

# Keratoconus Epidemiology Presentations at Najran Province, Saudi Arabia

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**Aim:** Our study aims to produce an estimation of the keratoconus disease epidemiology and important demographic factors in disease presentation in Najran city in the south of Saudi Arabia.

**Methods:** Keratoconus patients between 9 and 29 years of age at the eye clinic of King Khaled General Hospital in Najran Province with a confirmed diagnosis of keratoconus were recruited over one year period. Visual acuity, keratometry, corneal thickness and demographic data were collected and analysed.

**Results:** The keratoconus prevalence in Najran Province was found to be 87.3 cases per 100,000 people with an incidence of 28.47 per 100,000 cases. The disease presented more frequently in male patients (67.9%) with a statistically significant difference in the mean age between genders ( $p=0.014$ ). Most cases presented at a moderate stage, and almost half of the cases reported a family history of the disease. There were statistically significant differences in best visual acuity and corneal thickness between genders ( $p<0.05$ ). The majority of the cases were managed with contact lenses (56.08%).

**Conclusion:** Genetic and environmental factors could have a substantial role in the increased rate of keratoconus presentation in Najran Province. Screening programmes should dedicate more attention to late presentation to improve prevention and early detection. More studies on keratoconus epidemiology in Saudi Arabia are needed.

**Keywords:** keratoconus, incidence, prevalence, epidemiology, cornea

## Introduction

Keratoconus (KC) is characterised as a non-inflammatory, ectatic disorder of the cornea.<sup>1</sup> Typically, this disease is a progressive and bilateral yet asymmetric condition<sup>2</sup> which predominantly impacts the inferior-central two-thirds of the cornea.<sup>3</sup> During the early stages, stromal thinning results in a protruding conical shape, which induces “irregular” astigmatism and significant higher-order aberrations, both of which negatively impact visual performance.<sup>4</sup> Existing literature indicates that KC tends to occur in adolescence,<sup>3</sup> and the likely course of progression extends to the age of 30 or 40.<sup>5</sup>

The prevalence and incidence of KC has not yet been accurately determined. An early study has reported that the frequency of KC ranges from 50 to 230 cases per 100,000 individuals in the general population across North America.<sup>3</sup> A more recent study has estimated the incidence of KC as 5 to 23 cases per 10,000 people and its prevalence as 5.4 per 10,000.<sup>6</sup> Several analyses found on topographic data together with ocular slit-lamp examination which were conducted within the UK have demonstrated a KC frequency of 32 to 65 cases per 100,000 people.<sup>7-9</sup> The

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prevalence of KC varies widely; the corneal ectatic disorder affects an approximate average of 1 in 2000 individuals in any population, is equally distributed between men and women<sup>10,11</sup> and ranges from about 50 to 230 cases per 100,000 people.<sup>10</sup> A recent study on its prevalence in Saudi Arabia produced a ratio of 1:21 people in the population.<sup>12</sup> The disease is believed to be more common amongst Asians than Caucasians.<sup>13,14</sup> There is significant interest in investigating this ratio in different areas in Saudi Arabia and especially in the southern region of the country.

The purpose of our study is to provide the first epidemiological analysis to produce an estimation of the prevalence of KCN in Najran city in the south of Saudi Arabia.

## Participants and Methods

Data for this prospective, cross-sectional and observational study were obtained from a database of patients at the eye clinic of King Khaled General Hospital. The confidentiality and privacy of patients were maintained throughout the study. The study gained ethical approval from ministry of health-Saudi Arabia with IRB registration with KACST, KSA:H-11-N-081. The patients and parent or legal guardian of participants under 18 years of age provided informed consent. This study was conducted according to the declaration of Helsinki.

The routine daily clinical visit database was used to identify the KCN patients. The research analyses eye clinic visitors over a period of at least 6 to 12 months. The investigation is based on click study protocol.<sup>15</sup>

Recruitment extended to all patients of the Department of Ophthalmology at King Khaled General Hospital in Najran, Saudi Arabia between 2019 and 2020 who were suspected of having KC as well as patients who had been newly diagnosed with KC but were attending other tertiary hospitals in Najran Province. All subjects were examined for their case history, visual acuity, keratometry, refraction and ocular signs. Diagnoses were established based on changes in best-corrected visual acuity, familial KC, an irregular surface as evidenced by distorted corneal curvature, keratometry and corneal topography by means of a Pentacam (OCULUS, Wetzlar, Germany). There are many classifications to describe the severity of KC. For this research, we applied the keratometric classification, as it is a simple and applicable practice at our unit. According to average keratometric readings, eyes were sub-classified into mild (<48 dioptres), moderate (48–54 dioptres) or

severe (>54 dioptres) KC, scissoring of the retinoscopy reflex, or irregularity in the red reflex on direct ophthalmoscopy. Clinical signs included at least one of the following: central corneal thinning, apical stromal scarring, Vogt's striae, Fleischer's ring and Munson's sign. The sample excluded unusual cases for which a diagnosis could not be established with confidence. Continuous data are presented as mean  $\pm$  standard deviation. Frequency and prevalence data are presented as n (%). Data normality was verified using a standard normality test, continuous data were compared using unpaired Student's *t*-tests and categorical data were compared using chi-square tests. The results were analysed by using the package of SPSS23.

## Results

According to a 2019 report by the General Authority for Statistics in Saudi Arabia, the total population of Najran Province was 608,467 people, of whom 210,739 were between 9 and 29 years of age. King Khaled General Hospital is the main hospital that provides eye care. Keratoconus was present in 312 eyes amongst 184 patients attending this hospital. The annual prevalence of KC in Najran was found to be almost 87.3 cases per 100,000 in the city's population of individuals between 9 and 29 years of age. The incidence rate was found to be 28.47 cases per 100,000 in the targeted population. This disorder affected 0.41% of patients at the eye clinic of King Khaled General Hospital (Table 1).

Most of the KC patients were male (125; 67.9%), while 59 (32.0%) were female. The mean age was 26.45 years with a statistically significant age difference between genders ( $p=0.014$ ).

LogMAR visual acuity results were found to decrease alongside an increase in disease severity. However, visual acuity was stronger in males than in females to a statistically significant degree ( $p=0.0018$ ). There was no statistically significant difference between males and females in terms of corneal thickness pachymetry readings ( $p>0.05$ ; Table 2). In addition, improvement to visual acuity per eye was achieved with spectacles in 123 cases (39.4%) and with soft or hard contact lenses in 175 cases

**Table 1** Demographic Data for KC Patients

	Total	Female	Male
Age	26.45, $p=0.014$	27.66	25.73
Patients	184	59	125
Eye	312	115	196

**Table 2** Visual Acuity and Corneal Thickness Differences Between Males and Females in KC Cases

	Total	Female	Male
LogMAR visual acuity	0.38, p=0.0018	0.45	0.34
Pachymetry	453.37, p>0.05	454.57	452.67

(56.08%), and 14 cases (4.8%) were in need of a PKP procedure.

A family history of KC was present in 89 patients (48.3%), whereas 95 patients (51.7%) reported no family history. Most of the cases were in the moderate stage. Based on keratometry results, which were graded according to the Zednik grading system, the average keratometry reading was 50.47 mm for disease severity, and statistically significant differences were observed between males and females (p=0.03; Table 3).

## Discussion

The occurrence of KC varies widely at the global level according to the sample selection of patients, the location and the criteria for identification. Research has suggested an incidence and prevalence ranging from 0.3 cases per 100,000 people in Russia<sup>16</sup> to 2300 cases per 100,000 in India.<sup>17</sup> Only a few studies have explored KC in Saudi Arabia. For instance, Dr Assiri and his colleague have considered the incidence of KC in Asir Province in the south of Saudi Arabia and reported an estimation of 20 cases per 100,000 people.<sup>18</sup> In addition, KC has been cited as the most common reason for not performing refractive surgery in Saudi Arabia, accounting for almost one-quarter of cases and occurring with a proposed incidence of 18.7%.<sup>19</sup> Finally, recent reports have specified a higher rate of KC in children (1 case per 21) in Saudi Arabia compared to in other countries.<sup>20</sup>

Our study is the first report regarding KC epidemiology in Najran. Our results are comparable to those of other

**Table 3** Disease Severity Differences Between Males and Females Based on Keratometry Readings

	Total	Female	Male
Early stage	95	28	67
Moderate stage	200	89	111
Advanced stage	16	5	11
K1	44.2	45.1	43.63
K2	50.47	51.36	49.95
K average	47.33	48.26	46.79

reports from several locations in the world. Although some studies have identified a higher prevalence amongst women, our study observes a higher prevalence amongst men.<sup>5,21</sup> Family history also appears to be an important factor for the presentations of KC in Najran Province, which is consistent with studies that have suggested genetics as a factor<sup>22</sup> with a high rate of consanguinity.<sup>7</sup> However, the rate of KC presentation in our research exceeds that in comparable studies.<sup>23</sup> Our study further agrees with previous findings concerning the occurrence of bilateral and asymmetric disease. The prevalence rates of KC in certain areas like Arab Gulf and Egypt could be higher than previously believed.<sup>24,25</sup>

Environmental factors might also be relevant, as the hot, dry weather in Najran Province may increase the prevalence of KC.<sup>18</sup> In contrast, locations with colder temperatures exhibit lower incidences of KC.<sup>5,26</sup> Furthermore, the presentation of KC may be associated with a diversity of influences, such as eye rubbing, Down's syndrome, atopic disease, connective tissue disease, tapetoretinal degeneration and inheritance; nevertheless, its aetiology and pathogenesis are still indefinite.<sup>3</sup>

The average age for KC diagnosis in our study is relatively high considering that the disease emerged between the ages of 10 and 20 and progressed until the early 30s.<sup>9,27</sup> Late presentation could be a prominent reason for requiring keratoplasty rather than other forms of management, as non-surgical KC management tools could be utilised when the disease is diagnosed early.<sup>3,28</sup>

Rapid changes in corneal curvature, diminished visual acuity and heightened irregular astigmatism are considered warning signs of KC. Timely action in response to these signs is imperative for early detection and management. Late presentation of patients to the eye care centre could be reduced by educating the population as well as empowering eye care specialists and optometrists in primary health care centres, as they have a heavy impact on early disease detection and can refer cases to more specialised centres when appropriate.

Our study was limited by the absence of certain key demographic information. The nature of the study was a further limitation, as it is expected that some cases were missed due to geographical difficulties and population awareness hindering access to eye health care services.

Our study suggested a national screening programme, which helps in reducing the late presentation rate for the KC cases. That will have effectively help at increase survival rate to avoid corneal transplant. Most of Saudi

Arabia have similar habit in marriage; most of the cities have similarity in weather except some area. That increase the need of screening programme.

## Conclusion

The prevalence and incidence of KC in Najran Province is high in comparison to figures reported in other studies. The presentation of KC in Najran could be influenced by numerous factors, including genetics and environmental aspects. In the majority of cases, patients presented to the hospital by 3rd decade, and the disease was more prevalent in males. Knowledge of the epidemiology of KC is important for treatment plans and management of the disease. Moreover, it is crucial for improving the ability of clinicians to detect early corneal changes. The data obtained from this study can act as a reference guide for government officials, clinicians and trainees.

## Disclosure

The authors reported no conflicts of interest for this work.

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