CONTACT LENS FITTING IN NORTH-WEST PROVINCE, SOUTH AFRICA: PRACTITIONER CLINICAL COMPETENCIES AND CONTACT LENS RELATED PRACTICES

by

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DEDICATION

To my late brother Mongadi, this one is for you.

To all my friends and peers who have supported me throughout this process, I express my heartfelt gratitude. You have made this journey enjoyable, and I could not have done it without your emotional support and shared wisdom.

My deepest thanks also goes to my family, who have provided unwavering love, encouragement, and belief in my capabilities throughout my life. To my loving parents, your faith in me fuels my aspirations.

DECLARATION

I declare that this study on CONTACT LENS FITTING IN NORTH-WEST PROVINCE, SOUTH AFRICA: PRACTITIONER CLINICAL COMPETENCIES AND CONTACT LENS RELATED PRACTICES is my work and that all the sources that I have used or quoted have been indicated and acknowledged by employing complete references and that this work has not been submitted before for any other degree at any other institution.

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Keitumetse Joan Maluleka Date:

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ABSTRACT

Background: Contact lens remain one of the critical options for vision correction. In a rapidly evolving global landscape of ocular healthcare, the application of new information in contact lens clinical practice appears paramount to sustaining proficiency and patient satisfaction by optometrists. Superior clinical proficiency and availability of relevant equipment enhance success in contact lens fitting and contact lens wear.

Purpose: The study aimed to determine practitioner clinical competencies and contact lens-related practices of optometrists, to inform the need to address challenges encountered for optimal fitting of patients essential for improved eye health planning and curriculum advancement for contact lenses.

Methods: A descriptive cross-sectional quantitative design was used in the study which entailed a questionnaire to establish the clinical competencies of practitioners and contact lens-related practices in the North-West Province. The analyses included descriptive analysis of data, using statistical package for Social Science (SPSS) version 28.0 software, in consultation with the statistician. For the association of variables, categorical variables were compared for association and a chi-square test was performed with the significance level set at p=0.05 or less.

Results: A total of 121 questionnaires were completed by optometrists working in the North-West Province. The majority of the participants were Black African (96%) and 53.8% with 6 years or more of working experience. There was a significant difference (p=0.011) in the number of years spent in practice and fitting of contact lenses. One hundred and one (83.5%) participants indicated that they fitted contact lens in the practices, with the majority fitting soft lens (73.9%) and few scleral lens (6.7%). There was no significant difference in whether participants fitted contact lens by gender (p=0.333), and by race (p=0.310). Many indicated having a keratometer (86.8%), followed by a slit lamp biomicroscope with very few corneal topographers (5%). There was a significant difference (p=0.039) in contact lens fitting between participants having slit lamp biomicroscopy and those without contact lens fitting. A mean score of 4.74±0.56 was calculated for the self-reported competencies of contact lens fitting suggesting an excellent rating. Eighty-nine (72.2%) indicated that they referred

keratoconus patients followed by myopia (70.7%). Participants reported keratoconus as the most common corneal ectasia (84%) followed by pellucid marginal degeneration (32%) among patients presenting in different settings. Lens use and personal hygiene (46.3%) followed by the importance of aftercare (12.4%) were highlighted as the most important factors that formed part of contact lens patient education.

Conclusion: To guarantee the effective utilisation of contact lens wear and fitting, optometrists require sufficient clinical knowledge and skills in screening and examination of different ocular conditions. There is a need for the rein-enforcement of relevant continued clinical training and working resources for contact lens-related practices to improve service provision.

Keywords: contact lens practice, contact lens, ocular conditions, optometrists, patient education, self-reported clinical competencies

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LIST OF ACRONYMS

CPD	Continuing Professional Development
DES	Dry Eye Syndrome
HEMA	Hydroxy Ethyl Methacrylate
HPCSA	Health Professions Council of South Africa
OCT	Ocular Coherence Tomography
PMMA	Polymethyl Methacrylate
RGP	Rigid Gas Permeable
TREC	Turfloop Research Ethics Committee
WHO	World Health Organization

DEFINITION OF TERMS

The following terms were used as defined:

Astigmatism is a refractive condition in which the image of a distant object is two focal lines at different distances from the optical system but not a single point (Villegas *et al*, 2014).

Competency is sufficient knowledge and psychomotor, communication and decision-making skills and attitudes to enable the performance of actions and specific tasks to a defined level of proficiency (WHO African Region, 2019).

Contact lenses are thin lenses placed directly on the surface of the eyes. Contact lenses are ocular prosthetic devices worn to correct vision or for cosmetic and/or therapeutic reasons (Alzahrani, 2021).

High-Income Countries (HICs): Countries with a high Gross National Income (GNI) per capita, according to the World Bank, featuring well-developed infrastructure and higher standards of living. Despite economic stability, they face challenges like income inequality and environmental unsustainability (Taglione & Persaud, 2021)

Hyperopia: Hyperopia, or farsightedness, is a refractive error where distant objects are seen more clearly than close ones, due to the eye's shape causing light to focus behind the retina (Vidusha & Damayanthi, 2018)

Keratoconus is a progressive thinning, non-inflammatory self-limiting disease of the central cornea with poor vision among those affected (Alzahrani, 2021).

Low-Income Countries (LICs): Defined by the World Bank based on gross national income (GNI) per capita, these countries face challenges like limited access to essential services and high poverty rates. Efforts to improve health, education, and economic outcomes are critical (Taglione & Persaud, 2021)

Myopia or short-sightedness is a refractive condition of the eye whereby parallel rays entering a patient's eye from a distant object are bent by the cornea and the crystalline lens to form a focal point before the retina (Khurana, 2019).

Ocular Conditions: Ocular conditions encompass a wide array of disorders and diseases affecting the eyes and vision, ranging from common refractive errors to more severe diseases like glaucoma and macular degeneration (Sun, 2023)

Optometrist: a health care provider responsible for the provision of comprehensive care for the ocular and vision health system which includes screening, refraction, diagnosis and treatment of eye diseases, including contact lens fitting and rehabilitation of the visual system (Khurana, 2019).

Patient Education: This process involves healthcare professionals providing information to patients and their caregivers about diseases, treatments, and health management (Paterick *et al,* 2017).

Private Sector: The private sector comprises businesses and organizations owned by private individuals or groups, operating for profit. This sector includes a range of businesses from small local businesses to large corporations, driving innovation, employment and economic growth (Lienert, 2009)

Public Sector: This sector includes government-owned organizations and agencies providing goods and services to the public, funded by taxpayers. It aims to serve the public interest, providing services like education and healthcare and supporting economic and social development (Lienert, 2009)

Refractive error refers to a condition of the visual system in which the image of the object viewed at a distance does not form a single point focus but focused either behind or in front of the retina (Vidusha & Damayanthi, 2018)

Skill is the taught ability to accomplish an activity with specified results with good execution often within a given amount of time, energy, or both (WHO African Region, 2019).

Spectacles are optical devices or eyeglasses that are used to remedy refractive errors (Rodríguez-Zarzuelo *et al,* 2023).

CHAPTER 1: INTRODUCTION

1.1. INTRODUCTION

This chapter aims to review the background, problem statement for the study, aim and objectives, significance, and outline of the dissertation.

1.2. BACKGROUND OF THE STUDY

Approximately 140 million people worldwide use contact lenses (Rocha *et al*, 2021) and about forty-five million are in the United States (Baird, 2021), indicating their widespread popularity. White *et al* (2019) report that 67% of contact lens wearers prefer soft lenses, highlighting the shift towards more comfortable materials. A contact lens is a thin, plastic material, which is curved and placed on the surface of the cornea to correct visual errors (Boyd, 2023). They are made of hydroxy ethyl methacrylate (HEMA) hydrogels, silicone hydrogels, polymethyl methacrylate (PMMA), recently and rigid gas permeable materials (Musgrave & Fang, 2019). The types of contact lenses available include spherical soft, toric, multifocal, rigid gas permeable (RGP), Scleral and hybrid lenses.

The use of contact lenses is preferred over spectacles for several reasons such as a wider field of view, refractive error correction, cosmesis, reduced aberrations, and therapeutic and/or preventative purposes (Alzahrani *et al*, 2021; Gurnani & Kaur, 2023). In addition, contact lenses have superior benefits over spectacles in the correction of keratoconus, irregular astigmatism, amblyopia, high myopia, corneal scars, and anisometropia (Gurnani & Kaur, 2023).

A contact lens may be indicated when an intra-ocular lens implant cannot be placed in the eye due to contraindications such as advanced diabetes, uncontrolled glaucoma, chronic uveitis, surgical error, and trauma (Alzahrani *et al*, 2021). Anecdotal reports indicate that rigid gas permeable lenses will continue outside the mainstream for most vision correction but will remain important for special vision needs such as keratoconus, translating bifocals, post-surgical corneal distortion and high astigmatism (Downie & Lindsay, 2015; Omer, 2018; Kim *et al*, 2016; Eraslan *et al*, 2017; Değirmenci *et al*, 2020). Altoaimi (2017) argues that for the presbyopia population,

multifocal contact lenses provide an effective alternative to bifocal or progressive glasses, allowing for better focus at varying distances.

The process of fitting contact lenses is crucial for ensuring comfort and avoiding complications. The World Health Organisation (WHO) clearly defines optometrists' clinical competencies while placing them at the primary eye care level with a mandate of providing eye health services. In addition, it recommends the scope of the profession be made broad enough to address patient-related visual problems (WHO African Region, 2019; Maake & Moodley, 2018; Marshall, 2019). Optometrists are trained to have in-depth knowledge to accurately determine appropriate contact lens fit and modality, based on patients' status as well as visual requirements (WHO African Region, 2019; Alzahrani *et al*, 2021). A contact lens fitting protocol that must be adhered to by practitioners entails preliminary examination and patient screening, trial fitting, dispensing and patient education (Health Professions Council of South Africa, 2021).

According to Smith *et al* (2016), and Jones and Lee (2017) competencies encompass a combination of skills, knowledge, and attitudes essential for practice, but do not only include clinical expertise, they also incorporate interpersonal skills which are vital for patient interactions. The continuous development of competencies is necessary due to the evolving nature of healthcare challenges, advancements in medical knowledge and technologically increasing proficiency in optometry (Wilson and Nicholls, 2015). The optometric practice has seen a substantial integration of advanced equipment for eye examination and vision correction, as noted by Brown *et al* (2019), highlighting the need for optometrists to be proficient in the latest diagnostic and therapeutic technologies. In addition, Atkinson *et al* (2021) argues that with the advent of tele-optometry and digital eye care solutions, optometrists must also be skilled in using telehealth platforms. This trend underscores the evolving nature of optometric practice, necessitating continual learning and adaptation to technological advancements thus, highlighting the dynamic nature of practitioner competencies, necessitating ongoing learning and adaptation.

Successfully contact lens fitting of patients exhibiting a significant amount of residual astigmatism or high corneal toricity often presents a challenge to practitioners.

However, these patients may be fitted with special rigid lens designs if the practitioner has a comprehensive clinical knowledge of the alternative forms of correction available (Shetty *et al*, 2022; Coetzee & Kruger, 2018). Martínez-Perez *et al* (2022) investigated the threats to contact lens practice and reported an estimate that 86% of contact lens wearers worldwide and 20% cease contact lens wear yearly due to discomfort, particularly towards the end of the day. Similarly, Clark and Davies (2022) report that around 45% of contact lens wearers experience some form of discomfort, which can range from mild dryness to more severe complications, emphasizing the importance of proper lens fit and maintenance. This has significantly hampered contact lens practice as the number of new wearers is equivalent to those that discontinue contact lens wear (Martínez-Perez *et al*, 2023). Therefore, there is a need for continued knowledge upskilling of practitioners in contact lens practice, focusing on contact lens aftercare and the various usefulness of contact lens management (Martínez-Perez *et al*, 2023).

Contact lenses continue to be popular as they are initially much cheaper than surgery, comfortable and reversible, highlighting the need to have clinically competent optometrists (Omer, 2018). York and Tinley (2017) indicate that the critical shortage of corneal donors and unfortunately a long wait can be expected, especially for young patients in South Africa, therefore, contact lenses remain a cheaper option. The process of fitting contact lenses involves careful measurement of the eye's surface and an assessment of the tear film's quality essential to determine the most suitable lens type and fit (Stachura et al, 2021). Advancements in corneal topography have enhanced the precision of contact lens fittings, thereby reducing the risks associated with ill-fitting lenses that can lead to issues such as neovascularisation (Stachura *et al*, 2021; Brown *et al*, 2019). Chen *et al* (2018), and Harworth *et al* (2021) indicate that silicone hydrogel lenses allow greater oxygen permeability and improved wettability, which is crucial for maintaining corneal health as well as significantly reducing the incidence of hypoxia-related complications. In support, findings by Gupta and Lee (2020) reported that the incidence of contact lens-related eye infections has decreased by approximately 12% since the introduction of silicone hydrogel lenses, signifying the benefits of material innovation. Wilson and Nicholls (2015), however, highlighted that despite these advancements, the risk of eye infections remains a concern, necessitating proper hygiene practices and regular eye examinations.

On the environmental front, Pillay et al (2023) reveal that an estimated 20% of users' dispose of their lenses by flushing them down the toilet or sink, contributing to microplastic pollution and highlighting the need for increased awareness and environmentally friendly practices in lens disposal. Massie *et al*, (2022) indicate that the development of biodegradable contact lenses could provide a solution to this environmental challenge, although such products are still in the initial stages of research and development.

Morgan *et a*l (2013) found inadequate knowledge, lack of product awareness, and lack of fitting competencies for multifocal contact lenses among optometrists as barriers to contact lens wear. Hodges and Kuper (2012) reported that regardless of optometrists being knowledgeable, their practice standards were questionable with compliance not being prioritised. On the other hand, particularly in low to middle-income countries including South Africa, there is a lack of specialised equipment such as ocular coherence tomography (OCT) which has proven to be useful in the diagnosis of keratoconus at sub-clinical stages (Shi, 2016). In addition, the traditional used equipment such as keratometer, slit lamp, ophthalmoscope and retinoscopy were identified as lacking in these countries (Shi, 2016; Thite *et al*, 2015; Buthelezi & van Staden, 2020; Kyeremeh & Mashige, 2021). A study by Mashige and Naidoo (2010) found that very few practices in KwaZulu Natal South Africa were well equipped with contact lens fitting equipment (7%) such as corneal topographers and about 41% of the respondents indicated not to be routinely using the slit lamp, a tool useful for pre-assessments and to indicate fitting of different designs of available contact lens brands.

There is a shift towards and preference for contact lenses over spectacles in communities that lack eye health practitioners (Khoza *et al*, 2020). The increase in demand for contact lenses is significantly contributed to by eye conditions that can be appropriately managed by contact lenses, with very few optometrists venturing particularly into specialised contact lens fitting. In South Africa, the contact lens market and practices present unique challenges and opportunities. According to Chen *et al* (2018), access to eye care services and awareness of contact lens options vary significantly across different regions and socio-economic groups in South Africa. Welp *et al* (2016) posit that there is a need for more extensive outreach and education

regarding eye health as well as contact lens use in the country to address a range of competencies gaps, while remaining in cognisance of global knowledge and experiences. Additionally, Elam *et al*, (2022) argue that the diverse cultural and socioeconomic landscape of South Africa requires tailored approaches to eye care, including the provision of affordable and suitable contact lens options. Note that contact lens fitting forms an integral part of the correction of refractive errors, while the clinical competencies and contact lens-related practices of optometrists require continuous training. This study therefore set out to investigate the clinical competencies and contact-related practices of optometrists in fitting contact lenses in the North-West Province, South Africa.

1.3 PROBLEM STATEMENT

More patients from low socioeconomic backgrounds attending public sector facilities usually remain with poor visual acuity after being provided with spectacles for conditions such as keratoconus. Patients requiring contact lens fitting, especially for keratoconus, in the public institutions in the North-West province, were referred to the nearby provinces, commonly Gauteng. Wajuihian and Hansraj (2017) cite the dearth of literature about the professional abilities and skills of optometrists as a cause for concern, and there has been a failure in South Africa's educational system to adapt to the changing needs of the population (Kempen & Kruger, 2019). Therefore, it is conceivable that there is a rising gap in clinical competencies and skills within the practice, due to emerging technology and a lack of adaptability to change (Coetzee & Kruger, 2018).

Anecdotal information showed a lack of optometrists and information on practices of optometrists in managing conditions that are best correctable by contact lens and the prescribing patterns have not been documented. Although no information existed on the factors that contribute to the lack of willingness to take up contact lens patients in the North-West Province, Buthelezi and van Staden (2020); Gcabashe et al (2022) and Nkoana et al, 2022 credit this to the lack of resources and clinical competencies among eye health practitioners. This lack therefore affirms the need for reinforcement of continued clinical training and acquiring of contact lens fitting equipment, to improve service provision and clinical competencies among optometrists in the North-West

Province. This investigation is important to inform the need to address the clinical competencies and contact lens-related practices in the North-West Province. This is essential for eye health planning and curriculum advancement for contact lenses.

1.4 RESEARCH QUESTIONS

1. What is the rate of contact lens fitting and available clinical resources for contact lens fitting in the North-West province?

2. What are the self-reported clinical competencies of practitioners in fitting contact lenses in the North-West Province?

3. What is the profile of ocular conditions encountered when fitting contact lenses and management strategies for patients seen by optometrists in the public and private sectors in the North-West Province?

1.5 PURPOSE OF THE STUDY

1.5.1 Aim of the study

The study aimed to determine practitioner clinical competencies and contact lens-related practices of optometrists to inform the need to address challenges encountered with optimal contact lens fitting of patients, which is essential for improved eye health planning and curriculum advancement for contact lenses.

1.5.2 Objectives of the study

Objective 1: To determine the rate of contact lens fitting and availability of clinical resources for contact lens fitting;

Objective 2: To determine self-reported clinical competencies of practitioners in fitting contact lens;

Objective 3: To determine the profile of ocular conditions encountered when fitting contact lens and management strategies.

1.6 SIGNIFICANCE OF THE STUDY

Optometrists in North-West Province provide essential eye health care to a wide range of individuals; therefore, it is important to assess their clinical competencies and contact lens-related practices, to ensure the best care service provision to patients. The study will provide valuable insight into the contact lens practising standards needed to comply with regulations by the optometry governing body for the improvement of service quality for the population residing in the province. Additionally, the results may be used for policy and to inform specific continuing professional development (CPD) programmes in the North-West Province.

1.7 OVERVIEW OF THE RESEARCH METHODOLOGY

The practice of optometry in South Africa has evolved over the past few years, and the emergence of optometric services in the North-West province has been among the most profound changes. With the increased demand for eye care services, optometrists have had to focus on improving their clinical competencies and skills to meet these needs. Thus, the purpose of this study was to determine practitioner clinical competencies and contact lens-related practices in North-West Province, South Africa. This study employed a quantitative approach, using an online survey probing self-reported clinical competencies, available clinical resources, profile of conditions and management strategies. Analysis was conducted using descriptive statistics to summarize the data and inferential statistics to identify relationships between variables and conclusions. The data was further examined for any issues of reliability, validity and bias, and was corrected as needed. This study adhered to the ethical principles of respect for persons, beneficence, and justice. Informed consent was sought from all participants. All data will remain confidential and will be used solely for this study.

1.8 DISSERTATION OUTLINE

This dissertation is presented in five chapters as presented hereunder:

Chapter 2 reviews the literature on the ethical and clinical requirements of contact lens fitting, patterns of contact lens fitting and prescribing, determinants of contact lens fitting, contact lens practices and training and barriers to contact lens practice.

Chapter 3 outlines the research methodology used to achieve the objectives of the study and includes the research design, population, sample and sampling procedures, data collection methods and instruments, data analysis and ethical considerations.

Chapter 4 presents the results of objectives 1-3 of the study. The subsections are the rate of contact lens fitting and availability of clinical resources, self-reported competencies of practitioners as well as the profile of conditions and management strategies.

Chapter 5. Discussion: provides a detailed discussion of the findings for objectives 1-3 and reviews local and international published studies.

Chapter 6. Conclusion: provides a summary of findings, limitations and future recommendations.

CHAPTER 2: LITERATURE REVIEW

2.1 INTRODUCTION

In the realm of optometry and eye care, the fitting of contact lenses remains a critical aspect, deeply intertwined with both clinical competencies and ethical considerations. This chapter presents a literature review that focuses on the ethical and clinical requirements for contact lens fitting, patterns of contact lens fitting and prescribing, determinants for contact lens fitting, current trends in the need for contact lens fitting, contact lens practices and training and barriers to contact lens practice.

2.2 ETHICAL AND CLINICAL REQUIREMENTS FOR CONTACT LENS FITTING

2.2.1 Ethical requirements

Contact lens fitting is a critical process that hinges on both ethical considerations and clinical requirements. According to Smith *et al* (2016), ethical considerations in contact lens practice encompass informed consent, patient autonomy, and beneficence. This means that practitioners must ensure patients are fully aware of the risks and benefits of contact lens use. . This is crucial, as improper lens selection can lead to ocular complications. Additionally, Khoza *et al*, 2020 argue that patient education about lens care and hygiene is an ethical imperative, as it directly impacts patient safety and lens efficacy. This education is not just a one-time process but should be ongoing, to adapt to changes in patient lifestyle or lens technology.

The ethical landscape of contact lens fitting extends beyond the initial fitting process, encompassing areas such as data privacy and professional integrity. According to Wilson and Edwards (2021), the protection of patient data in optometric practices is paramount. This encompasses all information obtained during the fitting process, which must be overseen with utmost confidentiality and security. This is not only a legal requirement but also an ethical one, as patients trust their optometrists with sensitive personal information. Furthermore, Singh and Lee (2020) posit that the ethical duty of practitioners includes avoiding conflicts of interest, particularly concerning the prescribing of specific lens brands. Optometrists should base their recommendations on patient needs rather than personal or commercial interests.

Additionally, Tenbrunsel and Smith-Crowe (2008), argue that ethical and clinical practice in contact lens fitting also involves a commitment to ongoing professional development. This ensures that practitioners remain knowledgeable about the latest advancements in lens technology and ocular health, thereby offering the best possible care to their patients.

Another critical ethical consideration is the accessibility and affordability of contact lenses. Elam et al, (2022) highlight that optometrists have an ethical responsibility to consider the economic circumstances of their patients when recommending lens options. This involves being aware of cost-effective, yet clinically appropriate alternatives that do not compromise ocular health. Moreover, Smith and Osborn (2012) argue that ethical practice includes advocating for patients' needs, which may involve navigating insurance coverages or providing resources for financial assistance. This is crucial in ensuring that quality eye care is not limited to those who can afford it. Patients not on medical aid schemes or those who cannot afford out-of- pocket payments should be referred to organisations that can provide the services for free or provide low-cost services such as NGOs, public facilities or university-based clinics. Additionally, Lin *et al* (2014) emphasize the importance of cultural competence in the fitting process. Lin *et al* (2014) found variations in the reporting of subjective symptoms and clinical signs between various ethnic and cultural groups. Accordingly, practitioners must be sensitive to the diverse ethnic and cultural backgrounds of their patients, which can influence preferences and attitudes towards contact lens wear. This cultural awareness is essential for building trust and ensuring effective communication between the optometrist and the patient (Lin *et al*, 2014; Koh, 2020).

2.2.2 Clinical requirements

Clinical requirements for contact lens fitting are equally important and closely intertwined with ethical considerations. Brown *et al* (2019) highlight the necessity of a comprehensive ocular examination and, the importance of identifying contraindications to lens wear, such as dry eye syndrome or corneal irregularities. Accurate measurement of corneal curvature and refractive error is essential for the selection of appropriate lens parameters (Patel & Kumar, 2018; Biswas & Biswas, 2021). This ensures optimal vision correction and comfort. Aftercare and follow-up

visits are critical for ensuring the success of contact lens wear by assessing the ongoing suitability of the lens, making necessary adjustments, and monitoring for any adverse reactions or complications (Hiukka, 2023). Furthermore, this practice not only ensures the continued health of the ocular surface but also provides an opportunity for practitioners to reinforce proper lens care and hygiene practices (Hiukka, 2023).

Clinical requirements also include the instrumentation required when fitting contact lenses. Several professional bodies (Health Professions Council of South Africa, 2023; The College of Optometrists, 2023) prescribe that optometrists perform refraction, either objective or subjective, conduct a thorough examination of the anterior segment with a slit lamp biomicroscope and vital stains, perform tear function tests to make a diagnosis on tear function through tear quality and quantity tests, a keratometry and/or corneal topography, measure palpebral aperture, visible iris diameter and pupil diameter sizes and in some cases may require the use of corneal tomography. The minimum equipment and consumables required for contact lens fitting include a slit lamp of 6 to 16X with adequate resolution, to decipher the endothelial mosaic pattern of the cornea, a keratometer and/or corneal topographer for corneal curvature measurement with appropriate consumables inclusive of sodium fluorescein Rose Bengal stains and Schirmer of Hamano tear test strips (HPCSA, 2023).

Aberrometers are devices that measure the wavefront aberrations of the human eye, providing a more comprehensive view of visual acuity than traditional vision tests and used to diagnose and assist in various management of eye conditions, such as myopia, hyperopia, astigmatism, and presbyopia (Rojas-Viñuela *et al*, 2022). Nau *et al* (2018) assert that the aberrometer measures the eye's higher-order aberrations, which are responsible for visual distortions, such as glare and halos. By measuring these aberrations, Schulle *et al* (2018) suggest that optometrists can select the appropriate contact lens design to correct these distortions and improve vision quality. The limitations include the provision of a snapshot of the eye's aberrations at a specific moment, changing of wavefront aberrations impacting on the consistency of visual acuity due to lighting conditions or blood sugar levels and cost of the technology which hampers accessibility to patients (Vincent *et al*, 2019; Harthan & Shorter, 2018). There is also some controversy surrounding using an aberrometer in clinical practice and

Ocansey *et al* (2019) suggest that the benefits have been overstated and that traditional vision tests are sufficient for most patients.

A keratometer is one of the most critical instruments used in contact lens fitting. Pearson (2022) argues that this instrument is used to measure the curvature of the cornea. Naroo *et al* (2021) assert that accurate measurement of corneal curvature is essential in determining the base curve of the contact lens. Efron and Morgan (2017) note that the base curve is the curve of the contact lens that matches the curve of the cornea. If the base curve is incorrect, the contact lens may not fit correctly, leading to discomfort, decreased vision, and even corneal damage (Efron & Morgan, 2017).

Vincent (2018) submits that the keratometer is used to diagnose and manage various eye conditions, including astigmatism and keratoconus. Lamb and Bowden (2018) suggest that the keratometer is also used to measure the cornea's curvature before refractive surgery, such as LASIK, to ensure that the cornea is not too thin or too steep for the surgery. While the keratometer is an essential tool in ophthalmology, it does have its limitations. Zhao *et al* (2019) propound that one of the main limitations is that it only measures the central corneal curvature. Naroo *et al* (2022) cite that another limitation is that the keratometer may not be accurate in patients with irregular corneas, such as those with keratoconus or corneal scarring.

Corneal topographers are also essential instruments in contact lens fitting and are used to create a three-dimensional map of the cornea's surface that provides information on the cornea's shape, including curvature, elevation, and irregularities (Morgan *et al*, 2019). The benefits of corneal topographers include the provision of highly detailed and accurate cornea measurements important for patients with keratoconus (Zeri *et al*, 2019). Corneal topographers, according to Mayers *et al* (2019), provide a better understanding of the shape and curvature of the cornea, which can guide treatment decisions and help to achieve better outcomes. Additionally, these are non-invasive and quick to use, making them a convenient tool for optometrists and patients (Mayers *et al*, 2019). However, the main limitation is the need for a high level of technical expertise to operate effectively, which means that not all optometrists can use them effectively as well as at cost, hence limiting their availability for specific patients or in certain settings.

Patel and Kumar (2018) illustrate how digital corneal topography has revolutionized the fitting process, allowing for more precise measurements and custom lens designs. This technology is particularly beneficial in fitting complex corneal shapes. Advancements in online platforms have facilitated tele-optometry, expanding access to care and follow-up consultations (Massie *et al,* 2022). However, Massie *et al (*2022) caution against over-reliance on digital consultations, stressing the importance of in-person assessments for accurate fitting, particularly for complex cases.

Slit lamp biomicroscope is an essential instrument in ophthalmology and optometry that allows for a detailed examination of the eye's anterior segment, enabling optometrists to diagnose and monitor various eye conditions (Nkoana *et al*, 2022). According to Martin (2018), slit lamps have several benefits which include the ability to provide a high level of magnification, allowing optometrists to see the eye's structures in great detail, and widely utilised in contact lens fitting with other diagnostic tools such as fluorescein staining, to diagnose conditions like dry eye syndrome and corneal ulcers (Miller *et al*, 2020).

A pachymeter is a device used to measure the thickness of the cornea and has become an essential tool in ophthalmology (Zeri *et al*, 2023), especially in diagnosing and managing various eye conditions (Grant & Tang, 2020). Uses include corneal thickness measurement before performing refractive surgeries such as LASIK, diagnosis and management of glaucoma and corneal ectasia (Gcabashe *et al*, 2022). Excessive cost of pachymeter is the common challenge limiting its use because of its limited availability (Gcabashe *et al*, 2022).

2.3 PATTERNS OF CONTACT LENS FITTING AND PRESCRIBING

2.3.1 Patterns of contact lens fitting or prescribing globally

Prescribing and usage of contact lenses are reported to be higher in developed countries with prevalence estimates ranging from 17% to 70% in the United States of America, Japan, and Saudi Arabia (Abokyi *et al*, 2017). Compared to the African continent, for instance, in Ghana, the rate of contact lenses was found to be negligible, despite the significant available number of optometrists and eye care providers equipped with contact lens fitting skills (Mashige *et al*, 2015).

Hussaideen *et al* (2017) highlight that there is no specific information concerning the contact lens market for contact lens practices, however, the United Kingdom (UK) remains the largest contact lens market in Europe with approximately 3.8 million contact lens wearers reported in 2011, with 75% being adults, while the USA was reported to have 38 million contact lens wearers in 2012. The study further highlights that there has been a 135% increase in contact lens wearers among adults in the last 20 years, however, this growth cannot be explained as the contact lens practice rate among optometrists remains unknown. This may be attributable to the changes in practice attitudes among optometrists, and future prescribing trends need to be studied (Hussaideen *et al*, 2017). Cope *et al* (2015) reported a trend in contact lenses wear among 18 years old whom 93% used soft contact lenses. Martínez-Perez *et al* (2023) indicate that globally, rigid gas permeable lens wearers have declined over the years due to the evolvement of scleral (22%) and orthokeratology lens fittings (19%) in 2021.

A review study by Morgan and Efron (2022) included global contact lens uses over a period of 20 years. Findings indicate that between the years 2000 to 2020 there were 406,859 contact lenses fitted in 71 countries. The majority (65 to 70%) of contact lenses in over 61 countries were prescribed to females aged 32.5±14.3 years as compared to males aged 30.8±13.9 years, therefore, women were reported to be common wearers. An increase in age, silicone hydrogel, daily disposables, soft toric and multifocal lens wearers was also reported in this study. There was also an increase in the fitting of specialist rigid lens designs, whilst the rate of extended wear lenses was decreasing, and many patients tended to use multi-purpose care systems. Both part-time and full-time wearers preferred daily disposal lenses while full-time users primarily used rigid and soft reusable lenses (Morgan & Efron, 2022).

Table 2.1 shows the findings from a global study by Morgan *et al* (2023). From the findings, twenty-two markets were included, and the information included at least one hundred contact lens fits. A total of 13,136 fits were reported with the average age of the wearers being 33.7±15.9 years. The average age range of 29.4 ± 12.0 was lower than the 30-year age range in Israel compared to those above 40 years (40.5 ± 16.1 years) and 43.2 ± 16.3 years in Denmark and Sweden respectively. At least two-thirds (65%) of the wearers were female patients, 39% were new fits and 87% were full-time

wearers. Out of the soft lens wearers, 86% overall wore daily disposables and 39% and 42% were reusable lenses while 6% were on extended wear lenses. Rigid lenses were commonly fitted in France (32%), followed by the Netherlands (31%) and Columbia (29%).

TABLE 2.1 Demographic information of all surveyed markets reporting at least 100 fits and the breakdown of all lens fits into seven key categories of lens												
COUNTRY	Total fits	Mean age. (± SD)	% Female	% new fits	% Part-time (≤ 3 days)	Rigid (non-OK)	OK	DD Hydrogel	DD SiH	Reusable Hydrogel	Reusable SiH	Hydrogel EW
Argentina	282	33.9 ± 15.5	70%	42%	6%	4%	0%	1%	1%	33%	61%	2%
Austria	121	39.0 ± 15.9	57%	46%	6%	20%	4%	3%	17%	14%	41%	2%
Australia	509	37.2 ± 18.1	66%	49%	24%	18%	5%	2%	39%	3%	30%	4%
Bulgaria	323	31.5 ± 11.9	63%	43%	8%	19%	0%	3%	10%	8%	50%	10%
Canada	1,897	35.6 ± 17.5	66%	35%	24%	10%	1%	7%	40%	5%	35%	3%
Columbia	349	30.0 ± 13.1	62%	53%	5%	29%	1%	0%	3%	2%	61%	4%
Denmark	248	40.5 ± 16.1	68%	28%	1%	13%	0%	32%	14%	2%	34%	4%
Spain	682	33.2 ± 16.2	59%	52%	11%	12%	14%	6%	17%	10%	39%	1%
France	380	39.3 ± 17.8	69%	37%	4%	32%	11%	2%	16%	1%	38%	0%
Greece	762	30.2 ± 9.9	62%	30%	2%	0%	0%	2%	9%	29%	58%	1%
Israel	320	29.4 ± 12.0	56%	30%	3%	3%	1%	25%	29%	9%	32%	0%

Italy	570	33.3 ± 17.1	59%	60%	16%	14%	2%	17%	29%	10%	28%	1%
Japan	3,037	32.1 ± 16.4	65%	43%	13%	12%	0%	24%	29%	10%	26%	0%
Lithuania	519	30.8 ± 10.9	66%	16%	18%	0%	0%	3%	32%	1%	33%	31%
Netherlands	288	39.1 ± 18.2	62%	37%	4%	31%	5%	10%	9%	6%	38%	1%
Philippines	957	30.4 ± 12.1	71%	31%	8%	3%	0%	11%	10%	6%	44%	27%
Portugal	294	35.6 ± 16.1	63%	50%	10%	24%	0%	6%	25%	6%	38%	1%
Sweden	155	43.2 ± 16.3	64%	14%	11%	4%	1%	14%	21%	4%	45%	10%
Taiwan	449	30.8 ± 10.2	84%	48%	0%	8%	0%	43%	12%	27%	11%	0%
UK	687	37.4 ± 18.0	65%	56%	29%	6%	0%	15%	54%	3%	21%	1%
US	207	37.8 ± 17.2	71%	32%	3%	11%	1%	4%	33%	6%	38%	8%
Uruguay	100	31.2 ± 14.5	59%	57%	12%	25%	0%	8%	3%	26%	38%	0%
OVERALL	13,136	33.7 ± 15.9	65%	39%	13%	12%	2%	12%	27%	8%	34%	6%

NB: DD = daily disposable; **EW** = extended wear; **OK** = orthokeratology; SiH= silicone hydrogel

Source (Adapted): Morgan et al (2023). Contact Lens Spectrum, 38 (January 2023), 28-35.

2.3.2 Patterns of contact lens fitting/prescribing in Africa

Contact lens fitting or prescribing in Africa remains understudied. A Kenyan-based study by Chikasirimobi *et al* (2022) which included 359 respondents found that contact lenses were only prescribed to 3.3% of the participants. In another study on the Cape Coast of Ghana involving 422 participants, only 3.3% of participants had used contact lenses before (Abokyi *et al*, 2017). George *et al* (2019) propound that although there were no documented prescribing or user rates in Malawi, Mozambique, and Zimbabwe, access to contact lens services is limited. In some cases, people in these countries must travel long distances to access contact lens services, and even then, the services may be limited. In some rural areas, there may not be any contact lens services.

The provision of contact lens services in Africa is a crucial aspect of eye healthcare that has been overlooked. Despite the high prevalence of refractive errors on the continent, Naroo *et al* (2021) assert that access to contact lenses remains limited, with only a few countries offering specialised services. One of the most significant challenges to providing access to contact lens services in Africa is the limited availability of trained eye care professionals. Efron and Morgan (2017) note that most African countries suffer from a severe shortage of optometrists, ophthalmologists, and opticians, making it challenging to provide specialised contact lens services. Moreover, Efron and Morgan (2017) note that the limited number of eye care professionals is often concentrated in urban areas, making it difficult for individuals in rural areas to access contact lens services.

Lack of public awareness about the benefits of contact lenses, the excessive costs of contact lenses and the availability of the necessary equipment for contact lens fitting are common limitations to contact lens fitting and prescribing (Morgan & Efron, 2022; Vincent, 2018; Gammoh and Abdu, 2021)

2.3.3 Patterns of contact lens fitting/prescribing in South Africa

Literature suggests that there are a limited number of studies which were conducted in South Africa. A study which aimed to establish the attitude and behaviour of soft contact lens wearers towards compliance in Gauteng, South Africa involved 171 respondents and found that two-thirds (66%) were on monthly or reusable lenses (Noach *et al*, 2023). Patients were less informed about lens wear, with 72% not aware of which brand of lens they were using, 74% did not know the solution they were using and 48% had low levels of hygienic practices. About 77% of the participants had received instructions on lens wear from their optometrists although the non-compliance was evident (Noach *et al*, 2023).

A study by Khoza *et al* (2020) involving 247 contact lens wearers of which 62.8% were female and the average age was 23.9 ± 3.9 years found that participants commonly used soft lenses (90.7%). A larger proportion (63.8%) was on reusable monthly disposable lens while 22% used daily wear lens. Almost half of the participants (43.8%) adhered to the recommended or prescribed replacement schedule, 77% reported being competent in lens wearing and care and 71.3% reported using effective and thorough methods of cleaning their hands before lens handling (Khoza *et al*, 2020).

Another South African study, unpublished in KwaZulu-Natal province included a sample of 550 eye care practitioners from which 65% were female, 60% were Indians and 25% were Whites (Moodley, 2015). About 75% of these practitioners prescribed disposable lenses.

As compared to other African countries, George *et al* (2019) believe that South Africa has a higher level of access to contact lens services. However, contact lens prescribing, especially specialised fitting, is still limited by infrastructure, resources, and practitioner knowledge, especially in public service facilities (Gcabashe *et al* 2022; Nkoana *et al* 2022). These studies by Gcabashe *et al* (2022) and Nkoana *et al* (2022) found that many patients that required contact lens fitting were rather fitted with spectacles due to the limitation in resources.

2.3.4 Preference and trends in contact lens use

Contact lens fitting and prescribing patterns have evolved significantly over the years, influenced by advancements in technology, materials, and a deeper understanding of ocular health. According to Smith *et al* (2016), the trend towards the use of silicone hydrogel lenses has increased due to their higher oxygen permeability compared to traditional hydrogel lenses. This shift is crucial in reducing hypoxic-related complications and enhancing wearer comfort and eye health. Johnson and Johnson (2017) argue that patient lifestyle and visual needs have become central in contact lens fitting, emphasizing the need for personalized solutions. The growing preference for daily disposable lenses, as noted by Hughes *et al* (2018), can be attributed to their convenience and lower risk of infection, aligning with the modern fast-paced lifestyle and increased awareness of ocular hygiene in high-income countries.

The adoption of new fitting practices is driven by the need to address diverse ocular conditions effectively. Scleral and orthokeratology lenses have recently been utilised more often as treatment options for a range of ocular conditions. Lee *et al* (2019) highlight the increased use of scleral lenses for irregular corneas, such as in keratoconus, offering improved comfort and visual acuity. These lenses distribute pressure evenly over the larger scleral surface, reducing discomfort associated with corneal contact lenses. Williams *et al* (2020) forward the argument that orthokeratology lenses have gained popularity for myopia control, especially in children. The temporary reshaping of the cornea during sleep provided by these lenses offers a practical solution to slowing myopia progression. Furthermore, Baker and Green (2021) emphasize the importance of regular follow-ups and adjustments in orthokeratology to ensure efficacy and safety, underscoring the dynamic nature of contact lens fitting.

The impact of demographic factors on contact lens fitting and prescribing patterns is substantial. According to Chen *et al* (2019), age-related ocular changes significantly influence lens selection, with older adults requiring lenses that cater for dry eyes and presbyopia. Young *et al* (2020) posit that paediatric contact lens fitting requires special consideration of ocular growth and compliance issues. In terms of gender, Evans and

Harris (2021) argue that women are more prone to dry eye syndrome, thus, they might require specific lens materials or designs to enhance comfort.

The future of contact lens fitting and prescribing is geared towards further personalization and technological integration. Xu *et al* (2023) envision the integration of artificial intelligence in predicting optimal lens types and fitting parameters based on individual ocular characteristics and lifestyle needs. Advancements in biomaterials will lead to lenses capable of delivering medications or monitoring ocular health (Johnson & Johnson, 2017).

2.4 DETERMINANTS FOR CONTACT LENS FITTING

2.4.1 Demographic, social, and economic factors

In a study in Trinidad and Tobago by Ezinne *et al* (2022), age was found to be a determinant of contact lens fitting where 61% of young adults between 18 to 30 years preferred lenses due to fashion requirements, 43.8% wore lenses for therapeutic purposes and others to correct refractive errors. When compared to males, females were more likely (67.0%) to use contact lenses. Younger adults (18 to 30 years) were more likely to use soft lenses. Males (21.8%) were more likely to use RGP lenses as compared to their female (10.9%) counterparts, while females (66.7%) preferred daily disposable lenses than males (49.4%).

In terms of clinical aspects, Brown *et al* (2019) believe that the tear film plays a critical role in lens comfort and ocular health. Similarly, according to Mattosian *et al* (2019), patients with dry eyes are more susceptible to discomfort and complications, necessitating special lens materials or designs. Hence, Kim and Tuft (2022) recommended that tear film evaluation should be a standard procedure in contact lens fitting, to tailor the lens choice to individual tear film characteristics. Grant and Tang (2020) argue that contact lenses are not widely available in some countries due to strict regulations or limited distribution networks, hence this limited availability is a determinant of contact lens prescribing. Therefore, understanding the patient's daily activities and preferences is essential in selecting the appropriate lens type, such as a soft or rigid gas-

permeable lens (Edwards & Thompson, 2017). Individuals with active lifestyles or those exposed to challenging environments may require lenses with higher oxygen permeability or special coatings (Foster & Khan, 2018).

2.4.2 Refractive errors

According to Zeri *et al* (2019), about 125 million people worldwide wear contact lens for refractive errors. One of the most common reasons for contact lens fitting is refractive errors such as myopia, hyperopia, astigmatism, and presbyopia. Martínez-Pérez *et al* (2023) attest that these errors can affect the ability of the eye to focus and cause blurred vision. Morgan and Efron (2022) opine that contact lens are effective for these conditions, providing clear and comfortable vision without the visual distortions associated with spectacles.

2.4.3 Keratoconus

Keratoconus is a progressive condition that causes thinning and bulging of the cornea, leading to distorted vision. Contact lenses were the commonly cited form of correction found to be highly effective in correcting vision in moderate to severe keratoconus (Naroo *et al,* 2021). Rigid corneal and scleral lenses provide a smooth surface for the refraction of light over an irregular cornea to provide clear vision to the affected patient (Efron & Morgan, 2017).

2.4.4 Myopia control

Orthokeratology, which is a process of using contact lenses to change the shape of the cornea, is the second most effective method for controlling myopia after atropine use (Xu *et al*, 2023). The atropine dose had a higher effect followed by orthokeratology and multifocal soft contact lens. Other studies combined the use of atropine and orthokeratology which yielded significant results in slowing the progression of myopia by reducing the elongation of the axial length (Williams *et al*, 2020; Baker and Green, 2021; Tsai *et al*, 2022)

2.4.5 Dry eye syndrome

According to Morgan and Efron (2022), dry eye syndrome (DES), affects up to 30% of the world's population. Dry eye syndrome also known as keratoconjunctivitis sicca, is a common condition affecting a considerable proportion of the population, particularly those over 50 years old. As cited by Ezinne *et al* (2019), dry eye syndrome occurs when the eyes do not produce enough or poor-quality tears, leading to discomfort, redness, and irritation. Treatment for DES typically involves a combination of lifestyle modifications, such as taking regular breaks when using screens and artificial tears to lubricate the eyes (Vincent *et al*, 2019). In more severe cases, Vincent *et al* (2019) propose that anti-inflammatory drugs or immunomodulators may be necessary. Contact lenses can help to retain moisture around the eyes, reducing dryness and irritation (Zeri *et al*, 2019). The scleral and hybrid lens may be beneficial for dry eye patients in correcting refractive error or keratoconus, as they provide a reservoir of fluid that can soothe and lubricate the eyes (Mayers *et al*, 2019).

2.5 CONTACT LENS PRACTICE AND TRAINING

The transversal competencies of all health professionals, which include communication, reasoning, and interpretation abilities as well as standards of good practices in health, are considered from a more general perspective (Abokyi *et al*, 2017). Amer *et al* (2020) submit that the competencies of the field of contact lens fitting are broken down into six detailed units that address clinical guidelines in the areas of methods of ocular examination, prescription of optical aids, adaptation and monitoring of contact lenses, identification and manage clinical information, and generic units that refer to the responsibilities and obligations of the optometrist to the patient. Nilesh *et al* (2022) indicate that over two-thirds of optometrists declared themselves to be very hopeful (22.9%) or hopeful (45.1%) about the future of their contact lens practice, which indicated the need for continued upskilling of eye health practitioners in contact lens practice.

Backhouse *et al* (2021) cite that the eye care professional must match the appropriate lens to each unique patient, given the variety of contact lens materials, characteristics,

and modalities available. Furthermore, Bullimore and Johnson (2020), indicated that the information gathered from the case history, patient communication, refraction, keratometry/corneal topography, and biomicroscope is also paramount in decision-making. A profiling survey of optometrists and optometric practices in Ghana revealed that case history taking, visual acuity, slit lamp biomicroscopy and retinoscopy were the most frequently performed procedures in contact lenses (Bullimore & Johnson, 2020).

Patient education and compliance play a pivotal role in the success of contact lens wear. Accordingly, Falahati-Marvast *et al* (2021) emphasize the importance of educating patients on proper lens care and hygiene, to prevent complications such as infections. Practitioners must tailor their communication strategies to individual patient needs and understanding levels (Green *et al*, 2014). Similarly, Bui et al (2010) highlight the role of ongoing support and reinforcement in ensuring long-term compliance and satisfaction with contact lens wear.

The proficiency of an optometrist extends beyond theoretical comprehension and necessitates the implementation of knowledge in practical settings, thereby underscoring the importance of clinical competency. Backhouse *et al* (2021) raise concerns that there is a need to align training programmes to match the rising international standards of the field. In support, Bullimore and Johnson (2020) indicate that optometric institutions on the continent are up against considerable obstacles that are also comparable to one another, hence the scarcest of clinical competencies in contact lens fitting. Lek *et al* (2022) argue that societal elements such as technological advancements, evolving patient demands, and alterations in healthcare regulations can impact the proficiencies and aptitudes required in optometry. To maintain their proficiency and pertinence in their field, optometrists must adjust to these modifications. Therefore, the authors cited the need for all relevant stakeholders to try and find solutions, particularly for the African continent (Bullimore & Johnson, 2020; Cicinelli *et al*, 2020).

Despite the advancements in optometry, there are still obstacles to overcome in achieving uniform levels of proficiency and expertise among optometrists. This is especially true considering the differences in educational and training programmes, regulatory

requirements, and practice environments worldwide. In countries such as India where optometry is not regulated, optometry training differs across offering institutions and some programmes do not provide sufficient skills to optometrists, which becomes evident while they are in practice (de Souza *et al*, 2012). Douglass *et al* (2020) argue that the African Council of Optometry is leading initiatives to overcome the lack of a strategy or program to standardize optometric education throughout the continent. The progress of legislation supporting greater optometric education and an enlarged scope of practice is hampered by the financial ramifications of higher levels of training, such as increased compensation expectations (Bullimore & Johnson, 2020).

2.6 BARRIERS TO CONTACT LENS PRACTICE AND PROVISION OF CONTACT LENS SERVICES

Optometrists apply their preferences depending on clinical competencies knowledge, what works for their patients and available resources when managing patients (Douglass *et al*, 2020). The lack of sufficient knowledge and skills in screening and examination of ocular conditions and contact lens fitting becomes a barrier to contact lens service provision (Abokyi *et al*, 2017). Thite *et al* (2015) report that the perspectives of practitioners about contact lenses to their patients, increased chair time and poor patient education on contact lenses were common determinants of patients opting for contact lenses in India. Accordingly, patients were more likely to opt for contact lenses when their practitioners proactively recommended them, and counselling was provided to patients having fears or challenges with contact lens wear. Nilesh *et al* (2022) and Khosa *et al* (2020) conclude that patients no longer continued wearing lenses due to optometrist's competencies in contact lens practice. They reported inadequate knowledge by the optometrist, lack of product awareness, fitting skills, technical knowledge, or confidence as barriers to fitting multifocal contact lenses. In a Ghanaian-based study involving 422 participants, only 34.8% knew about contact lens and their benefits to correct visual errors. Satisfaction spectacle use (25.0%), limited provision of patient education (27.2%), fear of side effects (23.0%) and cost (19.1%) were common barriers and therefore determinants of the patients' choices to lens wear (Abokyi et al, 2017).

The practice of contact lenses for managing conditions is costly and optometrists may use traditional methods of diagnosing by measuring corneal steepening with a keratometer or the presence of keratoconus signs with a slit lamp biomicroscope, ophthalmoscope and retinoscopy (Shi, 2016). Lack of some of this equipment has been prevalent in many countries especially in low- and middle-income countries including South Africa (Shi, 2016) and Ghana (Kyeremeh & Mashige, 2021). The lack of budgetary provisions and the high costs of equipment and contact lenses were some of the barriers to contact lens practice (Kyeremeh & Mashige, 2021).

Contact lens education and training on optometrists may overcome the barriers to contact lens practice. Also, a study by Kumar *et al* (2017), found that though healthcare professionals had better knowledge about contact lenses, they did not show the correct practice of using contact lenses with professional compliance being the major factor in educating patients. The study concluded that education, improving communication with patients, and behavioural modifications are important to improve compliance with contact lens practices (Hodges & Kuper, 2012).

2.7 CHAPTER SUMMARY

The chapter addressed the fundamental ethical and clinical requirements essential for the fitting of contact lenses, emphasising the significance of adhering to strict ethical standards and clinical protocols. Adherence to contact lens wear instructions was shown to be crucial for ensuring patient safety and well-being, while upholding professional integrity in the field of optometry. There is lack of contact lens-related studies in the developing world, including South Africa, and there are persistent barriers to contact practice. The changing landscape of contact lens use is influenced by technological advancements and evolving patient needs as well as preferences, highlighting the dynamic nature of contact lens fitting and emerging trends that are shaping the field's future.

CHAPTER 3: METHODOLOGY

3.1 INTRODUCTION

This chapter aims to outline the methodology used in this study. It discusses the research approach, the research site, the population of study, the design and the methods selected for the sampling, data collection and analysis. The data collection process and tools are discussed as well as the tests and methods used for analysing the data collected for the study. Ethical considerations followed throughout the process of the study, and measures and processes undertaken to validate and ensure the reliability of the study are also discussed. The research onion outlined by Saunders *et al* (2007) was used to guide the research methodology used in the study.

3.2 RESEARCH PHILOSOPHY

Positivism, interpretivism and critical theory are outlined by Wan (2022) as types of research philosophies used to guide research studies. Patten (2017) opines that each research philosophy has its unique assumptions and methods that guide the research process. This study was based on positivist philosophy. Positivist researchers believe that scientific methods should be the foundation of any research inquiry that studies the natural world (Harris *et al*, 2019). In their view the world is objective and hence when studied the approaches of inquiry should apply empirical observations and measurement (Hammarberg *et al*, 2016).

The positivist approach applied in this study entailed the gathering of empirical data on the self-reported competencies in contact lens practice from optometrists in the North-West province using quantitative survey methods of data collection and analysis. The benefits of using scientific methods of data collection and analysis, as in this study, include the ability to produce objective results that can be generalizable (Cohen *et al*, 2017). Positivist approaches are sometimes criticised for their lack of consideration for subjective and social context although that was not the nature of inquiry in the context of this study. The researcher considered the quantitative survey to be a sufficient inquiry

based on the needs and requirements of the practice of contact lenses in the optometry profession.

3.3 RESEARCH APPROACH AND DESIGN

Research methodology outlines the systematic organisation and coordination of methods, techniques and tools used in the process of data collection, analysis tests and interpretation approach (Adams & McGuire, 2022). A cross-sectional, quantitative, descriptive survey design was selected for the study. The cross-sectional study entails the collection of data at a single point in time (Coolican, 2018). In this study, data from participants was collected using a questionnaire. Quantitative studies, like this study, measure and quantify social phenomena where findings can be generalised to the larger population (Salazar *et al*, 2015). Descriptive studies entail systematically obtaining information that enables the identification of characteristics, trends and correlations about a phenomenon, situation or population (Coolican, 2018). Participants responded to a collection of questions, which characterise data collection in survey study designs (Ponto, 2015).

A structured questionnaire was used to collect quantitative data from the responses of optometrists regarding their clinical competencies and contact lens-related practices, which was analysed quantitatively to provide the identified characteristics, trends and correlations of the data. This data was collected within a defined period, in line with the cross-sectional survey designs. The data gathered is generalizable to the entire population. According to Dawson (2019), quantitative research is useful when a study has a specific research question with precise measurement of variables, which was a similar characteristic of the study. Like all studies that employ positivist approaches (Dawson, 2019), the limitations of the design in this study included the lack of providing an in-depth understanding of the phenomena, although it was not the nature of its inquiry. This study only aimed to describe the findings of the survey on clinical competencies and contact lens-related practices.

3.4 RESEARCH SETTING

This study was conducted in North-West Province which is located west of Gauteng and south of Botswana. Its capital is Mahikeng. The region is predominantly characterized by flat areas with scattered trees and grassland, featuring the Magaliesberg mountain range in the Northeast and the Vaal River along its southern border. In terms of demographics, the 2022 population consisted of 1, 89 million males and 1, 92 million females. The population is predominantly composed of the 15-64 age group, which accounts for 2, 49 million individuals, followed by those aged 0-14 years (1, 08 million) and 65+ years (0, 235,816). The population groups are majorly Black African (3, 56 million), followed by White (171,886), Coloured (60,714), Asian (2,653), and others (5,894) (Stats SA, 2022). The North-West province has four districts which are Bojanala Platinum District, Dr Ruth Segomotsi Mompati, Ngaka Modiri Molema, and Dr Kenneth Kaunda districts.

3.5 POPULATION OF THE STUDY

A research population refers to a group of people who meet the criteria for inclusion in a study (Harris *et al*, 2019). Walliman (2021) argues that the selection of an appropriate research population is crucial because it affects the validity and generalizability of the study's findings. The population in this study included all optometrists who practiced within the province. One hundred and seventy optometrists were registered and practising in North-West Province.

3.6 SAMPLING

3.6.1 Sample and sample size

According to the Health Professions Council of South Africa (HPCSA), there were 4310 registered optometrists in 2023 with a patient ratio of 1:15 052 (K. Maupye, personal communication, November 6, 2022). Of these, 170 (3.9%) optometrists, both public and private sector are practising in the North-West province. Only 4 optometrists were employed in the four public hospitals in the North-West province, namely Job Shimankana Tabane Hospital, Mafikeng Provincial Hospital, Klerksdorp Hospital and Potchefstroom

Hospital. In the North-West province, the prevalence of people living with some form of sight impairment is reported to be 0.49% of the province's population (Stats SA, 2022).

Slovin's formula was used to estimate the sample size of optometrists to be included in this study. The formula is presented below.

$$n = \frac{N}{1 + N.e^2}$$

where n = the sample size

N = the population size = 170

E = error of margin = 5% and the confidence level was set at 95%.

Sample size was therefore n = 170/ (1+170 $(0.05)^2$) = 170/ (1+170 (0.0025))

= 170/1.425 = 119

This calculation reflects a balancing act between the desire for a representative sample and the practical constraints of sample size. In statistical terms, the chosen sample size of 119 is the outcome of aiming to minimize the margin of error while taking into account the total available population. The margin of error, in this context, represents the degree of uncertainty or the potential deviation from the true population parameters that one is willing to accept (Prabowo, 2020).

3.6.2 Sampling methods

Convenient sampling was employed in this study as few optometrists are practising in the North-West Province. All optometrists practising in the North-West province had an opportunity to participate. A database of optometrists was created using the address list, email address and mobile phone numbers, from various electronic data in the public domain including the list of optometrists registered with various medical aids and those on Google Maps. In examining practitioner clinical competencies and contact lens

practices, it was crucial to engage practising optometrists in the North-West Province. This method ensured that the participants were specifically chosen for their relevance to the research questions, leading to more insightful and pertinent data.

3.6.3 Inclusion and exclusion criteria

Inclusion criteria specify distinct characteristics of a collective of persons identified for participation in a study (Joubert *et al*, 2019) while the factors or characteristics that make the parts of the population not eligible for participation are referred to as the exclusion criteria (Garg, 2016).

All registered optometrists who practiced in North-West Province either as self-employed or those who were employees in private and public optometry services were included in the study. All optometrists whose contact information including email address and mobile phone numbers were accessible on optometry networks were eligible to participate and were included. Optometrists who had less than a year of practising experience and were unwilling to give consent were excluded from the study.

3.7 DATA COLLECTION

According to McDonough (2017), data collection refers to the systematic gathering and measurement of information on certain variables of interest. As stated by Chu and Ke (2017), research quality is determined by this crucial factor, which is vital for obtaining reliable findings.

3.7.1 Data collection tools

A questionnaire was developed from an extensive literature review and other validated questionnaires modified to suit the current study were utilised to gather data from optometrists in the North-West Province (WHO African Region, 2019; Alzahrani *et al*, 2021; Douglass *et al*, 2020; Abokyi *et al*, 2017; Khosa *et al*, 2020; Nilesh *et al*, 2022; Bullimore & Johnson, 2020; Cicinelli *et al*, 2020). The questionnaire consisted of 45 questions, divided into several sections, each designed to collect specific types of information.

The first section, Section A, which was covered by questions 1 to 9, focused on demographics and employment information. This section included questions about the respondents' district, gender, race, type of practice, and the number of years in practice. For instance, participants were asked to mark their district from options such as Bojanala Platinum District (Urban) and Dr Kenneth Kaunda District (Semi-urban). Additionally, they provided information about their qualifications beyond the Bachelor of Optometry, such as diplomas or master's degrees. The responses were expected to be in multiple-choice format or required the participants to mark the appropriate option. The purpose of this section was to contextualise the practitioners' backgrounds and work environments, which could influence their clinical competencies and practices.

Section B, which was covered by questions 10 to 29, delved into more specific aspects of contact lens practice and prescribing patterns. These included questions about the number of patients seen daily, the proportion requiring contact lenses, and whether the practitioners believed contact lens fitting was essential in both private and public sector facilities. Questions on availability of equipment, patient referral practices, practitioner competencies on patient examination, diagnosis, lens selection and fitting were also included. Questions in this section were designed to elicit clear responses, such as "Yes" or "No," and allowed for multiple-choice answers where appropriate. Additionally, respondents were asked to rate their competencies on a scale from poor to excellent in various areas such as taking contact lens case histories and performing pre-fitting clinical tests.

Section c, which was covered by questions 28 to 45, aimed to determine the commonly fitted conditions, the rate of contact lenses fitting, practitioner’s knowledge of latest developments and the practitioners’ involvements in contact lenses specific CPDs.

According to van de Ven and Poole (2017), questionnaires are an efficient method of gathering data from a large sample size. In this study, the sample size consisted of optometrists in the North-West Province, and using an online questionnaire allowed for a higher response rate, which was crucial in ensuring the accuracy and representativeness of the findings. Wu *et al*, (2022) indicate that sending clearly defined surveys to a refined

population positively impacts the online survey response rate. Using questionnaires is cost-effective and time-efficient (Adams & McGuire, 2022) as compared to interviews or observations.

3.7.2 Participant recruitment and data collection

To recruit participants, a link with an invitation letter and the questionnaire was distributed by e-mail to all optometrists practising in the North-West province whose mobile numbers were on the mailing list of the optometrists' search database and South African Optometry Association (SAOA) North-West WhatsApp groups. The same link was also sent to the mailing list of the optometrists registered with SAOA. A snowballing sampling was utilised whereby optometrists were requested to further distribute the link to their colleagues in their mailing lists on WhatsApp and email who meet the inclusion criteria such as to reach a wider audience. The link and reminder were sent repeatedly every week to the participants. The front page on the link contained an information document that informed participants about the purpose of the study. After familiarising themselves with what the study entailed, participants were required to click on an option on the online questionnaire agreeing to participate, after which they completed the questionnaire.

3.7.3 Data collection period

The link was sent to participants from June to mid-September 2023. Throughout the data collection period, a reminder was sent repeatedly to the participants.

3.8 DATA ANALYSIS

Data was coded, captured and analysed using the statistical package for Social Science (SPSS) version 28.0 software in consultation with the statistician. Kolmogorov-Smirnov test and the Shapiro-Wilk test were used to check the normality of the distribution of data at $p=0.05$ or less as a significant level. Data was summarised in the form of percentages, means and standard deviations. This was visualised in the form of figures and tables for better clarity.

In cases where the Likert scale was used, mean scores were calculated to deduce meaning from findings. On a Likert scale of 1 to 3 to check the frequency of lens prescribing, 1 indicated never, 2 indicated sometimes and 3 indicated often and an average score for all participants was calculated. A score from 1.00 and 1.67 indicated that participants never prescribed lenses, 1.68 to 2.34 indicated they sometimes fitted lenses and 2.35 to 3.00 indicated that they often prescribed lenses.

On a Likert scale of 1 to 5 to check self-reported knowledge and skills, 1 indicated poor, 2 indicated fair, 3 indicated average, 4 indicated good and 5 indicated excellent, and an average score was calculated for all participants. A score from 1.00 and 1.80 indicated that participants had poor knowledge, those between 1.81 and 2.60 had fair knowledge, those between 2.61 and 3.40 had average knowledge, those between 3.41 and 4.20 had good knowledge and those between 4.21 and 5.00 had excellent knowledge. For the association of variables, categorical variables were compared for association and a chi-square test was performed with the significance level set at p=0.05 or less.

3.8 RELIABILITY

Hammarberg *et al* (2016) argue that reliability is a crucial aspect of any study, especially when exploring clinical competencies and contact lens-related practices of optometrists in the contact lens fitting. Walliman (2021) notes that reliability refers to the consistency and stability of research findings over time and across different populations. Cohen *et al* (2017) attest that it is essential to ensure that the research findings are accurate, dependable, and can be replicated by other researchers. In the present study exploring the clinical competencies of optometrists in contact lens fitting, reliability was crucial to ensure that the results were consistent and dependable. It is especially important in the field of optometry, where a small error in contact lens fitting can have severe consequences for patients. To ensure reliability in a study exploring clinical competencies and contact lens-related practices of optometrists in contact lens fitting, several measures were taken.

3.8.1 Pilot study

A 10% sample of optometrists outside the sampling framework was selected to participate in the pilot study for operational purposes, making amendments to the tool where necessary and handling data. The questionnaire was circulated via a link. Errors and bias were eliminated by ensuring that questions requiring positive and negative responses were followed by requiring participants to state reasons why a particular response was chosen.

3.8.2 Internal Consistency

To assess the internal consistency of the questionnaire, a statistical measure like Cronbach's alpha was used. This involved analysing how closely related a set of items were as a group. A high Cronbach's alpha value (generally above 0.7) indicated that the questionnaire items were measuring the same underlying concept, thereby ensuring reliability.

3.9 VALIDITY

Cohen *et al* (2017) attest that validity is a crucial aspect of any research study, as it ensures that the results obtained are accurate and reliable. In this study, different types of validity were used while exploring the clinical competencies and contact lens-related practices of optometrists in contact lens fitting in North-West Province, South Africa.

3.9.1 Construct validity

Ghauri *et al* (2020) observe that construct validity refers to the degree to which a study measures what it claims to measure. In this study, construct validity was achieved through the use of a comprehensive literature review, to identify the key clinical competencies required for contact lens fitting. The researcher then developed a questionnaire based on these clinical competencies and contact lens-related practices, ensuring that the questions were relevant and comprehensive.

3.9.2 Face validity

Stokes and Wall (2017) promulgate that face validity refers to the degree to which a study appears to measure what it claims to measure. In this study, face validity was achieved through the use of a pilot study to test the questionnaire. The pilot study involved ten (10) optometrists who provided feedback on the clarity and relevance of the questions. This feedback was used to refine the questionnaire and ensure that it was easy to understand and relevant to the study.

3.9.3 Internal validity

Dooley (2017) suggests that internal validity refers to the degree to which a study can attribute the observed effects to the independent variable and not to other factors. In the study, internal validity was achieved by using a conveniently selected representative sample of optometrists in the North-West Province.

3.9.4 Content validity

Lankoski and Björk (2015) define content validity as the degree to which a study represents all aspects of the construct being measured. In this study, content validity was achieved through the use of a comprehensive literature review and eye health practitioners experienced in contact lens practice in the field of optometry. The questionnaire was designed to cover clinical competencies and contact lens-related practices, ensuring that the study represented all aspects of this construct.

3.10 ETHICAL CONSIDERATIONS

Ethical considerations are critical in any research study to ensure that the rights of participants are protected. This subsection examines the ethical considerations that were observed in the present study, exploring the practitioner clinical competencies and contact lens-related practices of optometrists in contact lens fitting in the North-West Province, South Africa. The study involved the use of informed consent, confidentiality, anonymity, justice and privacy to protect the participants.

3.10.1 Ethical clearance

The present study received ethical clearance (Appendix A: TREC/646/2022: PG) from the University of Limpopo Turfloop Research Ethics Committee (TREC) and then permission to collect data was obtained from the North-West Department of Health (Appendix C).

3.10.2 Informed Consent

The study ensured that informed consent was obtained from all the participants before participation. The participants were informed about the purpose of the study, their rights as participants, and what their involvement in the study would entail. They were also informed that their participation in the study was voluntary, and they could withdraw at any time without any consequences. The informed consent process was documented, and the participants were required to click on an option on the online questionnaire agreeing to participate before taking part in the study.

3.10.3 Confidentiality

The study ensured that the participants' confidentiality was protected. The data collected from the participants were kept confidential, and only the research team had access to the data. The study also ensured that the data collected was stored in a password-protected file to prevent unauthorized access and would be deleted after a period of five years.

3.10.4 Anonymity

The study ensured that the participants remained anonymous. The study used unique identification codes for each participant instead of using their names. The participants' names were not used in any of the study's documents or reports. The study also ensured that the participants' anonymity was maintained by not disclosing their identity in any of the study's findings, reports or publications.

3.10.5 Justice

The study ensured that the participants were treated fairly, and participation was voluntary. The study included participants from various backgrounds to ensure diversity.

The study also ensured that the participants' rights were respected and that they were not subjected to any form of discrimination based on their gender, race, religion, or any other demographic characteristic. None of the questions posed presented any psychological harm or emotional discomfort to the participants. No monetary or other inducements were given to the participants.

3.10 CHAPTER SUMMARY

The methodology selected was deemed suitable for the current study to establish the clinical competencies and contact-related practices of optometrists in the North-West Province, South Africa.

CHAPTER 4: RESULTS

4.1 INTRODUCTION

This chapter describes the results of the data obtained in the study and is presented concerning objectives 1–3. The results include demographic characteristics, the rate of contact lens fitting and availability of clinical resources relevant for contact lens fitting, self-reported competencies of practitioners as well as the profile of conditions and management strategies described as reported by the participants.

4.2 DEMOGRAPHIC AND EMPLOYMENT INFORMATION FOR OPTOMETRISTS

A total of 121 questionnaires were completed by optometrists working in the North-West Province. Table 4.1 shows the distribution of participants by gender, race, type of practice, practice setting and number of years in practice. Of all the participants, 73 (60%) were male and 116 (96%) were Black Africans. One hundred and three (85, 1%) participants indicated not having any postgraduate qualification. Seventy-three (60%) participants were employed in private practices and 12 (10%) in a franchise. Fifty-three (43.8%) participants were from Bojanala Platinum, an urban district with 56 (46.3%) participants having 5 years or less of practice experience and the remainder of the results are shown in Table 4.1.

Table 4.1 Demographic characteristics and employment information for optometrists (n=121)

Variable	N	%		n	%
Gender					
Male	73	60			
Female	48	40			
Race			**Practice setting**		
Black African	116	96	*NGOs &Other*	5	4
Indian	5	4	*Franchise*	12	10
White	0	0	*Self-employed practitioners*	29	24
Mixed raced	0	0	*Employed practitioners*	73	60
			Public	2	2
District			**Number of years in practice**		
Ngaka Modiri Molema	21	17.4	*5 years or less*	56	46.3
Bojanala Platinum	53	43.8	*6 to 10*	44	36.4
Dr Ruth Segomotsi Mompati	33	27.3	*11 to 15*	14	11.6
Dr Kenneth Kaunda	14	11.6	*16 or more*	7	5.8

4.3 OBJECTIVE 1: TO DETERMINE THE RATE OF CONTACT LENS FITTING AND AVAILABILITY OF CLINICAL RESOURCES FOR CONTACT LENS FITTING

Figure 4.1 shows that 101 (83.5%) participants fitted contact lens in their workplace.

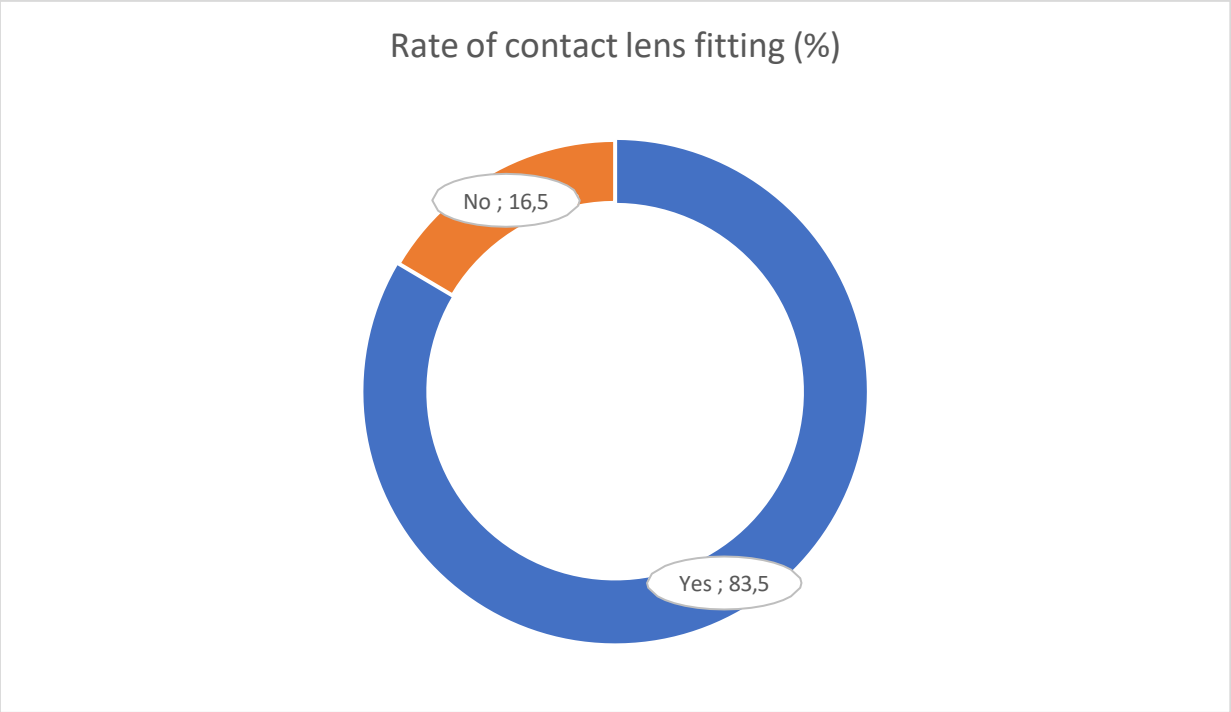

Figure 4.1 Rate of contact lens fitting (n=121)

One hundred and eleven (91.7%) participants indicated it was essential to fit contact lenses in private and public sector facilities while 10 (8.3%) disagreed. There was no significant difference on whether participants fitted contact lens by gender (p=0.333), and by race (p=0.310).

Figure 4.2 shows the possible reasons why some participants did not fit contact lens and 12 (9.9%) did not have adequate competencies to fit all types of contact lens. The type of practice was insignificantly associated with contact lens fitting (0.091).

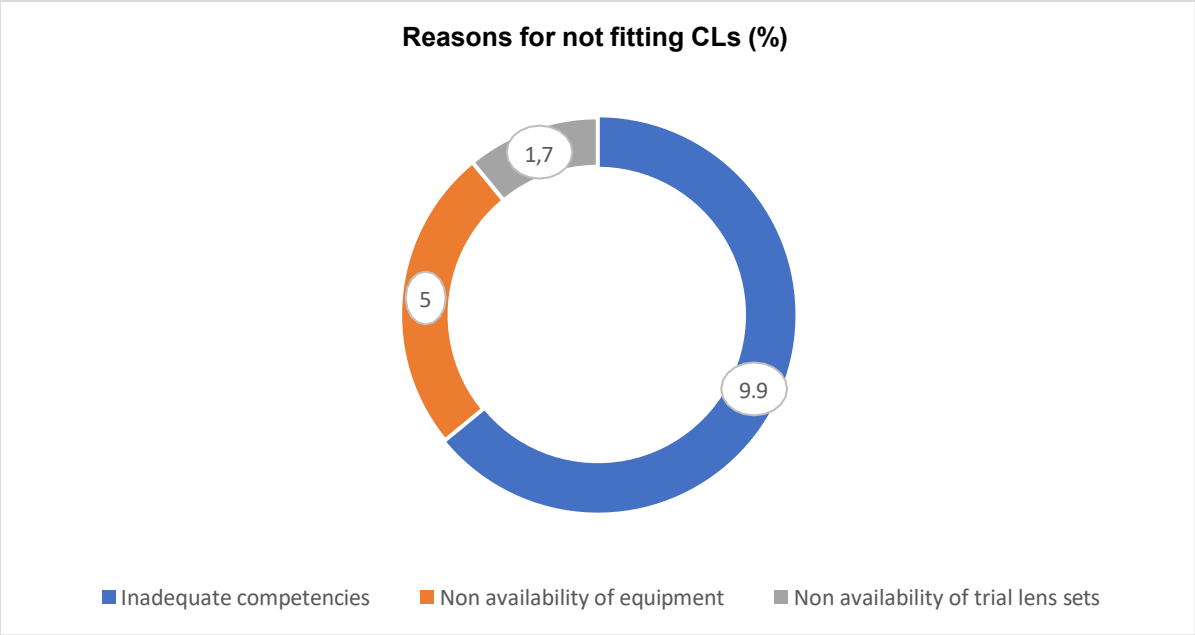

Figure 4.2 Reasons for not fitting contact lens

Figure 4.3 shows the commonly fitted lens types by participants and 88 (73.9%) participants reported fitting soft lens.

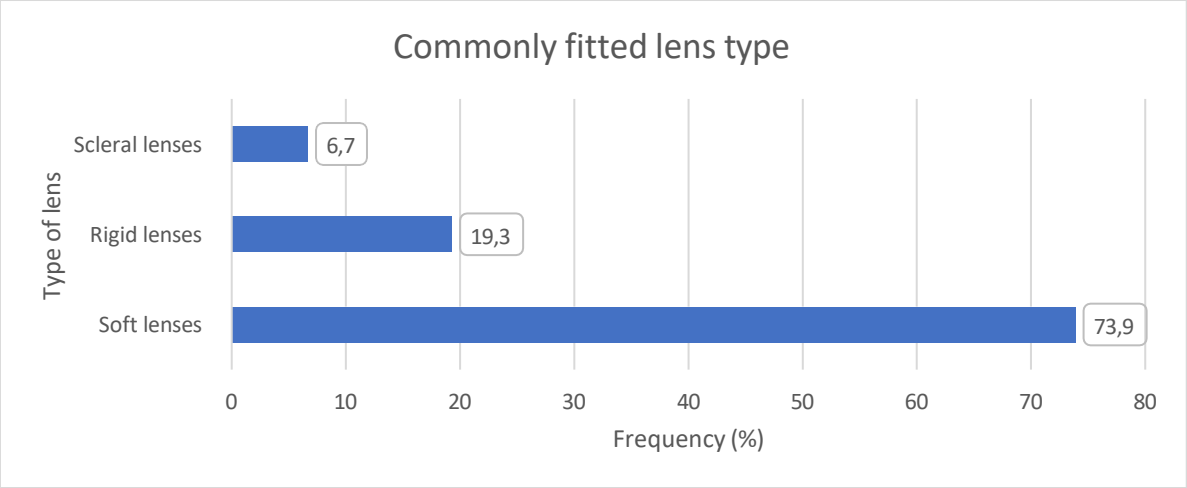

Figure 4.3 Commonly-fitted lens type

All the participants (100%) indicated having the relevant equipment to diagnose conditions that require contact lens fitting. Figure 4.4 presents reported available equipment in the respective practices where 105 (86.8%) indicated having a keratometer and 67 (55.4%) slit lamp biomicroscope. There was a significant difference (p=0.039) between participants having slit lamp biomicroscopy and those indicating not fitting contact lenses. One hundred and six (87.6%) reported having the necessary instruments for corneal profile and 15 (12.5%) did not have these in their workplace. None of the optometrists indicated having a pentacam, Hand-loop, magnifier, shadowgraph, inspection microscope and V-gauge in their workplace.

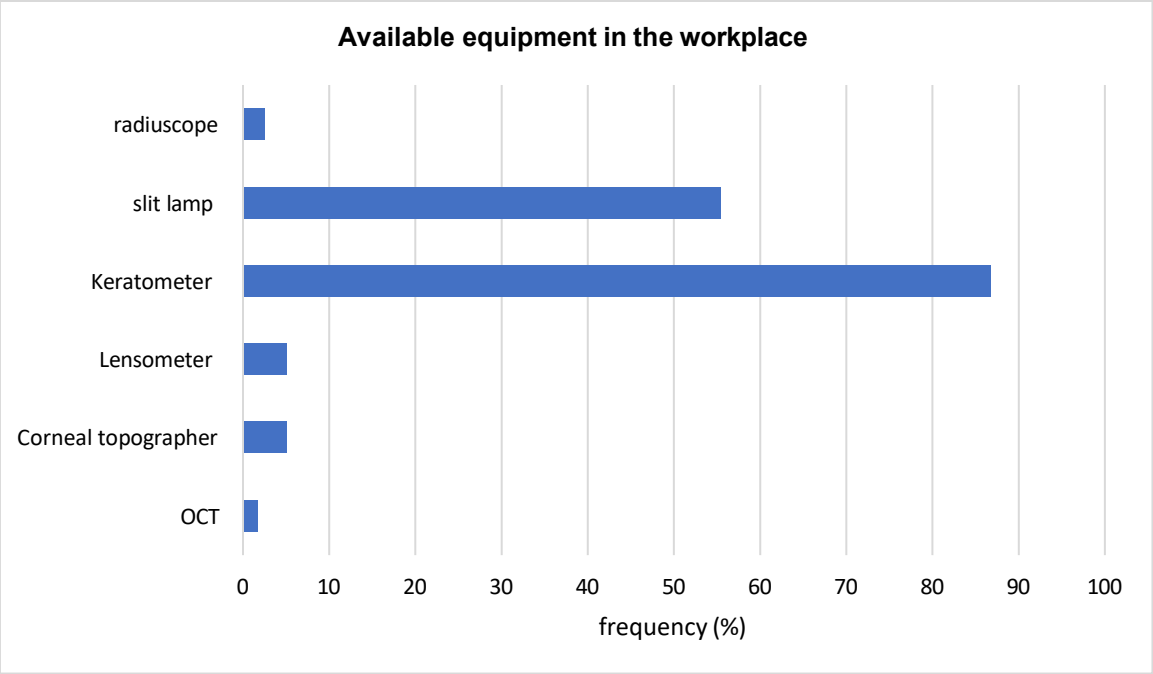

Figure 4.4 Available equipment in the workplace

Seventy-four (61.1%) reported that corneal topographer, followed by keratometer (51.2%), Autorefractor-Keratometer (42.9%) and pachymeter (5.7%) were instruments used to measure corneal curvature.

4.4 OBJECTIVE 2: TO DETERMINE SELF-REPORTED COMPETENCIES OF PRACTITIONERS IN FITTING CONTACT LENS

Table 4.2 shows frequencies and percentages of participants' responses on self-reported competencies in contact lens fitting with the lowest frequency of 109 (90.1%) on the ability to perform pre-fitting clinical tests.

Table 4.2 Participants responses on competencies in contact lens fitting

Question/Item	n (%)
Are you able to determine candidates for contact lens wear and those contraindicated?	114 (94.2%)
Are you aware of when each type of contact lens is indicated?	114 (94.2%)
Do you know the different contact lens solutions and their uses?	113 (93.4%)
Do you have the ability to use and interpret the findings of the keratometer, topographer and pentacam?	114 (94.2%)
Will you consider yourself competent in performing contact lens pre-fitting clinical tests?	109 (90.1%)
Are you aware of what information, from the pre-fitting tests, you need to consider before you choose the appropriate contact lens material, water content and design?	119 (98.3%)
Are you aware of when each type of contact lens fit is indicated? (e.g. sport, injury, industry, therapeutic, cosmetic)	114 (94.2%)
Are you able to choose the appropriate lens and differentiate lens material as well as prescribe it? (e.g. Rigid, Hydrogel, Silicone hydrogel, Scleral, Hybrid (Piggy-back)	111(91.7%)
Are you familiar with contact lens care regimens?	110 (90.9%)
Are you aware of contact lens wearing schedules (modality and replacement)	116 (95.9%)
Are you aware of different contact lens brands?	112 (92.6%)

Figure 4.5 shows the mean scores for competencies with an estimated average mean score of 4.74±0.56. Participants rated themselves as having good to excellent competencies in most aspects of contact lens fitting. The lowest ratings were on case history taking (79.3%) and corneal health evaluation (anatomy & physiology) (79.4%).

Most participants (75.2%) reported poor or average competencies for the determination of contact lenses to add power.

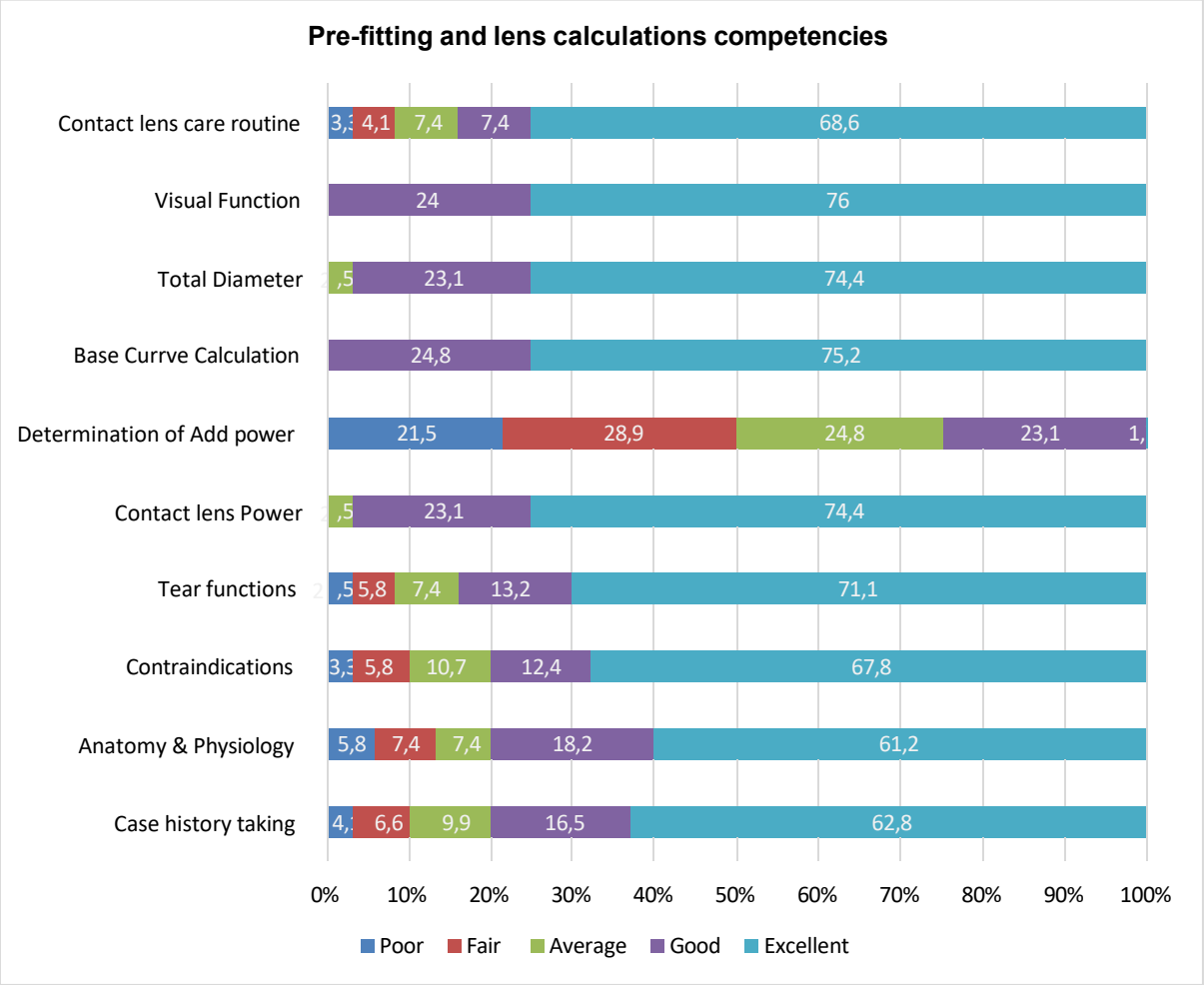

Figure 4.5 Competencies on pre-fitting procedures and parameter calculation reported by participants (n=121)

Eighty-two (67.8%) and 79 (65%) participants reported dry eye and tranquillizers as the most common medical condition and medication contraindicated for contact lens use, respectively. Other results on medical and medications contraindicated are presented in Table 4.3.

Table 4.3: Medical conditions and medications contraindicated for contact lens

Medical conditions contraindicated for contact lens use	n	%	Medications contraindicated for contact lens use	n	%
Allergies	75	61,9%	**Contraceptives**	14	11,5%
Dry eye	82	67,8%	**Antihistamine**	26	21,5%
Diabetes	12	9,9%	**Tranquilizers**	79	65%
Hay fever	3	2,4%	**Psych medication**	11	9,0%
Sinusitis	9	7,4%	**Diuretics**	73	60,3%
Epilepsy	5	4,1%			

Figure 4.6 shows the pre-fitting procedures reported by participants. Ninety-six (78%) indicated performing refraction (78.0%) slit lamp (71.9%) and tear tests (71.9%) on patients needing contact lens (Figure 4.6). There was a significant difference (p=0.011) between practice experience and fitting of contact lens.

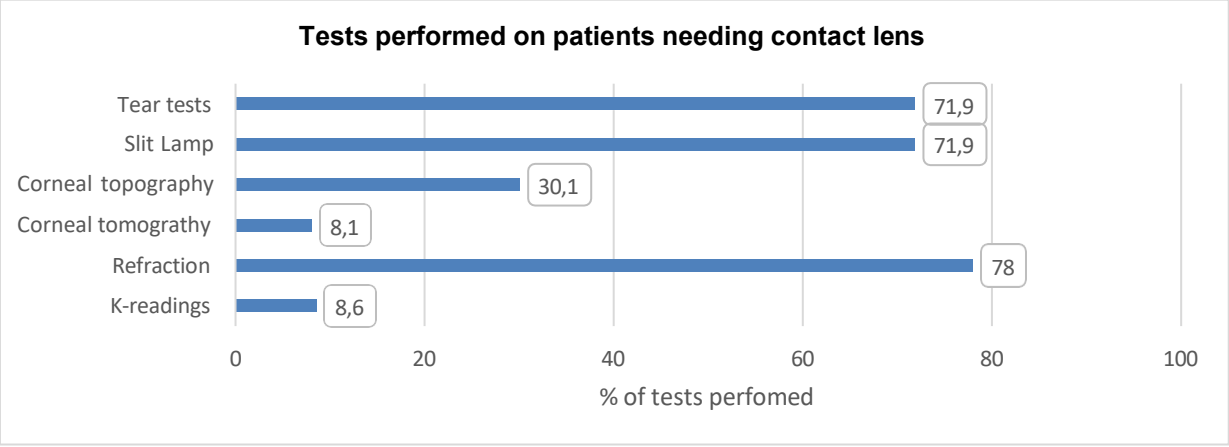

Figure 4.6 Pre-fitting procedures performed by participants (n=121)

Figure 4.7 shows the self-reported competency levels of participants with a mean score of 3.96±1.03. Two-thirds (66.9% to 71.1%) of the participants rated their contact lens fitting skills to be good to excellent. There was a significant difference (p=0.051) in the fitting of contact lenses between participants.

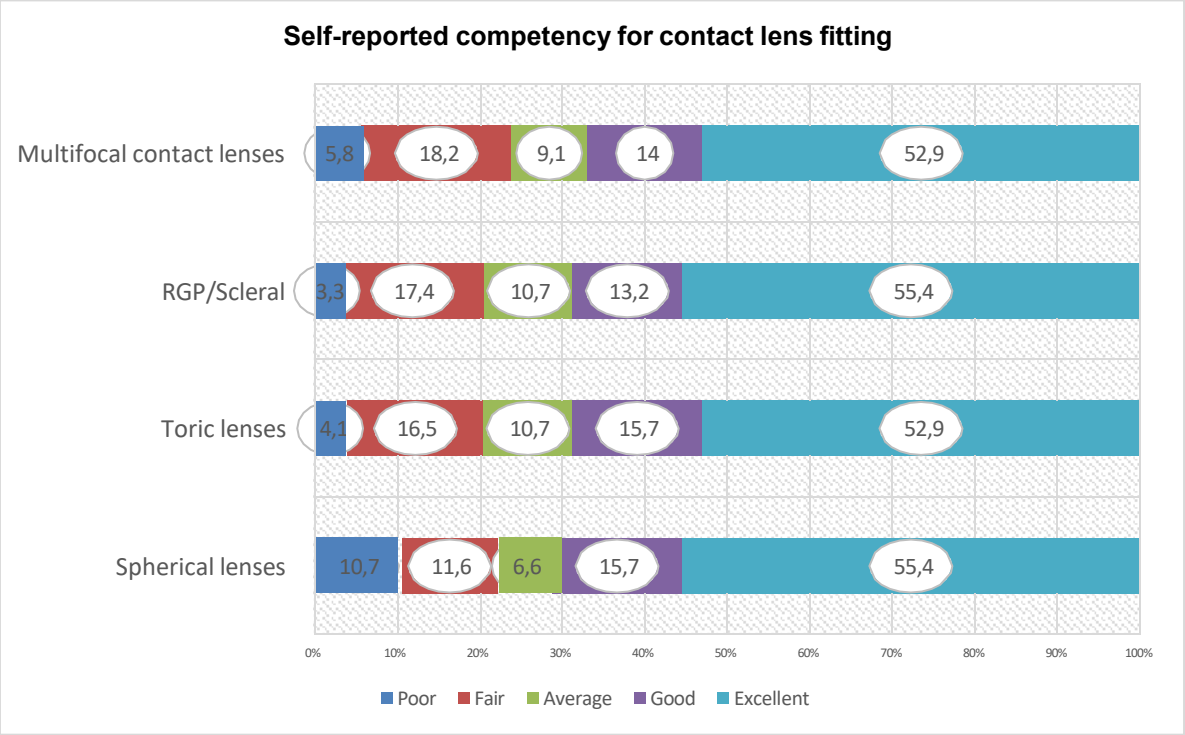

Figure 4.7 Self-reported competencies for contact lens fitting

Figure 4.8 presents an awareness of the latest developments in contact lens such as available tear supplements, contact lens available in the market, contact lens material and designs as well as companies providing designs and contact lens brands. A mean score of 4.01±1.02 was calculated for the mean knowledge reported by participants.

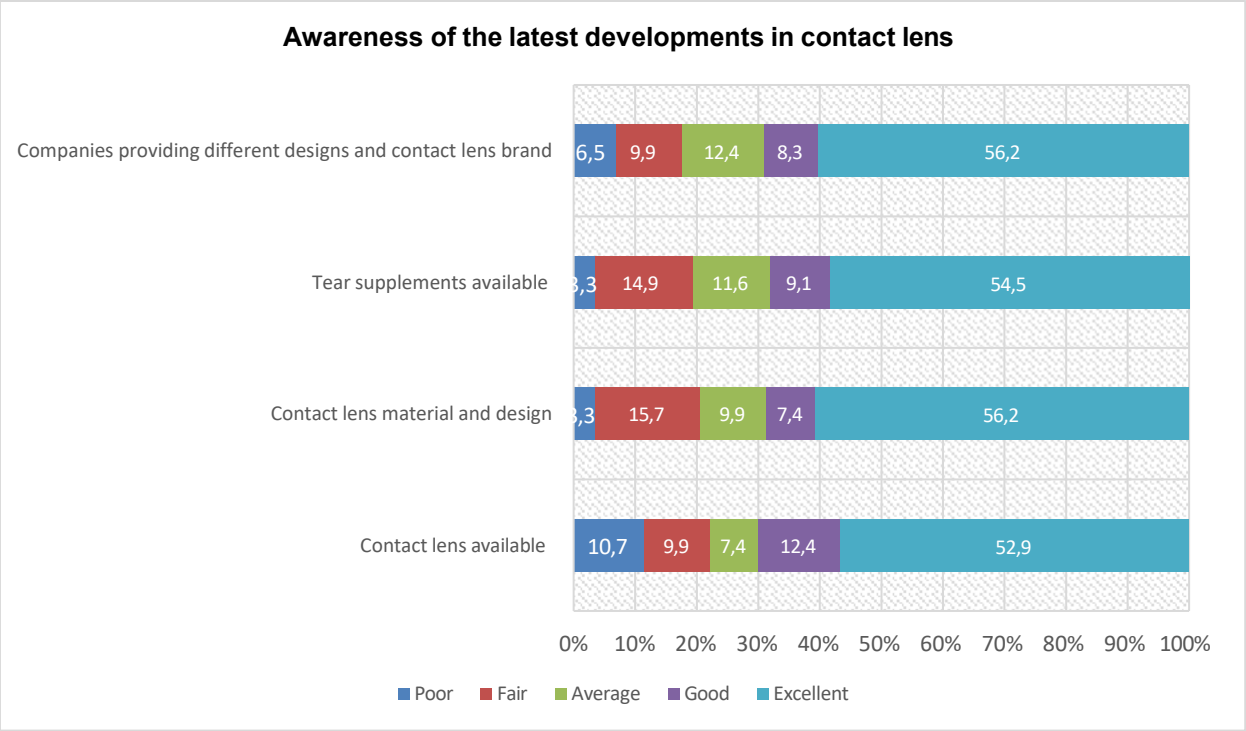

Figure 4.8 Awareness of contact lens

Figure 4.9 shows the emerging aspects that are perceived to affect the quality standards and skills of optometrists in contact lens practice. Sixty-five (53.7%) participants perceived new technology, equipment and software to be able to affect contact lens practice, 17 (14%) reported changes in market and consumer needs and 16 (13.2%) reported new models and management systems.

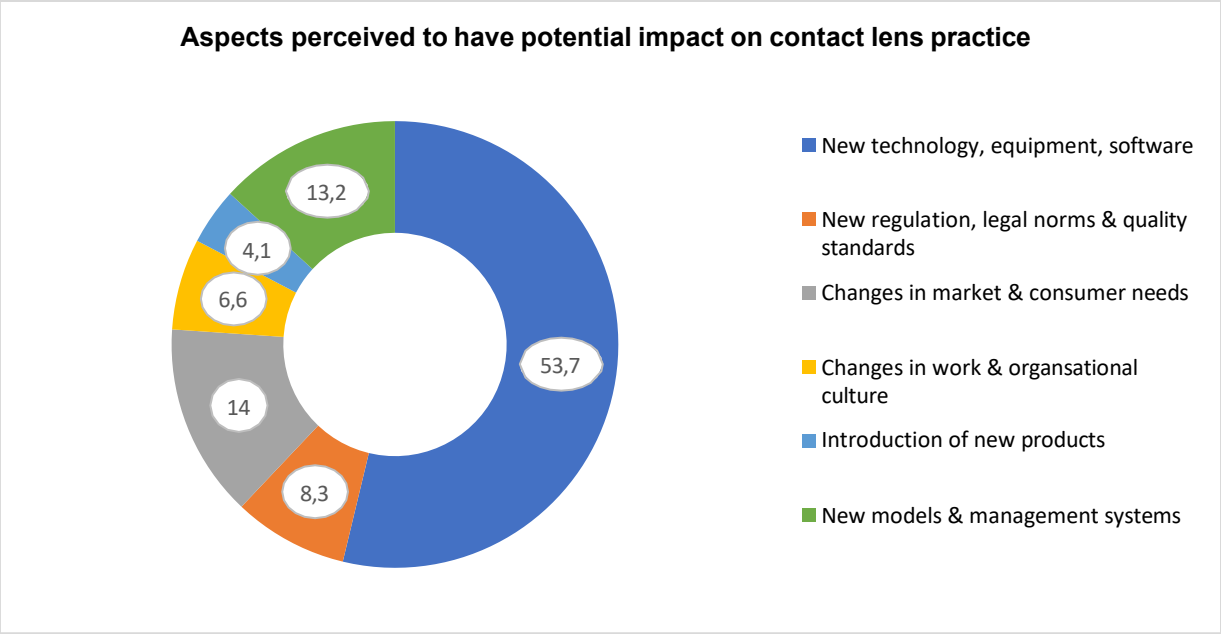

Figure 4.9 Aspects perceived to have a potential impact on contact lens practice

One hundred and seven participants (88.4%) reported having attended CPD training on contact lens activities in the last 2 years while 14 (11.6%) did not. Only 1 (0, 8%) participant reported that there were no benefits of attending an advanced course in contact lenses whereas 120 (99.2%) agreed. Of those alluding to the need to attend an advanced course in contact lenses, 113 (93.4%) preferred to do theory only, 4 (3.3%) theory and wet lab sessions and 3 (2.5%) wet lab sessions only. One hundred and seventeen (96.7%) reported they would register for an advanced contact lens fitting course if offered and 4 (3.3%) would not attend.

4.5 OBJECTIVE 3: TO DETERMINE THE PROFILE OF OCULAR CONDITIONS ENCOUNTERED WHEN FITTING CONTACT LENS AND MANAGEMENT STRATEGIES

Figure 4.10 presents management for patients requiring contact lenses in the various workplaces with many opting to refer patients to eye clinics (35.5%) and a few fitting contact lenses themselves (2.5%).

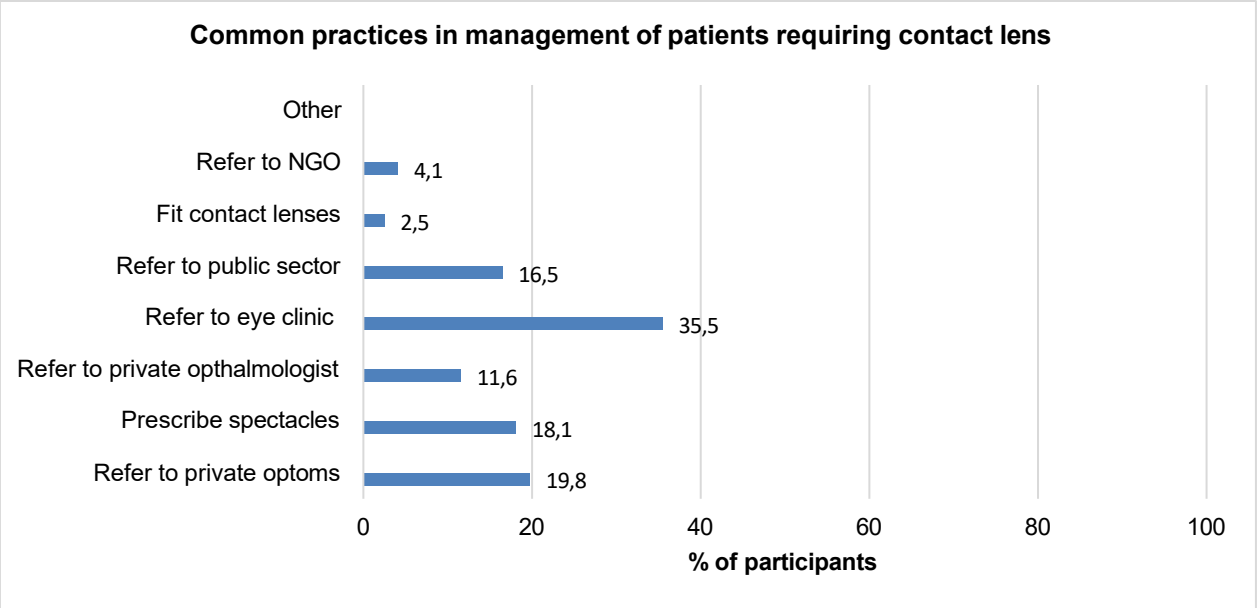

Figure 4.10 Common practices in the management of patients requiring contact lenses.

Eighty-nine (72.2%) indicated that they referred keratoconus patients followed by myopia (70.7%) as illustrated in Figure 4.11.

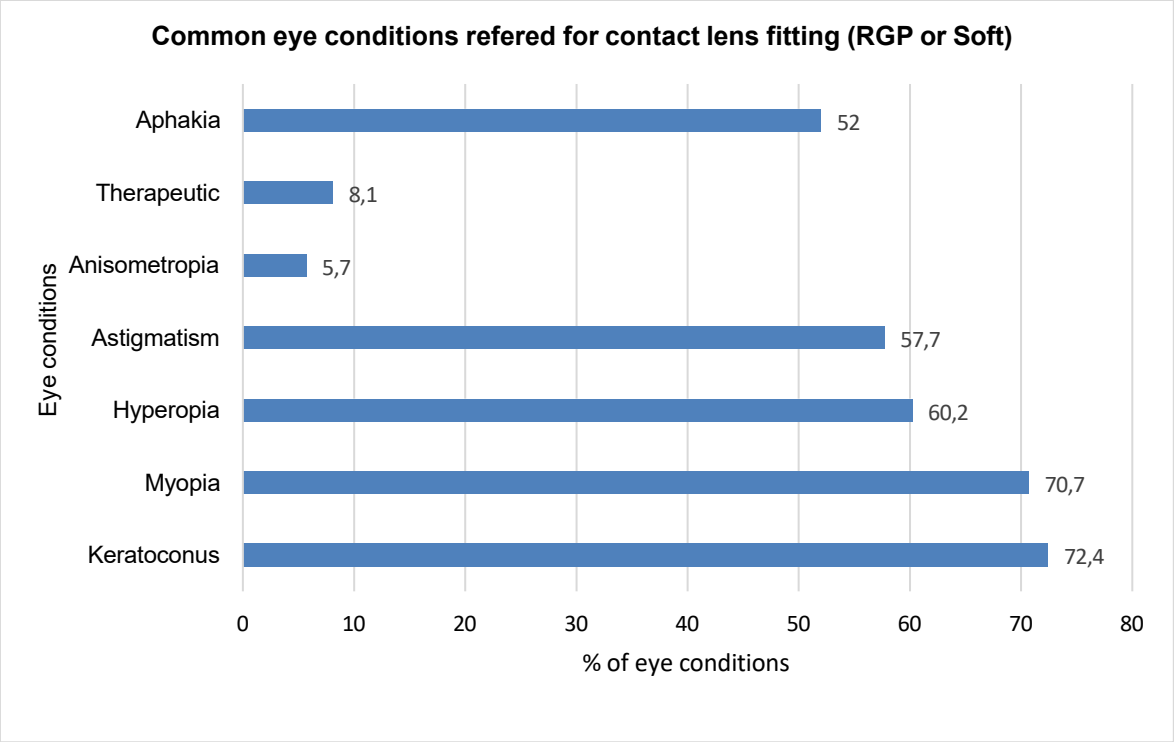

Figure 4.11 Common eye conditions referred for contact lens fitting

According to Figure 4.12, one hundred and twelve (84%) participants reported keratoconus as the most common corneal ectasia among patients presenting at the different settings, followed by pellucid marginal degeneration (PMD) at 32% and other results shown in Figure 4.10.

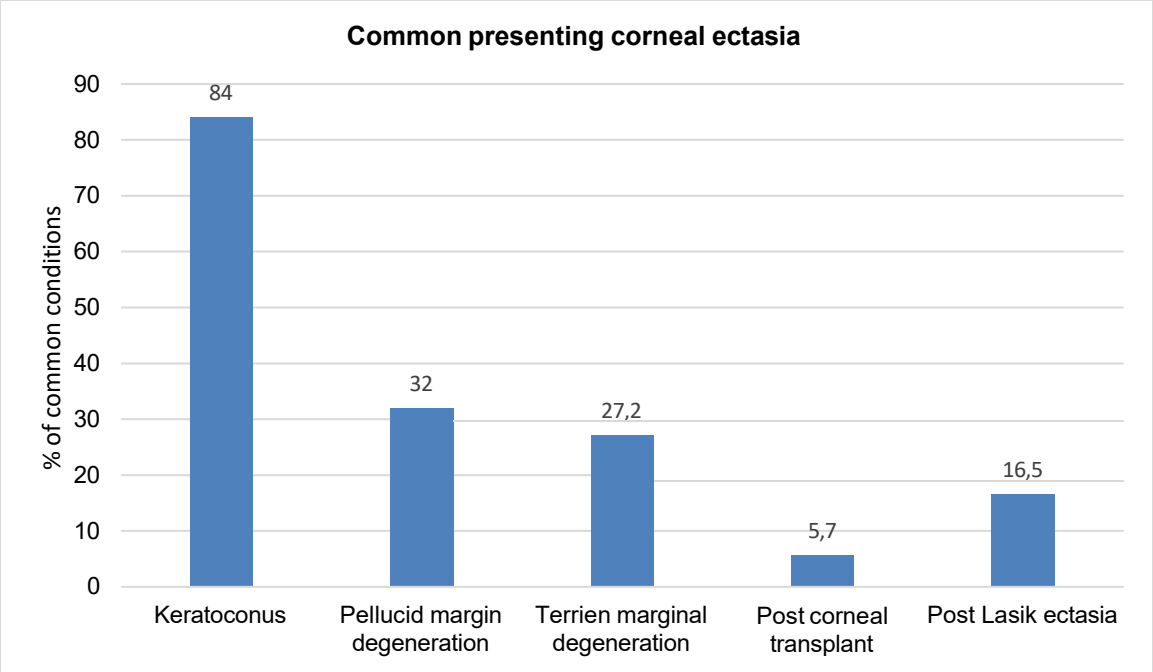

Figure 4.12 Common presenting corneal ectasia

Figure 4.13 shows the knowledge of participants on keratoconus patients' management with a mean of 4.29±1.04 indicating that they had excellent knowledge.

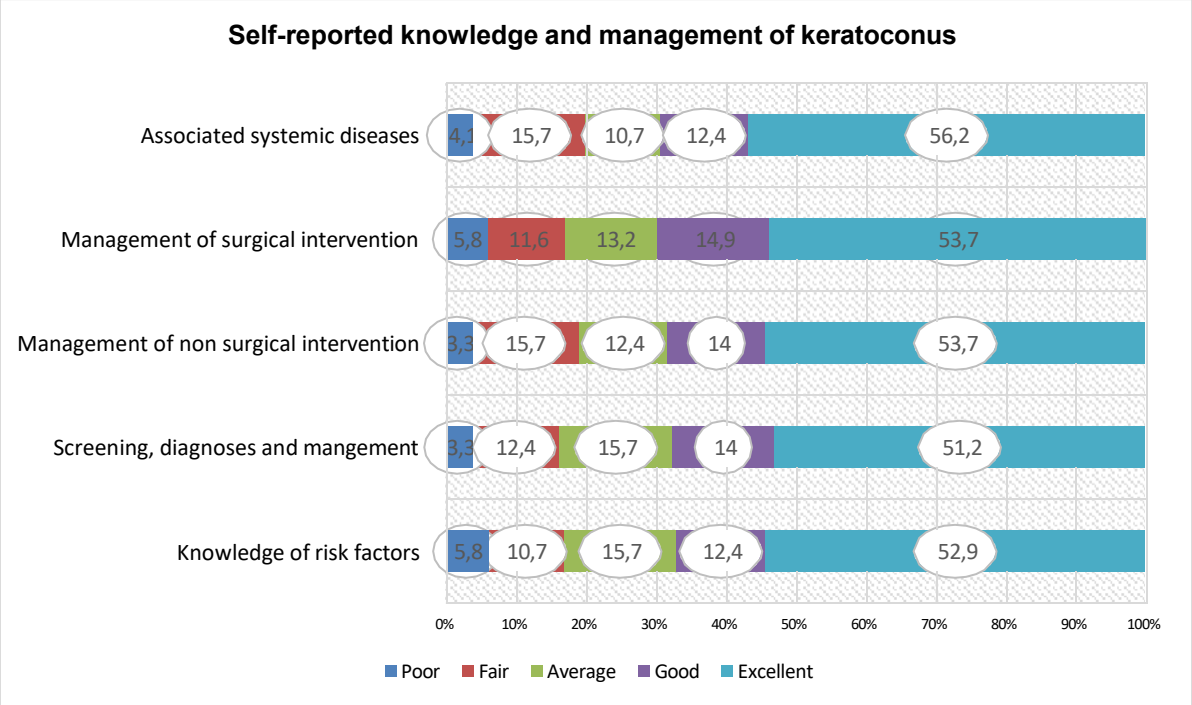

Figure 4.13 Self-reported knowledge and management of keratoconus

The average diagnosed cases reported for keratoconus, post-surgical corneal distortion, Aphakia, hyperopia, astigmatism (low and high), corneal abrasions, anisometropia, amblyopia and others fell in the category of between 0-5 patients per week. All participants indicated that about 0-5 patients were referred per week for RGP and soft lens fitting.

Spectacles management (95.1%) is mostly used as compared to contact lenses (42.1%). Single vision, bifocals and multifocal are equally reported as preferred management approaches (95.9%). Similar results are observed for bifocal (95.5%) and multifocal spectacles (95.5%) as well as combination contact lenses (35.5%) and bifocal/multifocal contact lenses (35.5%) as illustrated in Table 4.4

Table 4.4: Management approaches by optometrists

Management Approach	**1 (0%) n (%)**	**2(1-19%) n (%)**	**3 (20-39%) n (%)**	**4 (40-59%) n (%)**	**5 (60-79%) n (%)**	**6 (80-100%) n (%)**
Spectacles	0 (0%)	0 (0%)	0 (0%)	0 (0%)	5 (4.1%)	116(95.9%)
Contact lens	1 (0.8%)	31 (25.6%)	8 (6.6%)	4 (3.3%)	11(9. 1%)	51 (42. 1%)
Spectacles						
SV Spectacles	0(0%)	0(0%)	0(0%)	0(0%)	5(4. 1%)	116(95.9%)
BF Spectacles	0(0%)	0(0%)	0(0%)	0(0%)	5(4. 1%)	116(95.9%)
MF Spectacles	0(0%)	0(0%)	0(0%)	0(0%)	5(4. 1%)	116(95.9%)
Contact lens						
Soft contact lens	30 (24. 8%)	0(0%)	0(0%)	0(0%)	0(0%)	0(0%)
Rigid contact lens	30(24%)	15 (12. 4%)	14(11. 6%)	7(5. 8%)	13(10. 7%)	41(33. 9%)

Combination contact lens	27(22. 3%)	18(14, 9%)	18(14, 9%)	4(3, 3%)	10(8, 3%)	43(35, 5%)
Toric Lens	1(0,85)	16(13, 2%)	12(9, 9%)	7(5, 8%)	15(12, 4%)	40(33, 1%)
Bifocal/multifocal contact lens	16(13, 2%)	9(7, 4%)	3(2,5) %	14(11, 5%)	14(11, 6%)	43(35, 5%)
Prosthetic/therapeutic/ cosmetic contact lens	37(30, 6%)	17 (14%)	9 (7.4%	4 (3.3%)	12 (9.9%)	41 (33.9%)

One hundred and ten (90.9%) participants indicated that they gave lessons on abnormal signs, symptoms, and normal adaptive symptoms as well as provided patients with aids such as videos, audio or printouts while 11 (9.1%) did not. Lens use and personal hygiene (46.3%) followed by the importance of aftercare (12.4%) were highlighted as the most important factors that formed part of contact lens patient education (Figure 4.14).

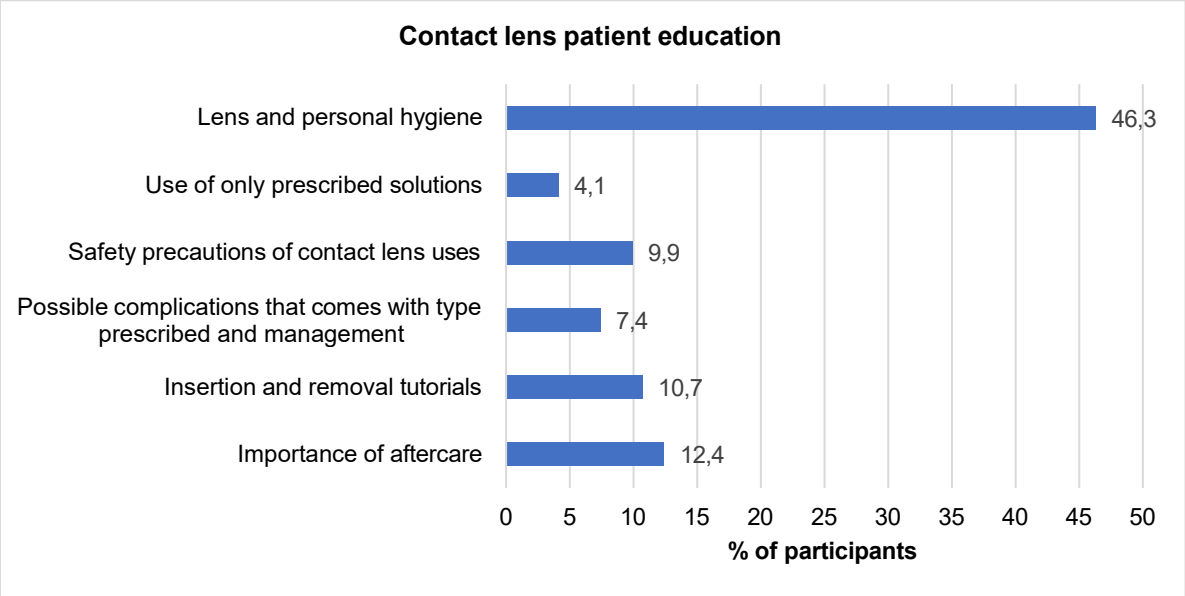

Figure 4.14: Contact lens patient education

One hundred and one (83.5%) and 94 (77.7%) participants indicated having taken additional qualification/training in skill, knowledge or competencies for managing keratoconus and myopia control, respectively. Of those who indicated having taken the

keratoconus and myopia control training, 66 (54.5%) attended a conference presentation and 28 (23.1%) a workshop presentation.

The majority of the participants (69.4%) felt that they were informed and competent in contact lens fitting. Eighty-five (70%) participants indicated an excellent rating for their overall knowledge of contact lens fitting (Figure 4.15).

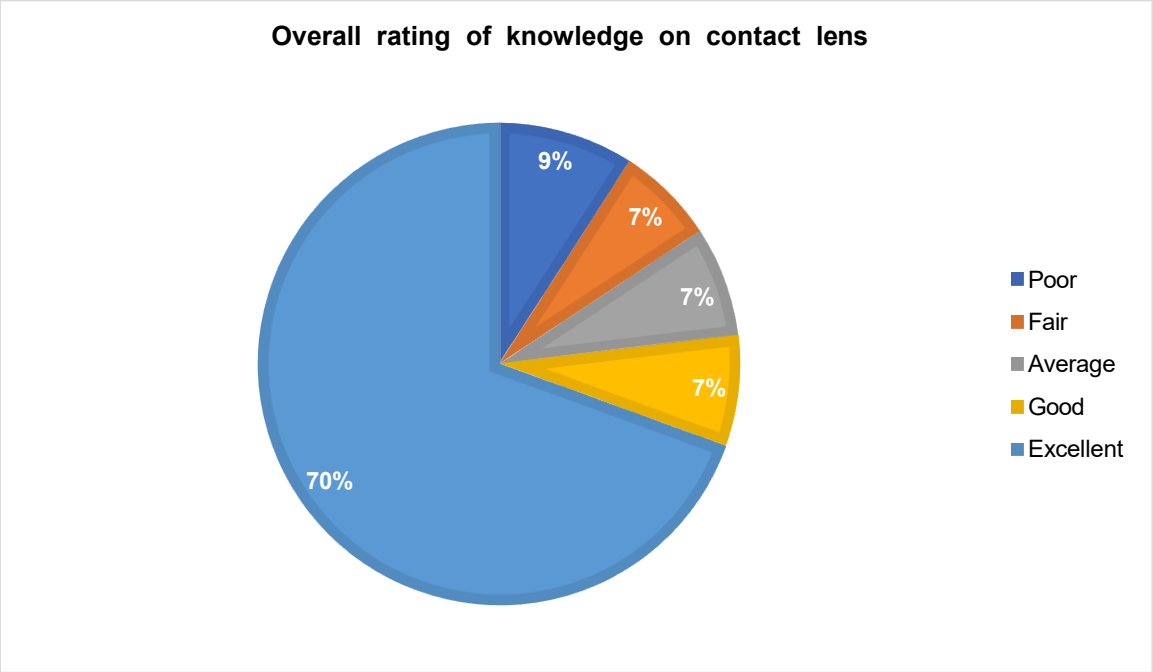

Figure 4.15: Overall rating of knowledge on contact lens fitting

4.6 SUMMARY

The demographics, rate of contact lens fitting and resource availability, self-reported competencies and profile of ocular condition as well as management strategies were presented by the results and there are identified aspects required to be addressed to improve contact lens practice in the North-West Province.

CHAPTER 5: DISCUSSION

5.1 INTRODUCTION

This chapter provides an in-depth discussion of the key findings for objectives 1-3 of the study, which include the rate of contact lens fitting and availability of contact lens clinical resources, self-reported competencies and profile of conditions and management strategies. The main results are discussed in the following subsections.

5.2 DEMOGRAPHIC INFORMATION OF PARTICIPANTS

One hundred and twenty-one participants participated from the estimated 170 optometrists (71.2%) in the province (GEMS Optometry Network, 2023). The sampled population had a good mixture of experience, geographical spread per district and years of experience in practice. More than half (53.8%) had spent six years or more in practice in the current study and were therefore somewhat adequately experienced according to Hodge *et al* (2015). Practice experience and sustained ongoing educational development influences clinical competencies according to Lek *et al* (2022). Just less than half (43.8%) were from Bojanala Platinum district, an urban district in the province (Stats SA, 2016). This can be related to findings in other studies where practitioners preferred to migrate to cities (Willie, 2023) probably for better earnings and living conditions.

The gender distribution is biased towards male optometrists practising in the North-West province, which is contrary to the findings by Maake and Moodley (2018). Females are reported to be opposed to opening a private practice which may be the possible reason for these findings (Review of Optometric Business, 2019). In addition, the entire province has only 4 public eye clinics and the remainder is private practice. Hence findings of the current study found that the majority of optometrists are employed in the private sector which is a normal trend in South Africa (Maake & Moodley, 2018). Abu (2020) argues that there is a disproportionate concentration of ophthalmic services favouring affluent areas, which is a prevailing pattern for healthcare delivery in general. With the Northwest Province being predominantly rural districts, scarcity of affordable optometric services

hampers access for the majority of citizens. As the majority of citizens rely on the public sector, there is a need for the prioritisation of the creation of public sector vacancies by the Government.

The North-West Province is dominated by the Black race (Stats SA, 2022), therefore aligned with the study findings, with the majority of optometrists being of the Black race. A significant number of optometrists indicated not having additional qualifications while the importance of continuing education for a profession that is continuously evolving is essential. Most optometrists were in private practice and self-employed which may be a possible argument for this result. Rodríguez-Zarzuelo *et al* (2023) cite that despite advancement in the field of optometry, regulatory requirements, practice environments and training programmes have been identified as contributing obstacles to achieving uniformity levels of proficiency. Therefore, keeping abreast with the latest developments in contact lenses and appropriate application of new information in clinical practice appears paramount to sustaining proficiency and patient satisfaction.

5.3 OBJECTIVE 1 TO DETERMINE THE RATE OF CONTACT LENS FITTING AND AVAILABILITY OF CLINICAL RESOURCES FOR CONTACT LENS FITTING

Many participants indicated that they fitted contact lenses in their workplace. Those who did not fit contact lenses cited reasons such as not having adequate clinical competencies to fit all types of lenses, lack of contact lens trial sets and appropriate equipment similar to other studies (Efron & Morgan, 2017; Gcabashe *et al*, 2022; Nkoana *et al*, 2022; Vincent, 2018). This finding is commendable because contact lens prescribing should be viewed as a necessity and a basic option like spectacles by any consulting patient (Khoza *et al*, 2020). A contrasting finding is that all participants in the current study reported having all the necessary equipment to diagnose conditions that require a contact lens fitting, mainly consisting of a keratometer and a slit lamp. In addition, the availability of slit lamps was significantly associated with contact lens fitting.

This finding may suggest that patients who consult with 16.5% of practitioners miss out on the opportunity to use contact lenses as a better option for their vision correction and are most probably referred, which adds to the already incurred costs and time constraints

as well as being prone to misdiagnosis as reported by Hodge *et al* (2015) and Nkoana *et al* (2022). Lack of awareness by patients, access to contact lens trials and lack of trained professionals are common challenges that reduce the number of patients seeking contact lens wear in Africa (Naroo *et al*, 2021).

Global studies from France (68%), Netherlands (69%) and Colombia (71%) have reported similar findings for soft contact lens fitting (Morgan *et al*, 2023) compared to the current study (73.9%). While the rate of soft lens fitting is commendable, there is a dire need to increase the fitting of the scleral and corneal rigid lens (Santodomingo-Rubido *et al*, 2022) because of the advent of keratoconus and other ocular conditions that may not be effectively managed with spectacles or soft lens. The disparity in lens types fitted needs to be viewed from a perspective of practitioners' adaptability and competence range and the preference for the soft lens, which, according to Jones *et al* (2023), may be due to their comfort and ease of fitting. The low rate for fitting rigid, scleral lenses and costs may suggest gaps in practitioner clinical competencies and/or patient demands while these provide better results for some ocular diseases (Brown *et al*, 2021).

Scleral lens use may further support management of conditions of severe dry eye (Mayers *et al*, 2019). Very few participants (12.5%) reported not having the necessary instruments developed to improve entire corneal profile understanding such as the corneal topographer and pentacam, compared to those indicating the contrary, as these may be unaffordable to practitioners due to cost. This is in support to reports by Thite, *et al* (2022) and Jacobs, *et al* (2021). The findings of the current study need to be interpreted with caution as participants may be referring to affordable equipment such as the keratometer, which restricts corneal profile evaluation, as compared to other instruments such as the corneal topographer, pentacam and ocular coherence tomographer (OCT). Inefficiencies in contact lens practice by optometrists leading to non-compliance, regardless of having received appropriate training, may be possible reasons for these findings which are in agreement to a report by Jacobs, *et al* (2021). Given the rapid advancement and technologies of lens materials and designs of contact lenses, there is, therefore, a need for prioritising continuous upskilling of practitioners in contact lens fitting (Hiukka, 2023; Nkoana *et al*, 2022).

Although most participants indicated being informed about instruments for measuring corneal curvature, with most choosing the corneal topographer, however, most were not available in the workplace, except for the keratometer. Keeping abreast with new developments aimed at improving contact lens fitting and having basic equipment in the workplace, as indicated in regulations of the profession appears paramount.

Contradicting views by studies have been reported, with Hodge *et al* (2015) indicating that more experienced practitioners show more confidence in fitting particularly rigid lenses, whereas Maehle *et al* (2017) and Wilkins (2020) suggest that the skill may fade over time when the practitioner does not often fit contact lens in practice. The number of years in practice was not associated with whether participants fitted contact lenses or not. It is therefore imperative that practitioners find ways to bridge the barriers such that they start prescribing contact lenses as a clinical strategy (Efron & Morgan, 2017; Nkoana *et al*, 2022). Various methods can be explored including collaborations between practitioners as a business strategy to improve the quality of care, particularly for the scarcity of equipment like a pachymeter and corneal topographer used for screening of keratoconus and other conditions at nascent stages (Santodomingo-Rubido *et al*, 2022).

5.4 OBJECTIVE 2: TO DETERMINE SELF-REPORTED COMPETENCIES OF PRACTITIONERS IN FITTING CONTACT LENS

The participants agreed that it was essential to have contact lens services both at private and public hospitals aimed at improving access. As the population increases, ophthalmic conditions requiring contact lens correction are also on the rise; this is in support to a report by Gcabashe *et al* (2022) and Nkoana *et al* (2022). This positive attitude towards contact lens fitting is likely to enable the participants to recommend contact lenses to patients including RGP and/or scleral lenses (Gill *et al*, 2010). Practitioners in large retail stores/franchises seem to have higher proactivity towards contact lens fitting as compared to those in private practices, hospitals and university clinics (Thite *et al*, 2022). The association between the type of practice and contact lens fitting was found to be insignificant, in contrast to findings by Hodge *et al* (2015).

The majority of participants indicated that they were competent in conducting contact lens pre-fitting tests which according to Toomey, *et al* (2021) and Alzahrani *et al* (2021) is required for determining appropriate indicated contact lens fit and modality guided by patients' requirements. The lack of practical abilities, which is shared by Welp *et al* (2016), who advocate for more hands-on training in optometric education, may be the reason for those who reported a lack or poor competencies. Many participants reported being knowledgeable and competent regarding contraindications, pre-fitting, lens calculations, lens materials, design, type of brands, solutions, care regiments, modality and replacement as well as choosing the appropriate lens. Woods *et al* (2023) highlight that self-assessment is essential for professional development, however, healthcare professionals frequently estimate their competence higher than objective assessments would suggest (Stenov *et al*, 2017). In this context, the study's relatively high mean scores for knowledge and abilities, such as the average mean score of 4.74±0.56 for self-competencies, should be interpreted with caution. As reported by Nilesh *et al* (2022), over two-thirds of optometrists (22.9%) declared themselves to be very hopeful or hopeful (45.1%) about the future of their contact lens practice and also highlighting the need for continued upskilling of eye health practitioners in contact lens practice.

The ability to use and interpret keratometer, topographer and pentacam results need to be interpreted with caution as a significant number indicated having keratometer compared to other instruments, which may not truly reflect what is reported as exposure and use as associated with being knowledgeable. Khoza *et al* (2020) and Nilesh *et al* (2022) concluded that patients stopped wearing lenses due to optometrists' inefficiencies in contact lens practice, highlighting the need for the few indicating incompetence or lack of knowledge in the current study to be upskilled and the significance of CPD cannot be overstated in keeping one's knowledge and skills up-to-date. This therefore necessitates acquiring competencies and proficiencies that require comprehensive comprehension of corneal profile which significantly impacts fitting and wearer comfort, lens materials, fitting principles and handling, as alluded by Peters (2017).

History taking and evaluating corneal health had lower proficiency, as stated by the participants, which is similar to findings by Yeung (2019), who cite the complexity of

specialised knowledge necessary for efficient case history taking in optometry. Superior self-reported competency rates for spherical soft and rigid contact lenses including scleral lenses, compared to toric and mutlifocal fitting, were reported by participants. This varying response is possibly dependent on common type of eye conditions patients present with; product awareness, fitting skills as well as technical knowledge among participants. Two-thirds (66.9 to 71.1%) of participants rated their contact lens fitting skills of spherical, toric, RGP and multifocal lens to be good to excellent with a mean score of 3.96±1.03, suggesting that they had a good rating in fitting.

Dry eye, allergies, tranquilisers and diuretics are among the most reported ocular conditions and medications contraindicated for contact lens use. Dry eye is usually associated with the use of contraindicated medications, influenced by environmental variations and sometimes existing with other ocular conditions such as allergies, hence may be the possible reason for the reported findings in the current study. This may negatively impact the selection, fitting, education of patients and providing of subsequent care. To guarantee effective utilisation of contact lens wear and fitting, optometrists require sufficient knowledge and skills in screening and examination of ocular conditions and manifesting mechanism of utilised medications to eliminate barriers to contact lens service provision (Abokyi *et al*, 2017; Barnett, 2023).

Refraction, slit lamp examination and tear tests were the most performed tests for patients presenting for contact lens fitting, which aligns with earlier reporting of available equipment by participants in the workplace. Performance of the tests is critical to determine patient suitability and may be a good predictor of contact lens wear success. The limitation to available equipment is in line with published reports, indicating this as a major barrier to contact lens practice, a consistent trend particularly in low and middle-income countries (Jacobs, *et al*, 2021; Thite, *et al*, 2022).

In terms of awareness of the latest developments in contact lenses, a mean score of 4.01±1.02 was calculated, suggesting that participants had good knowledge of latest developments including available tear supplements, contact lenses, lens materials, lens

designs and brands. This is highly beneficial because optometrists will more likely encourage patients on the uptake of contact lenses by practitioners (Moore, 2023).

The implementation of new technologies, new software or machines and equipment was identified as the most important aspect affecting quality standards as well as changes in the market and consumer requirements. This is in support of findings by Nilesh *et al* (2022). The various developed instruments for improving contact lens fitting and emerging market contact lens brands, new models, management systems, and varying regulatory frameworks are some of the existing disparities between developing and developed countries, affecting quality standards for contact lens practice globally. In addition, inadequate exposure to certain eye conditions such as keratoconus and pellucid marginal degeneration by participants in the current study may impede the acquisition of particular skills dependent on prevalent eye conditions requiring contact lens fitting. Zeri *et al* (2023) highlight the importance of ongoing education and development, as it is prone to sustain and improve expertise and competency in contact lens practice. Similarly, participants in the current study had attended CPD programmes in the last 2 years, alluding to the importance as well as benefits of attending advanced contact lens courses. Of concern was the few who indicated not attending CPD programmes (11.6%), some indicating preference to attend theory and wet labs (3.3%) and wet labs only (2.5%) as opposed to the majority preferring to do theory only for advanced contact lens course. This affects the attainment of superior competencies and application in contact lens practice by an optometrist that is prone to impact patient fitting and subsequent care (Douglass *et al*, 2020). Regardless of the majority of participants indicating to having superior competencies in contact lens fitting, the remainder also needed to be upskilled to improve contact lens service provision in the North-West Province. Existing barriers to optimal fitting of patients require all relevant stakeholders, including regulatory bodies, to play their role in eliminating identified contributing factors to poor contact lens practice. Optometrists have an ethical responsibility to provide quality contact lens services to the population served and practice as regulated by the Professional Board of Optometrists and Dispensing Opticians.

5.5 OBJECTIVE 3: TO DETERMINE THE PROFILE OF OCULAR CONDITIONS ENCOUNTERED WHEN FITTING CONTACT LENS AND MANAGEMENT STRATEGIES

Routine optometry consultations may result in poor endpoint visual acuities and successful contact lens fitting, presenting a challenge to practitioners (Coetzee & Kruger, 2018) which may be the possible reason for the more referrals reported by the participants as a form of management of patients requiring contact lens presenting at their respective workplaces. There is also a possibility of uncertainty in terms of being knowledgeable on the best possible management options available for patients among participants for the referrals to various places including the public sector (16.5%) where contact services are not provided. Other reasons may be socioeconomic as contact lenses may be costly to average citizens and those corrected with spectacles remain with poor vision irrespective of the underlying ocular condition requiring contact lens correction, for optimal vision achievement. Keratoconus is reported as the common presenting and referred condition by the participants. The complexity of pre-fitting and assessment of conditions such as keratoconus and pellucid marginal degeneration with RGP and/or scleral lens may be possible reasons for the findings, supported by the few participants who reported (6.7%) fitting scleral lens and RGP (19.3%) in the current study. In addition, the average diagnosed and referred cases per week were also low, ranging from 0-5 patients. Kim *et al* (2016) highlight that although RGP remains an important special needs lens for vision correction, due to the evolvement of scleral and orthokeratology, a decline is expected for RGP wearers. Therefore, there is a need for continued upskilling, and improving contact lens product knowledge aimed at holistically managing patients presenting with various eye conditions.

Myopia, hyperopia, astigmatism, and aphakia were referred to in lesser proportions, presumably due to their manageability with standard contact lens alternatives (Brown *et al*, 2021). Spectacle management, including single vision, bifocals and multifocal are utilised the most compared to contact lenses which could be linked to spectacles' convenience of use, low maintenance, and cost-effectiveness (Yanoff et al, 2017). In addition, the preference for single vision, bifocals, and multifocal emphasises spectacles'

versatility in controlling a variety of refractive problems (Yanoff et al, 2017). Although in some instances they were varied patterns, a similar response rate was reported for contact lens management approaches by the participants such as RGP, cosmetic, combination, bifocal/multifocal and torics, possibly indicating the indistinguishable levels of knowledge and competency among participants. Various existing comparable obstacles that institutions are up against in the continent are reasons for the scarcity of competencies and skills in contact lens practice, according to Bullimore and Johnson (2020). Hence there is a need to align training programmes in the African continent that match the rising international standards in the contact lens field (Backhouse *et al*, 2021).

Participants indicated being knowledgeable about keratoconus risk factors, screening and diagnosis, surgical and non-surgical management as well as associated systemic diseases. Furthermore, providing contact lens education to patients, highlighting the importance of lens use and personal hygiene as well as aftercare, including lessons on normal and abnormal adaptive symptoms using visuals for easier comprehension by patients is essential in contact lens practice. The possibility for these findings in the current study is supported by participants indicating having attended CPD, knowledge and/or competencies for managing keratoconus and myopia control as well as being aware of the latest contact developments on contact lens fitting from attending workshops and conferences in the current study. Abrahams *et al* (2022), emphasise the changing nature of optometric practice requiring continuing educational programmes. Abrahams *et al*, (2022) highlight that the effectiveness of CPD programmes is strongly dependent on their relevance and the incorporation of practical components, which is supported by participants' preference for theoretical parts and hands-on sessions in advanced courses.

5.6 CONCLUSION

The study offers an insightful status of contact lens practice in the North-West Province, characterised by a lack of resource availability, competencies in certain areas and knowledge that requires to be addressed.

CHAPTER 6: CONCLUSION, LIMITATIONS AND RECOMMENDATIONS

6.1 INTRODUCTION

This study was undertaken to investigate contact lens fitting in North-West Province, South Africa: practitioner clinical competencies and contact lens related practices with the aim of improving contact lens practice in the North-West Province. This chapter summarizes the key findings of the study and concludes the results of the research. The limitations and recommendations of the study are also discussed.

6.2 CONCLUSION

Optometry service provision in North-West Province is black-male-dominated, biased toward the private sector and favours urban areas. Practice experience and improving the attainment of postgraduate qualifications by optometrists in the North-West Province is essential for an evolving profession, particularly among those indicating fitting contact lenses. Although participants consider themselves knowledgeable about pre-fitting tests and having instruments used for measuring corneal curvature and corneal profile, the keratometer and slit lamp are the most commonly available and used instruments in contact lens practice. The identified self-reported incompetencies, particularly for toric, multifocal lenses and calculating add power require urgent attention as demand for contact lenses increases. The use of contraindicated medications and the existence of ocular ailments pose significant challenges for both the practitioner and the patients with fitting as well as contact lens-wearing modalities.

While keratoconus is common and the most referred eye condition to any eye clinic or private optometrists, soft spherical and toric contact lens materials are the most often prescribed lenses. The spectacle management approach is preferred most than contact lenses. Factors affecting quality standards in contact lens practice include the implementation of new technologies, changes in the market and consumer requirements, new models as well as management systems. Patient education on vision, contact lens use, personal hygiene and aftercare formed part of contact lens education by

optometrists. Participants are knowledgeable about keratoconus risk factors, and surgical and non-surgical management. For an advanced contact lens course, participants have a preference for attending theory only as opposed to wet labs. Regardless of the majority of participants indicating having superior competencies, the importance of ongoing relevant CPD programmes and the need for more wet labs attendance as opposed to attending theory only cannot be over-emphasised, to improve contact lens clinical practice. Overall, participants reported being well-informed and competent, however, there was a need to ensure that all stakeholders are involved in improving contact lens service provision in the North-West Province.

6.3 LIMITATIONS

The limitations of this study included:

A slow response rate on completing the Google forms prolonged the anticipated period of data collection. This reluctance could be attributed to various factors such as time constraints, perceived irrelevance of the study to their practice, or general disinterest in research participation. This lack of enthusiasm can significantly skew the study results, as it might mean that the responses gathered do not accurately represent the wider practitioner population in the region. Additionally, the unwillingness to participate might also reflect a broader issue of limited engagement with academic research within the optometry community in the area, which could have implications for the ongoing development and improvement of practice standards.

The study findings were more biased towards private practices as contact lens service provision rather than being integrated into primary eye care in hospitals in the North-West Province. This separation could lead to a lack of awareness, accessibility and availability to specialized optometric services like contact lens fitting for a significant portion of the population that relies on hospital-based care. The separation from primary eye care in hospitals might also contribute to a lack of interdisciplinary collaboration, which is essential for comprehensive patient care.

A quantitative research design approach using an online questionnaire (Google Forms) limited the depth of interaction, as opposed to conducting a qualitative

study to get in-depth information. This approach is cost-effective and can reach a wide geographical area. Poor response to these questionnaires, necessitating continuous follow-up requests, suggests a lack of engagement with the study, which could be due to the impersonal nature of online surveys. This limitation is significant as it can lead to incomplete data, impacting the study's validity and the robustness of its conclusions.

The study relied on responses from optometrists practising in the North-West Province without considering and/or probing further other factors affecting contact practice such as socio-economic status, and diversity of communities, therefore the findings may not be generalized to the entire province.

Lastly, the reliance on contact numbers obtained from internet sources to reach potential participants posed a challenge. The accuracy of such publicly available information is not always guaranteed, leading to potential difficulties in establishing contact with practitioners. Incorrect or outdated contact information could significantly reduce the response rate, further exacerbating the issue of limited participation. This reliance on potentially unreliable contact information highlights the challenges of conducting research without a pre-established network or database of practitioners, which is often the case in fields where the practice is highly privatized and decentralized.

6.4 STRENGTHS OF THE STUDY

The study had the following strengths:

The first study to investigate contact lens fitting in North-West province, South Africa: practitioner clinical competencies and contact lens related practices with the aim of improving contact lens practice in the North-West Province.

The study achieved a good response rate and provided a generalized idea of contact lens practice standards and knowledge in the North-West Province.

6.5 RECOMMENDATIONS

Based on the limitations and findings of this study the following recommendations are made:

Investigate the impact of socio-economic classes of patients on contact lens fitting

Investigate Barriers to Rigid and Specialty Lens Fittings including availability, cost, patient comfort and practitioner competencies.

Conduct longitudinal studies to track how practitioner competency evolves, to provide insights into the optimum duration and type of experience needed to achieve mastery in contact lens fitting.

Explore if gender dynamics impact patient preference or trust and if such factors influence the distribution of patients

Investigate the disparity in the availability of certain clinical resources, financial constraints, perceptions of usefulness, or lack of knowledge regarding these resources, thus offering insights to improve resource allocation and utilization,

Investigate geographical regional disparities that exist in contact lens fitting practices and resources, informing region-specific interventions.

In conclusion, contact lens service provision remains neglected and less prioritised in the public sector in the Northwest Province. The skewed distribution and lack of public sector vacancies and working resources remain a cause for concern. With the increase of ocular conditions requiring contact lens fitting, there is a need for a collaborative effort to ensure that contact lens services are available and affordable to all, regardless of socio-economic status in society and that optometrists are appropriately skilled in various contact lens fitting design materials.

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APPENDIX A: ETHICAL APPROVAL

University of Limpopo
Department of Research Administration and Development
Private Bag X1106, Sovenga, 0727, South Africa
Tel: (015) 268 4713, Fax: (015) 268 2306, Email: moore.hutamo@ul.ac.za

TURFLOOP RESEARCH ETHICS COMMITTEE

ETHICS CLEARANCE CERTIFICATE

MEETING: 22 May 2023

PROJECT NUMBER: TREC/646/2022: PG – Amended

PROJECT:

Title:	Contact lenses fitting in North-West Province, South Africa: Practitioner clinical competencies and contact lens related practices.
Researcher:	KJ Maluleka
New Supervisor:	Dr V Sukati
New Co-Supervisor/s:	Dr PMW Nkoana
School:	Health Care Sciences
Degree:	Master of Optometry

PROF D MAPOSA
CHAIRPERSON: TURFLOOP RESEARCH ETHICS COMMITTEE

The Turfloop Research Ethics Committee (TREC) is registered with the National Health Research Ethics Council, Registration Number: **REC-0310111-031**

Note:

i) **This Ethics Clearance Certificate will be valid for one (1) year, as from the abovementioned date. Application for annual renewal (or annual review) need to be received by TREC one month before lapse of this period.**

ii) **Should any departure be contemplated from the research procedure as approved, the researcher(s) must re-submit the protocol to the committee, together with the Application for Amendment form.**

iii) **PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES.**

Finding solutions for Africa

APPENDIX B: QUESTIONNAIRE

Contact lens fitting in North-West province, South Africa: Practitioner clinical competencies and contact lens related practices

Please mark with a (X) or insert value as appropriate		
SECTION A: Demographics and employment information		
1.	District	☐Bojanala platinum district Municipality (Urban) ☐Dr Kenneth Kaunda District (Semi-urban) ☐Ngaka Modiri-Molema district (Rural) ☐Dr Ruth Segomotsi District (Rural)
2.	Gender	☐Male ☐Female
3.	Race	☐ African ☐ White ☐ Coloured ☐ Indian
4.	Type of practice	☐Private individual ☐ Franchice ☐Partnership ☐Public ☐NGO
5.	Number of years in practice	☐5 Year or less ☐6-10 Years ☐11-15 Years ☐16 Years or More
6.	In addition to your B. Optom, which additional qualifications in optometry or related fields do you hold? Tick those appropriate?	☐Diploma ☐MOptom ☐MPH ☐MBA ☐Other ☐Master's degree ☐certificate ☐Other: Specify
7.	How many (average) patients do you see per day?	☐1-10 ☐11-20 ☐21-30 ☐31-40 ☐More than 40
8.	Of those presenting per day, how many usually require contact lens (average).	☐0-5 ☐6-10 ☐11-15 ☐More than 15

9.	Do you feel that it is essential to fit contact lens in private and public sector facilities?	☐ Yes ☐ No

SECTION B: Practices and prescribing patterns

10.	Do you fit contact lens at any of the hospitals/practice that you work in?	☐ Yes ☐ No If No, what are the possible reasons? ☐ Not allowed to fit by the hospital/DOH ☐ Allowed to but I do not have the necessary equipment ☐ Allowed to but I do not have contact lens trial sets ☐ Allowed to but I feel that I do not have adequate competencies to fit all type of contact lens
11.	Do you have the relevant equipment to diagnose conditions that require contact lens fitting?	☐ Yes ☐ No
12.	Please tick the equipment available at your workplace. Tick all available equipment	☐ Keratometer ☐ Corneal topographer ☐ Pentacam ☐ Slit lamp ☐ Hand-loop magnifier ☐ V-gauge ☐ Radiascope ☐ Inspection microscope ☐ Shadow graph ☐ OCT ☐ Lensometer ☐ Other_____
13.	How do you manage patients needing contact lens corrections? Choose appropriate choice/s	☐Refer to private optometrist ☐Refer to private ophthalmologist ☐Fit a pair of spectacles ☐Refer to any eye clinic ☐ Another public sector hospital ☐ NGO _____ ☐ Other _____
14.	Rate your competency in taking contact lens case history?	Poor☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐5 excellent
15.	Will you consider yourself competent in performing contact lens pre-fitting clinical tests?	☐ Yes ☐ No If Yes, using a scale from 1 to 5 grade your competency for the following where 1 is poor and 5 is excellent: Ability to examine the anatomy and physiology of the anterior segment of the eye? Poor☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐5 excellent

		Ability to diagnose all the contraindicated conditions for fitting all contact lens? Poor☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐5 excellent Ability toperform all the tear function tests and diagnosing related abnormalities? Poor☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐5 excellent In your facility, do you have the necessary instruments to measure the corneal profile? ☐ Yes ☐ No If Yes, corneal curvature is measured using (Can choose more than 1 option) ☐ Keratometer ☐ Automated Autokeratofractometer ☐ Corneal Topographer ☐ Corneal Tomographer ☐ Pachymeter
16.	Are you able to determine candidates for contact lens wear and those contraindicated?	☐ Yes ☐ No If yes, which of the following medical conditions are contra-indicated for the use of contact lens? Can choose more than 1 option ☐ allergies ☐ sinusitis ☐ hay fever ☐ epilepsy ☐ diabetes ☐ dry eyes Are you aware of the medications that are contraindicated for use during contact lens wear? ☐ Yes ☐ No If yes, which of the following medications are not to be used with contact lens wear? Can choose more than 1 option ☐diuretics ☐tranquilizers ☐antihistamines ☐psychiatric treatment ☐contraceptives.
17.	Do you have the ability to use and interpret findings of keratometer, topographer and pentacam?	☐ Yes ☐ No
18.	Are you aware of what information, from the pre-fitting tests, that you need to consider before you choose the appropriate contact	☐ Yes ☐ No

	lens material, water content and design?	
19.	Rate your competency on the ability to measure visual function of patients of any age with appropriate tests and techniques for contact lens fitting?	Poor☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐5 excellent
20.	Rate your competecy on the following:	Ability to calculate contact lens Base curve Poor☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐5 excellent Ability to calculate contact lens power Poor☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐5 excellent Ability to calculate total diameter Poor☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐5 excellent Ability to determine the add power for presbyopia contact lens Poor☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐5 excellent
21.	Are you aware of when each type of contact lens fit is indicated? (e.g. sport, injury, industry, therapeutic, cosmetic)	☐ Yes ☐ No
22.	Are you able to choose the appropriate and differentiate lens material as well as prescribing? (e.g. Rigid, Hydrogel, Silicone hydrogel, Scleral, Hybrid (Piggy-back)	☐ Yes ☐ No
23.	Do you know different contact lens solutions and their uses?	☐ Yes ☐ No
24.	Are you familiar with contact lens care regiments?	☐ Yes ☐ No If Yes, Rate your knowledge on contact lens care routine Poor☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐5 excellent

25.	Are you aware of contact lens wearing schedules (modality and replacement)	☐ Yes ☐ No
26.	Are you aware different contact lens brands?	☐ Yes ☐ No
27.	Which of the following tests do you perform on your patients who may need contact lens for correction?	☐ K- readings ☐ Ocular health examination(slit lamp) ☐ Refraction ☐ Tear Function tests ☐ Corneal Topography ☐ Corneal thickness (Pachymetry)
28.	Do you know when to fit each type of contact lens? Soft lens, RGP, toric, scleral, Multifocal?	☐ Yes ☐ No If Yes, rate your competency on the following on a scale of 1-5 where 1 is poor and 5 is excellent Ability to do pre-fitting, fitting, assess, order and dispense single vision spherical contact lens Poor☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐5 excellent Ability to do pre-fitting, fitting, assess, order and dispense single vision toric contact lens Poor☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐5 excellent Ability to do pre-fitting, fitting, assess, order and dispense rigid gas permeable and scleral contact lens Poor☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐5 excellent Ability to do pre-fitting, fitting, assess, order and dispense contact lens for presbyopia (Multifocal) Poor☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐5 excellent
29.	How many patients are referred for rigid gas permeable (RGP) or soft contact lens per week. Choose appropriate number that corresponds to the number of patients seen per week:	RGP 1☐0-5 2☐6-10 3☐11-15 4☐More than 15 Soft 1☐0-5 2☐6-10 3☐11-15 4☐More than 15
SECTION C: Profile of commonly fitted ocular conditions, and management strategies		

30.	For which conditions do you refer patients for contact lens fittings? Can choose more than 1 option	☐ Keratoconus ☐ Aphakia ☐ Myopia ☐ Hyperopia ☐ Astigmatism ☐Therapeutic ☐Amblyopia ☐Anisometropia ☐ Other _____
31.	Which type of contact lens do you prescribe? Please choose either often, sometime or never.	Hydrogel contact lens: ☐often (10>) ☐ sometimes (1-10) ☐never Conventional hydrogel contact lens: ☐often (10>) ☐ sometimes (1-10) ☐never Spherical contact lens: ☐ often (10>) ☐ sometimes (1-10) ☐never Soft toric contact lens: ☐ often (10>) ☐sometimes (1-10) ☐never Cosmetic contact lens: ☐often (10>) ☐ sometimes (1-10) ☐never Rigid gas permeable lens (RGP): ☐often (10>) ☐ sometimes (1-10) ☐never Scleral lens: ☐often (10>) ☐ sometimes (1-10) ☐never
32.	Which of the following conditions have you found to be common in your area of practice?	☐Keratoconus ☐Pellucid marginal degeneration ☐Terrien's marginal degeneration ☐Post-LASIK ectasia, ☐Post corneal transplant
33.	How many cases do you diagnose with each of these conditions (average) per week? Choose appropriate number that corresponds to the number of patients seen per week:	Keratoconus; 1☐0-5 2☐6-10 3☐11-15 4☐More than 15 Post-surgical corneal distortion; 1☐0-5 2☐6-10 3☐11-15 4☐More than 15 Aphakia; 1☐0-5 2☐6-10 3☐11-15 4☐More than 15 Myopia; 1☐0-5 2☐6-10 3☐11-15 4☐More than 15 Hyperopia; 1☐0-5 2☐6-10 3☐11-15 4☐More than 15 Astigmatism (low); 1☐0-5 2☐6-10 3☐11-15 4☐More than 15 Astigmatism (high); 1☐0-5 2☐6-10 3☐11-15 4☐More than 15 Corneal abrasions; 1☐0-5 2☐6-10 3☐11-15

		4☐More than 15 Anisometropia; 1☐0-5 2☐6-10 3☐11-15 4☐More than 15 Amblyopia; 1☐0-5 2☐6-10 3☐11-15 4☐More than 15 Other; 1☐0-5 2☐6-10 3☐11-15 4☐More than 15
34.	Choose appropriate number that corresponds to the percentages of patients that are managed using the following management approaches?	Spectacles;1☐0% 2☐1-19% 3☐20-39% 4☐40-59% 5☐60-79% 6☐80-100% Contact lens; 1☐0% 2☐1-19% 3☐20-39% 4☐40-59% 5☐60-79% 6☐80-100% SPECTACLES (%) SV spectacles; 1☐0% 2☐1-19% 3☐20-39% 4☐40-59% 5☐60-79% 6☐80-100% Bifocals spectacles; 1☐0% 2☐1-19% 3☐20-39% 4☐40-59% 5☐60-79% 6☐80-100% Multifocal spectacles; 1☐0% 2☐1-19% 3☐20-39% 4☐40-59% 5☐60-79% 6☐80-100% CONTACT LENS (%) Soft contact lens; 1☐0% 2☐1-19% 3☐20-39% 4☐40-59% 5☐60-79% 6☐80-100% Rigid contact lens; 1☐0% 2☐1-19% 3☐20-39% 4☐40-59% 5☐60-79% 6☐80-100% Combination contact lens; 1☐0% 2☐1-19% 3☐20-39% 4☐40-59% 5☐60-79% 6☐80-100% Toric contact lens; 1☐0% 2☐1-19% 3☐20-39% 4☐40-59% 5☐60-79% 6☐80-100% Bifocal/multifocal contact lens; 1☐0% 2☐1-19% 3☐20-39% 4☐40-59% 5☐60-79% 6☐80-100% Prosthetic/Therapeutic/Cosmetic contact lens; 1☐0% 2☐1-19% 3☐20-39% 4☐40-59% 5☐60-79% 6☐80-100%
35.	How many (average) keratoconic patients do you see per week?	1☐0-5 2☐6-10 3☐11-15 4☐More than 15
36.	Please rate your knowledge on keratoconus for each statement (On a scale of 1 to 5, where 1 is poor and 5 is excellent)	Knowledge of risk factors Poor☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐5 excellent

		Sreening , diagnosis and management Poor☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐5 excellent Management of non surgical interbvention Poor☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐5 excellent Management of surgical intervention (i.e. Cross linking, corneal rings, refractive surgery etc.) Poor☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐5 excellent Associated systemic diseases Poor☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐5 excellent Associated pathologies Poor☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐5 excellent
37.	Do you give lessons on abnormal signs and symptoms, normal adaptive symptoms and provide patients with aids such as videos, audios or print outs?	☐ Yes ☐ No
38.	Which of the following do you provide education and instructions to contact lens patients? Choose any that apply	☐Insertion and removal tutorials ☐ safety precautions of contact lens uses ☐ Lens and personal hygene ☐ Use of only prescribed solution ☐ Importance of aftercare ☐ Possible complications that comes with type prescribed and management
39.	Did you ever take additional qualifications/training in skills, knowledge or competencies for managing the following:	Keratoconus ☐ Yes ☐ No Myopia control ☐ Yes ☐ No If Yes, which type of training ☐ Post graduate degree/diploma/certificate ☐ Presentation in a workshop ☐ Presentation in a conference ☐Other

40.	Are you aware of latest developments in contact lens fitting?	☐ Yes ☐ No If yes, rate your knowledge on a scale of 1 to 5 where 1 is poor and 5 is excellent Lens available in the industry/market Poor☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐5 excellent Contact lens materials and designs Poor☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐5 excellent Tear supplements available in the market and properties contained for appropriate prescribing Poor☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐5 excellent Companies supplying different designs and contact lens brands Poor☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐5 excellent
41.	Please indicate the specific emerging aspects that may affect the quality standards and skills of optometrists employed in both private and public sector in contact lens practice. Choose any that apply	☐ Implementation of new technologies, new software or machines and equipment ☐ Changes in the market and consumer's requirements ☐ Production of new optometry products ☐ Changes in work organization and organizational culture within the optometry industry ☐ Implementation of new models and management systems ☐ Implementation of new regulation, legal norms, and quality standards, etc. ☐ Other
42.	Have you attended any CPD/training on contact lens activities in the last 2 years?	☐ Yes ☐ No
43.	Do you think you will benefit from attending an advanced course in contact lens?	☐ Yes ☐ No If Yes, would you prefer to do ☐ Theory only ☐ Wet lab sessions only ☐ Theory and Wet lab sessions

44.	Would you register for an advanced contact lens fitting course offered?	☐ Yes ☐ No
45.	Rate your overall knowledge on contact lens fitting on a scale of 1 to 5 where 1 is poor and 5 is excellent	Poor☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐5 excellent

Thank you for filling in the questionnaire

APPENDIX C: NORTH-WEST DEPARTMENT OF HEALTH APPROVAL

health
Department:
Health
North West Provincial Government
REPUBLIC OF SOUTH AFRICA

2030 NDP

1st Floor, Health Office Park
Private Bag X 2068
MMABATHO
2735

RESEARCH, MONITORING & EVALUATION

Tel: 27 (18) 391 4501
Email: MMolefeT@nwpg.gov.za
www.nwhealth.gov.za

Name of Researcher: **Ms. K.J. Maluleka**
University of Limpopo

Physical Address: _____

(Work/ Institution) _____

HEAD OF DEPARTMENT
2023 -05- 17
NORTH WEST DEPARTMENT OF HEALTH
PRIVATE BAG X 2068, MMABATHO, 2735

Subject: **Research Approval Letter – Knowledge and skills of optometrists in contact lens practice in North-West Province, South Africa.**

This letter serves to inform the Researcher that permission to undertake the above mentioned study has been granted by the North West Department of Health. The Researcher must arrange in advance a courtesy meeting with the District Chief Director and the Chairperson of the District Health Research Committee (DHRC) (as per their details below), to introduce their research team/members on the proposed research to be undertaken. The researcher can thereafter proceed to the identified institution/s and/or facility and produce this letter to the Management as proof that the research was approved by the NWDoH.

This letter of permission should be signed and a copy returned to the department. By signing, the Researcher agrees, binds him/herself and undertakes to furnish the Department with an electronic copy of the final research report. Alternatively, the Researcher can also provide the Department with an electronic summary highlighting recommendations that will assist the Department in its planning to improve some of its services where possible. Through this, the Researcher will not only contribute to the academic body of knowledge but also contributes towards the bettering of health care services and thus the overall health of citizens in the North West Province.

Below are the contact details.

APPENDIX D: LETTER TO REQUEST FOR PERMISSION

Block A, New Bophelong psychiatric,

Hospital, Mafikeng

2745

The Head of Department

North-West Department of Health

Cnr 1st street &, Sekame St

Mafikeng

2745

Dear Sir/Madam

Re: Permission to conduct to conduct research

I am a master student in optometry at the University of Limpopo pursuing a study titled: **CONTACT LENS FITTING IN NORTH-WEST PROVINCE, SOUTH AFRICA: PRACTITIONER CLINICAL COMPETENCIES AND CONTACT LENS RELATED PRACTICES** requesting permission to conduct my research among optometrists in the Northwest Province. The purpose of this study is to determine practitioner clinical competencies and contact lens related practices of optometrists to inform the need of

addressing challenges encountered for optimal fitting of patients' essential for improved eye health planning and curriculum advancement for contact lens. With population growth, the need of contact lens fitting is essential as conditions best corrected with contact lens are on the rise.

I therefore request permission to collect data among optometrists practicing in the Province using a questionnaire.

For further information you can contact my supervisors;

Dr VN Sukati

Email: velibanti.sukati@ul.ac.za

Tel: 031 268 3737

Dr PMW Nkoana

Email: pheagane.nkoana@ul.ac.za

Tel: 031 268 2952

For any queries about the research study contact: The Turfloop Research Ethics Committee (TREC) at the University of Limpopo

Email: TREC@ul.ac.za

Thanking you in advance for your cooperation.

Yours faithfully

Ms Maluleka KJ