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Knowledge of myopia control among newly qualified optometrists in South Africa

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Background: Undergraduate education is a crucial practitioner knowledge base impacting clinical decisions and should incorporate the latest myopia control research.

Aim: To describe the knowledge of myopia control among optometrists who have recently qualified from higher education institutions in South Africa.

Setting: An online survey was conducted among newly qualified optometrists (graduates of 2020 and 2021) in South Africa.

Methods: A quantitative, descriptive, cross-sectional study was conducted through self-administered questionnaires circulated via social media and higher education institutions. Closed-ended questions assessed the knowledge of factors predicting myopia onset and progression, ocular pathologies associated with high myopia and myopia control strategies.

Results: A response rate of 57.6% (n = 170) was obtained. Environmental factors and refractive status were considered important in predicting myopia progression, while parents' refractive status (60.59%) and ethnicity (40.59%) were less recognised. The link between primary open-angle glaucoma and high myopia was widely known (65.88%), with many other sight-threatening conditions not identified. Although orthokeratology (70%) and increased time spent outdoors (65.29%) were considered successful, participants' uncertainty of other strategies was evident by the significant percentage of unsure responses (24.71% – 44.12%).

Conclusion: Misinterpretation and outdated information resulted in knowledge gaps across the different sections, with the lowest performing section being knowledge of myopia control strategies. Ocular pathologies associated with high myopia are crucial to everyday clinical practice and the poor knowledge shown is most concerning.

Contribution: Higher education institutions should incorporate more of the latest research and clinical guidelines by creating more educational and training opportunities within their curricula.

Keywords: myopia management; myopia onset; myopia progression; management strategies; undergraduate education.

Introduction

Myopia is a global public health challenge because of its increasing prevalence, which is estimated to affect half the world's population by 2050.[1] While myopia prevalence estimates in African school children are currently in the single digits, this is expected to increase with more people on the continent moving towards urban living and the use of digital devices for play and learning.[2] In addition to monitoring the myopia prevalence rates, it is also essential to consider the number of patients presenting with high myopia.[3] High myopia places patients at increased risk for sight-threatening pathological conditions, such as glaucoma, myopic maculopathy and retinal detachment.[4,5] Patients are also impacted by the negative financial strain[6] and emotional toll on their quality of life.[7,8] However, the effects of high myopia extend beyond the patient and into the larger community by having a negative socioeconomic impact because of the loss of productivity.[9] High myopia occurs as a result of an early age of onset or an increased rate of annual myopia progression.[10] This is, therefore, the focus of myopia control strategies – aiming to delay myopia onset and slow myopia progression.[11] According to the World Health Organization (WHO),[12] a 90% decrease in high myopia prevalence is possible if myopia progression rates can be halved. The implementation of myopia control strategies largely rests with the optometrist, making them key influencers in myopia management.

Note: Additional supporting information may be found in the online version of this article as Online Appendix 1.

The role of the optometrist in myopia control is to diagnose and manage patients, with the goal of delaying myopia onset and slowing myopia progression.[13] For a child presenting with myopia, this begins by determining the true amount of myopia present using cycloplegic refraction,[14] before considering the factors that could affect myopia progression. Following the diagnostic workup, myopia control may be considered and discussed with patients and their parents or caregivers. As the inclusion of myopia control in a management plan is mainly at the discretion of the optometrist,[13] it is vital that we consider the extent of the knowledge base of optometrists.[15] Previous studies assessing the myopia control knowledge of qualified eyecare professionals have been conducted in Saudi Arabia,[16] India,[17] Australia,[15] Pakistan,[18] Spain,[19] across the African continent[20] and through global surveys.[21,22] While participants are aware of myopia control strategies and are concerned about increasing myopia prevalence, the most preferred management option was single-vision spectacles.[15,16,17,19,20,21,22] The studies concluded that implementation was largely hindered by lack of clinical guidelines, lack of experience and insufficient information.[15,16,17,19,20,21,22]

While continuing education and professional development courses have focused significantly on myopia control in recent years[23] and remain an important knowledge base for practitioners, undergraduate education ranks higher in influencing clinical decision-making[24] and as a source of information for myopia management.[15] Therefore, the aim of this study is to describe the myopia control knowledge of newly qualified optometrists to better understand the tools that newly qualified optometrists are equipped with to face the increasing prevalence of myopia.

Research methods and design

Study design and duration

The study design was a quantitative, descriptive, cross-sectional study using a questionnaire as a measurement tool. A self-administered online questionnaire was utilised to gather data from newly qualified optometrists in South Africa. The questionnaire was developed by reviewing literature and adapting an existing instrument used in a previous study with the author's permission.[15]

The study was conducted over a 2-month period from May 2022 to July 2022.

Population and sampling strategy

Newly qualified optometry graduates were chosen as the population for this study to best assess their existing knowledge base of myopia control from their undergraduate education and training in South Africa. In line with previous studies that considered newly qualified graduates,[25,26] the inclusion criteria for this study constituted the previous 2 years of graduates, i.e., the class of 2020 and 2021. By limiting the population to the past 2 years, this further helped reduce the impact of continuing education and continuous professional development programmes, which have focused on myopia control significantly in recent years. The study used convenience sampling and snowball sampling to recruit participants. Based on graduate numbers received from the different higher education institutions (HEIs) in South Africa, the population was found to be 295, with a sample size calculation estimated to be 168 using a 95% confidence interval. Participants were recruited via social media, where the link to the online questionnaire was shared alongside an approved advertisement. The link was shared via WhatsApp, LinkedIn and Facebook. In addition to social media, graduates of 2021 were also approached by the researcher via their former HEIs.

Development of the questionnaire

The questionnaire was developed and administered using the EvaSys system and contained closed-ended questions only. Initial questionnaire development was followed by reliability and validity testing prior to the pilot study. The questionnaire was only available in English, as English is the language of instruction at the Departments of Optometry in South Africa. Optometrists' knowledge of myopia control was tested in three sections that focused on the factors predicting myopia onset and progression, ocular pathology associated with high myopia and the strategies used in myopia control. These sections were deemed most crucial to describing the knowledge of myopia control, thereby underpinning clinical decision-making.

In the first section, participants indicated the importance of the different factors predicting myopia onset and myopia progression. Participants were required to assess the importance of six factors in predicting myopia onset and twelve factors in myopia progression. Each of the 18 factors had options of 'important', 'not important' or 'unsure'. Incorrect and unsure responses were allocated a zero point, while correct responses were assigned two points. In the second section, participants were required to select which ocular pathologies are associated with high myopia. From the thirteen ocular pathologies provided, seven were correct and were assigned two points, while incorrect options selected resulted in a one-point deduction. The penalty approach was used to achieve an accurate measure of knowledge in this section, as it was the smallest section containing only a single question where guessing would easily skew the result. The third section on strategies used in myopia control began with six statements relating to the diagnosis and management of myopia. These closed-ended questions used a three-point Likert scale which allowed participants to select 'agree', 'disagree' or 'unsure'. Correct responses were assigned one point, and incorrect or 'unsure' options were assigned a zero. Thereafter, participants proceeded to indicate the success of different management strategies in delaying myopia onset and slowing myopia progression. Correct responses were given two points, while incorrect and 'unsure' responses were given a zero.

Validity and reliability

Cronbach's alpha was computed for the first and third knowledge sections to indicate the level of correlation between questions within the section that it is found in. A reliability coefficient of 0.76 was found for the section centred on factors predicting myopia onset and progression, indicating adequate internal consistency.[27] A reliability coefficient of 0.61 was found for the section focused on the knowledge of myopia control strategies, implying adequate internal consistency.[27] However, instruments testing knowledge cannot simply rely on the Cronbach's alpha value, but rather each question and answer should be carefully inspected for accuracy.[27]

Face and content validity was also conducted by two optometrists prior to data collection. One of the optometrists, considered an expert in myopia control and who has presented on the topic, was tasked with inspecting the myopia control content and ensuring the questions and answers were in line with the current research in the field of myopia control. The other optometrist, with expertise in survey development as a postgraduate researcher, was asked to advise on the language used in the survey and the alignment between the objectives and the questions.

A pilot study was conducted thereafter, using the think-aloud feedback method to receive immediate feedback regarding questions that appeared ambiguous or unclear. Thereafter, participants were asked to clarify their immediate feedback and provide their overall impressions in a short interview. The seven pilot study participants selected via convenience sampling were from the class of 2022 and did not participate in the final study. Feedback from the qualified optometrists and pilot study participants was used to finalise the questionnaire prior to the main data collection phase.

Data analysis

The responses to the questionnaire were captured by EvaSys. Data analysis was supported by the Department of Biostatistics, University of the Free State. Further analysis was performed by the researcher using Statistical Package for Social Sciences (SPSS) Version 28. Categorical data were analysed using descriptive statistics and expressed as frequencies and percentages in all sections. The numerical data, which constituted the scores per section, were analysed using medians and interquartile ranges. Non-parametric tests were used for data analysis as the data were not normally distributed. The Chi-square goodness of fit test was used to determine the *P*-value for each question within the questionnaire. The *P*-value generated indicates whether the responses provided follow a specific distribution. A $P < 0.05$ was regarded as a statistically significant result of the Chi-square goodness-of-fit test. The Mann–Whitney *U* test was used for further analysis, with $\alpha < 0.05$ being considered statistically significant.

Ethical considerations

Full ethical approval was granted by the Health Sciences Research Ethics Committee (HSREC) of the University of the Free State. The ethics approval number was UFS-HSD2021/1936/2903. All procedures performed in the study were in accordance with the ethical standards of the institutional research committee and with the 1964 Helsinki Declaration and its later amendments of comparable ethical standards.

Participants accessed the online information document, which was presented prior to the start of the online survey (Online Appendix 1). It outlined the participants' rights regarding their voluntary participation and that their participation was confidential. No personal identifying characteristics would be requested from them. All data collected were handled in a strictly professional and confidential manner.

Results

Demographic profile

In total, 178 responses were received during the data collection period, with 170 meeting the inclusion criteria for data analysis. This represents a response rate of 57.6%. Most participants qualified in 2021 (62.4%). Over 60% of the participants are currently working in independent practices, franchise practices or corporate workplaces, with 4.12% currently not employed. Table 1 displays the demographics of participants.

Factors predicting myopia onset and progression

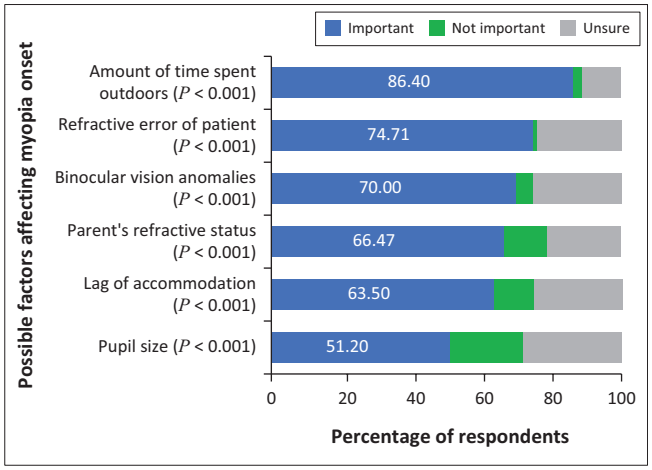
Based on their knowledge, participants were asked to judge the importance of six factors predicting myopia onset and twelve factors predicting myopia progression. The amount of time spent outdoors was selected as an important factor in predicting myopia onset by 86.4% of participants ($P < 0.001$), as seen in Figure 1. More than 65% of participants also identified parents' refractive status ($P < 0.001$) and the

TABLE 1: Demographics of study participants.

Characteristic	*n*	%
Gender identity		
Male	63	37.10
Female	98	57.60
Prefer not to answer	6	3.53
Not reported	3	1.76
Year of completing B. Optometry qualification		
2020	64	37.60
2021	106	62.40
Current employment status		
Independent and/or private practice	48	28.20
Franchise practice	24	14.10
Corporate	56	32.90
Academic institution	10	5.88
Self-employed	15	8.82
Public health clinic or hospital	10	5.88
Not employed	7	4.12

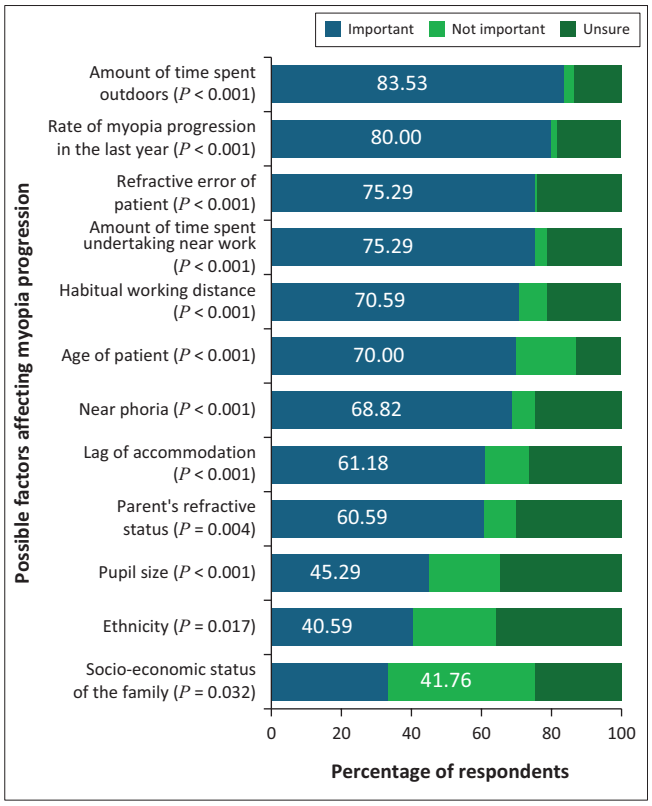
patient's binocular and refractive status ($P < 0.001$) as being important for myopia onset. The least selected factor was pupil size ($P < 0.001$). All questions in this section showed statistical significance with a $P < 0.05$ (Figure 1).

Of the factors important to myopia progression, time spent outdoors ($P < 0.001$) and time spent with near work ($P < 0.001$) were selected by 83.53% and 75.29% of participants, respectively (Figure 2). Other factors rated as important by more than 70% of participants include age ($P < 0.001$), refractive error of patient ($P < 0.001$), rate of myopia progression in the last year ($P < 0.001$) and habitual working distance ($P < 0.001$). The refractive status of the parents was only considered important by 60.59% of participants ($P = 0.004$) and ethnicity by 40.59% of participants ($P = 0.017$). Pupil size was only selected by 45.29% of participants ($P < 0.001$) and socio-economic status by 33.53% of participants ($P = 0.032$). All factors listed in the section regarding factors affecting myopia progression obtained a $P < 0.05$ (Figure 2).



Note: Chi-square results per question are indicated in brackets.

FIGURE 1: Percentage of participants judging the importance of factors predicting myopia onset, with the percentage of the highest response included.



Note: Chi-square results per question are indicated in brackets.

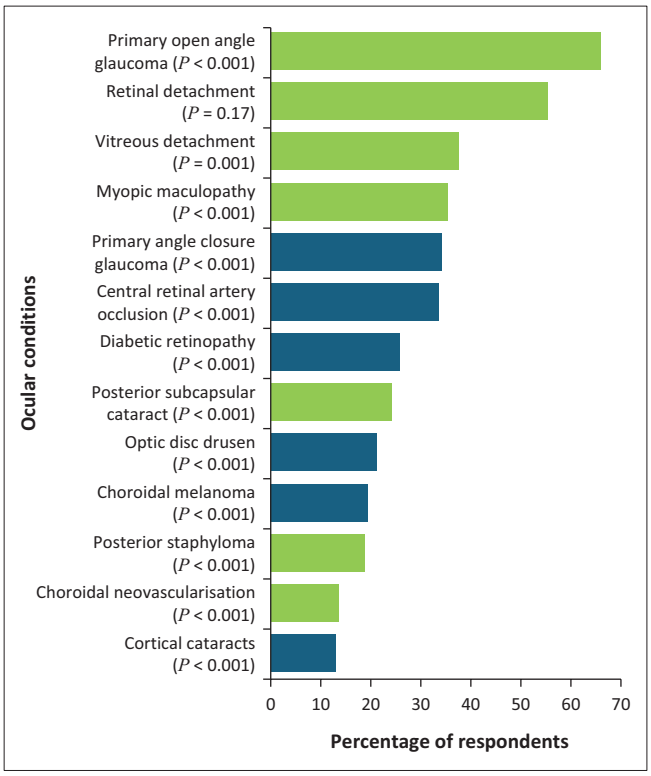
FIGURE 2: Percentage of participants judging the importance of factors predicting myopia progression, with the percentage of the highest response included.

Ocular pathology associated with high myopia

Participants were asked to identify pathologies that patients with high myopia are at increased risk for developing. The two ocular pathologies selected by most participants were primary open-angle glaucoma by 65.88% of participants ($P < 0.001$) and retinal detachment by 55.29% of participants ($P = 0.17$). The top four conditions selected have all been associated with high myopia (Figure 3). However, the third and fourth conditions, vitreous detachment ($P = 0.001$) and myopic maculopathy ($P < 0.001$), were selected by less than half of all participants at 37.65% and 35.29%, respectively. Conditions that were least selected but that are associated with high myopia include choroidal neovascularisation (13.53%), posterior staphyloma (18.82%) and posterior subcapsular cataract (24.12%).

Myopia diagnosis and strategies to delay onset and slow progression of myopia

Participants were first required to respond to statements regarding overall myopia diagnosis and management. Following this, based on their knowledge, participants were



Note: Chi-square results per question are indicated in brackets.

FIGURE 3: Percentage of participants associating high myopia with ocular pathology, with correct answers shaded green.

able to judge the success of various strategies to delay myopia onset and slow myopia progression.

Based on their knowledge of myopia control strategies, the majority of participants (84.12%) agree that the significant mainstream implementation of myopia control strategies can significantly decrease the prevalence of high myopia ($P < 0.001$) (Table 2). Most participants (68.24%) believed that myopia can be predicted prior to the first myopic refraction ($P < 0.001$) and almost three-quarters of participants believed that fast myopia progression is a –0.50 DS annual change in prescription ($P < 0.001$). While 63.53% of participants do believe that cycloplegic refraction should be performed ($P < 0.001$), only 28.24% of participants considered it necessary to identify patients with pseudomyopia prior to myopia control implementation ($P < 0.001$). Almost one-third of participants (32.94% and 32.35%) responded as 'unsure' for the statements relating to cycloplegic refraction and pseudomyopia (Table 2).

Of the strategies to delay myopia onset, most participants identified increased time outdoors (84.71%) and less time watching television (67.65%). All three strategies listed to delay myopia onset showed statistical significance ($P < 0.001$), as seen in Table 2. The strategy deemed to be most successful at slowing myopia progression was orthokeratology (70%) (Figure 4). The next most selected strategy was advice to spend time outdoors at 65.29% ($P < 0.001$). This was followed by atropine (0.1% – 0.5%) and peripheral defocus contact lenses tied at 54.71% and atropine (0.05%) at 54.12%. More than half of all participants also selected the following optical options: multifocal contact lenses ($P = 0.489$), progressive addition spectacle lenses ($P < 0.001$), bifocal spectacle lenses ($P < 0.001$) and peripheral defocus spectacle lenses ($P = 0.645$). Almost half of the participants deemed under-correction of a patient's distance prescription as being successful at slowing myopia progression ($P < 0.001$). For many strategies, between 24.71 and 44.12% of participants selected 'unsure' as a response.

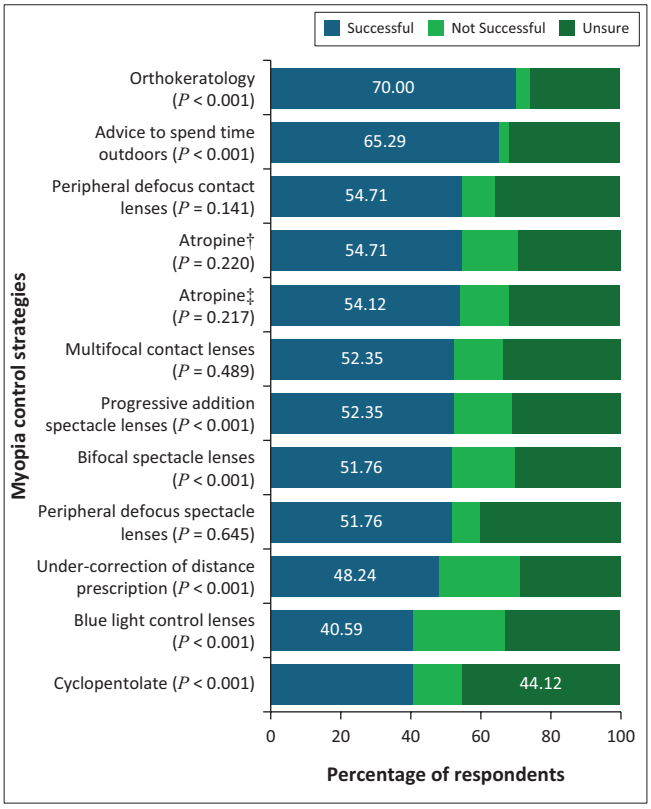
Overall knowledge

The knowledge section that tested the strategies used in myopia control resulted in the lowest median and interquartile range, as seen in Table 3. The highest median and interquartile ranges were found in the section relating to the factors predicting myopia onset and progression. A perfect result of 100% was achieved by one participant in the section on ocular pathologies. With all sections combined, the median percentage was 44.9%, with the lowest result of 19.4% and the highest result of 72.4%. Participants were also asked regarding additional myopia control education that was received since leaving undergraduate education. Almost a quarter of the participants (22.9%) indicated that they had attended a course or training post-qualification.

Further analysis of the results, using the Mann–Whitney U test, found a statistically significant difference between the graduating year and the overall percentage of knowledge found. The class of 2020 had a higher statistically significant knowledge percentage compared to the class of 2021, $z = -3.199$, $P = 0.001$.

TABLE 2: Analysis of knowledge of clinical testing and diagnosis of myopia ($N = 170$).

Statement	*P*	Responses (percentage of participants)		
		Agree	Disagree	Unsure
Knowledge of clinical testing and diagnosis of myopia				
Myopia progression of – 0.50 DS per year is considered fast progression	$P < 0.001$	70.00	10.59	19.41
Significant mainstream implementation of myopia control strategies can significantly decrease the prevalence of high myopia	$P < 0.001$	84.12	0.00	15.88
Myopia can be predicted prior to the first myopic refraction of a patient	$P < 0.001$	68.24	9.41	22.35
Cycloplegic refraction should be performed prior to implementing myopia control strategies	$P < 0.001$	63.53	3.53	32.94
It is unnecessary to differentiate pseudomyopia from myopia prior to implementing myopia control strategies	$P < 0.001$	39.41	28.24	32.35
Knowledge of strategies to delay myopia onset		**Yes, successful**	**Not successful**	**Unsure**
Advice to spend time outdoors	$P < 0.001$	84.71	2.94	12.35
Less time watching television	$P < 0.001$	67.65	14.12	18.23
Increased Vitamin D supplements	$P < 0.001$	53.53	3.53	42.94



Note: Chi-square results per question are indicated in brackets.
†, 0.1 – 0.5%; ‡, 0.05%.

FIGURE 4: Percentage of participants indicating the success of myopia control strategies on myopia progression, with the percentage of the highest response included.

Discussion

This was the first study that aimed to describe the myopia control knowledge of newly qualified optometrists in South Africa. Overall, participants in the study displayed the

TABLE 3: Descriptive statistics of the different knowledge sections.

Knowledge section	Percentage			
	Median	Inter-quartile range	Minimum	Maximum
Factors predicting myopia onset and progression	52.7	33.3–61.1	11.1	88.8
Ocular pathologies associated with high myopia	46.2	34.6–61.5	11.5	100.0
Strategies to delay myopia onset and slow myopia progression	41.7	30.6–55.6	5.6	83.3
Total knowledge percentage	44.9	36.0–57.1	19.4	72.4

poorest knowledge in the section relating to myopia control strategies and performed best in the section regarding factors affecting myopia onset and progression. Most of the newly qualified optometrists who responded were currently employed in various settings and were mostly from the 2021 graduating year. This could be attributed to the two-pronged approach of advertising with both the HEIs and social media platforms. Potential participants in the 2020 graduating year were only accessed via distribution of the advertisement through social media.

Knowledge of factors affecting myopia onset and progression

Of the six factors listed in the survey, three have been proven to predict myopia onset. These factors were the amount of time spent outdoors, the refractive error of a patient and parents' refractive status. These factors were correctly identified by 86.4%, 74.71% and 66.47% of participants, respectively. However, more than 60% of participants also identified lag of accommodation and binocular vision anomalies to be important in predicting myopia onset. This could be attributed to earlier theories of myopia development and progression based on the lag of accommodation[28] that have since been disproven.[29,30] This result may imply that participants are still retaining older knowledge that has already been debunked.

Of the 12 factors listed in the survey, eight have been proven to predict myopia progression. While the exact process of myopia development is not precisely known, the contributions of both genetic and environmental factors have been well reported.[31,32] The eight proven factors comprise three environmental factors, two genetic factors and three based on the patient's current status. The three environmental factors that have been linked to myopia progression were correctly identified by more than 70% of participants, i.e., habitual working distance,[33,34,35] amount of time spent outdoors[33,36] and time spent undertaking near work.[33,34] Similar findings were found in studies assessing knowledge in Australia, India and Saudi Arabia, where such environmental factors were ranked 'important' or 'very important' by 60% – 86% of participants.[15,16,17]

Genetic factors of ethnicity and parents' refractive status were thought to be important by only 40.59% and 60.59% of participants, respectively. Ethnicity, which research has proven to be a risk for higher myopia progression,[37] was also ranked in the bottom three by participants in previous studies.[15,16,17] Parents' refractive status has been shown to have an impact on both myopia onset[38] and myopia progression.[33,39] More participants linked a parent's refractive status to myopia onset (66.47%) as compared to myopia progression (60.59%). The importance of parents' refractive status was similar to the study conducted in Saudi Arabia, where 60% of participants ranked the factor as 'important' or 'very important', but lower than the findings in Australia (78%) and India (84%).[15,16,17]

The importance of factors relating to a patient's current refractive status was ranked high by participants: age (70.00%), current refractive status (75.29%) and rate of myopia progression in the last year (80.00%). These findings concur with previous studies assessing knowledge, where these three factors were ranked 'important' and 'very important' by between 70 and 98% of participants.[15,16,17] The importance of age, current refractive status and current annual progression has been proven to predict myopia progression.[40,41] This indicates that the majority of participants were knowledgeable about the impact of environmental and current findings on myopia progression, while the overall knowledge of genetic factors was poorer than that reported in previous studies.

Lag of accommodation and near phoria were selected by about two-thirds of participants as being an important factor in myopia progression, which is incorrect.[30] In previous studies, these factors were also incorrectly graded as 'important' and 'very important' by 62% – 74% of participants.[15,16,17] While the measurement of lag of accommodation and diagnosis of binocular vision anomalies are important for a clinical workup with myopic patients,[42] as it was initially thought to impact myopia progression,[28] its effect on both myopia onset and progression has not been proven.[30,40,43] This again indicates that a majority of participants are still basing their understanding of myopia progression on earlier theories that have since been abandoned.

The remaining factors that were included, with no proven impact on myopia progression, were pupil size and socioeconomic status of the family. While socioeconomic status was correctly deemed 'not important' by 41.76% of participants, only half this number (20.00%) regarded pupil size to be 'not important'. Similar findings regarding pupil size (20% and 21%) were consistent with studies from Saudi Arabia and India.[16,17]

Knowledge of ocular pathology associated with high myopia

From the list of thirteen ocular pathologies presented, seven of the conditions have been associated with an increased risk in patients with high myopia, with the other six conditions showing no proven link to high myopia. Of the seven correct conditions, two were correctly selected by the majority of

participants, viz. primary open-angle glaucoma (POAG) (65.88%) and retinal detachment (55.29%). When comparing an emmetropic patient to a myopic patient, the risk of POAG is almost double.[4] The percentage of participants correctly identifying POAG is less than the 79.5% found in the study by Douglass et al.[15] but more than the 49.34% found by Chaurasiya et al.[17] The increased risks associated with high myopia should be considered when performing intraocular pressure testing, assessment of the optic nerve head and interpretation of the visual field results.[44]

Another complication causing a three times greater risk in patients with high myopia compared to patients with low myopia is retinal detachment.[4,5] This sight-threatening pathology is because of the increased axial length causing increased mechanical tension.[5] While correctly selected by more than half of the participants in the current study, this was significantly lower than optometrists in Australia (90.00%) and Saudi Arabia (75%) but higher than their counterparts in India (45.03%).[15,16,17] Knowledge of this complication would affect the diagnostic workup of patients presenting with high myopia, as a dilated fundus examination would be mandatory to check for retinal tears and detachments. Patients with high myopia should also be informed of the symptoms of a retinal detachment and advised to seek immediate attention should these symptoms present.[44] The tissue degeneration resulting in retinal detachments is also linked to other complications, such as posterior staphylomas and vitreous detachments.[5] Posterior staphylomas were only correctly identified as an associated factor of high myopia by 18.82% of participants and vitreous detachments by 37.65% of the participants.

The remaining conditions that are associated with high myopia were accurately selected by a small portion of participants: choroidal neovascularisation (13.53%), posterior subcapsular cataract (24.12%) and myopic maculopathy (35.29%). Patients presenting with myopia have a 100-fold higher risk of developing myopic maculopathy as compared to emmetropic patients.[4] Myopic maculopathy and choroidal neovascularisation are known to have the most devastating effect on patients' vision, therefore requiring careful examination on every optometric visit.[4,12] While choroidal neovascularisation was the lowest reported correct answer in this study, it was also poorly identified (15.56%) by participants in India but by more than half of participants (58.6%) in Australia.[15,17] Regarding cataracts and high myopia, a meta-analysis conducted by Haarman et al.[4] concluded that the strongest association was found between high myopia and posterior subcapsular cataracts, while no association was found between myopia and cortical cataracts. The risk of posterior subcapsular cataracts can be almost three times higher in a myopic eye than in an emmetropic eye.[4] While 87.06% of participants were correct to not associate cortical cataracts with high myopia, only 24.12% of participants correctly identified the association of posterior subcapsular cataracts. Previous studies conducted did not, however, specify the type of cataract in the question.[15,17]

The six factors indicated as not being linked with high myopia were incorrectly identified by a minority of participants per condition. These included cortical cataracts (12.94%), choroidal melanoma (19.41%), optic disc drusen (21.18%), diabetic retinopathy (25.88%), central retinal artery occlusion (33.53%) and primary angle closure glaucoma (34.12%). The range of incorrect responses was thus between 13% and 34%. This range of incorrect responses is higher than similar studies which did not exceed 20%.[15,16,17] The section testing ocular pathology was negatively marked, thus meaning that a mark was subtracted for every incorrect pathology selected. From 170 participants, there were 250 incorrect conditions selected. For this section, only one respondent was able to achieve a perfect score, correctly identifying only the seven associated conditions. This finding was lower than the 5% of 309 participants who correctly identified the associated conditions in the study by Douglass et al.[15]

Optometrists' knowledge of the ocular pathologies associated with high myopia is crucial in everyday clinical practice. While some of the ocular pathologies require no immediate intervention, the knowledge of the increased risk could affect the tests performed, education provided to the patient, and the patient's follow-up schedule.[5,44] Patients with low to moderate levels of myopia are also at increased risk for pathological complications, as compared to emmetropes.[4]

Knowledge of myopia diagnosis and strategies to delay onset and slow progression of myopia

According to the WHO,[12] high myopia prevalence can be reduced by 90% if the myopia progression annually is halved. Participants in this study overwhelmingly agreed (84.12%) with the statement that 'Significant mainstream implementation of myopia control strategies can significantly decrease the prevalence of high myopia'. Notably, zero participants disagreed with the statement as the remaining participants selected 'unsure'. Myopia control requires the two-pronged approach of delaying the onset of myopia in pre-myopes and slowing the progression of myopia in those already diagnosed.[11] Pre-myopes at increased risk for early onset must be identified, and preventative strategies prescribed to delay the onset as much as possible.[1] Most participants (68.24%) did indicate that myopia could be predicted prior to the first myopic refraction, and most participants (84.71%) were aware of the advice to spend time outdoors. Research has shown that increased time spent outdoors can delay myopia development and onset.[36,45]

Prior to the implementation of myopia control strategies for controlling myopia progression, the total amount of myopia should be correctly measured without the influence of accommodation.[14] This can be done through cycloplegic

refraction, which helps to also detect pseudomyopia, which, as the name suggests, is a condition masquerading as myopia.[46] Based on prior studies investigating the knowledge, attitude and practice of qualified optometrists, 17% – 64% of participants routinely used cycloplegic agents when assessing children presenting with myopia.[15,16,17,18] In the current study, while 108 participants (63.53%) correctly indicated that cycloplegic refraction should be performed prior to myopia control, only 40 of the 108 participants went further to indicate that it is necessary to differentiate pseudomyopia before beginning myopia control. This indicates that while participants may be aware of what tests need to be performed, they may not fully understand the clinical reasoning behind them.

An increase in axial length during childhood development does result in the worsening of myopia throughout the childhood years.[10] However, fast annual progression of myopia is regarded as a worsening of the prescription by a spherical equivalent of 1.00 D or more.[35] Of the 136 participants (80%) who previously indicated that the rate of annual myopia progression is an important factor in predicting future progression, most of these participants (118 of 136) incorrectly identified 0.50 D of myopia progression as fast progression. This could suggest that participants are aware of the importance of some factors in predicting myopia progression but need more interpretation of the possible values.

Of the eight optical strategies included in the survey, research has shown four strategies to be successful in slowing myopia progression. The success of orthokeratology has been highlighted by meta-analyses[47,48] and other reviews, including the latest Cochrane Systematic Review.[49,50] As a strategy for slowing myopia progression, orthokeratology was deemed successful by the largest number of participants. This aligns with previous studies where orthokeratology was also the top choice for slowing myopia progression.[15,21,22]

More than half of the participants also correctly regarded other optical strategies as successful – in particular, peripheral defocus spectacle lenses, multifocal contact lenses, and peripheral defocus contact lenses. Multifocal contact lenses, while intended for presbyopic patients, have proven to cause slower myopia progression.[51] Newer spectacle designs focused on peripheral defocus[52,53] and dual-focus contact lenses[54,55] have also shown success in slowing axial length elongation. While ranked third in this study, peripheral defocus contact lenses were considered to have the highest perceived efficacy in a study of eyecare professionals across Africa.[20]

While initially thought to be successful, bifocal and multifocal spectacle lenses have not been able to consistently show significant decreases in myopia progression.[50] However, more than half of all participants still considered bifocal and multifocal spectacles to be successful at slowing myopia progression. This is more than what has been reported in previous studies.[15,16,17,20,21,22] This demonstrates that participants could be relying on out-of-date information regarding myopia control strategies.

Another early strategy employed was under-correction of distance prescription, which was thought to decrease accommodative demand.[56] Following conflicting results,[57,58] under-correction is not currently a recommended myopia control strategy.[50] Of the 170 participants, less than a quarter correctly indicated under-correction to be an unsuccessful strategy, while almost half thought the strategy to be successful. This aligns with a study of eyecare professionals in Africa where under-correction was still routinely performed by more than half of those who responded.[20] Conversely, two global studies of eyecare practitioners from Asia, Australasia, Europe and North and South America found that more than 70% of participants did not consider under-correction to be a successful strategy.[21,22] This disparity further highlights the need for eyecare practitioners in Africa to be equipped with the latest research in myopia control.

A pharmaceutical approach that has yielded success is atropine (0.05%), which was proven in the Low-concentration Atropine for Myopia Progression (LAMP) study.[59] This multi-year randomised placebo-controlled clinical trial showed decreased myopia progression with a minimum rebound effect.[50,60,61] Low-dose atropine and moderate-dose atropine were selected as successful by more than half of the participants. While atropine was ranked higher in similar studies in Australia and India,[15,17] the only other study conducted in Africa reported pharmaceutical agents as being the least effective by eyecare professionals.[20] Another pharmaceutical agent, cyclopentolate, was also included in the survey. As there is currently no evidence that the use of cyclopentolate slows myopia progression, less than 5% of participants in other studies considered it successful.[15,17] However, in this study, 40.59% of participants rated cyclopentolate as successful and 44.12% of participants were unsure of its success in slowing myopia progression. This could be because of a participant assuming a strategy is successful as it has been included in the survey.

Second to orthokeratology, almost two-thirds of participants correctly identified the success of increased time spent outdoors on myopia progression. Studies have shown the protective benefits of increased time spent outdoors for children already diagnosed with myopia.[62,63] This lifestyle change was also ranked in the top two most successful strategies by participants in previous studies.[15,17,21]

The lowest performing section for participants in this study was the strategies to delay myopia onset and slow myopia progression. Within this section, the majority of participants scored well in the first and second parts of the section testing overall management and success of strategies on myopia onset. However, the section on myopia progression was poorly answered. A large percentage of participants, in the range of 24.71% – 44.12%, selected 'unsure' for many of the strategies

listed. All 'unsure' responses were graded zero, thus impacting the total score. This uncertainty could indicate a lack of confidence by participants to definitively state whether a strategy is successful or not.

The class of 2020 outperformed the class of 2021 in terms of overall knowledge. The additional 12-month work experience appeared to have a positive effect on knowledge of myopia control. The class of 2020 could also have benefitted from more exposure to continuous professional development activities relating to myopia control after leaving their undergraduate programmes. This benefit was limited for the class of 2021, as this study was conducted within their first 7 months post-graduation. Previous international studies assessing the knowledge of myopia control included qualified optometrists with varying years of experience who based their responses on their accumulative knowledge and clinical experiences. As the participants in this study completed the questionnaire in their first 7–19 months post-graduation, the results of this study are thus uniquely situated to provide insight into the knowledge gained at HEIs in South Africa.

While most participants were convinced of the impact myopia control implementation can have on myopia prevalence, this study identified several gaps in the knowledge base of newly qualified optometrists in South Africa. While some gaps in knowledge showed a lack of interpretation and background, others were because of a reliance on older myopia control research.

Limitations

While the survey did meet the minimum sample size for a 95% confidence interval, the survey was voluntary and could be limited by participants with a particular interest in myopia control choosing to participate. Surveys testing knowledge can sometimes feel tedious and result in fatigue, which could lead to participants simply choosing the middle option to complete it faster. While the participants were limited to the past two graduating classes, continuing professional development or additional courses attended could impact the knowledge tested. The completion of the survey did rely on participants having to recall their undergraduate knowledge. Lack of recall of content covered within the undergraduate training could influence the perception of undergraduate education and training regarding myopia control.

Recommendations

This study served as a baseline measure of myopia control knowledge of newly qualified optometrists in South Africa. With continuous revision of undergraduate syllabi and clinical training in the topic of myopia control at HEIs, future studies could be undertaken to compare to the current study to evaluate if a change in the current findings occurred. Future studies should also explore the management practices in controlling myopia beyond the knowledge and attitude of qualified optometrists in South Africa.

Conclusion

The sections tested in this questionnaire are essential for the implementation of myopia control but also for routine optometric clinical care. The low median percentages found across all sections indicate there are significant gaps in the knowledge of newly qualified optometrists as it relates to myopia control. With the large number of myopic patients of varying levels presenting in clinical practice every day, it is essential that all optometrists are equipped with the correct knowledge to help direct diagnosis and management. Thus, undergraduate educational development, regularly incorporating the latest research and clinical guidelines within their curricula, would be essential to generate new cadres of graduates that are adequately prepared to practice in the field of myopia control.

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Competing interests

The authors declare that they have no financial or personal relationships that may have inappropriately influenced them in writing this article.

Authors' contributions

N.R. and N.N. developed the project's concept and methodology. N.R. conducted the investigation and part of the data analysis and wrote the initial manuscript. N.N. supervised the research process, analysis and the editing of the article. All authors, N.R. and N.N., approved the final version of the article.

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Data availability

The data that support the findings in this publication are available on request from the corresponding author, N.N.

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