participants

Items		No	Percentage
Age	≤30	220	55
	31-50	149	37.2
	>50	31	7.8
Gender	Male	174	43.5
	Female	226	56.5
Educational level	Primary	30	7.4
	Secondary	57	14.3
	University	225	56.3
	Postgraduate	88	22
Family income	Unsatisfactory	60	15
	Sufficient and enough	271	67.8
	Sufficient and abundant	69	17.2
Ever heard of GA	Yes	297	74.2
	No	103	25.8
Family history of GA	Yes	67	16.8
	No	333	83.2
Gluten protein is present in wheat	Yes	304	76
	No	96	24

Age: Mean±SD=32.4±11.7

Table 2: Perception of GA and Associated Symptoms among the Studied Participants

Items	Yes no (%)	No no (%)	I do not know no (%)
GA affects the small intestine	189 (47.3)	24 (6)	187 (46.7)
People with GA must eat a particular diet.	280 (70)	23 (5.8)	97 (24.2)
Can patients with GA consume gluten-containing foods, such as bread	60 (15)	200 (50)	140 (35)
Symptoms of GA			
Fatigue	244 (61)	20 (5)	136 (34)
Distension	225 (56.2)	21 (5.3)	154 (38.5)
Diarrhea and an offensive smell	146 (36.5)	36 (9)	218 (54.5)
Stress and depression	161 (40.2)	42 (10.5)	197 (49.3)
Neuropathy	136 (34)	42 (10.5)	222 (55.5)
Can a GA occur without symptoms	67 (16.8)	156 (39)	177 (44.2)

Table 3: Awareness of Risk Factors and Complications of GA among the Respondents Studied

Items	Yes no (%)	No no (%)	I do not know no (%)
Risk factors awareness of GA			
Rheumatoid arthritis	73 (83.2)	75 (18.8)	252 (63)
Familial	132 (33)	82 (20.5)	186 (46.5)
Type I diabetes	92 (23)	84 (21)	224 (56)
Thyroid diseases	91 (22.8)	69 (17.2)	240 (60)
Down syndrome	52 (13)	123 (30.8)	225 (56.2)
Complications of GA			
Malnutrition	202 (50.5)	46 (11.5)	152 (38)
Lactose intolerance	165 (41.2)	40 (10)	195 (48.8)
Loss of calcium	154 (38.4)	59 (14.8)	187 (46.8)
Neurological diseases	99 (24.8)	62 (15.5)	239 (59.7)
Infertility and abortion in females	77 (19.2)	79 (18.8)	244 (61)
Cancer	55 (13.8)	106 (26.4)	239 (59.8)

Table 4: Participants' Opinions Regarding the Effect of GA on Social Life

Items	Yes no (%)	No no (%)	I do not know no (%)
Gluten allergy patients have hesitation and fears about eating out	242 (60.4)	27 (6.8)	131 (32.8)
Gluten allergy patients find it difficult to obtain Gluten-free products	198 (49.5)	61 (15.3)	141 (35.2)
GA is an obstacle to a normal social life	153 (38.2)	103 (35.8)	144 (36)
GA is an obstacle to socialization	118 (29.5)	126 (31.5)	156 (39)
Social awareness of GA is enough	87 (21.8)	185 (46.2)	128 (32)
Travel and holidays are forbidden activities for a GA individual.	69 (17.3)	156 (39)	175 (43.2)
Are there a variety of gluten-free products available on the market?	157 (39.3)	78 (19.5)	165 (41.2)
Are there more developments towards gluten-free products in your area?	132 (33)	96 (24)	172 (43)
Do you think that a gluten-free diet is healthy for everyone?	136 (34)	99 (24.8)	165 (41.2)
Gluten-free items at food stores are prominently labeled.	158 (39.5)	80 (20)	162 (40.5)
Restaurants and cafes around my area serve gluten-free products	89 (22.2)	140 (35)	171 (42.8)

Table 5: Distribution of GA Knowledge by Gender

Variables	Male no (%)	Female no (%)	*p-value
N	174	226	
Ever heard of GA			
Yes	124 (71.3)	173 (76.5)	0.2
No	50 (28.7)	53 (23.5)	
GA disease results from the gluten protein present in wheat			
Yes	127 (73)	177 (78.3)	
No	47 (27)	49 (21.7)	0.2
GA affects the small intestine			
Yes	75 (43.1)	114 (50.4)	0.3
No	11 (6.3)	13 (5.8)	
I do not	88 (50.6)	99 (43.8)	
GA patients must follow a special diet			
Yes	105 (60.4)	175 (77.5)	0.001*
No	15 (8.6)	8 (3.5)	
I do not	54 (31)	43 (19)	
Can people with GA eat products containing gluten protein, like bread?			
Yes	31 (17.8)	29 (12.8)	0.3
No	82 (47.1)	118 (52.2)	
I do not	61 (35.1)	79 (35)	

*χ^2 test

Table 3 illustrates the participants' awareness of the risk factors and complications associated with GA. The most frequent risk factor mentioned was Rheumatoid arthritis (83.2%), followed by Familial (33%), Type I diabetes (23%), Thyroid diseases (22.8%), and Down syndrome (13%).

Malnutrition was shown to be the most mentioned GA complication (50.5%), followed by lactose intolerance (41.2%), calcium loss (38.4%), neurological illnesses (24.8%), female infertility and abortion (19.2%), and cancer (13.8%).

Table 4 highlights participants' perspectives on how GA affects social life. Sixty percent of participants reported that GA patients have hesitation and fears about eating out; slightly less than half (49.5%) mentioned that GA patients find it difficult to obtain Gluten-free products; slightly less than forty percent (38.2%) reported that GA an obstacle to a normal social life; slightly less than one-third (29.5%) stated that patients with GA have an obstacle to socialization; slightly more than one-fifth (21.8%) answered that social awareness

Slightly less than 40% of the participants indicated that there is a variety of gluten-free items accessible on the market; around one-third (33%) noted that there are more

advancements towards gluten-free products in their region; and 34% reported that a gluten-free diet is beneficial for everyone.

Approximately 40% (39.5%) of participants agreed that gluten-free products in food markets are clearly labeled, and slightly more than one-fifth (22.2%) confirmed that restaurants in their region serve gluten-free products.

Table 5 displays the participants' knowledge of GA by gender. Females are significantly more aware that people with GA must follow a particular diet. Otherwise, there is no significant difference between males and females in terms of the following questions: have they ever heard of GA, the illness comes from the gluten protein contained in wheat, the disease affects the small intestine, and individuals with GA ingest meals containing gluten protein, such as bread.

DISCUSSION

This study provides insight into the current level of public awareness and perception of gluten allergy (GA). among adults in Arar City, Northern Saudi Arabia. Overall, the findings suggest that while general awareness of GA exists, important gaps remain in understanding its clinical features, associated conditions, and broader impact on daily life.

A relatively high proportion of participants reported that they had heard of GA and recognized the presence of gluten in wheat. This aligns with findings from previous studies conducted in Saudi Arabia, where awareness levels ranged from 51.6% to 82.1% [15,19,20,22,23]. Similar levels of awareness have also been reported in Iraq, where 64.6% of participants were able to correctly define the condition [17]. These findings suggest that general exposure to the concept of GA is increasing in the region, possibly due to greater public discussion and dietary trends.

Despite this general awareness, more detailed knowledge appeared to be limited. Less than half of the participants correctly identified the small intestine as the primary organ affected, and a noticeable proportion held misconceptions about dietary restrictions, with some believing that gluten-containing foods could still be consumed under certain conditions. While most participants recognized the importance of a special diet, this understanding was not consistently supported by accurate knowledge of disease mechanisms or consequences. Similar patterns have been reported in other Saudi studies, where awareness of dietary restriction was higher than understanding of disease pathology [20].

With regard to symptoms, fatigue and abdominal distension were the most frequently identified, followed by gastrointestinal and psychological manifestations. Although these responses reflect partial awareness, they also indicate variability in understanding, particularly regarding less obvious or asymptomatic presentations. Previous studies have shown that a significant proportion of individuals are unaware that the condition may present without clear symptoms, which contributes to underdiagnosis [19]. This highlights the need for more focused educational efforts addressing both typical and atypical presentations.

In terms of risk factors, rheumatoid arthritis and other autoimmune-related conditions were commonly identified by participants. This is consistent with existing evidence showing a higher prevalence of GA among individuals with autoimmune disorders [4]. The association with type 1 diabetes mellitus is particularly well established, with studies indicating a significantly increased risk compared with the general population [24,25]. International evidence further supports these findings, including data from the United Arab Emirates and Sweden demonstrating links between GA, diabetes, and genetic conditions such as Down syndrome [14,27]. However, the large proportion of “I do not know” responses in this section suggests that public understanding of these associations remains incomplete.

Awareness of complications was also moderate, with malnutrition, lactose intolerance, and calcium deficiency being the most frequently reported. While these findings are in line with previous Saudi studies [15]. knowledge of more serious long-term complications, such as neurological disorders and malignancy, was limited. This gap is important; as poor understanding of complications may reduce motivation for strict dietary adherence.

One of the more notable findings of this study relates to the perceived social impact of GA. A substantial proportion of participants believed that affected individuals experience difficulty eating outside the home and face challenges in accessing gluten-free products. These findings are consistent with previous research from Saudi Arabia and Turkey, which reported similar concerns regarding food availability, labeling, and social discomfort [20,28]. In the local context, these perceptions may reflect cultural dietary patterns, reliance on wheat-based foods, and limited availability of clearly labeled gluten-free options in restaurants and markets. However, the study did not explore these contextual factors in depth, which represents an area for future research.

Gender differences were observed in awareness of dietary requirements, with females demonstrating higher knowledge in this area. While this finding is statistically significant, the study did not explore potential reasons behind this difference. It may be related to greater involvement of females in food preparation, nutrition awareness, or health-related information seeking, but further investigation is needed.

Study Limitations

This study has several limitations that should be considered when interpreting the findings. The use of an online questionnaire distributed through social media may have introduced selection bias, likely resulting in overrepresentation of younger, more educated, and digitally active individuals, which limits the generalizability of the results. The convenience sampling approach further reduces the representativeness of the study population. In addition, reliance on self-reported responses may have introduced response bias, including misunderstanding of questions or socially desirable answers. Although the questionnaire was carefully developed and pilot-tested, it did not undergo

formal reliability assessment. Finally, the analysis was primarily descriptive and did not explore predictors of knowledge or sources of information, which could have provided deeper insight into awareness patterns.

CONCLUSIONS

The findings of this study indicate that while general awareness of gluten allergy is relatively common among adults in Arar City, detailed understanding of its symptoms, risk factors, and complications remains limited. Misconceptions and knowledge gaps persist, particularly regarding disease mechanisms and long-term consequences.

These results highlight the need for targeted public health interventions aimed at improving awareness and understanding of GA. Efforts should focus on community education through primary healthcare services, public campaigns, and collaboration with food providers to improve labeling and availability of gluten-free options. Addressing these gaps may contribute to earlier recognition, better disease management, and improved quality of life for affected individuals.

Future Recommendations

Future research should adopt more representative sampling methods to better reflect the general population and improve the validity of findings. There is a need to develop and validate standardized Arabic tools for assessing awareness of gluten-related conditions, along with studies exploring sources of information and factors influencing public knowledge. Analytical research identifying predictors of misconceptions would be valuable. At the community level, future efforts should focus on evaluating targeted educational interventions, including school-based programs, primary healthcare initiatives, and public awareness campaigns, as well as assessing the availability and labeling of gluten-free products in local markets and food establishments.

Clinical Implications

The study findings emphasize the need to strengthen public awareness of gluten allergy, particularly regarding its symptoms, associated conditions, and complications. Primary healthcare providers should play a central role in early recognition and patient education, supported by dietitians who can guide appropriate dietary practices. In addition, collaboration between healthcare systems, public health authorities, and the food industry is essential to improve access to clearly labeled gluten-free products and suitable food options. Enhancing awareness at both clinical and community levels can support earlier diagnosis, better dietary adherence, and improved quality of life for affected individuals.

Data Availability Statement

Data supporting the findings of this study are available from the corresponding author upon reasonable request.

Conflict of Interest

The authors declare no conflict of interest.

Author Contributions

MMAM: principal investigator, conceptualization, study design, data analysis and interpretation, software, and drafting of the manuscript. YA: contributed to study design, data analysis, and initial drafting. RZFA, YWA, ASA, AMAA, and KSAA: involved in data collection, coding, and contribution to the initial draft. All authors reviewed and approved the final version of the manuscript.

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