

Awareness of Keratoconus and its Relationship with Eye Rubbing Among the General Population in Makkah, Saudi Arabia: A Cross-Sectional Study

Rola Rashad Alsulami*, Khadija T. Habib**, Rayan A. Alghamdi***, Jumanah A. Alsairafi**, Eyad R. Fatani****, Ashjan Y. Bamahfouz*****

ABSTRACT

The objective of the study was to evaluate the awareness of keratoconus (KC) and its association with eye rubbing among Makkah, Saudi Arabia residents. A cross-sectional study. The study was conducted in Makkah, Saudi Arabia from October to November 2024. This research involved 717 participants aged 18 years and older. Data were gathered through an online self-administered survey and analyzed using SPSS version 26. Participants' understanding of KC (keratoconus) was classified into two levels: poor awareness (scoring below 60%) and good awareness (scoring 60% or higher). Of the participants, only 38.2% had heard of KC, and 23.3% correctly identified it as corneal thinning. Most (64%) acknowledged the harm caused by frequent eye rubbing, but only 13.9% linked it to KC. Visual problems were prevalent (59.3%), with refractive errors being the most common. A significant correlation existed between knowledge level and previous KC diagnosis (p -value=0.003), as well as the use of visual lenses (p -value<0.001). However, knowledge was negatively correlated with age (r =-0.08, p -value=0.019), emphasizing knowledge gaps among older populations. The study also revealed reliance on non-medical sources, such as social media, for information about KC. The results revealed a critical lack of awareness regarding KC and its risk factors in Makkah. Educational initiatives targeting modifiable behaviors, such as eye rubbing, and improving access to accurate medical information are necessary to enhance early diagnosis and management.

Keywords: Awareness; Keratoconus; Relationship; Eye Rubbing; Saudi Arabia

INTRODUCTION

Keratoconus (KC) is a corneal ectatic condition defined by focal corneal thinning and anterior protrusion¹. In the early stages of the condition, patients might have variable degrees of irregular astigmatism, which can be rectified with glasses. However, as the illness advances, the ectasia worsens, resulting in a significant drop in visual acuity. In severe cases, corneal scarring might develop, aggravating the visual impairment^{2,3}. Nottingham provided the first explanation for this syndrome in 1854⁴.

The incidence of KC is estimated by statistics to be 1.38 cases per 1,000 persons⁵. Numerous significant risk factors for KC were found in the available data, such as a family history of KC, allergies, asthma, eczema, and frequent eye rubbing. Additionally, compared to non-eye rubbers, habitual eye rubbers had a threefold higher chances ratio of developing KC⁶. According to a King Khaled Hospital survey in Saudi Arabia, 44.8% of KC patients rub their eyes. Moreover, it accounted for 100% of cases and was the most prevalent risk factor among KC patients.

During normal clinical evaluations, eye care practitioners inquire about the frequency of eye rubbing among symptomatic individuals, especially those with ocular allergies, as they are concerned about this habit⁷. Repetitive mechanical trauma from eye rubbing can

cause weakness in the cornea by increasing apoptosis and oxidative damage, principally due to cyclic shear stress exerted on the cornea's microstructures⁸.

Recent investigations conducted among Saudi populations to examine their degree of knowledge regarding KC indicated that 94.1% in Madinah City⁹, and 85.74% in Aseer Province, had a low level of understanding¹⁰. Furthermore, according to the participants from the Madina study and the Aseer province, 28.4% and 27.3%, respectively, believed that there is a link between KC and eye rubbing^{9,10}. Furthermore, an earlier survey conducted by Alnahdi et al. in Jeddah city discovered that 48.8% of participants were aware of KC, with reading materials and lectures being the most common sources of information¹¹. Further, 75.8% of participants rubbed their eyes, with irritation accounting for 40.9% of the cases¹¹. Knowledge of KC was categorized as fair (31.9%), good (4.8%), and poor (63.3%)¹¹. Remarkably, more than one-third (34.3%) of the participants believed that touching one's eyes could cause KC¹¹.

There is still a knowledge gap regarding KC awareness and its connection to eye rubbing in the Makkah community, despite the fact that this research offered helpful insights into the degree of knowledge of KC in different parts of Saudi Arabia. As a result, this study aimed to measure the level of awareness regarding KC and its relation to eye rubbing in Makkah City, Saudi Arabia.

* Ophthalmology, Makkah health cluster, Makkah, Saudi Arabia.
Email: Rolaalsolami1@gmail.com

** College of medicine, Umm Al Qura University
Makkah, Saudi Arabia.

*** General physician, King Abdulaziz Specialist Hospital
Taif, Saudi Arabia.

**** College of Medicine, King Abdulaziz University
Jeddah, Saudi Arabia

***** Department of Ophthalmology, Umm Al Qura University
Makkah, Saudi Arabia

MATERIALS AND METHODS

Study design, setting, and time frame: A cross-sectional study was conducted in Saudi Arabia from October to November 2024.

Inclusion and Exclusion Criteria: The study included all residents of Makkah city aged 18 years or older, regardless of gender. Individuals under 18 years of age and those who declined to provide consent were excluded from participation.

Sample size: Using the following formula, OpenEpi version 3.0 determined the minimal sample size needed for this investigation: $n = [DEFF_{*} Np(1-p)] / [(d^2/Z^2(1-\alpha/2 * (N-1) + p*(1-p))]$, and it was taken into consideration. estimating the expected frequency to be 5% while maintaining the design effect at 1.0 and the confidence interval (CI) at 95%. 377 people were determined to be the sample size.

Data Collection: Items from a previous study carried out in Jeddah, Saudi Arabia¹¹ were incorporated in a pre-made online questionnaire. Using Google Forms, a self-administered survey in Arabic was disseminated via social media sites Instagram (Meta Platforms, Inc., Menlo Park, California, United States), WhatsApp (WhatsApp LLC, Menlo Park, California, United States), and Twitter (Twitter, Inc., San Francisco, California, United States). The method of convenience sampling was applied. The survey was broken up into three portions and contained twenty-two questions. Patients' consent, agreement to participate in the study, and demographic data, such as age, gender, marital status, and educational attainment, were all included in Section one. The second section inquired about eye condition medical and family history. The third section focused on evaluating KC awareness and perception and how it relates to eye rubbing. For the knowledge assessment, each correct response was assigned one point, and the total score was calculated by summing the points for all questions. A score below 60% of the maximum possible score indicated poor awareness, while a score of 60% or higher reflected good awareness⁹.

Data Analysis: The data were analyzed using SPSS version 26. Descriptive statistics, such as means and standard deviations (Mean

Table 1. Demographic characters of participants (n=717)

Variable	n (%)
Age (years)	
18-30	296 (41.3)
31-40	159 (22.2)
41-50	151 (21.1)
> 50	111 (15.5)
Age (years) (Mean ±SD)	35.99 ±13.41
Gender	
Female	523 (72.9)
Male	194 (27.1)
Mitral states	
Single	315 (43.9)
Married	402 (56.1)
Education level	
Below secondary	24 (3.3)
Secondary	155 (21.6)
Diploma	56 (7.8)
Bachelor's	404 (56.3)
Postgraduate	78 (10.9)
Are your healthcare workers?	
No	530 (73.9)
Yes	187 (26.1)

Table 2. Prevalence of allergies and vision problems (n=717)

Variable	N (%)
Did you have any type of allergy?	
No	301 (42)
Yes	416 (58)
If yes, what type of allergy?	
Eye allergy	171 (41.1)
Nasal allergy	188 (45.2)
Chest allergy	95 (22.8)
Food or antibiotic allergy	70 (16.8)
Skin allergy	132 (31.7)
Gastrointestinal tract allergy	31 (7.5)
Do you have visual/eye problems?	
No	292 (40.7)
Yes	425 (59.3)
If yes, what visual/eye problem?	
Refractive error	343 (81.3)
Squint	19 (4.5)
Use visual lenses	60 (14.2)
Keratoconus	24 (5.7)
Surgery for RE	67 (15.9)
Eye surgery	9 (2.1)
Is there a family history of keratoconus	
No	665 (92.7)
Yes	52 (7.3)
Why do you rub your eyes?	
I don't rub my eye	127 (17.7)
Itchy	294 (41)
Allergy	123 (17.2)
Stress or headache	173 (24.1)

± SD), were used for quantitative data. For qualitative data, expressed as frequencies and percentages, the Chi-squared test (χ^2) was applied to assess relationships between variables. Non-parametric data were analyzed using the Mann-Whitney and Kruskal-Wallis tests. Correlations were evaluated using Spearman's test, and a p-value of less than 0.05 was considered statistically significant.

RESULTS

Among the 717 participants, 41.3% were aged between 18 and 30 years, with an average age of 35.99 ± 13.41 years. The majority (72.9%) were female, and 56.1% were married. Over half (56.3%) held a bachelor's degree, while 26.1% worked in healthcare (Table 1).

The study revealed that 58% of participants reported having allergies, with nasal allergies (45.2%) and eye allergies (41.1%) being the most common. More than half (59.3%) experienced visual or eye problems, with refractive errors (81.3%) being the most frequent issue. Only 5.7% were diagnosed with keratoconus (KC), and 7.3% had a family history of the condition. The primary reason for eye rubbing was itchiness (Table 2).

Findings showed that only 38.2% of participants had heard of KC, and just 23.3% were aware that it involves thinning of the cornea. Approximately 35% recognized a link between KC and allergies, while 43.7% knew that KC could cause visual impairment. A significant portion (43.4%) were unaware of KC treatments, and only 3.1% believed it was untreatable. Although 64% acknowledged that frequent eye rubbing could harm the eyes, only 13.9% understood it could lead to KC (Table 3).

The most common sources of information about KC were physicians (14.4%), social media (9.3%), and the internet (9.2%) (Figure 1).

Only 2.9% of participants demonstrated good knowledge of KC (Figure 2).

While higher levels of knowledge were observed among those aged 18–30 years (57.1%), females (71.4%), single individuals (57.1%), those with a bachelor's degree (85.7%), and non-healthcare workers, these associations were not statistically significant ($p > 0.05$) (Table 4).

A significant negative correlation was found between participants' age and their total knowledge score ($r = -0.08$, $p = 0.019$) (Figure 3).

Additionally, good knowledge of KC was significantly higher among those who used visual lenses (50%) ($p < 0.05$). However, no significant relationship was found between KC knowledge and the presence of allergies or other vision problems ($p > 0.05$) (Table 5).

Participants diagnosed with KC showed a significantly higher prevalence of good knowledge (25%) ($\chi^2 = 8.85$, $p = 0.003$) (Figure 4).

DISCUSSION

In this study, of the 717 participants, the majority were females (72.9%) and 56.3% had a bachelor's degree, and 26.1% were healthcare workers.

Table 3. Participants' responses to knowledge items about keratoconus (N=717)

Variable	N (%)
Heard about keratoconus	
No	443 (61.8)
Yes	274 (38.2)
What is keratoconus?	
Don't know	315 (43.9)
Corneal inflammation	83 (11.6)
Increased corneal thickness	131 (18.3)
Autoimmune disease	21 (2.5)
Thinning of corneal thickness (correct answer)	167 (23.3)
Is there a relationship between keratoconus and allergy?	
No	79 (11)
Don't know	385 (53.7)
Yes (correct answer)	253 (35.3)
Does keratoconus lead to visual impairment?	
No	30 (4.2)
Don't know	374 (52.2)
Yes (correct answer)	313 (43.7)
Treatment method of keratoconus	
Medical glass	165 (23)
Medical lenses	100 (13.9)
Eye drops	88 (12.3)
Surgery	244 (34)
Don't know	326 (45.5)
No treatment present (correct answer)	22 (3.1)
Frequent eye rubbing is:	
A safe habit	28 (3.9)
A habit that may lead to keratoconus (correct answer)	100 (13.9)
A habit that may harm the eye	459 (64)
Don't know	130 (18.1)

Figure 1. Sources of information regarding keratoconus among studied participants (n=717)

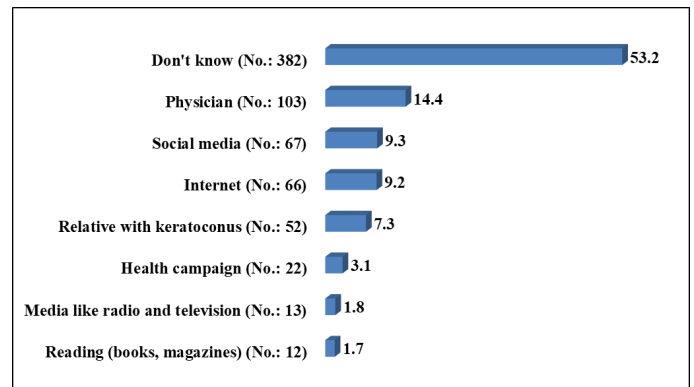


Figure 2. Percentage distribution of level of knowledge about keratoconus (n=717)

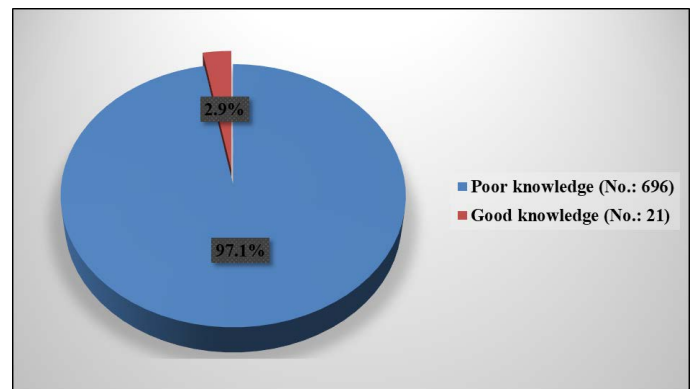


Figure 3. Spearman's correlation analysis between the total knowledge score and participants' age.

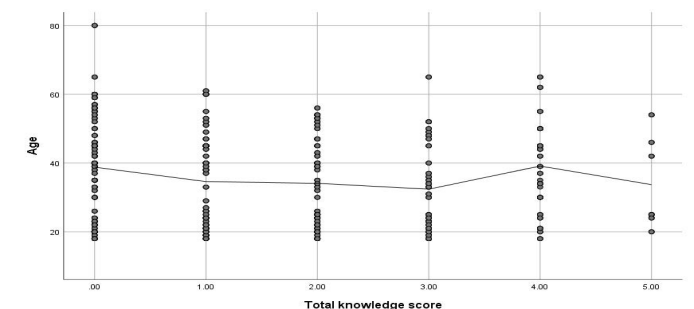


Figure 4. Relationship between level of knowledge about keratoconus and previous diagnosis (N=717)

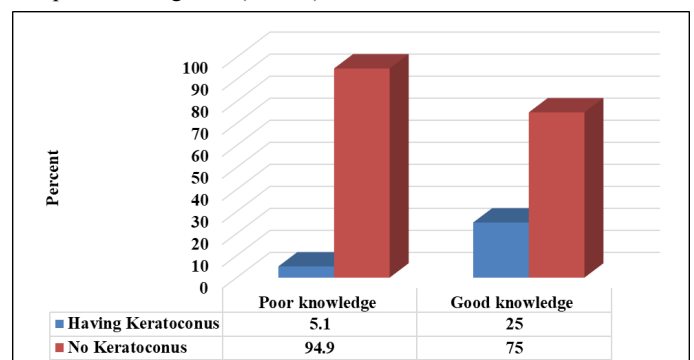


Table 4. Relationship between level of knowledge about keratoconus and participants' demographics and being a healthcare worker (n=717)

Variable	Knowledge level		χ^2	p-value
	Poor knowledge N (%)	Good knowledge N (%)		
Age (years)				
18-30	284 (40.8)	12 (57.1)	6.71	0.082
31-40	159 (22.8)	0 (0.0)		
41-50	145 (20.8)	6 (28.6)		
> 50	108 (15.5)	3 (14.3)		
Age (years) (Mean $\pm$ SD)	36.05 $\pm$ 13.41	33.71 $\pm$ 12.64		
Gender				
Female	508 (73)	15 (71.4)	0.02	0.874
Male	188 (27)	6 (28.6)		
Mitral states				
Single	303 (43.5)	12 (57.1)	1.53	0.216
Married	393 (56.5)	9 (42.9)		
Education level				
Below secondary	24 (3.4)	0 (0.0)	8.61	0.071
Secondary	152 (21.8)	3 (14.3)		
Diploma	56 (8)	0 (0.0)		
Bachelor's	386 (55.5)	18 (85.7)		
Postgraduate	78 (11.2)	0 (0.0)		
Are your healthcare workers?				
No	518 (74.4)	12 (57.1)	3.15	0.076
Yes	178 (25.6)	9 (42.9)		

Table 5. Relationship between level of knowledge about keratoconus and the prevalence of allergies and vision problems among studied participants (N=717)

Variable	Knowledge level		χ^2	p-value
	Poor knowledge N (%)	Good knowledge N (%)		
Did you have any type of allergy?				
No	289 (41.5)	12 (57.1)	2.04	0.153
Yes	407 (58.5)	9 (42.9)		
If yes, what type of allergy?				
Eye allergy	168 (41.3)	3 (33.3)	0.23	0.632
Nasal allergy	182 (44.7)	6 (66.7)	1.71	0.191
Chest allergy	95 (23.3)	0 (0.0)	2.72	0.099
Food or antibiotic allergy	70 (17.2)	0 (0.0)	1.86	0.173
Skin allergy	129 (31.7)	3 (33.3)	0.01	0.917
Gastrointestinal tract allergy	31 (7.6)	0 (0.0)	0.74	0.389
Do you have visual/eye problems?				
No	283 (40.7)	9 (42.9)	0.04	0.84
Yes	413 (59.3)	12 (57.1)		
If yes, what visual/eye problem?				
Refractive error	331 (80.7)	12 (100)	2.84	0.092
Squint	19 (4.6)	0 (0.0)	0.58	0.445
Use visual lenses	54 (13.2)	6 (50)	12.96	<0.001
Keratoconus	21 (5.1)	3 (25)	8.58	0.003
Surgery for RE	67 (16.3)	0 (0.0)	2.33	0.127
Eye surgery	9 (2.2)	0 (0.0)	0.26	0.604
Is there a Family history of keratoconus				
No	644 (92.5)	21 (100)	1.69	0.193
Yes	52 (7.5)	0 (0.0)		
Why do you rub your eyes?				
I don't rub my eye	121 (17.4)	6 (28.6)	5.34	0.148
Itchy	285 (40.9)	9 (42.9)		
Allergy	123 (17.7)	0 (0.0)		
Stress or headache	167 (24)	6 (28.6)		

It was found that 58% of the participants had allergies, nasal allergy (45.2%) and eye allergy (41.1%) were the most common. More than half (59.3%) had visual/eye problems, with refractive errors (81.3%) the most common problem and only 5.7% had KC. Only 7.3% had a family history of keratoconus, in a previous study conducted in Jeddah by Alnahdi et al., skin atopy was the most common (17.9%) and only 3.8% reported keratoconus¹¹. In a recent study in Al-Taif conducted by Alshehri et al., nearly half of the participants (49.7%) reported a history of allergies, with the most common type being eye allergies, affecting 151 participants (54.3%). With a small number of participants, 22 (4.4%) were diagnosed with keratoconus, with 90 (18.0%) reported a family history of the disease¹². A high prevalence levels of allergies were shown in the western region of Saudi Arabia^{13,14}.

Although only 38.2% heard about keratoconus, and 23.3% knew that it was a thinning of corneal thickness. Only 35% knew about the correlation between allergies and keratoconus. The majority of participants (64%) acknowledged that frequent eye rubbing is harmful to the eye, but most of the participants (43.4%) did not know the treatment of keratoconus, which emphasizes the need for targeted educational initiatives to increase awareness. These findings align with Alnahdi et al., which showed that 48.8% of the participants had previously heard about KC and only 21.4% of the participants reported correctly that KC is thinning of the cornea¹¹.

Furthermore, research in the region of Asser revealed that 59.0% of study subjects said they knew about KC. In terms of their knowledge of KC, 26.9% were aware that it causes a decrease in corneal thickness, 27.3% thought that KC and allergies were related, and 59% said that it can cause blindness¹⁰. These results demonstrated ignorance of KC and the value of public health education.

This study highlighted a significant lack of awareness about KC and its association with eye rubbing among the general population in Makkah, Saudi Arabia. These findings are consistent with similar studies conducted in other regions, such as Madina, Hail, and Aseer, where awareness levels ranged from 5.9% to 14.26%^{9-11,15,16}.

Eye rubbing emerged as a key risk factor in this study, with participants frequently engaging in the behavior due to itching caused by allergies. This finding aligns with Alnahdi et al., who reported that 75.8% of participants in Jeddah engaged in eye rubbing, with a significant portion identifying itching as the cause¹¹. Similarly, Sahebjada et al. confirmed in a meta-analysis that eye rubbing is a major environmental trigger for KC progression in genetically predisposed individuals¹⁵. These findings emphasize the importance of public education on the harmful effects of eye rubbing.

Demographic factors such as education level and family history of KC were significant predictors of awareness in this study. Participants with higher education or a family history of KC demonstrated greater knowledge, consistent with findings from Hail, Madina, and Aseer^{9,10,15}. However, the absence of a significant association between age and awareness in this study contrasts with other regions, where younger individuals were typically less informed^{9,15}.

The reliance on non-medical information sources, such as social media and the internet, further underscores the need for healthcare providers to play a more proactive role in education. Studies in Jeddah, Riyadh, and Madina highlighted the effectiveness of structured health campaigns delivered through clinical settings and public initiatives^{11,15,16}.

Timely detection and intervention remain critical in managing KC, especially given its silent progression during its early stages. Advanced

diagnostic tools, including corneal tomography, and therapeutic options like corneal cross-linking, are effective but underutilized due to poor public awareness^{10,15}. Public health campaigns should promote early diagnosis and discourage modifiable risk factors, such as eye rubbing, to reduce disease progression.

Hence, this study underscores the urgent need for targeted educational initiatives addressing the lack of awareness about KC and its risk factors. By increasing public knowledge and encouraging preventive behaviors, healthcare authorities can improve early diagnosis rates and reduce the burden of advanced KC cases in Saudi Arabia.

This study investigated the relationship between knowledge about keratoconus and various health outcomes, including allergies, vision problems, and previous diagnoses, among 717 participants. The findings revealed significant patterns that highlighted the importance of awareness and education regarding keratoconus. With similar studies conducted in other regions, such as Madina, Hail, and Aseer^{9-11,15,16}.

The analysis of allergy prevalence showed that participants with poor knowledge reported a higher rate of allergies (58.5%) compared to those with good knowledge (42.9%), although this difference was not statistically significant (p -value=0.153). This lack of significance suggested that knowledge about keratoconus might not directly influence allergic conditions. Other factors, such as environmental exposures and genetic predispositions, might play a more critical role in allergy prevalence. In contrast, a significant relationship was found between knowledge and visual problems. Participants with poor knowledge reported a lower prevalence of keratoconus (5.1%) compared to those with good knowledge (25%), yielding a p -value of 0.003. This suggested that greater awareness was associated with higher recognition of keratoconus, potentially leading to earlier diagnosis and intervention. Additionally, the significant difference in the use of visual lenses (p <0.001) indicated that individuals with better knowledge were more likely to seek corrective measures.

The study also found a statistically significant negative correlation between age and knowledge score (r = -0.08, p -value=0.019). This suggested that older participants might possess less knowledge about keratoconus, possibly due to reduced access to educational resources or changing information dissemination methods over time. This finding emphasized the need for educational programs specifically designed to address the knowledge gaps in older populations^{9,15}.

Regarding the family history of keratoconus, no participants with good knowledge reported such a history, while 7.5% of those with poor knowledge did. This highlighted potential differences in awareness that could affect diagnosis and management strategies. Additionally, the reasons for eye rubbing did not significantly differ between knowledge levels, suggesting that such behaviors might stem more from habitual actions than from a lack of understanding about keratoconus. Overall, the findings underscore the critical need for targeted educational initiatives aimed at increasing awareness about keratoconus across all age groups. Enhancing knowledge can lead to better management of visual health and potentially improve outcomes for individuals at risk of keratoconus^{11,15,16}.

This study highlights significant relationships between knowledge about keratoconus and both allergy prevalence and visual problems. The negative correlation between age and knowledge scores further emphasizes the importance of tailored educational efforts. Future research should focus on evaluating the effectiveness of such interventions and exploring additional factors influencing knowledge and health outcomes related to keratoconus.

CONCLUSION

This cross-sectional study revealed a substantial gap in awareness about KC and the harmful impact of eye rubbing among adults in Makkah, Saudi Arabia. Although most participants recognized that frequent eye rubbing can damage the eye, only a small fraction understood its specific role in contributing to KC. Furthermore, overall knowledge levels were strikingly low, with merely 2.9% of participants demonstrating “good” awareness. These findings underscored the need for enhanced educational initiatives—both community-wide and in clinical settings—that focus on early detection, prevention strategies, and treatment options for KC. Promoting accurate information about risk factors such as ocular allergies and habitual eye rubbing might facilitate earlier diagnosis and intervention, ultimately mitigating the progression of KC and improving visual outcomes. Future research should examine the effectiveness of tailored awareness campaigns and explore additional demographic and clinical variables that might influence knowledge levels and preventive behaviors.

Authorship Contribution: After reviewing the final draft for publication, all authors agreed to take responsibility for every part of the work.

Potential Conflicts of Interest: None

Competing Interest: None

Acceptance Date: 21 July 2026

REFERENCE

1. Krachmer JH, Feder RS, Belin MW. Keratoconus and related noninflammatory corneal thinning disorders. *Surv Ophthalmol* 1984;28(4):293-322.
2. Rabinowitz YS. Keratoconus. *Surv Ophthalmol* 1998;42(4):297-319.
3. Naderan M, Rajabi MT, Zarrinbakhsh P, et al. Effect of Allergic Diseases on Keratoconus Severity. *Ocul Immunol Inflamm* 2017;25(3):418-423.
4. Gokul A, Patel DV, McGhee CN. Dr. John Nottingham's 1854 Landmark Treatise on Conical Cornea Considered in the Context of the Current Knowledge of Keratoconus. *Cornea* 2016;35(5):673-8.
5. Hashemi H, Heydarian S, Hooshmand E, et al. The Prevalence and Risk Factors for Keratoconus: A Systematic Review and Meta-Analysis. *Cornea* 2020;39(2):263-270.
6. Shammari RS. Prevalence, clinical features, and associated factors of keratoconus patients attending ophthalmology department, King Khalid Hospital, Hail City, Saudi Arabia. *J Clin Exp Ophthalmol* 2015;6(3):1.
7. Bawazeer AM, Hodge WG, Lorimer B. Atopy, and keratoconus: a multivariate analysis. *Br J Ophthalmol* 2000;84(8):834-6.
8. Kaldawy RM, Wagner J, Ching S, et al. Evidence of apoptotic cell death in keratoconus. *Cornea* 2002;21(2):206-9.
9. Kordi ES, Almokhtar AM, Alshareef EK, et al. Alharbi JO, Alharbi AH. Awareness About Keratoconus and Its Relation With Eye Rubbing: A Cross-Sectional Study in Medina. *Cureus* 2022;14(11):e32030.
10. Alamri A, Alrizqi AA, Aljohani AA, et al. Awareness of Keratoconus and Its Association With Eye Rubbing Among the Population in Aseer Province. *Cureus* 2023; 15(7): e41271.
11. Alnahdi A. Eye rubbing: a survey of awareness of keratoconus and its relation with eye rubbing in Jeddah. *World Fam Med J* 2021;19(2):141-50.
12. Alshehri AM, Bajunaid M, Althobaiti RA, et al. Awareness of keratoconus among the population of Taif City, Saudi Arabia: a cross-sectional study. *Cureus* 2024;16(10):e72170.
13. Alkhawajah AA, Buali HH, Alzahrani MM, et al. Public knowledge, attitude, and practice toward *Helicobacter pylori* infection in Saudi Arabia. *IJMDC* 2024;8(1):227-233
14. Almughais ES, Alshehri MH, Alsatti M, et al. Awareness and perception of anti-obesity medications among Al-Ahsaa, Riyadh, and Hail in Saudi Arabia populations. *Cureus* 2023;15(6):e40425.
15. Sahebjada S. Eye rubbing in the etiology of keratoconus: a systematic review and meta-analysis. *Graefes Arch Clin Exp Ophthalmol* 2021;259:2057-67.
16. Alshammari ZA. The level of awareness of keratoconus among the general population in Hail Region, Saudi Arabia. *Cureus* 2023;15(12):e50026.