Optometry Unit Department of Clinical Surgical Sciences,

Faculty of Medical Sciences, St Augustine,

The University of the West Indies.

TITLE: The Epidemiology of Keratoconus in Trinidad and Tobago

STUDENTS: Elicia Bissoon : 816020090

Destiny Lawrence

SUPERVISOR: Dr. Ezinne Ngozika E OD, MOptom

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TITLE OF RESEARCH

The Epidemiology of Keratoconus in Trinidad and Tobago

ABSTRACT

Aim: The aim of this study is to determine the prevalence of Keratoconus in Trinidad.

Method : A clinic based retrospective study was done using files from patients that visited the UWI Optometry Clinic and the Caribbean Eye Institute from the years 2010-2020 and were diagnosed with keratoconus. Information on demography, risks and associated factors, clinical presentation and methods of management and treatment were obtained. Data collected were exported to Statistical Package for Social Science (SPSS). Frequency, percentage frequency and chi-square tests were collected from the data in order to obtain the results.

Result : A total of 150 keratoconus patients' files were used in this study. KC was found to be more prevalent in females (51.7%). It was found to be higher in ages 21-30 (37.10%), and in Indians (57%). 86.67% of KC patients resided in urban areas and 21.33% were first diagnosed in 2021. 9.90% had a family history of KC, 19.2% had allergies and 47% rubbed their eyes. The most common associated systemic diseases were found to be sinus and asthma. Mean VA was 0.9981, mean Kmax was 53.1662 and mean CCT was 481.2952. Most common symptom and signs were decrease in VA (79%) and Vogt's Striae (32.09%). Most popular management method for KC in Trinidad was found to be CXL. (33.33%)

Conclusion - From the findings of the data collected it can be concluded that the prevalence of Keratoconus in Trinidad was found to be higher in females, Indians in Trinidad and ages 21-30.

ABBREVIATIONS

KC – Keratoconus

OD – Right Eye

OS – Left Eye

OU – Both Eyes

CXL – Collagen Cross- linking

SCLS – Scleral Lenses

RGP – Rigid Gas Permeable Lenses

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INTRODUCTION

1.0 Introduction

Keratoconus (KC) refers to the thinning of the cornea and is noted to be seen in 1 in 2000 people (Omer et al, 2021). There is speculation of the many risk factors of KC. As a result of the many case studies and research conducted worldwide, there is now evidence that these factors are indeed linked to KC. The risk factors of KC include genetics, chronic eye inflammation, eye rubbing, age, asthma, allergies and eczema. In a worldwide study conducted, it was found that the ratios of eye rubbing, family history of KC, allergy, asthma and eczema being a risk factor of KC were 3.09, 6.42, 1.42, 1.94 and 2.95 respectively. Keratoconus can be diagnosed by identifying many of its clinical signs, whether early or late. There are external signs, slit lamp signs and retro illumination signs. The external signs of KC are Munson's sign and Rizzuti's sign which are both classified as later, more advanced signs of KC. Slit lamp signs of KC includes Vogt's striae, Fleischer ring, corneal thinning, corneal apical scarring, hydrops, prominent corneal nerves and a rupture in the Bowman's layer. Retro illumination signs of KC are scissoring reflex and oil droplet sign (Christy et al, 2021). It must be noted that though there are many signs of KC, not all are present, at times there may not be any at all. Majority of the time, KC patients are oblivious to the fact that they have KC. The symptoms of KC include blurring of vision, presence of glare and halos around light, difficulty seeing at night, eye irritation or even headaches that are associated with eye pain, increased sensitivity to bright light. For early stages of keratoconus, spectacles can be used to achieve clear vision. However, as it advances, management options comprise of the use of scleral contact lens and corneal collagen cross-linking. Corneal cross-linking consists of the application of vitamin B-12 to the second layer of the cornea. For KC patients who have advanced the most, the management options available are corneal rings, also known as intacs, which are C-shaped rings that are implanted in the eye to flatten the surface of the cornea and a corneal transplant.

In a worldwide study done in 2020, the global prevalence of keratoconus was found to be 1.38 in 1000 population; 20.6 per 1000 in women and 18.33 per 1000 in men. (Hashemi, Heydarian, Hooshmand, Saatchi, Yekta, Aghamirsalim, Valadkhan, Mortazavi, Hashemi, Khabazkhoob et al, 2020).Countries that were found to have a high prevalence of KC are

India (Gokhale et al,2013) , Egypt, South Africa, Kenya, Sudan, Ghana and Nigeria (Akowuah, Kobia-Acquah, Donkar, Adjei-Anang, Ankamah-Lomotey et al, 2021) and Middle Eastern and Asian countries (Hashemi, Khabazkhoob, Yazdani, Ostadimoghaddam, Norouzirad, Amanzadeh, Miraftab, Derakhshan, Yekta et al, 2014).

The cause of KC is not known, but some studies reported it to be hereditary, genetically related and associated with allergic conjunctivitis, hot weather conditions and even consanguineous marriages (Gokhale et al, 2013).Asians were reported to have a higher prevalence of KC than white Caucasians (Gordon et al, 2011).

Keratoconus has been a growing topic worldwide but has continued in being standstill here in Trinidad and Tobago. The epidemiology of keratoconus is not known because no study has been done on keratoconus in Trinidad and Tobago. Available studies on keratoconus were done in (Gokhale et al,2013) and African countries such as Egypt, South Africa, Kenya, Sudan, Ghana and Nigeria (Akowuah, Kobia-Acquah, Donkar, Adjei-Anang, Ankamah-Lomotey et al, 2021).

Trinidad and Tobago is made up of a heterogeneous ethnic population comprising of those of Asian and African descent who have both been proven to have a high prevalence keratoconus in other countries (Gokhale et al, 2013) (Akowuah, Kobia-Acquah, Donkar, Adjei-Anang, Ankamah-Lomotey et al, 2021). Also, unpublished data from optometry clinics in Trinidad shows that there might be a high prevalence of KC in Trinidad. This study therefore aims to determine the epidemiology of KC in Trinidad.

1.1 Background of Study

1.1.1 Globally

Epidemiologic data on Keratoconus is uncovered mostly from hospital-based studies. The reported incidence ranges from 1.3 to 25 per 100,000 per year across various different populations with a prevalence of 8.8 – 229 per 100,000 (Vazrani and Basu, 2013). With regards to ethnicity, it is known that Asians have a higher incidence and prevalence compared to Caucasians and other ethnicities – seen in Europe- insinuating that ethnicity has a great influence on the presence of Keratoconus (American Academy of Ophthalmology, 2015).

In Asia; which includes Middle East, India, Pakistan and Polynesia, the disease is not only more prevalent but may also have early onset and faster progression. The incidence of the

disease in Middle Eastern countries such as Saudi Arabia and Iran was determined to be between 20 in 100,000 and 24.9 in 100,000 and an incidence of 7.6 in 100,000 in Japan (Gokhale et al,2013).

The overall presence of KC in Africa was estimated to be 7.9% with the prevalence of males and females to be 9.3% and 5.8% respectively (Akowuah et al, 2021). The authors recorded no association between KC and gender and age that was found to be of any significance (Akowuah et al, 2021).

Furthermore, the incidence and prevalence rates reported in North America tend to vary widely, as a long-term study recorded a prevalence of 54.5% per 100,000 in the general population (Nallasamy et al, 2019). However, some other studies suggest that the incidence may be as high as 1 in 400 individuals amongst those with family history of Keratoconus than in the general population (Nallasamy et al, 2019).

1.1.2 Regionally

There is no proof of this study being completed anywhere in the Caribbean region. Thorough research was done to ensure that no articles or studies that are Caribbean based were missed, but all of the research done came up empty handed. Therefore, there is no evidence pointing to any background of the epidemiology of Keratoconus in the Caribbean.

However, in Latin America, a variety of studies were found in relation to the prevalence of Keratoconus. In Mexico, the prevalence of keratoconus among the adolescent population between the ages of 10-20 years was shown to be that of 1.8%, affecting 66% of females and 33.3% of males, with the mean age of presentation being 16.1 years. (Valdez-Garcia et al, 2015). It was also found that the most common refractive error amongst keratoconus patients in Mexico was compound myopic astigmatism which had a prevalence of 87.3% and was present in all grades. (Cruz -Becerril et al, 2015).

In Brazil, a correlation between Keratoconus and Dry Eye Disease was found, where 83.6% of Keratoconus patients (51/61) had Dry Eye Disease. (Sandrin et al, 2018). This finding supports the hypothesis that inflammation on the ocular surface is present in Keratoconus patients and might play a role in the progression of Keratoconus, a study also done in Brazil showed that there was a decrease in the number and proportion of patients submitted to corneal transplantation due to keratoconus and an increase in the number and proportion of patients submitted to the surgery due to bullous keratoplasty and Fuchs Endothelial Dystrophy (Libario et al, 2019).

1.1.3 Nationally

Unfortunately like the other Caribbean islands, there are no research-based studies done on the prevalence of the epidemiology of keratoconus in Trinidad and Tobago to this date. Hence there is a strong need for this study to be completed.

1.2 Statement of the Problem

Keratoconus is a progressive condition of the cornea that leads to a decrease in visual acuity, owing to corneal thinning and irregular astigmatism. It is of paramount importance that this disease is detected and treated efficiently. The average prevalence of keratoconus is 1.38 per 1000 in the general population (Fint et al, 2005). Prevalence of KC varies widely across different populations depending on many factors such as geographic location, genetic factors and diagnostic criteria used in different countries, ranging from 9 per 100,000 in Japan to 2300 per 100,000 in India (Gordon shag et al, 2015).The occurrence of KC is also suggested to be greater in countries with dusty, hot and dry climates (Hashemi et al, 2016) which leads research to believe that the environmental factors in genetically susceptible patients may cause the disease. Awareness of the relationship between demographic factors, clinical characteristics and topographic indices will help to plan a regular management protocol that is not only important for diagnosis but also to organize an effective early detection and screening program. Several studies have examined these parameters in various ethnic groups but there has been no studies found regarding the prevalence of keratoconus in Trinidad and Tobago. Therefore this study aims to determine the prevalence of keratoconus among patients that visited UWI Optometry Clinic in Couva and The Caribbean Eye Institute located in Valsayn.

1.3 Aim of Study

The aim of this study is to determine the epidemiology of Keratoconus among patients that visited the UWI Optometry Clinic in Couva and the Caribbean Eye Institute in Valsayn from January 2010 to December 2020.

1.3.1 Specific Objectives

1. To ascertain the demographical characteristics of Keratoconus patients in Trinidad and Tobago.
2. To determine the risk and associated factors.
3. To investigate the methods of clinical presentation.

4. To evaluate the methods of treatment and management.

1.4 Research Questions

1. What are the demographical characteristics of keratoconus patients in Trinidad?
2. What are the risks and associated factors amongst KC patients in Trinidad?
3. What are the methods of clinical presentations of KC in Trinidad?
4. What are the methods of management of KC patients in Trinidad.

1.5 Significance of Study

- The main beneficiary of this study will be the assistance in the research development of KC in Trinidad and Tobago. This will encourage other medical professionals and students to perform research on this topic.
- The community of Trinidad and Tobago can also benefit from this study. If the prevalence is found to be high, a strategy can be put into place in order to raise awareness on the topic as well as to help the community. It may lead to keratoconus being an importance topic in hospitals therefore medical treatment may then be offered in the public health care system
- The participants of this study will also benefit as it will allow them to learn more about their disorder and offer different management options.
- The findings of this study will also be beneficial towards the regional development of research on keratoconus in Caribbean countries. Being the first keratoconus study performed in Trinidad and Tobago and even in any of the Caribbean countries, this can lead to a regional discussion of keratoconus amongst fellow optometrists, as well as students of optometry in countries throughout the Caribbean. This study will be useful as a reference and guide in studies on keratoconus performed both nationally and regionally in the future.

LITERATURE REVIEW

Keratoconus is characterized by progressive corneal protrusion and thinning, leading to irregular astigmatism and impairment in visual function (Vazirani et al. 2013). This disease has a great impact on patient's quality of life and has a prevalence of 1/2000 in the general population, however, Corneal Topography devices was used in recent studies and the prevalence was found to be much higher (Najmi et al, 2019). This Literature Review focuses on the Epidemiology of Keratoconus -and its prevalence- with regards to the objectives outline in this research study; Demographics, Risk Factors, Presentation, Methods of Management and Quality of Life.

7.1 Prevalence

Bak Nielson et al, (2019) did a study in Denmark for the purpose of describing the annual incidence rate of keratoconus in Denmark and prevalence of keratoconus in the National Danish Patient Register between the period 1995-2015 and 1977-2015 respectively. All patients registered with ICD – 8 code 378.79 (keratoconus) and ICD- 10 codes DH 18.6 (keratoconus) and DH 198A (keratoconus in association with Down Syndrome) between 1977 – 2015 were included in this study. Patients (n=7) who had received refractive surgery before being diagnosed with keratoconus were excluded. With regards to prevalence, the results in this study showed that out of a total 5707251 inhabitants in Denmark, a total of 2846 persons had been diagnosed with keratoconus between 1977 and 2015. This yields an overall prevalence of 44 per 100,000 persons. However, the data in this study does not support an increase in incidence in the range of 5-10-fold or an incidence in the range of 13.3 per 100,000 as reported by Godefrooij et al (2017) in the Netherlands as it is reported in this study that 22% of Dutch population are immigrants. In comparison, the Danish population only consisted of 9.4% immigrants. This study also did a sub-analysis and it showed that the average incidence rate 2011-2015 was 20% lower when excluding immigrants. The difference in population demographics between the Netherlands and Denmark may partly explain the considerable difference in incidence, as the prevalence of keratoconus in known to be considerably higher in Middle Eastern and Asian population, even after migration to areas of lower prevalence (Pearson et al, 2000).

Hwang et al (2018) conducted a study in South Korea to determine the prevalence and incidence of keratoconus between the period 2009-2014. This study included a sample size of 47990761 subjects. The findings of this study showed that out of the 47990761 subjects that participated, 17931 had keratoconus during the 6 year period. As it relates to prevalence, this study indicates the prevalence in the general population during the 6 year study period to be 37.4 cases per 100,000 people. Previously reported prevalence rates of keratoconus have varied widely depending on the geographical location, the diagnostic criteria, and the cohort of patients selected in each study (Gokhale, 2013). The prevalence of keratoconus in other studies ranged from 0.3 cases per 100,000 individuals in Russia (Gorskova et al, 1998) to 2300 cases per 100,000 individuals in central India (Jonas et al, 2009). However, this study states that the most commonly cited prevalence is 0.054% in Minnesota, USA, from a hospital-based study in which the diagnosis was based on a combination of scissor movement in retinoscopy (during refraction), and keratometry. By contrast, in the study in rural Maharashtra in centra India, the prevalence of keratoconus in individuals over 30 years old was studied based only on the anterior corneal power obtained by keratometry. In that study, the prevalence of keratoconus was 2.3%. However, the prevalence dropped to 0.6% using cutoff power of >49D and to 0.1% using a cutoff of >50D. (Jonas et al, 2009).

Al-Amri et al, (2018) did a study in Saudi Arabia for the purpose of examining the prevalence of Keratoconus among patients who were interested in undergoing refractive surgery between the period January – December 2017. A total of 2931 patients were included in this study. Of these, 2280 patients (77.8%) were not candidates for refractive surgery. These patients had a mean age of 24.1 years and 1231 (out of the 2280) patients were male. Moreover, out of the subjects who did not undergo refractive surgery, 548 (24%) had keratoconus, 400 (17.5%) were keratoconus suspects, 344 (15.1%) had thin corneas, 321(14.1%) had high myopia, and 52(2.3%) had a high astigmatism. The incidence of keratoconus in Saudi Arabia refractive surgery prospects was 18.7% which was higher than the historical range (Hashemi et al, 2018). Keratoconus was also deemed the most common reason for not performing refractive surgery and accounting for 24.0% of cases in which surgery was not performed. The findings in this study were compared to findings to those previously obtained in the Middle East. The keratoconus incidence observed in the current study is higher than that previously reported in the Middle East and other regions. A 2005 Saudi Arabian study done by A. Assiri et al, found a keratoconus incidence of only 20

cases/100,000 people (0.02%). However, that study relied upon keratometry data to detect keratoconus and only included patients referred to a provincial tertiary ophthalmology department. Because corneal tomography is the gold standard for detecting keratoconus (Pearson et al, 2000) it is possible that this 2005 incidence was artificially low. This study's findings (24.0% prevalence) are somewhat in agreement with a recent study that found a 17.5% prevalence of keratoconus among college-age refractive surgery prospects in northern Egypt (S. Saro et al, 2018). It may have been that the methods used in this study were more sensitive for detecting keratoconus because the incidence of keratoconus suspects was also higher than that in a college-age Palestinian population (17.5% vs. 8.4%).The authors of this study found it puzzling as to why presumably healthy, young refractive surgery candidates would have such a high prevalence of keratoconus, so assuming, that the findings of the current study and the prior Egyptian study may indicate that keratoconus is more prevalent than believed in some regions.

2.2 Demographical

2.2.1 Age

Shanti et al (2018) conducted a study in two ophthalmology centers (Tertiary Ophthalmology Center of An-Najah National University Hospital and An-Noor Center at the Specialize Arab Hospital) in Palestine, for the purpose of exploring the demographic profile of Palestinian Keratoconic patients during the period 2009-2016. The medical files of 936 Keratoconic eyes of 505 Keratoconic patients were included in this study. The study's findings showed that the age at presentation ranged from 8 to 62 years, with a mean (SD) age of 23.33 (7.37) years. It is worth mentioning that around 75% of them presented between 16 and 30 years of age with high prevalence rate among this age group (21–25), to which around 32.3% of patients belonged, followed by the age groups 16–20 and 26–30, with 26.5% and 16.4%, respectively. The study also showed a dramatic decrease at both age margins, especially when patients aged. The results of this study were nearly consistent with a Malaysian study, where the mean age of disease onset was 20.9 ± 5.6 years (Mohd-Ali et al, 2012). Meanwhile, in Saudi Arabia, the mean age at diagnosis was slightly lower than in this study, about 17.7 years for males and 19.0 years for females (Assiri et al, 2005). On the other hand, a higher mean age, around 27 years, was detected in Caucasian populations, suggesting a later disease onset (Assiri et al ,2005), which is also seen in Macedonia, as the mean age at the time of disease

detection was 26.81 ± 1.25 (Ljubic A, 2009). In general, this study's results agreed with those of internationally published studies concerning the early age of onset (Garcia et al, 2014). Several possible reasons could be cited here to explain these differences, including genetics and environmental and geographical factors, such as consanguineous marriages and ultraviolet exposure, which are considered the main risk factors for KC development and thus may explain the much earlier age of onset in the Saudi Arabian study compared with other studies.

Rafati et al (2019) conducted a study at Noor Eye Hospital in Iran for the purpose of evaluating the demographic profile, clinical, and topographic characteristics of keratoconus patients between the period March 2011 and March 2017. The study sample size included 1080 eyes of 540 patients. The mean age of the participants was 31.04 ± 8.54 years (range, 13-63 years), and 69.3% of the patients were male. The results of this study showed that the highest and lowest frequency of keratoconus was seen in the age group 20-30 years and above 50 years, respectively. Bilateral keratoconus was detected in 93.3% [95% confidence interval (CI): 91.68-94.75] of the subjects. 43.7% (95%CI: 32.88-54.48), 55.6% (95%CI: 44.73-66.38), and 0.8% (95%CI: 0.75-0.78) of the cases had nipple, oval, and globus cones, respectively. The cone was central in 52.1% (95%CI: 41.10-63.11), paracentral in 43.6% (95%CI: 36.13-51.04), and peripheral in 4.3% (95%CI: 00.76-7.86) of the cases. The frequency percentage of keratoconus according to severity was 15.2% (95%CI: 13.09-17.46), 56.4% (95%CI: 53.37-59.37), and 28.4% (95%CI: 25.75-31.21) for mild, moderate, and severe keratoconus, respectively. Among different parameters, only cone location had a significant association with age as the frequency of paracentral and peripheral cones increased with ageing (P = 0.002). According to previous studies, the mean age of the keratoconus patients (on the first visit) was 23-28 years in European countries (Barrientos et al,2014), 25-39 years in the USA (Zadnik 1994), and 18-24 years in Asian countries (Sharma R et al, 2009). Therefore, the mean age of the patients in this study was higher than other Asian and even European patients. The frequency distribution of the patients in different age groups showed that the majority of the patients (48.7%) presented to the clinic when they were 20-30 years old, which is consistent with the results of previous studies reporting that keratoconus is prevalent in the 2nd and 3rd decades of life and is less common in older patients (Mohd-Ali et al,2012). An important finding of the present study was the high frequency of patients above 30 years, comprising 44.5% of the whole patients, which can explain the higher mean age of patients in this study compared to other Asian studies. The

possible reasons may be different etiologic factors, lack of early detection, and delayed presentation for medical care. Therefore, it should be kept in mind that Iranian keratoconus patients may present at older ages than expected.

2.22 Gender

Valdez-Garcia et al (2014) conducted a study in Mexico on an adolescent population for the purpose of exploring the epidemiology of keratoconus in this country, to compare the prevalence rates of this condition with international literature reports. 500 charts were randomly selected from patients between 10 and 20 years of age in order to acquire personal information that was needed for analysis. The study's findings showed that the prevalence of keratoconus was 1.8%, affecting 66% of females and 33.3% of males. This study cannot be compared to an equally designed study from Mexico because no other studies use a similar population. This study's 1.8% prevalence rate compares to that of Jonas et al. in India, where they obtained a 2.7% prevalence rate in a sample of 4711 subjects, and in a study conducted in Jerusalem by Millodot et al., who reported a prevalence rate of 2.34% in a sample of 981 volunteers. Even though these studies exhibit slightly higher prevalence rates, the results can be regarded as being somewhat similar to those reported in these studies, especially if the prevalence rates of this study is compared to those found by Ihalainen (0.03%).In relation to gender, prevalence rates of 66.6%and 33.3% were found for women and men, respectively. When comparing these results to those of the study conducted in Cubaby Diaz et al. --- who reported similar prevalence rates per gender at 66% for females and 34% for males, had a sample of 73 patients --- it is evident that these results are in contrast to those observed in several studies from the United States.

2.23 Ethnicity

Mohd-Ali et al (2012) conducted a study in Malaysia for the purpose of evaluating the demographic profile, refraction, visual acuity, corneal curvature (K) and severity of Keratoconus patients from a cornea specialist center, to improve the management of keratoconus in this country. In this study, the records of 13,000 patients were reviewed and the patients were categorized into 4 age groups: (Gp 1:<23 years, Gp 2: 23-32 years, Gp 3:

33-42 years, Gp 4: >42 years). The study findings showed that a total of 159 patients had keratoconus and the prevalence was 1.2%. The racial distribution was 50% Chinese, 20.8% Malays, 18.2% Indians and 10.5% others. Additionally, mean age at the time of diagnosis was 21.46 ± 6, being 21.96 ± 6.07 for males and 20.20 ± 6.29 for females. No significant difference was detected in the mean age between genders ($p = 0.681$). Majority of the patients observed were of Indian (39%) and Malay (37%) origin, however no significant difference between races was detected here as well ($p > 0.05$). The results of this study demonstrate apparent differences in the percentage of cases observed among different ethnic groups in this country. Malaysia is a multiracial country consisting of three main ethnic groups. Data from Malaysia census population and housing report 2010 showed that around 49.74% of the population were Malays, 22.80% Chinese and 1.30% Indians. Majority of the keratoconus patients were of Indian and Malay origins. Similar trend was also observed in a tertiary eye care center in this country (Mohd- Ali et al, 2011). Despite the claim by Rabinowitz (1998), who states that all ethnic groups are equally affected, the variation in the percentage suggests that genetic factor may influence the development of the disease. Earlier reports indicate a 4–7.6-fold increase in keratoconus incidence among Asian population compared to Caucasians. Georgiou et al. (2004) whose study population mostly comprised people from the Indian continent found lower incidence of atopy among Asians compared to Caucasians. Furthermore, there were reports stating that the Asian keratoconus patients were generally younger when the condition first presented and required corneal grafting at earlier age. According to Pierson et al (2000) majority of Asian keratoconus patients reaches the advanced stage by the second decade of their life. However, larger multicenter studies are needed to further confirm these findings.

2.3 Risk Factors & Presentation

2.3.1 Refractive Errors

Cruz-Becerril et al (2015) conducted a study on Mexican patients for the purpose of determining the prevalence of refractive errors in patients with keratoconus and to describe their clinical characteristics. The records of Mexican patients from the year 2012 were reviewed in this study and the refractive errors were documented and analyzed. The study

population comprised 426 patients, including 785 eyes with keratoconus. The findings of this study showed that compound myopic astigmatism had a prevalence of 87.3% and was deemed the most common refractive error presented in the keratoconus population. On reviewing the literature, it is evident that a relationship exists between keratoconus and astigmatism. Intriguingly, this study did not find published data on other astigmatism variants, such as mixed astigmatism. The prevalence of keratoconus ranges from approximately 0.05 to 0.6, because of the different definitions and diagnostic criteria used. On the other hand, the frequency of refractive errors is high, ie, these errors are present in 50% of people aged older than 40 years, and are the main cause of low vision (Ziaiei et al, 2013). Keratoconus is usually accompanied by astigmatism, a type of refractive error, which changes with progression of the disease (Lim N et al, 2002). There is a considerable number of studies describing the prevalence and types of keratoconus, but there is insufficient information about the prevalence of refractive errors in this disease in some countries (Vazirani et al, 2013). A recent study of 93 Mexican patients with keratoconus (Lara et al, unpublished data 2014) found a high frequency of myopic astigmatism (87%) and a low frequency of mixed astigmatism (7.5%). Furthermore, Li et al found keratoconus to be the most common corneal disease in patients aged 10–19 years, with a prevalence of 21.2%,17 and the main method for correcting low vision to be contact lenses, indicating the importance of knowing the refractive error in order for clinical intervention to be effective.

2.3.2 Environmental Factors

Eye rubbing is a common habit that occurs spontaneously before sleep when awakening and throughout the day as a response to ocular irritation fatigue and emotional stress (Shetty R et al, 2017). It was stated that abnormal eye rubbing could be secondary to bothersome symptoms such as dryness and itching, and it can be psychogenic with compulsive or unprovoked rubbing (Hawks E et al, 2014). In a survey that included 240 keratoconus patients, it was found that 65.6% of them had a history of eye rubbing (Shneor E et al, 2013).McGhee et al (2015) also found that 48% of keratoconus patients rubbed their eyes. In a Saudi study, it was found that 44.8% of patients had eye rubbing (Al Shammari Z et al,2016). Rabinowitz (2003) in his case-control study reported that in 218 keratoconus patients and 183 healthy age-matched controls, eye rubbing was present in 83% of keratoconus subjects compared to 58% in healthy controls. Moreover, a study from Iran

showed that there was a healthy relationship between the positive history of eye rubbing and prevalence of keratoconus (Heshemi H et al, 2014).

Al Shammari Z et al (2013) in the Saudi study reported that the most common risk factors between keratoconus patients were eye-rubbing representing 100%. Positive history of eye rubbing represented a higher frequency of keratoconus patients (Al Shammari Z et al, 2013). The study also found that corneal curvature became worse by the asymmetric eye rubbing. Asymmetric keratoconus was found to be related to the eye that was severely affected by abnormal eye rubbing and monocular keratoconus in a patient with bilateral eye-rubbing was found to be related to hand dominance. Additionally, it was found that keratoconus developed after 14 months in case of chronic compulsive eye rubbing and psychogenic eye rubbing. Also, it was found that eye rubbing was a significant risk factor in the development of keratoconus in patients with a history of parental consanguinity.

2.3.3 Hereditary/genetics

Schneor et al (2020) conducted a study in Israel for the purpose of accurately examining the phenotype of 56 first-degree relatives of patients with sporadic keratoconus in hopes of determining the genetic aetiology of Keratoconus. The results of the study found that Keratoconus/ Keratoconus suspects was diagnosed in the 18% of first-degree relatives, atleast one abnormal parameter was evident in 34% of first-degree relatives, and sex was not a factor influencing prevalence of corneal abnormalities. This study provided accurate and specific phenotypic description of the corneas of first-degree relatives of patients with keratoconus (KC) using corneal tomography. The results of this study may help determine the genetic aetiology of keratoconus in Israel. The prevalence of manifest keratoconus in this cohort (4%) was similar to that found in the general population in Israel (2.3-3.3%).In contrast, the prevalence of KC suspect in first-degree relatives (14%) was much higher than previously reported for this population (0.5%). Thirty-two percent of keratoconus relatives had abnormal anterior topography and a third had at least one defect in corneal tomographic parameters measured with the Sirius. While the prevalence of these issues had not been addressed in a large population-based study in Israel, it is significantly higher than in a small cohort of normal patients from a previous study.

The expectation would be that in population in which keratoconus is a dominant monogenic disease, a large percent of family members will have manifest keratoconus. Alternatively, in a population in which it is a complex disorder involving several genes and environmental triggers, it would be expected that an increased prevalence of various corneal abnormalities in family members would be seen, although not necessarily manifest disease. The results of the study support the later scenario: that keratoconus in Israel appears to be a complex disorder. In this study, the first-degree relatives have a larger number of corneal abnormalities than controls. This implies that keratoconus is caused by changes at many genes and each will contribute to the shape of the cornea: some will impact corneal thickness, others anterior curvature and even others will be responsible for posterior curvature. Also, there was no evidence of sex-linkage. Male and female relatives had a similar prevalence of abnormalities.

2.4 Methods of Management

Studies on the different types of surgical and non-surgical management used amongst patients diagnosed with Keratoconus were found. A relatively new yet effective surgical management option is the Corneal Cross Linking treatment. A study was done by A. Godefrooj et al (2016) in the Netherlands to investigate and prove that Cross Linking was an effective way to manage Keratoconus. The study found that approximately 25% fewer corneal transplants were performed in the 3-year period following the introduction of Cross Linking, compared to that prior the introduction of this treatment. The non-surgical management of ectasia aims to halt disease progression and includes guidance regarding avoidance of eye rubbing as well as other methods of vision rehabilitation such as; spectacles, soft contact lenses, spherical rigid gas permeable lenses, hybrid contact lenses and scleral contact lenses (Crawford et al, 2020). A study done in Mexico amongst Keratoconus patients reports that the spherical rigid contact lenses was the most frequently adapted lens (96%) and the contact lens parameters varied with disease progression. RGP contact lens are the most suitable non-operative management option for patients with keratoconus, which can provide satisfactory visual quality and improve the regularity of corneal surface. But whether the wear of RGP contact lens on the cornea, the chronic hypoxia stimulation, the change of tear components, the pro-inflammatory effect on ocular surface and the induction of apoptosis can promote the progression of keratoconus is still not concluded (Zhang et al, 2020).

2.5 Quality of Life

A study entitled "The influence on refractive correction on the vision-related quality of life in keratoconus patients" was conducted by Ortiz – Toquero et al (2016) to assess the impact of refractive correction on the vision-related quality of life (VR-Qol) in keratoconus patients compared to healthy myopic patients. The Spanish version of NEI-VFQ-25 was administered two consecutive times to 25 keratoconus patients (RGP CL wearers) and 25 healthy myopic subjects (RGP and soft CL wearers). The first time was to assess the VR-QoL for spectacle wearing, such as those for refractive correction, and the second time was for CL wearing. The study showed that Keratoconus patients showed a lower VR-QoL impairment ($P < 0.01$) than healthy subjects in total and all subscale score of NEI-VFQ-25 related to wearing spectacles. With CL correction, keratoconus patients showed a VR-QoL improvement with statistically significant differences ($P < 0.04$) in only four subscales, including distance activities, mental health, color vision and peripheral vision, compared with healthy subjects. In the keratoconus group, compared to spectacle use, CL wear improved the VR-QoL score ($P = 0.01$) and all subscales except for ocular pain ($P < 0.01$) and mental health ($P = 0.25$).

A cross sectional study entitled "Quality of life in Keratoconus" was conducted by M. Kymes et al (2004) to examine the vision-related quality of life of patients in the Collaborative Longitudinal Evaluation of Keratoconus (CLEK) Study. The National Eye Institute-Visual Function Questionnaire (NEI-VFQ) was administered to 1166 CLEK Study patients at their first annual follow-up examination. Associations between clinical and demographic factors and NEI-VFQ scale scores were evaluated. The study results showed that Binocular entrance visual acuity worse than 20/40 was associated with lower quality of life scores on all scales except General Health and Ocular Pain. A steep keratometric reading (average of both eyes) >52 diopters (D) was associated with lower scores on the Mental Health, Role Difficulty, Driving, Dependency, and Ocular Pain scales. Scores for CLEK patients on all scales were between patients with category 3 and category 4 age-related macular degeneration (AMD) except General Health, which was better than AMD patients, and Ocular Pain, which was worse than AMD patients.

A study entitled "Quality of life in Keratoconus Patients After Penetrating Keratoplasty" was conducted by H. Yildiz et al (2010) to determine vision-related quality of life (QoL) measured with the National Eye Institute Visual Function Questionnaire (NEI-VFQ) in

keratoconus (KCN) patients who have undergone penetrating keratoplasty (PK) in one or both eyes. This study included 149 consecutive patients who had undergone PK for Keratoconus. The results showed that out of the 149 patients, 83 (55.7%) were male and approximately half of the patients (76/149; 51.0%) had PK in both eyes. Additionally, visual acuity with current correction in the better eye was better than 20/40 in 80% of patients (119/149). This study's sample had significantly lower (worse) NEI-VFQ scores compared to that of the Collaborative Longitudinal Evaluation of Keratoconus (CLEK) historical control group for the subscales of role difficulties such as ; dependency, driving, and peripheral vision. In general, scores of this study's samples were between scores of patients with age-related macular degeneration (AMD) category 3 and 4. However, it was seen that in patients with visual acuity better than 20/40 (in the better eye) showed significantly higher scores in all subscales except color vision. There was a significant relationship between minimum time since the graft of 5 years or greater, and NEI-VFQ overall score was better than AMD category 3 ($P = .004$).

METHODOLOY

This chapter outlined the research design, study size, study population, sample size, sampling procedure, inclusion and exclusion criteria, test and instrument used, data collection procedure, data analysis, legal and ethical considerations.

3.1 Ethical consideration

- Ethical approval was received from the UWI Campus Research Ethics Committee.
- Letter of permission was given to the UWI Optometry Clinic in order to access files.
- Permission was granted from the UWI Optometry Clinic and The Caribbean Eye Institute to access patients' files.
- Confidentiality of the participant was maintained since no names were recorded from files.
- The data collected from the patients' files were kept in a safe place that was only accessible to the hosts of this study.

3.2 Study design

This study was a clinic-based retrospective study of patients that visited the Couva optometry clinic from January 2010 to December 2020 and were diagnosed with keratoconus.

3.3 Study population

This study focused on all the keratoconus patients that visited the UWI Optometry and Caribbean Eye Institute from 2010 to 2020. The patient files collected amounted to 150.

3.3.1 Study setting

This study will be performed in Couva optometry clinic in Trinidad and Tobago. Trinidad is a part of the twin islands called Trinidad and Tobago with a general population of approximately 1.4 million (as of 2019). Trinidad lies close to the continent of South America, is northeast of Venezuela, and northwest of Guyana. The climate of Trinidad is tropical with relatively high humidity with the warmest months being April, May and October, with an average temperature of 32 degrees (Watts, 2021). The original inhabitants of Trinidad

migrated from the Orinoco River delta region of northeastern South America and spoke an Arawakan language, however a variety of ethnic groups with different backgrounds such as; East Indians (35.4%), Africans (34.2%), Mixed (22.8%), Caucasian (0.6%) and other races (7.0%) have settled on the island since then (Brereton,2012).

The U.W.I Optometry Clinic is located at the Couva Hospital and Multi-Training Facility. It is a teaching clinic which offers a wide range of eye examinations such as; a comprehensive and routine eye exam, contact lens exam, binocular vision exams, as well as low vision eye exams for low vision patients in Trinidad & Tobago. Patients come from various parts of the country to access the eye care services. The Caribbean Eye Institute is the first group practice of Ophthalmology in Trinidad and Tobago. It is located at 5 Igneri Road, Valsayn South.

3.3.2 Inclusion Criteria

- All patients that visited the UWI Optometry clinic and The Caribbean Eye Institute from 2010 to 2020 and were diagnosed with keratoconus will be included.

3.3.3 Exclusion Criteria

- Patients with a history of corneal pathology, traumatic corneal scars, corneal keratoplasty that are not caused by KC will be excluded.
- Patients with incomplete information in their files will be excluded.

3.4 Data Collection Tools

Patients' files and data extraction sheet will be used as data collection tools in this study.

3.5 Data Collection Procedure

1. Obtain clearance from Ethics Committee

2. Obtain permission to view files from Optometry Unit Coordinator and from The Caribbean Eye Institute.

3. Once permission is granted, all files of patients that visited the UWI Optometry Clinic and the Caribbean Eye Institute from Januaury 2010 to December 2020 will be retrieved from the archives and all those diagnosed with keratoconus extracted. Data extraction google doc was used to collect information concerning their demographics, risk factors, clinical characteristics and methods of management.·

3.6 Data Management

All data collected will be imputed into a Microsoft Word Excel and exported to Statistical Package for Social Sciences (SPSS) for analysis.

3.7 Data Analysis

Tools in SPSS include Chi square used to analyse the data obtained. A p-value of less than 0.05 will be considered statistically significant.

8.9 Data Protection

- Personal information of the patients will not be collected, thus will be kept anonymous throughout the study.
- All data collected will be kept in a password control computer where only the principal investigator and the core researchers will have access to it.

RESULTS

4.1 Demographic profile of the study participants

This study consisted of a total of 150 KC patients. The genders were almost divided into half with females being in lead at 51.7%. The age group with the highest number of patients (37.1%) was 21-30.Over half of the patients (57%) were of Indian descent .86.67% of the KC patients resided in urban areas. Majority of the patients (51.7%) were students.58.9% of the patients' files that were used in the study had KC in both their right and left eyes. 21.33% were first diagnosed with KC in 2010 while there were 60% that were diagnosed over 5 years from 2021.

Table 1 showing Demographical characteristics of the KC patients

Variables	**Frequency**	**Frequency Percentage**
Gender	**N= 150**	**N= 100%**
Female	78	51.7
Male	71	47.0
Age group (in years)		
10-20	37	24.50
21-30	56	37.10
31-40	40	26.50
41-50	11	7.30
51-60	3	2.00
Over 60	2	1.30
Ethnicity		
Indian	84	56.00
African	52	34.70
Mixed	13	8.70
Other	1	0.06

Area of residence		
Urban	133	86.67
Rural	17	11.33
Employment Status		
Student	78	51.70
Unemployed	18	11.90
Employed outside the office	9	6.00
Employed inside the office	5	3.30
Unknown	40	26.50
Presence of Keratoconus		
Right Eye (OD)	34	22.50
Left Eye (OS)	26	17.20
Both Eyes (OU)	89	58.90
Year Presented with Keratoconus		
2010	32	21.33
2011	10	6.67
2012	6	4.00
2013	9	6.00
2014	7	4.67
2015	7	4.67
2016	19	12.67
2017	27	18.00
2018	3	2.00
2019	14	9.33
2020	6	4.00
Unknown	10	6.67

Years since diagnosis		
5 years and above	90	60.00
4 years	27	18.00
3 years	3	2.00
2 years	14	9.33
1 year	6	4.00
Unknown	10	6.67

4.2 : Objective 2 : Risks and associated factors amongst KC patients in Trinidad

Out of 150 patients 9.90% stated that there was indeed a family history of KC. 19.2% of the patients had allergies while 47.00% confirmed that they did rub their eyes. Majority of the patients (81.30%) did not have any associated systemic diseases. This data can be viewed in table 2 below.

Table 2 showing Risks and Associated Factors of KC

Variable	**Frequency**	**Percentage Frequency**
Family History of KC	**n= 150**	**n=100%**
Yes	15	9.90
No	135	89.40
Allergies		
Yes	29	19.2
No	121	80.10
Rubbing of Eyes		
Yes	71	47.00
No	79	52.30
Presence of Associated Systemic Disease		
No	122	81.30

Yes	28	18.67

Table 3 showing Associated Systemic Diseases present and percentage frequency based on the number of patients presented with a systemic disease

Associated Systemic Disease	Frequency (n=28)	Percentage Frequency (n=100%)
Sinus	15	50.00
Angina	2	6.67
Asthma	5	16.67
Arthritis	2	6.67
Migraines	3	10.00
Glaucoma Suspect	1	3.33
Down Syndrome	1	3.33
Diabetes	1	3.33
Hypertension	1	3.33
Turner's Syndrome	1	3.33
Heart Attack	1	3.33
Graves' Disease	1	3.33
CVD	1	3.33
High Cholesterol	1	3.33

For table 3 above, the associated systemic diseases present were analyzed according to the number of patients that presented with systemic diseases. It was seen in table 2 that 28 patients presented with associated systemic diseases. Of these, 50.00% presented with sinus.

4.3 : Objective 3 : Clinical Presentations of KC

The mean VA was found to be .9981 OD and 1.0086 OS. The mean Kmax for the right eye was 53.1662 and 53.1662 for the left eye The mean of CCT OD and OS were found to be 480.2500 and 482.3404 respectively.

Table 4 showing Clinical Characteristics of patients

	N	Minimum	Maximum	Mean	Std. Deviation
OD VA	150	.00	3.00	.9981	.96054
OS VA	149	-.12	3.00	1.0086	.98145
K1 OD	122	5.37	482.00	48.9636	40.15003

K2 OD	122	4.69	74.20	48.0402	7.95252
KMAX OD	125	7.43	112.30	53.1662	10.70749
K1 OS	119	6.85	68.50	46.0540	6.85352
K2 OS	115	5.88	68.40	48.6057	7.89162
KMAX OS	117	7.38	94.70	53.1427	9.39767
CCT OD	48	272.00	582.00	480.2500	51.59437
CCT OS	47	372.00	609.00	482.3404	41.02029
VA AFT MGT OD	53	.00	2.00	.4094	.39234
VA AFT MGT OS	40	-.12	1.30	.3390	.35731
Valid N (listwise)	10				

Table 5 showing Chi Square Tests

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.190[a]	1	.663		
Continuity Correction[b]	.027	1	.870		
Likelihood Ratio	.190	1	.663		
Fisher's Exact Test				.787	.434
N of Valid Cases	150				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 7.20.

b. Computed only for a 2x2 table

Figure 1 : Pie Chart showing Symptoms patients presented with

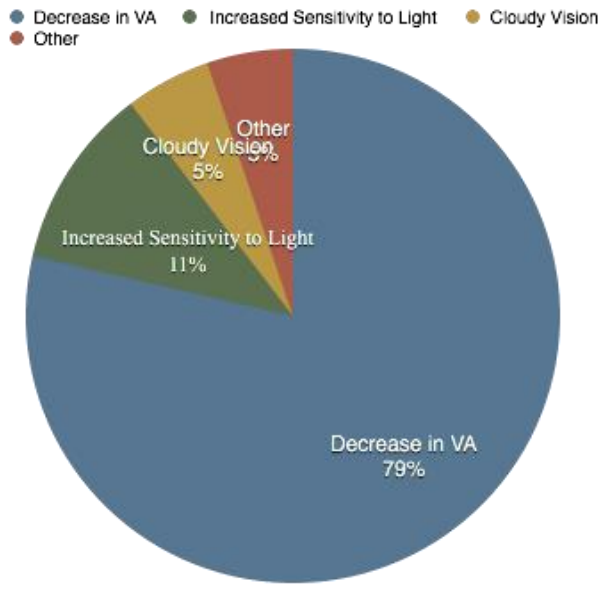

Figure 1 above shows the symptoms patients reported having. These symptoms included decrease in VA, Cloudy vision, increased sensitivity to light and other with decrease in VA being the most common at 79%.

Table 6 showing presence of findings on the Slit Lamp

	Frequency (n= 150)	**Percentage Frequency (n= 100%)**
Yes	81	54.00
No	69	46.00

Over half (54%) of the patients presented with signs upon doing the slit lamp examination. The results can be viewed above in table 6.

Table 7 showing Abnormalities seen on SLE

Signs	**Frequency (n= 81)**	**Percentage Frequency (n= 100%)**
Vogt's Striae	26	32.09
Fleisher's Ring	23	28.39
Apical Scar	14	17.28
Munson's Sign	12	14.81
Acute Hydrops	10	12.34
Oil Droplet	8	9.87
Central Stromal Thinning	6	7.40
Other	26	32.09

From table 6, it can be seen that 81 patients presented with signs upon slight lamp examination. Of these 81 patients, 32.09% presented with Vogt's Striae, making it the most common sign out of all.

Table 8 showing the Relationship between Clinical Characteristics and Area of Residence

			Area of Residence		P Value
			Rural	Urban	
Presence of KC	No	Count	3	28	0.116
		% within Area of Residence	17.6%	21.1%	
	Yes	Count	4	29	
		% within Area of Residence	23.5%	21.8%	
	Not Sure	Count	10	76	
		% within Area of Residence	58.8%	57.1%	
Family History of Keratoconus	No	Count	0	15	2.13
		% within Area of Residence	0.0%	11.3%	
	Yes	Count	17	118	
		% within Area of Residence	100.0%	88.7%	
Allergies	No	Count	4	25	0.216
		% within Area of Residence	23.5%	18.8%	
	Yes	Count	13	108	
		% within Area of Residence	76.5%	81.2%	
If yes, name the allergy:	Dust	Count	13	109	8.45
		% within Area of Residence	76.5%	82.0%	
	Pollen	Count	3	20	
		% within Area of Residence	17.6%	15.0%	
	Penicillin	Count	0	1	
		% within Area of Residence	0.0%	.8%	
	Combination	Count	1	0	
		% within Area of Residence	5.9%	0.0%	
	Dust and Pollen	Count	0	2	
		% within Area of Residence	0.0%	1.5%	
Rubbing of Eyes	No	Count	6	65	1
		% within Area of Residence	35.3%	48.9%	
	Yes	Count	11	68	
		% within Area of Residence	64.7%	51.1%	
Associated systemic disease	None	Count	15	107	4
		% within Area of Residence	88.2%	80.5%	
	Sinus	Count	0	3	
		% within Area of Residence	0.0%	2.3%	
	Heart Disease	Count	1	5	
		% within Area of Residence	5.9%	3.8%	
	Asthma	Count	0	4	
		% within Area of Residence	0.0%	3.0%	
	Glaucoma	Count	0	8	
		% within Area of Residence	0.0%	6.0%	
	Arthritis	Count	1	2	
		% within Area of Residence	5.9%	1.5%	
	Diabetes	Count	0	2	
		% within Area of Residence	0.0%	1.5%	
	Combination	Count	0	2	
		% within Area of Residence	0.0%	1.5%	
Does patient have dry eyes?	No	Count	1	8	0
		% within Area of Residence	5.9%	6.0%	
	Yes	Count	16	125	
		% within Area of Residence	94.1%	94.0%	

MGMT OF KC RE	Intact	Count	0	5	17.574
		% within Area of Residence	0.0%	3.8%	
	CXL	Count	3	47	
		% within Area of Residence	17.6%	35.3%	
	Sclerals	Count	4	25	
		% within Area of Residence	23.5%	18.8%	
	Corneal Transplant	Count	4	9	
		% within Area of Residence	23.5%	6.8%	
	RGP	Count	2	10	
		% within Area of Residence	11.8%	7.5%	
	Referral	Count	2	12	
		% within Area of Residence	11.8%	9.0%	
	Monitor	Count	0	13	
		% within Area of Residence	0.0%	9.8%	
	Combination	Count	0	1	
		% within Area of Residence	0.0%	.8%	
	None	Count	1	8	
		% within Area of Residence	5.9%	6.0%	

In table 8, the relationship between the clinical characteristics of the patients and area of residence was analyzed. Based on the results, it is seen that majority of the patients that resided in urban areas had a presence of keratoconus. 88.7% of patients with a family history of KC resided in urban areas, as well as 81.2% had allergies. Majority of the patients living in rural areas (64.7%) stated yes for rubbing of eyes. For associated systemic disease, almost all the associated systemic diseases listed were larger in urban areas. For both rural and urban areas, the presence of dry eyes were 94.1% and 94% respectively. For management of KC, 3.8% of those living in urban areas had intacs, 35.3% had CXL done, 9.8% received advice to monitor and 0.8% received combination treatment. 23.5% of the patients living in rural areas had sclerals, 23.5% had corneal transplants and 11.8% had referral letters. 6% of those living in urban areas received no treatment while 5.9% residing in rural areas also received no treatment.

Table 9 showing relationship between Ethnicity and Clinical Characteristics.

Table 9 showing relationship between Ethnicity and Clinical Characteristics.

			Ethnicity				
			African	Indian	Mixed	Other	P Value
Presence of KC	No	Count	13	16	2	0	3
		% within Ethnicity	25.0%	19.0%	15.4%	0.0%	
	Yes	Count	10	21	2	0	
		% within Ethnicity	19.2%	25.0%	15.4%	0.0%	
	Not Sure	Count	29	47	9	1	
		% within Ethnicity	55.8%	56.0%	69.2%	100.0%	
Family History of Keratoconus	No	Count	2	11	2	0	4
		% within Ethnicity	3.8%	13.1%	15.4%	0.0%	
	Yes	Count	50	73	11	1	
		% within Ethnicity	96.2%	86.9%	84.6%	100.0%	
Allergies	No	Count	8	19	2	0	1
		% within Ethnicity	15.4%	22.6%	15.4%	0.0%	
	Yes	Count	44	65	11	1	
		% within Ethnicity	84.6%	77.4%	84.6%	100.0%	
If yes, name the allergy:	Dust	Count	45	65	11	1	6
		% within Ethnicity	86.5%	77.4%	84.6%	100.0%	
	Pollen	Count	5	16	2	0	
		% within Ethnicity	9.6%	19.0%	15.4%	0.0%	
	Penicillin	Count	1	0	0	0	
		% within Ethnicity	1.9%	0.0%	0.0%	0.0%	
	Penicillin	Count	0	1	0	0	
		% within Ethnicity	0.0%	1.2%	0.0%	0.0%	
	Combination	Count	1	1	0	0	
		% within Ethnicity	1.9%	1.2%	0.0%	0.0%	
	Dust, Pollen	Count	0	1	0	0	
		% within Ethnicity	0.0%	1.2%	0.0%	0.0%	
Rubbing of Eyes	No	Count	26	42	3	0	4
		% within Ethnicity	50.0%	50.0%	23.1%	0.0%	
	Yes	Count	26	42	10	1	
		% within Ethnicity	50.0%	50.0%	76.9%	100.0%	
Associated systemic disease	None	Count	44	66	11	1	16
		% within Ethnicity	84.6%	78.6%	84.6%	100.0%	
	Sinus	Count	1	2	0	0	
		% within Ethnicity	1.9%	2.4%	0.0%	0.0%	
	Heart Disease	Count	3	3	0	0	
		% within Ethnicity	5.8%	3.6%	0.0%	0.0%	
	Asthma	Count	1	1	2	0	
		% within Ethnicity	1.9%	1.2%	15.4%	0.0%	
	Glaucoma	Count	1	7	0	0	
		% within Ethnicity	1.9%	8.3%	0.0%	0.0%	

	Arthritis	Count	1	2	0	0	
		% within Ethnicity	1.9%	2.4%	0.0%	0.0%	
	Diabetes	Count	0	2	0	0	
		% within Ethnicity	0.0%	2.4%	0.0%	0.0%	
	Combination	Count	1	1	0	0	
		% within Ethnicity	1.9%	1.2%	0.0%	0.0%	
Does patient have dry eyes?	No	Count	2	5	2	0	3.22
		% within Ethnicity	3.8%	6.0%	15.4%	0.0%	
	Yes	Count	50	79	11	1	
		% within Ethnicity	96.2%	94.0%	84.6%	100.0%	
MGMT OF KC RE	Intact	Count	1	4	0	0	29.90
		% within Ethnicity	1.9%	4.8%	0.0%	0.0%	
	CXL	Count	18	27	5	0	
		% within Ethnicity	34.6%	32.1%	38.5%	0.0%	
	Sclerals	Count	7	20	2	0	
		% within Ethnicity	13.5%	23.8%	15.4%	0.0%	
	Corneal Transplant	Count	6	6	1	0	
		% within Ethnicity	11.5%	7.1%	7.7%	0.0%	
	RGP	Count	6	3	3	0	
		% within Ethnicity	11.5%	3.6%	23.1%	0.0%	
	Referral	Count	6	6	1	1	
		% within Ethnicity	11.5%	7.1%	7.7%	100.0%	
	Monitor	Count	5	7	1	0	
		% within Ethnicity	9.6%	8.3%	7.7%	0.0%	
	Combination	Count	1	0	0	0	
		% within Ethnicity	1.9%	0.0%	0.0%	0.0%	
	None	Count	2	7	0	0	
		% within Ethnicity	3.8%	8.3%	0.0%	0.0%	

From table 9 above, it can be seem that a large percentage of Africans (96.2%) had a family history of KC and 84.6% had allergies. Half (50%) of Africans, as well as 50% of Indians, did in fact rub their eyes. 96.2% of those of African descent had dry eyes, with Indians following closely behind at 94%. For management options, 4.8% of Indians has intacs, 23.8% had sclerals and 8.3% had no treatment. 34.6% of Africans had CXL done, 11.5% had

corneal transplants, 11.5% used RGP lenses, 11.5% were given referrals, 9.6% were advised to monitor it and 1.9% had a combination of the treatments.

Table 10 showing the relationship between Gender and Clinical Characteristics.

			Gender		
			Male	Female	P Value
Presence of KC	No	Count	20	11	4.468
		% within Gender	28.2%	14.1%	
	Yes	Count	14	18	
		% within Gender	19.7%	23.1%	
	Not Sure	Count	37	49	
		% within Gender	52.1%	62.8%	
Family History of Keratoconus	No	Count	8	7	0.216
		% within Gender	11.3%	9.0%	
	Yes	Count	63	71	
		% within Gender	88.7%	91.0%	
Allergies	No	Count	17	12	1.737
		% within Gender	23.9%	15.4%	
	Yes	Count	54	66	
		% within Gender	76.1%	84.6%	
If yes, name the allergy:	Dust	Count	55	66	4.769
		% within Gender	77.5%	84.6%	
	Pollen	Count	14	9	
		% within Gender	19.7%	11.5%	
	Penicillin	Count	1	0	
		% within Gender	1.4%	0.0%	
	Other	Count	0	1	
		% within Gender	0.0%	1.3%	
	Combination	Count	1	1	
		% within Gender	1.4%	1.3%	
	Dust, Pollen	Count	0	1	
		% within Gender	0.0%	1.3%	
Rubbing of Eyes	No	Count	30	41	1.584
		% within Gender	42.3%	52.6%	
	Yes	Count	41	37	
		% within Gender	57.7%	47.4%	
Associated systemic disease	None	Count	58	63	5.557
		% within Gender	81.7%	80.8%	
	Sinus	Count	1	2	
		% within Gender	1.4%	2.6%	
	Heart Disease	Count	3	3	
		% within Gender	4.2%	3.8%	
	Asthma	Count	1	3	
		% within Gender	1.4%	3.8%	
	Glaucoma	Count	6	2	
		% within Gender	8.5%	2.6%	
	Arthritis	Count	1	2	
		% within Gender	1.4%	2.6%	
	Diabetes	Count	1	1	

		% within Gender	1.4%	1.3%	
	Combination	Count	0	2	
		% within Gender	0.0%	2.6%	
Does patient have dry eyes?	No	Count	4	5	0.039
		% within Gender	5.6%	6.4%	
	Yes	Count	67	73	
		% within Gender	94.4%	93.6%	
MGMT OF KC RE	Intact	Count	3	2	16.114
		% within Gender	4.2%	2.6%	
	CXL	Count	22	28	
		% within Gender	31.0%	35.9%	
	Sclerals	Count	17	11	
		% within Gender	23.9%	14.1%	
	Corneal Transplant	Count	4	9	
		% within Gender	5.6%	11.5%	
	RGP	Count	3	9	
		% within Gender	4.2%	11.5%	
	Referral	Count	5	9	
		% within Gender	7.0%	11.5%	
	Monitor	Count	8	5	
		% within Gender	11.3%	6.4%	
	Combination	Count	0	1	
		% within Gender	0.0%	1.3%	
	None	Count	7	2	
		% within Gender	9.9%	2.6%	

In table 10, the relationship between gender and clinical characteristics were analyzed. Majority (91%) of females had a family history of KC while 84.6% of females had allergies, 81.7% of males had no associated systemic diseases. 94.4% of males and 93.6% of females had dry eyes. 4.2% of males had intacs as the management and treatment method, 23.9% used scleral lenses, 11.3% were informed to monitor and 9.9% had no treatment or management. 35.9% of females had CXL done, 11.5% had corneal transplants, 11.5% used RGP lenses, 11.5% were given referrals and 1.3% used a combination of treatments.

Table 11 showing the relationship between Age and Clinical Characteristics

			Age						
			10 to 20	21 to 30	31 to 40	41 to 50	51 to 60	60 and Over	Pvalue
Presence of KC	No	Count	9	11	7	3	0	1	5.67
		% within Age	24.3%	19.6%	17.5%	27.3%	0.0%	50.0%	
	Yes	Count	8	12	9	1	1	1	
		% within Age	21.6%	21.4%	22.5%	9.1%	33.3%	50.0%	
	Not Sure	Count	20	33	24	7	2	0	
		% within Age	54.1%	58.9%	60.0%	63.6%	66.7%	0.0%	
Family History of Keratoconus	No	Count	4	4	6	1	0	0	1.98
		% within Age	10.8%	7.1%	15.0%	9.1%	0.0%	0.0%	
	Yes	Count	33	52	34	10	3	2	
		% within Age	89.2%	92.9%	85.0%	90.9%	100.0%	100.0%	
Allergies	No	Count	7	10	10	2	0	0	2.02
		% within Age	18.9%	17.9%	25.0%	18.2%	0.0%	0.0%	
	Yes	Count	30	46	30	9	3	2	
		% within Age	81.1%	82.1%	75.0%	81.8%	100.0%	100.0%	
If yes, name the allergy:	Dust	Count	31	46	30	9	3	2	22.45
		% within Age	83.8%	82.1%	75.0%	81.8%	100.0%	100.0%	
	Pollen	Count	5	8	9	1	0	0	
		% within Age	13.5%	14.3%	22.5%	9.1%	0.0%	0.0%	
	Penicillin	Count	1	0	0	0	0	0	
		% within Age	2.7%	0.0%	0.0%	0.0%	0.0%	0.0%	
	Combination	Count	0	0	0	1	0	0	
		% within Age	0.0%	0.0%	0.0%	9.1%	0.0%	0.0%	
	Other	Count	0	1	1	0	0	0	
		% within Age	0.0%	1.8%	2.5%	0.0%	0.0%	0.0%	
	Dust, Pollen	Count	0	1	0	0	0	0	
		% within Age	0.0%	1.8%	0.0%	0.0%	0.0%	0.0%	
Rubbing of Eyes	No	Count	21	24	21	4	0	1	5.42
		% within Age	56.8%	42.9%	52.5%	36.4%	0.0%	50.0%	
	Yes	Count	16	32	19	7	3	1	
		% within Age	43.2%	57.1%	47.5%	63.6%	100.0%	50.0%	
Associated systemic disease	None	Count	27	52	30	9	3	0	86.02
		% within Age	73.0%	92.9%	75.0%	81.8%	100.0%	0.0%	
	Sinus	Count	0	1	1	1	0	0	

		% within Age	0.0%	1.8%	2.5%	9.1%	0.0%	0.0%	
	Heart Disease	Count	2	1	3	0	0	0	
		% within Age	5.4%	1.8%	7.5%	0.0%	0.0%	0.0%	
	Asthma	Count	1	1	1	0	0	1	
		% within Age	2.7%	1.8%	2.5%	0.0%	0.0%	50.0%	
	Glaucoma	Count	5	0	3	0	0	0	
		% within Age	13.5%	0.0%	7.5%	0.0%	0.0%	0.0%	
	Arthritis	Count	0	1	2	0	0	0	
		% within Age	0.0%	1.8%	5.0%	0.0%	0.0%	0.0%	
	Diabetes	Count	0	0	0	1	0	1	
		% within Age	0.0%	0.0%	0.0%	9.1%	0.0%	50.0%	
	Combination	Count	2	0	0	0	0	0	
		% within Age	5.4%	0.0%	0.0%	0.0%	0.0%	0.0%	
Does patient have dry eyes?	No	Count	3	3	2	0	0	1	8.11
		% within Age	8.1%	5.4%	5.0%	0.0%	0.0%	50.0%	
	Yes	Count	34	53	38	11	3	1	
		% within Age	91.9%	94.6%	95.0%	100.0%	100.0%	50.0%	
MGMT OF KC RE	Intact	Count	0	1	3	1	0	0	69.89
		% within Age	0.0%	1.8%	7.5%	9.1%	0.0%	0.0%	
	CXL	Count	16	18	14	2	0	0	
		% within Age	43.2%	32.1%	35.0%	18.2%	0.0%	0.0%	
	Sclerals	Count	4	15	7	1	1	0	
		% within Age	10.8%	26.8%	17.5%	9.1%	33.3%	0.0%	
	Corneal Transplant	Count	2	5	3	1	2	0	

From table 11 above, it can be seen that 100% of those age 51-60 and over 60 had a family history of KC, as well as had allergies. 100% of those aged 51-60 and over 60 had a dust allergy. All of those (100%) aged 51-60 rubbed their eyes and had no associated systemic diseases. 100% of those age 41-40 and 51-60 had dry eyes, with ages 10-20, 21-30 and 31-40 being close. Intacs were used by 9.1% of those ages 41-50, 43.2% of the 10-20 year old patients had CXL done, 33.3% of those age 51-60 used scleral lenses, 66.7% of those ages

51-60 had corneal transplant done, 50% of those over 60 used RGP lenses, 18.2% of those ages 41-50 were advised to monitor, 9.1% of those ages 41-50
had a combination of the treatment options and 50% of those over 60 did not receive any treatment.

Table 12 showing the Distribution according to Occupation

			Occupation									
			Student	Accounting Professional	Elevator Technican	Business Operations Assistant	Cleaner	Teacher	Housewife	Unemployed	Retired	
Presence of KC	No	Count	7	13	2	1	1	1	2	0	4	15
		% within Occupation	15.6%	23.2%	50.0%	33.3%	33.3%	25.0%	40.0%	0.0%	14.3%	
	Yes	Count	12	15	1	1	1	1	0	0	2	
		% within Occupation	26.7%	26.8%	25.0%	33.3%	33.3%	25.0%	0.0%	0.0%	7.1%	
	Not Sure	Count	26	28	1	1	1	2	3	2	22	
		% within Occupation	57.8%	50.0%	25.0%	33.3%	33.3%	50.0%	60.0%	100.0%	78.6%	
Family History of Keratoconus	No	Count	6	5	0	0	0	1	0	1	2	7
		% within Occupation	13.3%	8.9%	0.0%	0.0%	0.0%	25.0%	0.0%	50.0%	7.1%	
	Yes	Count	39	51	4	3	3	3	5	1	26	
		% within Occupation	86.7%	91.1%	100.0%	100.0%	100.0%	75.0%	100.0%	50.0%	92.9%	
Allergies	No	Count	6	10	0	1	2	1	0	0	9	11
		% within Occupation	13.3%	17.9%	0.0%	33.3%	66.7%	25.0%	0.0%	0.0%	32.1%	

	Yes	Count	39	46	4	2	1	3	5	2	19	
		% within Occupation	86.7%	82.1%	100.0%	66.7%	33.3%	75.0%	100.0%	100.0%	67.9%	
If yes, name the allergy:	Dust	Count	39	47	4	2	1	3	5	2	19	46
		% within Occupation	86.7%	83.9%	100.0%	66.7%	33.3%	75.0%	100.0%	100.0%	67.9%	
	Pollen	Count	5	8	0	0	2	1	0	0	7	
		% within Occupation	11.1%	14.3%	0.0%	0.0%	66.7%	25.0%	0.0%	0.0%	25.0%	
	Penicillin	Count	0	1	0	0	0	0	0	0	0	
		% within Occupation	0.0%	1.8%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	
	Other	Count	1	0	0	0	0	0	0	0	0	
		% within Occupation	2.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	
	Combination	Count	0	0	0	1	0	0	0	0	1	
		% within Occupation	0.0%	0.0%	0.0%	33.3%	0.0%	0.0%	0.0%	0.0%	3.6%	
	Dust, Pollen	Count	0	0	0	0	0	0	0	0	1	
		% within Occupation	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	3.6%	
Rubbing of Eyes	No	Count	14	31	2	1	0	2	4	2	15	14
		% within Occupation	31.1%	55.4%	50.0%	33.3%	0.0%	50.0%	80.0%	100.0%	53.6%	
	Yes	Count	31	25	2	2	3	2	1	0	13	
		% within Occupation	68.9%	44.6%	50.0%	66.7%	100.0%	50.0%	20.0%	0.0%	46.4%	
Associated systemic disease	None	Count	40	46	2	3	2	4	2	1	22	108

		% within Occupation	88.9%	82.1%	50.0%	100.0%	66.7%	100.0%	40.0%	50.0%	78.6%	
	Sinus	Count	1	0	0	0	0	0	0	0	2	
		% within Occupation	2.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	7.1%	
	Heart Disease	Count	1	2	0	0	1	0	1	0	1	
		% within Occupation	2.2%	3.6%	0.0%	0.0%	33.3%	0.0%	20.0%	0.0%	3.6%	
	Asthma	Count	1	1	1	0	0	0	0	1	0	
		% within Occupation	2.2%	1.8%	25.0%	0.0%	0.0%	0.0%	0.0%	50.0%	0.0%	
	Glaucoma	Count	1	5	0	0	0	0	0	0	2	
		% within Occupation	2.2%	8.9%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	7.1%	
	Arthritis	Count	1	0	0	0	0	0	2	0	0	
		% within Occupation	2.2%	0.0%	0.0%	0.0%	0.0%	0.0%	40.0%	0.0%	0.0%	
	Diabetes	Count	0	0	1	0	0	0	0	0	1	
		% within Occupation	0.0%	0.0%	25.0%	0.0%	0.0%	0.0%	0.0%	0.0%	3.6%	
	Combination	Count	0	2	0	0	0	0	0	0	0	
		% within Occupation	0.0%	3.6%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	
Does patient have dry eyes?	No	Count	3	4	1	0	0	0	0	0	1	4
		% within Occupation	6.7%	7.1%	25.0%	0.0%	0.0%	0.0%	0.0%	0.0%	3.6%	
	Yes	Count	42	52	3	3	3	4	5	2	27	
		% within Occupation	93.3%	92.9%	75.0%	100.0%	100.0%	100.0%	100.0%	100.0%	96.4%	
MGMT OF KC RE	Intact	Count	1	1	0	0	0	0	0	1	2	87

		% within Occupation	2.2%	1.8%	0.0%	0.0%	0.0%	0.0%	0.0%	50.0%	7.1%	
	CXL	Count	12	21	0	0	3	2	1	0	11	
		% within Occupation	26.7%	37.5%	0.0%	0.0%	100.0%	50.0%	20.0%	0.0%	39.3%	
	Sclerals	Count	9	10	2	2	0	0	4	0	2	
		% within Occupation	20.0%	17.9%	50.0%	66.7%	0.0%	0.0%	80.0%	0.0%	7.1%	
	Corneal Transplant	Count	5	3	0	1	0	0	0	1	3	
		% within Occupation	11.1%	5.4%	0.0%	33.3%	0.0%	0.0%	0.0%	50.0%	10.7%	
	RGP	Count	6	4	1	0	0	1	0	0	0	
		% within Occupation	13.3%	7.1%	25.0%	0.0%	0.0%	25.0%	0.0%	0.0%	0.0%	
	Referral	Count	2	8	0	0	0	0	0	0	4	
		% within Occupation	4.4%	14.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	14.3%	
	Monitor	Count	4	3	0	0	0	1	0	0	5	
		% within Occupation	8.9%	5.4%	0.0%	0.0%	0.0%	25.0%	0.0%	0.0%	17.9%	
	Combination	Count	1	0	0	0	0	0	0	0	0	
		% within Occupation	2.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	
	None	Count	2	5	1	0	0	0	0	0	1	
		% within Occupation	4.4%	8.9%	25.0%	0.0%	0.0%	0.0%	0.0%	0.0%	3.6%	

In Table 12 above, the distribution according to occupation is evaluated. 100% of the elevator technicians, business operations analyst, cleaners and housewives reported having a family history of KC. 100% of elevator technicians, housewives and those unemployed had allergies. 100% of the cleaners reported rubbing of eyes. 100% of the business operations analysts, cleaners, teachers, housewives and those unemployed had dry eyes. 50% of those unemployed used intacs as the management option, 100% of the cleaners had CXL done, 80% of the housewives used sclerals, 50% of those unemployed had corneal transplants done, 25% of elevator technicians and teachers used RGP lenses, 14.3% of accountants and those retired were given referrals, 25% of teachers were advised to monitor, 2.3% of students had a combination of treatments done and 25% of elevator technicians did not receive any management or treatment.

4.4 : Objective 4 : Management and Treatment Options Used

Table 13 showing whether the patient received treatment for KC

	Frequency (n=150)	Percentage Frequency (n=100%)
Yes	92	64
No	54	36

From table 13, it can be seen that 64% of the KC patients that participated in this study received treatment and management,

Table 14 showing Frequency and Percentage Frequency of Treatment and Management Options used

Management Method	Frequency (n=150)	Percentage Frequency (n=100%)	Frequency of those that received treatment (n=96)	Percentage frequency (n=100%)
Intacs	2	1.33	2	2.08
CXL	59	33.33	59	61.46
Sclerals	25	16.67	25	26.04
RGP Lenses	1	0.67	1	1.04
Corneal Transplant	9	6.00	9	9.38
Referrals	6	4.00	6	6.25
Monitor	4	2.67	4	4.17
None	54	36.00	-	-

In table 14, it was found that 33.33% of the patients that participated in the study had CXL done. However, from table 12 it was found that only 96 patients received treatment. Of these 96 patients, 61.46% had CXL done.

DISCUSSION

5.1 Discussion

5.1.1 Demographical Characteristics

The demographical characteristics of this research study showed that 21-30 years age group had the highest prevalence of keratoconus when compared to others. Also, prevalence of KC was also found to decrease with increase in age in our study. Similar findings were recorded by Shanti et al (2018) in two ophthalmology centres in Palestine, where 75% of KC patients were between 16 and 30 years.

As it relates to gender, it was found in this study that keratoconus had a higher prevalence (51.7%) in females than that of males (47.0%). These results are quite similar to a study conducted by Valdez-Garcia et al (2014) in Mexico where keratoconus affected 66% of females and 33% of males.

Also, prevalence of keratoconus with regards to ethnicity was also investigated. Findings from this research study showed that out of all races presented, highest prevalence was found in Indians with a percentage of 56%. Similar findings were seen in a study conducted in Malaysia by Mohd - Ali et al (2012) where the majority of keratoconus patients observed were Indians (39%) followed by Malays (36%). Despite the claim by Rabinowitz (1998), who states that all ethnic groups are equally affected, the variation in the percentage suggests that genetic factor may influence the development of the disease.

5.1.2 Risk and Associated Factors

In this research study, out of 150 patients, the risk and associated factors were found to be family history of keratoconus (9.90%), allergies such as rubbing of eyes(47 %) and associated systemic diseases such as sinus (50 %) and asthma (16.67%) found only in 28 patients. Similar findings were found in a survey in Israel that included 240 keratoconus patients, and 65.6% of them had a history of eye rubbing (Shneor E et al, 2013). Also,

McGhee et al (2015) also found that 48% of keratoconus patients rubbed their eyes in their study in…. However, most Keratoconus patients (81.3%) did not present with any associated systemic diseases in both studies.

5.1.3 Clinical Presentations

For this research study, the minimum OD VA, maximum OD VA and mean OD VA was fond to be .00 , 2.00 and 0.9981LogMar respectfully. The minimum, maximum and mean OS VA were found to be -0.12, 3.00 and 1.0086 LogMar. Similarities were found in a study done in Israel where the minimum and maximum VA were found to be -0.8 and 0.78 LogMar (Shneor E et al, 2013). Average VA recorded in a study in Malaysia, was 0.73 in males and 0.81 LogMar in females(Mohd-Ali et al,2012).The mean K1, K2 and Kmax OD was found to be 48.9636, 48.0402 and 53.1662 with the maximum of each being 482, 74.20 and 112.30 respectively. The mean K1, K2 and Kmax OS was found to be 46.0540, 48.6057 and 53.1427 with the maximum being 68.50, 68.40 and 94.70. Shneor et al (2013) also found that the average anterior and posterior K readings were 48.91D and 63.68D respectively. Mean K readings found in a Malaysian study was 54.68D and 53.51D in males and females. (Mohd-Ali et al, 2012). Mean CCT OD and OS were found to be 480.2500 and 482.3404 in our study. The minimum CCT OD was 272 and the maximum was 582. The minimum and maximum CCT OS was found to be 372 and 609 respectfully. The average CCT in the study performed in Israel, found the average CCT to be 533.6 (Shneor E et al,2013) .

Symptoms that patient reported in this study were decrease in VA, cloudy vision and increased sensitivity to light. As seen from table 5 in the results, 79% of the 150 participants in this study reported having a decrease in their VA. This can also be reflected in the mean VAs found as they were indeed quite high. In a paediatric study done in 2016 in Lebanon, it was found that upon initial presentation of a routine check-up for KC patients, the most common symptom in 10 out of 16 patients was reduced vision (Khoury et al. 2016).

Of the 150 patients in this study, signs on the slit lamp were seen on 81 of the patients. The most common sign seen on SLE in the 81 patients was Vogt's Striae at 32.09% followed by Fleisher's ring (28.39%), and apical scar (17.28%). In the Lebanon study, corneal hydrops

was the most common sign seen in slit lamp exam used for KC diagnosis (Khoury et al. 2016).

Dry eyes were found to be significantly associated with the area of residence (p=0). Similar finding was recorded in a study in New Zealand where dry eye was found to be associated with area of residence especially among those living in rural areas. Also, there was no significant link between clinical characteristics and area of residence. In a study in New Zealand, it was found that the rural population had worse dry eyes compared to urban (Osae et al, 2020). No significant relationships were found between age, gender, ethnicity, occupation, and clinical characteristics.

5.1.4 : Management and Treatment of Keratoconus

For this study, 64% of the patients reported managing and treating their keratoconus. The most common form of management and treatment used for KC patients in Trinidad was found to be Collagen corneal cross-linking (CXL). Of the 91 that received treatment, 61.46% did CXL, 26.04% use scleral lenses, 9.38% had corneal transplants done, 6.25% were given referrals, 4.17% were advised to monitor and 2.08% had intacs. In a study done in Latin America , 65.9% of 977 eye care practitioners prescribed rigid contact lens while 40.4% prescribed KC comanaged the KC with ophthalmologists (Viera et al, 2022). In another study done in India, 188/193 newly diagnosed eyed were fitted with contact lenses while 5 were advised surgery. For those in the study who were previously diagnosed,144 eyes continued to wear RGP lenses. Out of the remaining 28 eyes, 3 were fitted with RGPs, 16 refitted with piggyback, 2 were fitted with custom RGP lenses and 7 were advised to use scleral lenses or have surgery (Mahadevan et al, 2009).

5.2 :Conclusion

A total of 150 keratoconus patients participated in this study. It was found that ages 21-30 had the highest prevalence of keratoconus in Trinidad and Tobago. Females were found to have a higher prevalence of keratoconus in Trinidad in comparison to males. The ethnicity with the highest prevalence was Indians. However, Africans were not far behind. Rubbing of eyes, sinus and asthma were found to be the most prevalent risk factors. For clinical presentation, decrease in VA was the most common symptom and Vogt's Striae and Fleischer's ring were the most common signs. Average VA were found to be 0.9981 and

1.0086 for right and left eye while average K readings were found to be 53.1662 and 53.1427. Average CCT readings were found to be 480.25OD and 482.3404 OS.

5.3 : Limitations and Recommendations

5.3.1 Limitations

- Lack of research studies done locally and regionally which makes it difficult to obtain information nationally and locally to reference.
- Not all patient files had all the information needed to perform this study, therefore blanks were left.
- There is a bias since it was a hospital/clinical record based collected from only two centres hence the findings cannot be generalized.

5.3.2 Recommendations

- Similar studies that focus on keratoconus in Trinidad and Tobago should be done.
- Future studies should include the general public in order to educate them about this disease.
- Studies on keratoconus should be done in other Caribbean countries.

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APPENDIX

THE UNIVERSITY OF THE WEST INDIES
ST. AUGUSTINE, TRINIDAD AND TOBAGO, WEST INDIES
CAMPUS RESEARCH ETHICS COMMITTEE
TELEPHONE: (1-868) 662-2002 ext. 82755 E-mail: campusethics@sta.uwi.edu

September, 8 2021

Dr. Ngozika Ezinne, Destiny Lawrence, Elicia Bissoon,
Optometry unit, Department of Clinical Surgical Sciences
Faculty of Medical Sciences
Email: Ngozika.ezinne@my.uwi.edu

Dear Dr. Ngozika Ezinne,

Ref: CREC-SA.1181/09/2021

Title: Epidemiology of Keratoconus in Trinidad & Tobago

I am pleased to advise that your application for research on the above captioned topic has met the criteria for Exemption from Review from the Campus Research Ethics Committee, St. Augustine.

Sincerely,

Professor Jerome De Lisle
Chair
Campus Research Ethics Committee