



KERATOCONUS IN NORTH INDIA: A DEMOGRAPHIC AND CLINICAL PROFILE STUDY

Dr Kavya Bansal¹, Dr Rupali Kashyap², Dr Tanvi Gupta^{3*}, Dr Tanisha Mittal⁴

¹. Senior Resident, Department of Ophthalmology, Guru Nanak Eye Centre, Maulana Azad Medical College, New Delhi

². Senior Resident, Department of Ophthalmology, Sardar Vallabh Bhai Patel Hospital, New Delhi

^{3*} Senior Resident, Department of Ophthalmology, University College of Medical Sciences and GTB hospital, Delhi

⁴. Cornea Fellow, LJ Eye Institute, Ambala

***Corresponding Author:** Dr Tanvi Gupta

*E-mail: tanvidoc.ssn@gmail.com

Abstract

Purpose: To evaluate the demographic profile and clinical characteristics of newly diagnosed patients with keratoconus (KC) in North India and to analyze the relationship between age, sex, and disease severity.

Methods: A cross-sectional observational study was conducted at a tertiary eye care hospital between August 2020 and July 2022. Two hundred sixty-eight consecutive patients with clinically confirmed KC were included. Each underwent comprehensive evaluation, including visual acuity testing, slit-lamp biomicroscopy, and corneal imaging with the Sirius (CSO, Florence, Italy) systems [8]. Data regarding age, sex, and maximum keratometry (K max) were collected. KC severity was graded using K max. Statistical analyses were performed using SPSS v20, with $p < 0.05$ considered significant.

Results: The mean self-reported age at first presentation was 19.3 ± 6.1 years, and the mean age at diagnosis was 20.4 ± 6.0 years (range 4–43). Of the total patients, 62% ($n = 166$) were male and 38% ($n = 102$) were female. The mean K max was 59.4 ± 13.2 D. Most patients were diagnosed between 14 and 23 years, presenting with moderate-to-severe disease (K max = 51–61 D). Pediatric KC (≤ 18 years) accounted for 39% ($n = 104$), while adult KC (> 18 years) comprised 61% ($n = 164$). Pediatric cases showed significantly higher mean K max (62.1 ± 15.0 D) than adults (57.2 ± 11.4 D, $p < 0.01$). A weak negative correlation between age and K max ($r = -0.21$, $p = 0.04$) indicated a mild decline in severity with increasing age [9].

Conclusion: KC in North India presents predominantly in late adolescence and early adulthood with a male predominance [2]. Pediatric KC tends to be more severe. Regional screening and awareness programs are essential for early detection and intervention.

Introduction

Keratoconus (KC) is a progressive, bilateral, non-inflammatory condition characterized by stromal thinning and corneal ectasia, leading to irregular astigmatism and vision impairment [1]. The global prevalence is approximately 1.38 per 1000 individuals, with slightly higher rates among males [2]. A

complex interplay of genetic, biomechanical, biochemical, and environmental factors plays a major role [3]. Clinically, it presents with findings such as corneal protrusion, Fleischer's ring, and Vogt's striae confirmed by topographic imaging [4].

The disease typically manifests during puberty and progresses through late teens and early adulthood [5]. Various studies have shown earlier onset and faster progression among Asian populations [6,7]. Despite this, large-scale Indian epidemiological data—especially from the Northern region—remains limited [9]. This study aimed to describe the demographic and clinical profile of newly diagnosed KC patients in the Northern region and explore the relationship between age, sex, and KC severity.

Materials and Methods

This was a cross-sectional observational study conducted at a tertiary eye care hospital in Northern India between August 2020 and July 2022.

Inclusion criteria: Newly diagnosed patients with clinical KC, with or without ocular inflammation [9].

Exclusion criteria: Corneal degenerations, corneal infections or dystrophies, secondary ectasia (post-LASIK or traumatic) and previous ocular surgery [10].

Examination protocol: Ocular history, visual acuity testing, slit-lamp biomicroscopy, corneal topography (Atlas 9000), pachymetry (Sirius CSO), and fundoscopy [8] was done for all the patients. KC diagnosis required topographic KC probability $\geq 40\%$, anterior elevation $\geq 12 \mu\text{m}$, and posterior elevation $\geq 25 \mu\text{m}$ [9].

Statistical analysis: Data were analyzed using SPSS v20 [11]. Mann–Whitney U test compared sex and age groups, and Spearman's correlation assessed relationships between K max and age ($p < 0.05$ significant) [12].

Results

A total of 268 patients with clinical KC were included in the analysis. The mean self-reported age at first presentation was 19.3 ± 6.1 years, and the mean age at diagnosis was 20.4 ± 6.0 years (range: 4–43 years). Of the total patients, 62% ($n = 166$) were male and 38% ($n = 102$) were female. The mean K max was 59.4 ± 13.2 D, consistent with previously reported moderate-to-severe disease in similar populations [10].

Most patients were diagnosed between 14 and 23 years of age, typically presenting with moderate to severe KC (K max = 51–61 D) [9]. Table 1 summarizes the age and sex distribution, showing a male predominance. No significant difference was found in mean diagnostic age between males and females ($p = 0.24$) [11].

Table 1. Age and Sex Distribution of KC Patients (n = 268)

Age group (years)	Males n (%)	Females n (%)	Total n (%)
< 10	6 (2.2)	4 (1.5)	10 (3.7)
10 – 13	20 (7.5)	12 (4.5)	32 (11.9)
14 – 18	44 (16.4)	18 (6.7)	62 (23.1)
19 – 23	48 (17.9)	28 (10.4)	76 (28.3)
24 – 28	20 (7.5)	22 (8.2)	42 (15.7)
29 – 33	14 (5.2)	10 (3.7)	24 (9.0)
34 – 43	14 (5.2)	8 (3.0)	22 (8.2)
Total	166 (62)	102 (38)	268 (100)

Pediatric KC (≤ 18 years) accounted for 39% ($n = 104$), while adult KC (> 18 years) comprised 61% ($n = 164$). Pediatric KC had higher mean K max (62.1 ± 15.0 D) than adults (57.2 ± 11.4 D, $p < 0.01$) [12]. This aligns with global studies showing younger patients present with more advanced disease [13,14].

Table 2 presents KC severity by age group. Although no major sex-related difference in severity was found ($p = 0.27$), females aged 24–28 years had slightly higher K max ($p = 0.03$) [15].

Table 2. KC Severity by Age Group

Age group (years)	Mean K max (D)	Severity Level	Comment
< 10	63.5 ± 15.2	Severe	Rare pediatric onset
10 – 13	61.2 ± 13.1	Severe	Rapid progression possible
14 – 18	62.1 ± 15.0	Severe	Most active progression
19 – 23	59.8 ± 12.5	Moderate – severe	Peak prevalence group
24 – 28	58.0 ± 11.4	Moderate	Female > male severity
29 – 33	56.5 ± 10.8	Moderate	Stable course
34 – 43	54.1 ± 9.9	Mild	Minimal progression

Figure 1. Scatter plot showing the relationship between age and K max ($r = -0.21$, $p = 0.04$), indicating a mild decline in severity with increasing age.

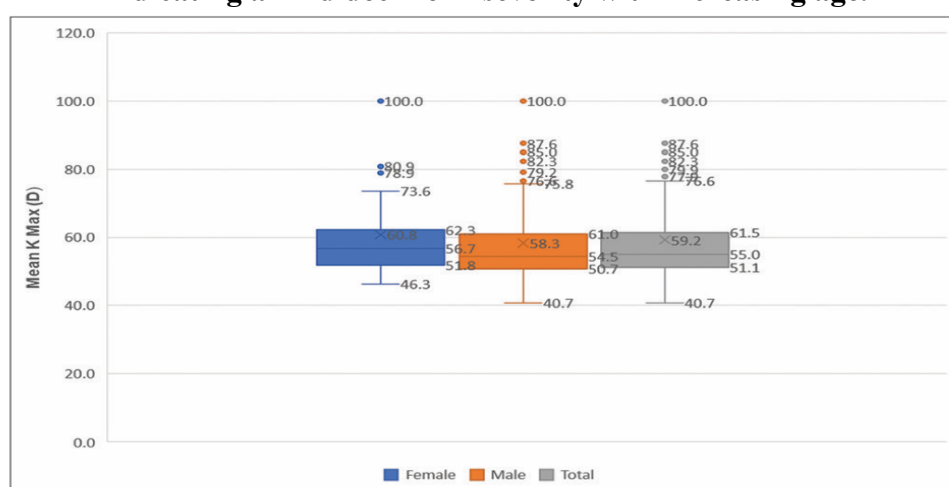


Figure 1: Box and whisker charts of the mean K Max of female keratoconus (KC), male KC, and total KC patients at the time of diagnosis

A weak negative correlation between age and K max ($r = -0.21$, $p = 0.04$) indicated a mild decline in severity with increasing age [16]. Figure 1 shows this correlation trend.

Discussion

This study demonstrates early-onset and moderate-to-severe KC in North India, aligning with prior regional studies [9–12]. The mean diagnostic age (20.4 years) is comparable to reports from India, China, and Oman [9–12], while Iran and New Zealand show older presentation trends [15,16]. Israel and Saudi Arabia report slightly younger ages [13,14]. These variations may result from genetic, environmental and climatic factors [2,3,6].

Male predominance (62%) is noted which corresponds to studies from India, Oman, and Palestine [9,12,17]. However, some literature shows female predominance or no sex difference [13,15]. Females aged 24–28 showed higher severity, possibly linked to hormonal factors as a result of estrogen-related biomechanical softening during pregnancy, use of oral contraceptives and lactation [18,19].

The predominance of adolescent and young adult onset supports the concept that KC manifests during hormonal and biomechanical changes [1,5]. The limited number of diagnoses beyond the fourth decade supports this [17].

Age group under 18 years shows that pediatric KC (39%) are found to be of more severity, confirming that younger patients show faster progression and may need earlier intervention [20,21]. Early detection and management are therefore most important in such cases [9,10].

Conclusion

Keratoconus in the Northern region primarily affects late adolescents and young adults, with a distinct male predominance, consistent with national and global epidemiological trends [9,12]. Pediatric keratoconus, although less frequent, is characterized by earlier onset, rapid progression, and greater disease severity, emphasizing the need for early recognition and timely intervention to preserve visual function [20,21].

Community-level awareness initiatives and school-based screening programs play a critical role in the early detection of keratoconus, particularly in underserved populations. Routine preoperative corneal imaging—using topography or tomography—should be mandated before refractive procedures to identify subclinical or forme fruste cases and prevent iatrogenic ectasia [22].

Further longitudinal, multicentric studies with larger cohorts are warranted to delineate the genetic, environmental, and regional determinants influencing keratoconus expression in Indian populations [10,15]. A deeper understanding of these factors will support the development of evidence-based screening, preventive, and management strategies tailored to regional needs.

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