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Experiences and Attitudes of Optometry Students Regarding Online Learning During the COVID-19 Pandemic

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Burnout Among Faculty Members in Optometric Education: a Gender-Based Analysis

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Background

Optometric educators across the United States are active clinicians, scholars and administrators, often expected to serve in these roles within the same day. Whether taking responsibility for the development of their students, providing evidence-based care to their patients or fulfilling the mission of their academic institution, they constantly balance these related but competing interests with the roles they inhabit in their personal lives. This ceaseless balancing act can devolve into role conflict leading to burnout, especially for women.[1-5] Existing literature that addresses burnout has almost exclusively focused on larger professions or academic medicine; there is a significant gap in the literature regarding the relationship between gender and burnout among optometric educators.[6-8] This study focuses on that gap to contribute to a greater understanding of how gender and burnout intersect in optometric education by identifying contributing factors to burnout that have gender-based differences. A better understanding of the gender-based risk factors for burnout is the first step in creating academic environments where all faculty members can thrive.

The Association of Schools and Colleges of Optometry (ASCO) reports that there are approximately 800 full-time faculty members distributed across 23 schools and colleges of optometry in the United States, 60% of whom are women.[9] By comparison, the Association of American Medical Colleges (AAMC) reports (2024) that there are more than 240 times the number of medical school faculty members (201,112) at medical schools in the United States than there are optometric educators.[10] Given the relative dearth of optometric educators, the dynamism required of these professionals to successfully serve in these roles, and the increasingly disproportionate representation of women in these roles, it is critical to understand the factors contributing to attrition, dissatisfaction and burnout especially among women optometric faculty members.

Burnout is described as an "occupational phenomenon" (ICD-11) characterized by three dimensions: "feelings of energy depletion or exhaustion, increased mental distance from one's job or feelings of negativism or cynicism related to one's job, and reduced professional efficacy."[11] This article describes burnout in optometric educators and identifies gender-related trends based on a national survey.

Trends in burnout

The COVID-19 pandemic worsened a rising trend of faculty burnout in academic medicine,[12-13] especially among women in academic medicine.[14] Large-scale studies of burnout in optometric educators have not been done. A single study addressed burnout at one college of optometry, focusing on comparative rates of burnout between academic programs.[15] The current study is the first to assess levels of burnout among optometric educators on a national scale.

Studies conducted more broadly in academic medicine and health professions education are applicable given the similar expectations of faculty members across these disciplines. In a representative study of burnout among faculty members at U.S schools of pharmacy, the authors reported that 41.3% of faculty members identified being emotionally exhausted. Emotional exhaustion is a common characteristic of burnout[16] and is defined as "emotional and physical depletion without recovery" that leads to occupational disengagement.[17] Importantly, this symptom of burnout was noted to be disproportionately prevalent among faculty members at lower academic ranks and those having children age 1-12 years.[16] Having children is a particularly common burnout risk factor among medical professionals.[18-20] However, support from both colleagues and administrators has been shown to positively impact retention and job satisfaction.[21]

Impact of gender

The prevalence and severity of burnout is likely impacted by gender.[1-2] This disproportionate relationship between burnout and gender is particularly relevant given the over-representation of women in optometry as educators and students. Studies conducted in academic medicine suggest that women faculty members may suffer from higher levels of burnout than their colleagues.[2-4] A mismatch between actual percent effort among the various roles a faculty member holds and the priorities for individual faculty members has been shown to contribute to burnout in academic medicine, and this lack of alignment may be particularly impactful for women.[7-8] Some studies have estimated that burnout may be 20-50% higher in women than in men.[1,22] This is likely based on historical societal expectations and gendered expectations, the workplace gender climate, maternal bias and lack of parity in salary and promotion.[12,14,18] Gender climate has been described as the "formal and informal institutional

attitudes and programs to promote gender equity in the workplace."[23]

Maternal bias occurs when individuals are discriminated against based on their role as a mother. One study found that one-third of physician mothers experienced maternal bias.[22] Although gender equity has improved substantially in the workplace and society at large, women are often still viewed as shouldering more of the caretaking tasks in their personal lives.[12,14,24] It has been unknown how gender impacts the experience of faculty members as it relates to burnout and work-life balance and to what extent the aforementioned issues impact the work experience of women in optometric education.

Consequences of burnout

Burnout negatively impacts faculty members' engagement with their students, patients, colleagues and administrators, leaving them less able to fulfill their many roles. Academic medicine studies suggest that burnout increases attrition and decreases productivity.[25-26] Additionally, when faculty members are experiencing burnout in their professional lives, they are less able to cope with the challenges in their personal lives and experience higher rates of sleep disorders, depression and pain, and lower levels of coping skills.[26]

Statement of Purpose

Using the data gathered from a national survey of optometric faculty members,[27] we sought to describe quantitatively the degree of burnout among faculty members in the context of optometric education and to identify any differences related to the gender of those faculty members and how they experienced factors related to burnout. The original study from which this subanalysis was derived involved the distribution of the Standpoint™ Faculty Engagement Survey to faculty members at schools and colleges of optometry via ASCO. While the survey broadly addressed many different dimensions of faculty engagement that were described in a prior publication,[27] this article focuses specifically on burnout. By providing a description of the level of burnout, the contributing reasons and gender-based factors, the authors hope to help schools and colleges of optometry better understand and address the needs of their faculty in this area.

Methods

Instrument

A modified version of the AAMC's Standpoint™ Faculty Engagement Survey was used in this study to assess levels of faculty engagement across 17 dimensions. The AAMC Standpoint™ Faculty Engagement Survey was developed by a team of AAMC staff, subject matter experts, clinicians and psychometricians and has been shown to have strong external and internal validity.[28-29] This online survey was designed to measure faculty engagement and job satisfaction among faculty members at U.S. medical colleges, but many aspects that influence engagement in academic medicine are also relevant to optometric education. Competing teaching, research, service and patient care roles are not unique to medicine, thus the AAMC Standpoint™ Faculty Engagement Survey is also an appropriate instrument for optometry, dental, chiropractic and pharmacy schools and colleges. To ensure validity of the instrument, only minor modifications were made such as inserting "optometric" or replacing "medicine" with "optometry"; the content of the instrument was preserved in terms of item number and type (Likert scale). Additional slight modifications were required to ensure alignment with the organizational structure and workplace environments of optometry schools and colleges compared to medical schools, but the content of the questions was retained. Due to the proprietary status of the Standpoint™ Faculty Engagement Survey, only portions of the full instrument were included in this article. Of the 15 primary dimensions having Likert-type response scales ranging from 1 – Strongly Disagree to 5 – Strongly Agree, each demonstrated adequate internal consistency reliability with the lowest subscale reliability value being $\alpha = 0.774$ (compensation) and the highest being $\alpha = 0.950$ (departmental governance).

More specific to burnout, this instrument included questions regarding the number of weekly hours, allocation of effort, faculty wellness, intent to leave and self-reported levels of burnout. Each of these aspects has been shown in previous studies to contribute to the complex equation that leads to burnout.[2,6-7]

Data collection

The target population was paid faculty members at U.S. schools and colleges of optometry. According to ASCO's Annual Faculty Data Report for academic year 2021-2022, 793 full-time faculty members were distributed across the 23 U.S. schools and colleges of optometry, with approximately 1,100 total paid faculty.[9] Following IRB approval from Robert Morris University, we obtained permission from the ASCO Board of Directors to distribute the survey to paid faculty members of member institutions. An introductory email with the accompanying hyperlink for the online survey, built and hosted on the QuestionPro platform, was sent to the executive director of ASCO who then forwarded the email to the deans and presidents of ASCO member institutions. Individual institutional leaders were responsible for forwarding the invitation to participate to their respective faculty members. The invitation included a description of the survey along with an explanation of the purpose of the

survey. The informed consent for the survey accompanied the survey, and after informed consent was obtained, faculty members could begin the survey. The survey was open for approximately 30 days in spring 2022. A reminder email was sent with 1 week left in the active window for the survey. All faculty members at the 23 U.S. schools and colleges of optometry with active email addresses had an opportunity to participate in the study; however, some faculty members may not have received the invitation and survey link due to the indirect method of distribution. As participants completed the survey online by accessing a hyperlink, anonymity was preserved as no identifying information was collected and IP addresses were not stored. Self-reported respondent characteristics are reviewed below.

Analysis

The survey data were exported from QuestionPro into SPSS statistical software (version 28) for analysis.[30] The data set was trimmed to exclude categories where the expected cases were less than five, which would violate the assumptions of the chi square analysis due to specific assumptions of the statistical analyses conducted.[31] Initial descriptive statistics that were calculated included measures of variability and measures of central tendency for summary scores of the topics embedded within the survey. Participation rate and completion rate were also computed, and the results of these calculations have been published elsewhere.[27] Chi square tests of independence were performed to determine whether respondent gender was independent from their responses on several items related to burnout. Gender-based analyses were conducted using binary terms (man and woman) because the number of respondents who identified as another gender was insufficient for conducting statistical comparative analyses. Respondents had the freedom to answer or skip items as they chose. The n value is reported for each survey item. Alpha for significance testing was set at 0.05.

Results

Respondents

The final data set used for analysis included 225 total unique respondents. These respondents represent 28.4% of full-time faculty or 20.5% of all paid faculty. Respondents were faculty members at 18 of the 23 (78.3%) ASCO member institutions, with 67 (30.3%) of 221 respondents coming from the institution providing the largest portion of the sample and two institutions providing just one respondent each (0.5%). The median number of respondents per institution was 10. Of the overall sample of respondents, nearly all reported being full-time faculty members (n = 206 of 222, 92.8%). Additionally, most respondents identified as white (n = 141 of 179, 78.8%), a woman (n = 113 of 180, 62.8%) and had a Doctor of Optometry degree without other terminal degrees (n = 178 of 224, 79.5%). Of respondents choosing to answer an item about sexual orientation (n = 181, 80.4%), most identified as being heterosexual (n = 164, 90.4%).

Other defining characteristics of the respondents included in the following analyses were somewhat more varied. Although most respondents (n = 94 of 179, 52.5%) were born between 1977 and 1995 and could be considered Millennials, this nearly 20-year span in the birth year category may suggest a notable variability across these respondents' experiences as related to age. Just more than half of the respondents (n = 118 of 224, 52.7%) were newer to their institutions, with their tenure ranging from having just started in the current academic year to 10 years. In terms of academic tenure and rank, interestingly, most respondents (n = 128 of 224, 57.2%) reported being Associate or full Professors, but only 34.3% (n = 76) of 222 respondents reported being tenured or on tenure track. Approximately a third of respondents reported that their primary appointment was in primary care (n = 72 of 223, 32.3%) followed by pediatrics/binocular vision (n = 44 of 223, 19.7%). Other primary appointments reported were in ocular disease, cornea/contact lens, basic science and other; each reported by approximately 11% of the respondents. Finally, half (n = 112 of 222, 50.6%) of faculty respondents served in some administrative role in addition to their faculty role.

Faculty wellness

Faculty wellness was one of the lowest-scoring items on the entire survey. More than a third of respondents (36.2%, n = 75 of 207) felt that their optometry school or college did not cultivate faculty wellness. Of those, nearly half (12.6%, n = 26 of 207) strongly disagreed that faculty wellness was emphasized to the correct degree by their home institution. In addition to a relatively low mean compared with other survey items, there was a gender-based statistically significant difference in perceptions of faculty wellness. Women (M = 2.96) were less likely than men (M = 3.37) to respond that the culture at their institution cultivated faculty wellness, $t(173) = 2.090$, $p = 0.038$.

Levels of burnout

Of the 183 who responded to this item, 15.3% (n = 28) reported no burnout, 36.6% (n = 67) were at risk of burnout, and nearly half (48.1%, n = 88) reported that they were experiencing self-defined burnout. More pervasive and intense forms of burnout were reported by 15.9% (n = 29) of respondents. **Table 1** depicts the levels of burnout and corresponding faculty member

responses.

TABLE 1
Levels of Burnout (N = 183)

Item	n	%
I enjoy my work; I have no symptoms of burnout	28	15.3
I am under stress, and don't always have as much energy as I did, but I don't feel burned out	67	36.6
I am definitely burning out and have one or more symptoms of burnout (e.g., emotional exhaustion)	59	32.2
The symptoms of burnout that I'm experiencing won't go away. I think about work frustrations a lot	21	11.5
I feel completely burned out. I am at the point where I may need to seek help	8	4.4

Table 1. *Click to enlarge*

TABLE 2
Relationship Between Gender and Burnout

Chi Square Test of Independence			
Items		Gender	
		Man	Woman
I enjoy my work; I have no symptoms of burnout	Observed	20	8
	Expected	10	18
I am under stress, and don't always have as much energy as I did, but I don't feel burned out	Observed	21	45
	Expected	23	43
I am definitely burning out and have one or more symptoms of burnout (e.g., emotional exhaustion)	Observed	14	42
	Expected	20	36
The symptoms of burnout that I'm experiencing won't go away. I think about work frustrations a lot.	Observed	4	14
	Expected	6	12
χ^2 (3, N = 168) = 20.347, p < .001			

Table 2. *Click to enlarge*

A Chi square test of independence was performed to determine whether respondent gender was independent of reported levels of burnout. Observed and expected counts for each answer choice were calculated. The data set was trimmed to eliminate items and gender categories in which expected cell values were less than five. The results of the Chi square test of independence were statistically significant, indicating that gender and burnout were dependent, χ^2 *(3, N = 168) = 20.347, p < .001*. The pattern of responses demonstrated that women experienced higher levels of burnout than expected and men experienced less burnout than expected. Although more women reported burnout at each level, the gender-based difference between expected and observed counts was the largest for the answer choice "I enjoy my work; I have no symptoms of burnout," where less than half as many women as expected reported no burnout and twice as many men as expected reported no burnout. The most important findings from this analysis indicate that the two categories of burnout in which women were most disadvantaged were in the categories of "no symptoms of burnout" and "definitely burning out." **Table 2** contains the results of the gender-based analysis of burnout using the Chi square test of independence.

Intention to leave

Respondent choices, disaggregated by gender, as to why they might leave their institution are displayed in **Table 3**. The value in the percentage column indicates the percentage of the respondents of that gender who selected the item as a potential reason for leaving the profession. In nearly every case, a higher proportion of woman respondents than man respondents identified choices as a potential reason for leaving. More than a third of woman respondents (n = 41, 37.6%) reported that work-life balance/burnout was a reason they might leave, but only 20.3% (n = 12) of man respondents reported this as a potential reason to leave. Although slightly fewer woman respondents identified compensation/benefits as a reason they might leave (n = 38, 34.9%), this represented a difference of 18% over the proportion of man respondents who selected this item (n = 10, 16.9%). Women were nearly twice as likely as men to identify advancement opportunities as a reason they would consider leaving (13.6% of men, 25.7% of women). To summarize, the three key differences that appeared to disadvantage women vs. men were work-life balance, compensation and advancement opportunities.

TABLE 3
Reasons for Leaving by Gender (N = 168)

Reasons you might leave (choose all that apply)	Man (n=59)		Woman (n=109)	
	n	%	n	%
Work-life balance/Burnout	12	20.3	41	37.6
Compensation/Benefits	10	16.9	38	34.9
Personal/Family reasons	17	28.8	34	31.2
Professional and/or advancement opportunities	8	13.6	28	25.7
Geographic location	10	16.9	19	17.4
Change in institutional leadership	3	5.1	8	7.3
Workplace climate issues (e.g., respect, inclusion, equity)	1	1.7	6	5.5
Issues with department leadership/supervisor	5	8.5	5	4.6

Table 3. *Click to enlarge*

A Chi square test of independence using the variables gender and how likely the faculty members were to leave their institutions found no significance difference in the likelihood of women and men leaving, χ^2 *(4, N = 168) = 6.842, p = .144*. This finding suggests that although women and men have different reasons for potentially leaving their academic institutions, these gender-based differences do not necessarily translate to how likely the faculty member is to leave. The sample size for this question (n = 168) was smaller than for previous questions. The smaller sample size might have been related to the question's position in the survey, or respondents may have been hesitant to answer due to the content of the question.

Workload

The results of additional gender-based analyses indicate that there were no statistically significant gender-based differences in the areas of average work hours per week, *t(168) = 0.871,p = .385*. There was also not a statistically significant impact of

gender on the perceptions of time allocation across the major dimensions of faculty responsibilities including teaching *t(174) = 1.110, p =.268*, research t*(174) = 0.267, p = .790*, patient care *t(174) = 0.218, p = .828*, and administration *t(174) = 0.472, p = .638*. The additional findings seemingly indicate that women and men are doing similar types and amounts of work, at least as measured on a general level by the survey items included in this analysis.

Discussion

Given the gender-related differences in perceptions of faculty wellness, prevalence and severity of burnout, and reasons for leaving the school or college of optometry, it becomes clear that men and women experience the expectations of an optometric educator differently. These findings are consistent with gender-based differences in medicine.[5,22-24,32] Women felt more strongly that their institutions did not appropriately prioritize "faculty wellness." Women were more likely to feel that their wellness was not being prioritized, which may make them more susceptible to burnout. Given differing gender-based role expectations in their personal lives, wellness needs of optometric educators are also likely to vary based on gender. The results presented herein suggest that the specific needs of women optometric educators are neither being fully met nor recognized. Individual faculty wellness is a bulwark against burnout; therefore, it behooves optometric school and college administrators to understand and implement practices that facilitate and support faculty needs.[33]

The results of this study provide evidence that women in optometric education may be more likely to experience burnout and their experience of that burnout may be more severe than it is for men. This trend is consistent with other studies of women in academic medicine, a disparity that has become even more dramatic since the onset of the COVID-19 pandemic.[4,6,14] Because there were no gender-related differences in how much work was performed or the nature of the work, it is likely that the reasons for the disproportionate prevalence of burnout have more to do with other contextual factors.

Workplace climate issues (including respect, inclusion, equity and diversity) were responsible for the largest gender-related difference in satisfaction. Perhaps the most salient indicator of women's experience and how it relates to burnout were the top reasons women cited for potentially leaving their institution: work-life balance/burnout, family reasons, compensation/benefits and advancement opportunities. Work-life balance has been identified in academic medicine as a factor that disproportionality contributes to burnout in women.[1,5] "Family reasons" is another factor that contributes more substantially to burnout in women as measured by previous studies on the subject, but our study did not find a significant difference in this area.[2,19,32] Compensation and advancement opportunities are often linked, and women were substantially more likely to leave based on both of these reasons than men. If women feel that they are not being compensated equitably for the same work, it could contribute to disengagement and, ultimately, burnout.[34] Equally important, appropriate compensation promotes a feeling of being valued, which is also a protective factor against burnout.[34] The gender-based difference in promotion opportunities as a contributor to attrition represents an area for improvement for schools and colleges of optometry.

This study found that women optometric faculty are more likely to experience burnout, a finding consistent with the literature.[3,19] This gender-related difference is likely driven by specific evidence from previous work showing that women were five times more likely to stay home to care for a sick child and spent 8.5 more hours per week on domestic activities than their partners.[1,5,32] These gendered and disproportionately deleterious expectations likely lead to increased conflict between personal and professional roles for women. According to a large cross-sectional survey of academic physicians, women were more likely to have experienced a recent conflict between their personal and professional lives.[1] This conflict between roles leads to increased stress that ultimately contributes to higher levels of burnout. The scope of this study was insufficient to address the complex factors contributing to burnout, but the results indicate that many of the larger trends regarding burnout present in academic medicine may also be relevant to optometric faculty members.

Limitations

This study has multiple limitations. This initial gender-based analysis of burnout was derived from a large, cross-sectional study on faculty engagement and burnout and was not intended to fully address the complex phenomenon of burnout among faculty members in optometric education. The validated instrument used in the study addressed burnout as one dimension of faculty engagement. Future work more narrowly and specifically focused on burnout could be beneficial toward informing how optometric education may best intentionally and effectively support its faculty and insulate them from burnout's contributing factors.

Examining intersectionality in the context of burnout was also beyond the scope of this study, but other studies in medicine have demonstrated it is an important area that should be addressed in future studies.[35-36] Specifically, the majority of respondents in this study were white (78.8%), and those with multiple marginalized identities are likely disadvantaged more severely and correspondingly more vulnerable to burnout than others. This complex interaction between gender, race and burnout warrants additional investigation.

A greater degree of gender inclusivity should be incorporated into future studies on the topic, but the respondent characteristics and the methodology of this study did not facilitate examining the impact of gender except as a binary construct. Ultimately, the research reported here represents the initial effort to understand burnout and the differential experience of burnout by gender in optometric education on a national scale. Toward this end we were successful. However, we acknowledge that more must be done to not only deeply understand burnout, but also to develop interventions that promote the vitality of faculty members in optometric education, regardless of gender.

Conclusion

Women are more likely to experience burnout, a finding of specific importance to optometric education given that most optometric faculty members are women. This analysis addressed a gap in the literature as previous studies have failed to address the topic of burnout among optometric educators. Important findings from this study are that women, more than men, feel that their wellness is not prioritized appropriately, and women are also more likely to list compensation, work-life balance and advancement opportunities as potential reasons to leave their academic institution. Collectively, these findings suggest that to reduce burnout and faculty attrition, culture change across optometric education may be needed to more effectively support a reality where women are the majority of optometric educators.

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Management of Corneal Abrasion Following Intravitreal Injection: a Teaching Case Report

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Introduction

A corneal abrasion is a disruption of the corneal epithelial integrity, usually due to external trauma, ocular foreign bodies, chemical burns or contact lenses.[1] Corneal abrasions account for the largest proportion of eye-related complaints in emergency departments, with an incidence of three in 1,000 visits per year in the United States. Additionally, many patients with corneal abrasion report directly to optometrists, ophthalmologists and urgent care clinicians.[2,3] Although many heal within a few days, abrasions can result in significant morbidity, suffering and loss of productivity for some patients.[4,5] Knowledge of the tissue repair response within the human cornea is crucial to understanding a corneal abrasion patient's best, safest and most effective treatment plan.

Case Description

Initial encounter

A 67-year-old male presented for a walk-in optometry clinic visit with acute, constant and intense right eye pain, redness, photophobia and tearing that began 1 day earlier. This patient had been seen several times in the previous 16 months by a retinal specialist in the clinic for a central retinal vein occlusion (CRVO) and chronic cystoid macular edema (CME) of the right eye. The patient was seen the day before the walk-in encounter by the retinal specialist, who administered the patient's seventh intravitreal injection of aflibercept in the right eye. The procedure was documented as successful and without complication. However, upon arriving home, the patient experienced rapid onset of the symptoms described.

Other than the CRVO/CME, the patient's ocular history consisted of emerging moderate nuclear sclerotic cataracts with vacuoles in both eyes, compound myopic astigmatism and presbyopia. His medical history was significant for type 2 diabetes, hypertension and hypercholesterolemia. The patient's medication list consisted of metformin, metoprolol and atorvastatin. Best visual acuity was 20/70 in the right eye, which was decreased from his post-CRVO acuity (usually between 20/40 and 20/50). Visual acuity was a stable 20/30 in the left eye. Results of entrance testing, including confrontation visual fields, pupils and extraocular motilities, were unremarkable except for a 1+ afferent pupillary defect in the right eye, which was stable since the onset of the CRVO.

External examination, eyelids, eyelashes, conjunctiva, cornea and iris were all unremarkable during slit-lamp and anterior segment examination of the left eye. The anterior chamber was deep and quiet. An undilated view through the pupil revealed mild-to-moderate nuclear sclerosis of the crystalline lens with multiple small central vacuoles. Intraocular pressure measured by non-contact tonometry was 19 mmHg.

In the patient's right eye, external examination, eyelids and eyelashes were all unremarkable. The patient showed diffuse mild injection on the bulbar conjunctiva. There was a 3-mm round area of subconjunctival hemorrhage at the aflibercept injection site on the superior bulbar conjunctiva. Slit-lamp examination of the cornea revealed a 0.50 mm x 2.0 mm V-shaped epithelial defect on the central cornea, which stained with sodium fluorescein **(Figure 1)**. No residual corneal epithelium requiring debridement was present around the wound border, and no foreign body was present during eyelid eversion. The anterior chamber was deep and quiet. An undilated view through the pupil revealed moderate nuclear sclerosis of the crystalline lens. The patient was diagnosed with a corneal abrasion of the right eye, presumed to be the result of eyelid speculum trauma. One drop of 0.5% proparacaine was instilled in-office in the right eye for initial comfort and cooperation with placement of a bandage contact lens (BCL) (senofilcon A). The patient was prescribed 0.5% moxifloxacin ophthalmic solution 4 times daily. Additionally, the patient was given a sample of Refresh Optive artificial tears to use as needed for irritation. Immediately after placement of the BCL, the patient noted a significant improvement in pain. The patient was told to return in 2 days for a follow-up examination. Ideally, he would have been seen the next day. However, he had transportation available only on certain days. He was given contact information for the on-call ophthalmology resident and instructed to report if his symptoms worsened in the interim. The retinal specialist was contacted about this encounter, and he was thankful for the communication.

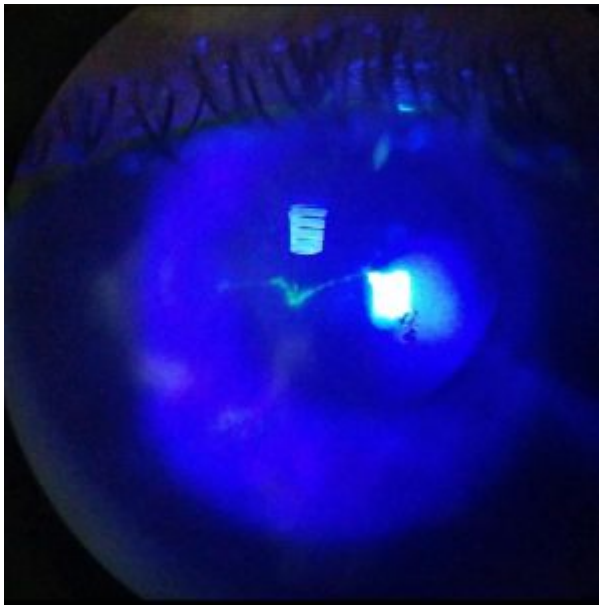

Figure 1. *Right eye at initial encounter: V-shaped epithelial defect on the central cornea. Click to enlarge*

Follow-up

The patient returned for follow-up as scheduled with no ocular complaints. He reported compliance with the topical medication regimen as prescribed. He reported no pain since the application of the BCL 2 days prior. He also reported that his vision was back to normal, and that photophobia and tearing were resolved. Best-corrected visual acuities returned to baseline at 20/50 in the right eye and 20/30 in the left eye. External examination, eyelids, eyelashes, anterior chamber and anterior segment findings were stable in the *left* eye.

External examination, eyelids, eyelashes and anterior chamber were stable in the *right* eye. At the aflibercept injection site, a 1-mm area of resolving subconjunctival hemorrhage remained. The BCL was still present. It was gently "floated" using artificial tears prior to removal to lessen the chance of new corneal epithelial damage. Following lens removal, corneal evaluation showed an intact epithelium with no sodium fluorescein staining. Intraocular pressure was measured as 19 mmHg in the right eye and the left eye using Tonopen. Because the corneal abrasion had healed, the patient was told to discontinue the 0.5% moxifloxacin. He was, however, told to frequently instill Refresh Optive artificial tears in the right eye at least 4 times daily for the next week. He was cautioned about the possibility and symptoms of recurrent corneal erosion. The patient was counseled on following up with his retinal specialist for ongoing intravitreal injections as scheduled.

3 months later

The patient presented to the optometry walk-in clinic in a similar fashion as before, 1 day after receiving an intravitreal injection of aflibercept in the right eye. He reported eye pain, tearing and photophobia beginning 2-3 hours following the injection. His visual acuity had worsened to 20/150. All other clinical findings were stable/unchanged compared to his initial urgent examination, and Tonopen-measured intraocular pressures were 18 mmHg in each eye. Following the examination, the patient was diagnosed with a 2.5 mm x 3.0 mm oval central corneal abrasion in the right eye following aflibercept injection **(Figure 2)**. The mechanism was presumed to be due to the eyelid speculum. The patient was treated in-office with 1 drop of 0.5% proparacaine for comfort and cooperation with placement of a BCL (senofilcon A). He was prescribed 0.5% moxifloxacin ophthalmic solution to use 4 times daily and advised to use Refresh Optive artificial tears as-needed.

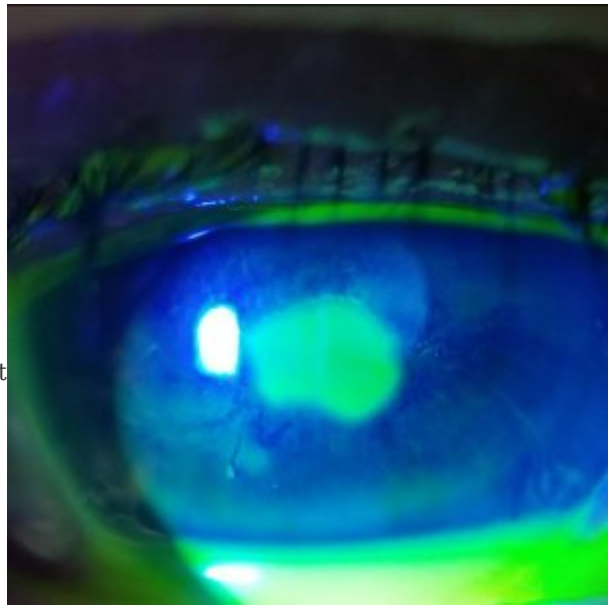

Figure 2. *Right eye 3 months after initial encounter and initial successful treatment: oval central corneal abrasion Click to enlarge*

The patient responded favorably again and returned for follow-up 2 days later. He was symptom-free and vision returned to his baseline. All other ophthalmic findings and metrics were stable/unremarkable. The BCL was floated/removed, 0.5% moxifloxacin was discontinued, and the patient was told to use artificial tears 4 times daily for the next week. During a discussion with the treating retinal specialist, who was not comfortable assessing corneal findings, it was recommended that the patient be pressure-patched until the following morning for future injections. Following this intervention, the patient has not suffered from a new corneal abrasion after intravitreal injection or a spontaneous recurrent corneal erosion.

Education Guidelines

Key concepts

1. The basic anatomy and kinetics of the corneal epithelium
2. The cellular response to corneal epithelial trauma
3. Making the diagnosis of corneal abrasion
4. Appropriate treatment plans based on the clinical scenario

Learning objectives

1. Recognize the clinical presentation of corneal abrasion including history, symptoms and signs
2. List the potential differential diagnoses of corneal abrasion
3. Initiate an effective and safe management plan for a patient with a corneal abrasion
4. Explore different management strategies in complicated scenarios involving corneal abrasion or those involving patients with high risks

Discussion questions

1. Knowledge and concepts about the clinical case and condition

a. What is the pathophysiology of corneal abrasion?
b. What are the primary concerns of patients presenting with corneal abrasion?
c. What complications can occur secondary to corneal abrasion?

2. Differential diagnosis and risk factors

a. What other eye conditions can result in symptoms like those experienced with corneal abrasion?
b. What other eye conditions can result in clinical signs like those seen with corneal abrasion?
c. If a corneal abrasion is suspected, what are pertinent case history elements to explore to maximize safety in the treatment approach?

3. Management and the role of optometry in the care of patients with corneal abrasion

a. What is the prognosis of a small- to medium-sized corneal abrasion without complications?
b. How would you minimize the risk of permanent corneal damage in a patient with a corneal abrasion who received a bottle of topical tetracaine from the emergency department prior to seeing you?
c. Name two ophthalmic fourth-generation fluoroquinolones and two ophthalmic second-generation fluoroquinolones
d. How soon should a newly diagnosed 5-mm central corneal abrasion in a 15-year-old patient be seen for follow-up: 1 day, 5 days, 1 week or as-needed only?

4. Critical-thinking scenarios

a. How might the addition of a topical corticosteroid or cycloplegic interfere with corneal epithelial wound healing in a patient with corneal abrasion and concurrent traumatic anterior uveitis?
b. A patient with poor hand hygiene who chronically overwears and sleeps in contact lenses presents with a new corneal abrasion. Why is there a safety concern for the use of a BCL?
c. A new patient presents to your office with a large, central, non-traumatic epithelial defect of the right cornea. This is 3 days after being treated by a local emergency department with ciprofloxacin and tetracaine eye drops, each 5 times daily. Since the emergency department visit, the patient's pain has not improved, and vision is slightly worse. What differentials/complications should be considered in this patient?

Assessment of learning objectives

This teaching case is suitable for fourth-year optometry students and new practitioners in numerous settings. For learners who prefer independent study, this learning assignment can be completed in its entirety by the student alone, but should be reviewed with a practicing optometrist or ophthalmologist. However, a small-group setting, which can be in-person or virtual, is preferred. In this environment, students could be assigned the task of reading the case elements and the discussion prior to their meeting. Students should also be expected to complete and record the discussion questions prior to their group gathering. Ideally the group leader would be a faculty member, optometry resident or senior optometrist within their organization. Upon meeting, the abstract can be read to reset the tone for the discussion, and each of the discussion questions can be reviewed. All learners present should share their responses. A unique aspect of corneal abrasion is that it can be managed in multiple safe and effective ways. The variety of responses from the learners can help solidify this idea, which can aid the clinician in corneal abrasion cases that are not so straightforward.

Discussion

A corneal abrasion is a disruption of the corneal epithelial integrity, usually due to external trauma, ocular foreign bodies, chemical burns or contact lenses.[1] The condition should be suspected in patients who present due to acute ocular pain, conjunctival injection, foreign body sensation or lacrimation following ocular trauma. Other symptoms may include blepharospasm, blurred vision and headache. Symptoms are often dependent on the size and location of the corneal epithelial defect.[6] Traditionally, a diagnosis of corneal abrasion is based on a history of recent ocular trauma and the presence of a corneal epithelial defect observed with a slit-lamp biomicroscope with and without sodium fluorescein.[7] However, differential diagnoses include recurrent corneal erosion, herpes simplex keratitis, herpes zoster keratitis, corneal foreign body and traumatic uveitis.

Homeostatic balance of the human corneal epithelium depends on a critical cycle of cellular loss, renewal/proliferation, differentiation and migration. The basal cell layer of the corneal epithelium is a single layer of columnar cells that lies anterior to the basement membrane, connected via hemidesmosomes.[8-12] Basal cells are the only corneal epithelial cells capable of division. These basal cells are renewed via stem cells near the limbus. Then, they gradually proliferate more centrally. Others differentiate and migrate anteriorly into the middle layers of corneal epithelium. These new wing cells have a concave posterior and a convex anterior surface. Desmosomes and gap junctions connect wing-cell-to-wing-cell and wing-cell-to-surf-ce-cell.[13]

Surface cells are the most anterior layer of the corneal epithelium. The cellular height, usually 2 layers thick, is significantly shorter and more stratified than both basal and wing cells.[14] Surface cells are nonkeratinized and squamous. Over time, surface cells mature, are gradually sloughed off, and are replaced by the underlying wing cells.[15] In a normal cornea, the turnover from basal cell renewal through loss of surface cells takes about 7 days.[16,17] This can take significantly longer in patients with corneoscleral/limbal disease or those with concurrent use of corticosteroids.[18,19] Additionally, the corneal epithelium of patients with a history of diabetes mellitus has been shown to be thinner, of lower cell density, more fragile and have a reduced barrier function than the corneal epithelium of patients who do not have diabetes.[18-26]

During corneal epithelial homeostasis, the limbal epithelial stem cells divide occasionally in order to replace surface cells that slough off.[27,28] However, in response to trauma, such as a corneal abrasion, the proliferation rate temporarily increases 8- to--fold in the limbus and approximately 2-fold in the periphery and central cornea.[27,29,30] The wound healing process has been described in two distinct phases. Phase one involves cellular and subcellular reorganization, triggering epithelial cell migration at the edge of the wound.[31,32] Phase two involves the cellular proliferation, differentiation and ultimately stratification to restore the damaged epithelial layer(s).[32,33] These cellular pathways are mediated by various growth factors, cytokines,[34,35] purinergic receptors,[36] toll-like receptor 4,[37] rho-associated protein kinase,[38,39] proteinases such as matrix metalloproteinases,[40-43] neuropeptides[44,45] and extracellular matrix.[35,46] In the event of corneal trauma, such as a corneal abrasion from a fingernail scratch, tissue repair may occur fairly quickly, in hours to days.[16,17] However, if the traumatic event damages the basement membrane, renewal of this layer and hemidesmosomes can take several weeks or months.[47,48]

Following a corneal abrasion, a primary consideration for both the optometrist and the patient is pain management because significant ocular discomfort is expected. This is due to corneal epithelial damage near terminal branches of the sensory nerve fibers derived from the ophthalmic branch of the trigeminal nerve.[49] Several treatment strategies exist to decrease pain in these patients. They include cycloplegics, topical non-steroidal anti-inflammatory drugs (NSAIDs), pressure-patching, topical anesthetics and BCLs.

Patients who have ciliary flush, anterior chamber cell and/or flare and photophobia suggestive of ciliary spasm could potentially benefit from topical cycloplegics such as cyclopentolate. However, cycloplegics have not been shown to be superior to placebo for managing pain in patients with corneal abrasion.[50,51] There does not appear to be a delayed wound healing effect in corneal abrasion patients using cycloplegics. Many eyecare professionals reserve cycloplegics for larger corneal abrasions or when ciliary spasm or intraocular inflammation are present.[51,52] The patient in this case report did not have an appreciable anterior chamber reaction, and his ocular pain subsided immediately upon BCL placement. For these reasons, a cycloplegic was not prescribed.

Multiple topical NSAIDs have been studied clinically for management of corneal abrasion pain. Subjectively, ketorolac was not shown to be superior to placebo in one 2001 study.[53] However, the treatment group required less supplementary oral analgesia to control their pain. Studies of the efficacy of diclofenac for treating pain due to corneal abrasion have produced mixed results. One study did not find a statistically significant difference in pain management with diclofenac vs. placebo on day 1 of treatment, but did find that patients in the diclofenac group were less likely to rank their pain as moderate or severe on days 2 and 3.[54] Another study found that topical diclofenac resulted in a 3-fold better improvement in pain compared to the control medication when assessed 2 hours after instillation.[55] The diclofenac group also required less supplemental oral analgesia compared to the control group.

Other topical NSAIDs such as flurbiprofen and indomethacin have also been studied as potential pain-management strategies for patients with corneal abrasion. While the medications showed some promise, larger multicenter studies are needed for corroboration.[56-58] One group performed a systematic review and meta-analysis of earlier works that examined pain management, corneal healing and complications for different treatment modalities for corneal abrasion. They found only two events considered to be major complications among 1,046 patients who received a topical NSAID.[59] While there is an association between topical NSAIDs and corneal toxicity, impaired corneal sensation, persistent epithelial defects, infiltrative keratitis and corneal melts, it appears that these high-criticality events occur in low frequency.[60-65] One study found no statistically significant difference in corneal wound healing by day 5 when comparing combined topical indomethacin/gentamicin to topical gentamicin alone.[56]

Topical anesthetic use for pain management is a controversial topic in optometry, ophthalmology and emergency medicine. Anecdotal reports of a new patient presenting with a corneal abrasion who brings along a bottle of tetracaine either stolen or received from an emergency department physician have been circulating for decades. A thorough literature review makes these reports sound plausible. Use of these medications outside of the clinical setting are largely discouraged in optometry and ophthalmology due to the risk of potentially sight-threatening topical anesthetic abuse keratopathy.[66,67] Interestingly, emergency medicine has continued to investigate the use of topical proparacaine, amethocaine and tetracaine for corneal abrasion and other corneal trauma with very small patient sample sizes and variable results.[68-70] As a result, for eyecare professionals, aside from the outpatient clinical setting, it is considered common practice to discontinue or confiscate these medications if a patient presents with one. The Wills Eye Manual, specifically marketed to both eyecare providers and emergency physicians, does not list topical anesthetics for corneal abrasion as a treatment option.[1] Meta-analyses of patients receiving topical anesthetics for corneal abrasions showed a relatively low and fairly even number of complications when compared to the control groups.[59]

Pressure-patching is a non-medication pain management strategy for patients with corneal abrasion. The rationale rests on the inability of the eyelid to wipe across the wounded epithelial surface cells and exposed corneal nerve endings during blinks.

Historically, pressure-patching was routinely embraced as part of the treatment process for corneal abrasion despite a lack of evidence for the practice.[71,72] Most eyecare providers no longer perform patching due to the loss of binocularity, persistent foreign body sensation, inability to instill topical medications, microbial growth potential, the potential for reduced corneal oxygenation or impaired wound healing.[73-76] Additionally, there is no strong evidence linking pressure-patching to appreciable improvements in pain or healing rates in patients with corneal abrasion.[53,77] However, although better treatment modalities exist, pressure-patching is not contraindicated in all scenarios. The patient in this teaching case report received 5% povidone-iodine application prior to each aflibercept injection and a drop of 0.5% topical moxifloxacin immediately following each procedure. Therefore, the risk of endophthalmitis or infectious keratitis was not a significant concern with pressure-patching for 24 hours. In this scenario, patching was an effective plan for the patient and physician.

A second consideration for corneal abrasion management is the promotion of corneal healing. BCLs are frequently used in corneal surgery for this purpose.[78] Favorable observations have been appreciated with conditions such as neurotrophic keratitis,[79] ocular chemical injuries[80] and ocular graft-vs.-host disease,[81] as well as following refractive surgery[82,83] and penetrating keratoplasty.[84] They have been shown to improve Ocular Surface Disease Index scores, tear break-up time and comfort in dry eye syndrome patients immediately following cataract surgery.[85,86] However, there is not enough evidence in the literature on the topic of BCLs specifically for treatment of corneal abrasion to either support or refute the benefits on healing or pain control. With that said, BCLs are still commonly used for these purposes. Currently, several high dK/t soft contact lens materials, including Air Optix® Night & Day Aqua (lotrafilcon A), Purevision® (balafilcon A) and Acuvue® Oasys (senofilcon A), have FDA approval for therapeutic use for a variety of corneal indications including pain relief, enhanced corneal healing, corneal protection, corneal sealing and drug delivery.[87] Complications associated with BCLs are rare, but do exist with high-criticality scenarios such as infectious keratitis.[88,89] Because of this, a thorough risk assessment of a patient's potential for developing infectious keratitis must precede the use of BCLs.

The third consideration for corneal abrasion management is antibacterial prophylaxis. In the literature, there is an absence of compelling evidence to support routinely prescribing topical antibiotics for the prevention of bacterial keratitis. However, one study from Nepal found that only 4% of patients receiving topical chloramphenicol for traumatic corneal abrasion (n = 442) developed a corneal ulcer.[90] Interestingly, the most significant determinant of bacterial keratitis development in these patients was found to be the time between the corneal trauma and the patient presenting for treatment. In this study, 109 patients presented for treatment 18-24 hours after the injury, and four (3.7%) developed ulceration. Of the 49 patients presenting 24-48 hours after trauma, 14 (29%) subsequently developed a corneal ulcer. In this study, due to ethics, there was not a control group that did not receive topical antibiotics. However, many eyecare providers and emergency physicians prescribe topical antibiotics to promote a sterile corneal epithelium during the healing stages of a corneal abrasion.[7,91]

The class of topical antibiotic selected, its preparation, dosing schedule and treatment period often vary depending on the prescriber's preferences, which are determined by the abrasion size, location and other potential ocular surface biofilm risk factors. *Pseudomonas aeruginosa*, for example, has been shown to exhibit resistance to contact lens disinfectants.[92,93] Additionally, this species has been shown to colonize contact lens materials during wear and survive in contact lens storage cases.[94,95] Because of this, optometrists and other prescribers must proceed with caution when considering BCLs and selecting topical antibiotics for corneal abrasions in contact lens wearers who are non-compliant with their recommended daily lens care regimen. The Wills Eye Manual recommends a topical fluoroquinolone for corneal abrasion in contact lens wearers, as well as those that occur in other high-risk scenarios, such as fingernail or vegetative matter trauma.[1] Of topical fluoroquinolones, highly virulent bacteria such as *Pseudomonas* and resistant forms of *Staphylococcus aureus* show the highest susceptibility to the fourth-generation preparations.[96] One study found that 96.2% of gram positive cocci isolated from bacterial keratitis was susceptible to topical gatifloxacin, a fourth-generation fluoroquinolone, whereas only 60.4% were susceptible to topical ciprofloxacin, a second-generation fluoroquinolone.[97] When it comes to methicillin-resistant *S aureus*, the literature has shown resistance that ranges from 68% – 85% for topical moxifloxacin and 71% – 85% for topical gatifloxacin, which is concerning given that these are both fourth-generation medications.[98-100]

The decisions of which formulation and class of topical antibiotic to prescribe for a corneal abrasion often depend on the patient's ability to instill eye drops frequently, the age of the patient and the need for high-risk or broad-spectrum coverage. Aside from topical fluoroquinolones, there are additional classes of topical ophthalmic antibiotics to consider, including aminoglycosides, polymyxin B combinations and others. For a corneal abrasion that warrants an ophthalmic antibiotic ointment, Neosporin® (neomycin/polymyxin B/bacitracin) is one option that has broad-spectrum antibiotic activity. Tobramycin 0.3% is one of multiple topical ophthalmic antibiotics that is available as both a solution and a suspension. Erythromycin is a topical ophthalmic antibiotic that is only available as an ointment. Dosing for ophthalmic antibiotic ointments for corneal abrasion is often a decision based on the prescriber's preference. One reason to prescribe an antibiotic ointment for a corneal abrasion is the longer contact time between the medication and the ocular surface compared to a solution or suspension. Optometrists should prescribe these medications with moderate consideration, balancing the efficacy of an ointment's instillation frequency with the predictable side effect of blurred vision due to the viscosity of the ointment. Additionally, if a

BCL is to be placed in conjunction with a topical ophthalmic antibiotic, formulations such as ophthalmic ointments or suspensions may destabilize the contact lens or cause prolonged blurred vision during treatment.

The decision of how to intervene with antibacterial prophylaxis, pain management and healing promotion often depends on the specifics of the case history and the clinical presentation. For instance, cases of suspected corneal abrasion that initially present much later after onset may have only minimal clinical signs that may only warrant a much more conservative approach, such as artificial tears. Other patients, for instance, with unclear history and/or dramatic slit-lamp findings, may warrant consideration of other treatment modalities, such as oral antiviral prophylaxis. Some family physicians recommend an initial follow-up of no more than 24 hours for most corneal abrasions.[7] However, there is no consensus in the optometry and ophthalmology communities on timing of follow-up. This decision is dependent on multiple factors. Many eyecare professionals follow up with patients based on the key factors driving the encounter, such as the patient's pain level, size and location of the corneal epithelial defect, and systemic and ocular comorbidities.

The patient in this case report suffered from a corneal abrasion twice following intravitreal injections administered by the same retinal specialist. The retinal specialist had no other patients calling to report pain symptoms or presenting to the same-day optometry clinic with an abrasion. There were several key questions to consider related to etiology. Was the etiology centered around patient-specific risk factors? Was this a technical problem at the hands of the retinal specialist, or the result of poor cooperation by the patient during the procedure? Was the trauma caused directly by an external source, such as an eyelid speculum or fingertip, or was it the result of hyperexposure of the ocular surface while the eyelid speculum was in place? These questions are challenging to answer after the fact, but it was crucial to at least consider each given this patient's concurrent history of CRVO with CME and the long-term visual prognosis in the right eye in question. One meta-analysis showed that corneal abrasions have been reported as a major complication following intravitreal injections. However, the frequency was low, 46 cases after 44,734 injections over a 4-year period.[101] Another retrospective study found slightly better results, but found that 0.60% of intravitreal injections resulted in an urgent follow-up visit, with corneal abrasions representing approximately 10% of those encounters.[102]

Conclusion

Intravitreal injections are one of the most common procedures performed by ophthalmologists in the United States. It is estimated that 5.9 million were performed in 2016, and the number is expected to rise yearly.[103] As this continues, optometrists should be clinically prepared for the potential complications, such as corneal abrasion. With that said, it is more likely that optometrists would encounter patients with corneal abrasions due to other causes, such as fingernails, pet scratches, foreign bodies and chemical burns. Corneal abrasion is associated with multiple complications, such as recurrent corneal erosion,[104,105] microbial keratitis[106] and corneal scarring, which can result in varying degrees of vision loss. Pressure-patching is largely considered obsolete compared to more contemporary treatment approaches. However, it was successful as an ongoing post-intravitreal injection treatment for the patient in this case report. With the highest criticality complication of a corneal abrasion being infection with patching, this risk was mitigated using betadine prep prior to intravitreal injection and topical moxifloxacin following the procedure.

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Racial and Ethnic Diversity Trends in Optometry and Ophthalmology Residency Training Programs: a 2-year Review

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Background

The population of the United States of America is becoming increasingly diverse. According to 2020 Census data, approximately 40% of the population reports race or ethnicity other than White alone.[1] Recent studies indicate that racial and ethnic diversity in healthcare occupations does not mirror this trend.[2,3] An increasing amount of evidence suggests that racial, ethnic and cultural concordance between patients and their physicians fosters positive patient experiences by building better trust and communication and healthy doctor-patient relationships.[4,5] Additional benefits of increasing racial and ethnic diversity among healthcare professionals include improved healthcare quality and better access to care among underserved populations, which can further lower the overall cost of healthcare delivery.[6-8] Therefore, it is imperative that increased measures are taken to diversify the healthcare workforce. In healthcare academic settings, robust URM representation among faculty and staff could attract a more diverse pool of student applicants. An increase in diversity of students enrolled in healthcare training programs may lead to greater cultural competency, which would then allow trainees to better serve the healthcare needs of an ever-growing diverse population.[9]

To increase racial and ethnic diversity in the healthcare workforce, individuals from URM backgrounds must enroll in healthcare training programs. Recent efforts to report diversity in healthcare training programs indicate that there continues to be lower proportions of URM groups than would be expected based on population demographics, including enrollment in optometry school and ophthalmology residency programs.[2,10,11] For example, Census data indicate that in 2020, approximately 12.4% of the general population identified as Black or African American.[12] That year, only 1.7% of practicing optometrists and 3.3% of optometry students in the United States identified as Black or African American.[13] In addition, ophthalmology training programs have lower numbers of URM residents than many other medical subspecialties.[11] Understanding and acknowledging the diversity trends in optometry and ophthalmology training programs is essential in creating strategies to improve access to high quality eye care for all members of the U.S. population.

Until recently, race and ethnicity data were not collected for individuals enrolling in optometric residency programs. Because residency training is commonly required for individuals pursuing careers in optometric education, a better understanding of the representation of URM populations entering optometric residency training is essential in planning future strategies to increase diversity of eyecare professionals. The primary goal of this study was to determine whether there are differences intraprofessionally (within optometry or ophthalmology only) or interprofessionally (comparing optometry and ophthalmology) in racial/ethnic representation among residents in optometry (OD) and ophthalmology (MD/DO) programs. A secondary goal of this study was to determine whether data collection for optometric residency programs is accurately capturing the intended information.

Methods

This study was conducted under exempt status granted by Salus University and did not constitute human subject research.

Data collection

The self-reported data for racial/ethnic identities of optometry residents for the 2019-2020 and 2020-2021 academic years were obtained from the Optometry Residency Match (ORMatch).[14] The self-reported data for racial/ethnic identities of ophthalmology residents (medical and osteopathic) for the 2019-2020 and 2020-2021 academic years were extracted from the publicly available Data Resource Book published yearly by the Accreditation Council for Graduate Medical Education (ACGME).[15] Racial/ethnicity data on the U.S. population were obtained from the 2020 U.S. Census.[20] The Census collected race and ethnicity data using a two-part required questionnaire. One questionnaire part specifically asked for an individual's race, and a second part asked for Hispanic or Latino origin. The racial/ethnic category designations differed slightly between each of the data sources.

Statistical analysis

A descriptive analysis of the data was performed. Racial and ethnic categories were compared between the optometry and ophthalmology data for each year, 2019-2020 and 2020-2021. Differences for each category, where similarities between datasets existed, were calculated intraprofessionally and interprofessionally. In the intraprofessional difference comparison, a number deviating from zero demonstrated a difference in the percentage of URM residents between 2019-2020 and 2020-2021 within optometry and ophthalmology. In the interprofessional comparison, a number deviating from zero demonstrated a difference in the percentage of optometry and ophthalmology residents in that year. The interprofessional differences were calculated by subtracting the ophthalmology percentage from the optometry percentage.

Racial and ethnic category totals for the optometry and ophthalmology data were also compared to the 2020 U.S. Census data.

Results

The racial/ethnic categories used by both ORMatch and ACGME were American Indian or Alaska Native, Asian, Black or African American, Hispanic, Latino or of Spanish Origin, Native Hawaiian or Other Pacific Islander, White, Other, and Unknown **(Table 1, Figure 1)**. In the 2019-2020 academic year, the number (percentage) of optometry residents in those categories were as follows: 0 (0%), 109 (28.4%), 10 (2.6%), 25 (6.5%), 1 (0.3%), 206 (53.6%), 0 (0%) and 33 (8.6%). In the 2019-2020 academic year, the number (percentage) of ophthalmology residents in those categories were as follows: 2 (0.1%), 371 (24.5%), 32 (2.1%), 61 (4%), 1 (0.1%), 760 (50.3%), 93 (6.2%) and 192 (12.7%).

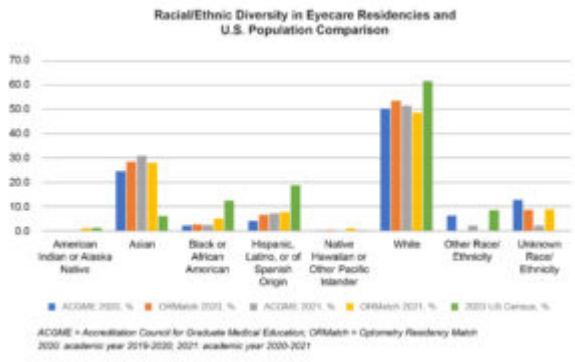

Figure 1. *Click to enlarge*

In the 2020-2021 academic year, the number (percentage) of optometry residents in those categories were as follows: 4 (1%), 111 (28%), 20 (5%), 30 (7.6%), 4 (1%), 193 (48.6%), 0 (0%) and 35 (8.8%). In the 2020-2021 academic year, the number (percentage) of ophthalmology residents in those categories were as follows: 1 (0.1%), 473 (30.9%), 35 (2.3%), 108 (7.1%), 1 (0.1%), 789 (51.5%), 32 (2.1%) and 32 (2.1%).

In the 2020-2021 academic year, the ACGME data included an additional category unique to only that dataset: Multiple Race/Ethnicity. The number (percentage) of ophthalmology residents in this category was 60 (3.9%).

Intraprofessional differences were calculated for both the optometry and ophthalmology data from 2019-2020 to 2020-2021. Findings are listed in **Table 2** in columns labeled OD-OD Diff 20-21 and OMD-OMD Diff 20-21.

Interprofessional differences were calculated between the optometry and ophthalmology data where each racial/ethnic category was the same for both years of data. The summary of these findings is listed in Table 2 in the columns labeled OD-OMD Diff 2020 and OD-OMD Diff 2021.

The 2020 Census collected race and ethnicity data using a two-part questionnaire, which allowed an individual to choose a race and also identify as of Hispanic or Latino origin. There was a total of six single-race categories: White, Black or African American, American Indian or Alaska Native, Asian, Native Hawaiian or Other Pacific Islander, and Some Other Race.[21] If an individual chose two or more races, they were categorized in the "Multiracial" population. For ethnicity, there were two categories: Hispanic or Latino and Not Hispanic or Latino. The largest race/ethnicity group was White alone (61.6%), followed by Hispanic or Latino (18.7%), Black or African American alone (12.4%), two or more races (10.2%), Some Other Race alone (8.4%), Asian alone (6%), American Indian/Alaska Native alone (1.1%) and Native Hawaiian/Pacific Islander alone (0.2%) (Figure 1).

TABLE 1

Category	ACGME 2020, % (N)	ORMatch 2020, % (N)	ACGME 2021, % (N)	ORMatch 2021, % (N)
American Indian or Alaska Native	0.1 (2)	0 (0)	0.1 (1)	1.0 (4)
Asian	24.5 (371)	28.4 (109)	30.9 (473)	28.0 (111)
Black or African American	2.1 (32)	2.6 (10)	2.3 (35)	5.0 (20)
Hispanic, Latino, or of Spanish Origin	4.0 (61)	6.5 (25)	7.1 (108)	7.6 (30)
Native Hawaiian or Other Pacific Islander	0.1 (1)	0.3 (1)	0.1 (1)	1.0 (4)
White	50.3 (760)	53.6 (206)	51.5 (789)	48.6 (193)
Multiple Race/Ethnicity	-	-	3.9 (60)	-
Other Race/Ethnicity	6.2 (93)	0 (0)	2.1 (32)	0 (0)
Unknown Race/Ethnicity	12.7 (192)	8.6 (33)	2.1 (32)	8.8 (35)
Grand Total	1512	384	1531	397

ACGME = Accreditation Council for Graduate Medical Education; ORMatch = Optometry Residency Match 2020: academic year 2019-2020; 2021: academic year 2020-2021; n: number; (-): data not available/applicable

Table 1. *Click to enlarge*

TABLE 2

Category	OD-OD Diff 20-21, %	OMD-OMD Diff 20-21, %	OD-OMD Diff 2020, %	OD-OMD Diff 2021, %
American Indian or Alaska Native	1	0	-0.1	0.9
Asian	-0.4	6.4	3.8	-2.9
Black or African American	2.4	0.2	0.5	2.7
Hispanic, Latino, or of Spanish Origin	1.1	3.1	2.5	0.5
Native Hawaiian or Other Pacific Islander	0.7	0	0.2	0.9
White	-5	1.2	3.3	-2.9
Multiple Race/Ethnicity	-	-	-	-
Other Race/Ethnicity	0	-4.1	-6.2	-2.1
Unknown Race/Ethnicity	0.2	-10.6	-4.1	6.7

OD-OD Diff 20-21: difference in ORMatch data from 2019-2020 to 2020-2021 academic year; OMD-OMD Diff 20-21: difference in ACGME data from 2019-2020 to 2020-2021 academic year; OD-OMD Diff 2020: ORMatch percentage – ACGME percentage for 2019-2020 academic year; OD-OMD Diff 2021: ORMatch percentage – ACGME percentage for 2020-2021 academic year; (-): data not available/applicable

ACGME = Accreditation Council for Graduate Medical Education; ORMatch = Optometry Residency Match

Table 2. *Click to enlarge*

Discussion

It has been firmly established that racial and ethnic disparities exist across most, if not all, medical specialties. It is known from prior reports that having a more diverse medical workforce translates to overall better access to health care, increased cultural competency within the workplace, and ultimately better health outcomes for the general population.[6,16,17] Studies indicate there are fewer practicing physicians in communities where high proportions of racial and ethnic minorities reside.[7] The physicians who serve these communities are more likely to be URM physicians, and URM physicians are more likely to care for patients of their racial or ethnic group.[6,7] According to Marrast et al., non-White physicians care for 53.5% of minority and 70.4% of non-English-speaking patients.[6] These trends indicate that increasing the number of practicing URM physicians may increase access to health care for URM patients, potentially decreasing the healthcare disparities in these populations.

Recent research indicates that racial and ethnic diversity may be decreasing in academic clinical medicine.[16] It is thought that perhaps this decline is due to inability of academic institutions to recruit and/or retain URM faculty due to factors such as lower compensation, biases in the hiring processes, and/or lack of advancement of existing URM faculty via promotion. The proportion of ethnic and racial diversity in medicine has also been seen to decrease with increasing academic rank.[18] These trends, as well as low numbers of faculty identifying as URM in ophthalmology[19] and optometry, may be a barrier to recruitment of URM into eyecare professions. Although mentorship and networking programs have been successful at increasing racial and ethnic diversity in U.S. medical residency programs,[3] further efforts to expand these opportunities should be considered in order to make substantive progress in creating a more diverse healthcare workforce in the eyecare professions.

The data presented in this review indicate that racial/ethnic representation among residents within optometry and ophthalmology residency programs varies from year to year in both professions. A limited dataset is available for optometry resident race and ethnicity, as this information has been collected by ORMatch since only 2019-2020 and published by the Association of Schools and Colleges of Optometry since academic year 2021-22. The optometry data from 2019-2020 to 2020-2021 (Table 2 OD-OD Diff 20-21) demonstrated an increase in residents for the American Indian or Alaska Native, Black or African American, and Hispanic, Latino, or of Spanish Origin categories. There was little to no change for the Asian, Native Hawaiian or Other Pacific Islander, Other Race/Ethnicity, and Unknown Race/Ethnicity categories. Lastly, there was a decrease in the White category. ACGME annual race and ethnicity data describing matched ophthalmology residents also indicated disparities in URM representation in ophthalmology residents for 2019-2020 and 2020-2021. Ophthalmology resident data from 2019-2020 to 2020-2021 (Table 2 OMD-OMD Diff 20-21) showed an increase in the Asian, Hispanic, Latino, or of Spanish Origin, and White categories, little to no change in the American Indian or Alaska Native, Black or African American, and Native Hawaiian or Other Pacific Islander categories, and a decrease in the Other Race/Ethnicity and Unknown Race/Ethnicity categories.

The interprofessional difference (OD-OMD Diff columns of Table 2) comparison showed a fairly stable number of residents in the categories of American Indian or Alaska Native and Native Hawaiian or Other Pacific Islander, but both were very small in number and percentage. Larger shifts were seen in nearly every other category. The shift in the Asian category was due to the increase in ophthalmology residents during the 2020-2021 year while the optometry resident population remained nearly unchanged. Variations for the White category were due to a relatively flat population of ophthalmology residents and a decrease in the percentage of White optometry residents in the 2020-2021 year. In 2019-2020, optometry and ophthalmology had similar percentages in the category of Black or African American, but optometry saw an increase in the next year. The opposite was true for the category of Hispanic, Latino, or of Spanish Origin where optometry had a higher percentage of residents in 2019-2020 and both professions had similar percentages in 2020-2021. The remaining differences in the categories of Other Race/Ethnicity and Unknown Race/Ethnicity showed more variability, which can be attributed to an additional category of Multiple Race/Ethnicity in the ophthalmology-only data, causing a skew in these categories.

The proportion of URM groups in optometry and ophthalmology does not reflect the racial composition of the U.S. population. In addition, the categories utilized by different organizations collecting race/ethnicity data are not consistent. The data collection improvements made by the U.S. Census Bureau from 2010 to 2020 demonstrate the importance of including two or more races to accurately capture the racial and ethnic distribution in the United States. This yielded a better analysis of the diversity profile, specifically pertaining to race and Hispanic origin, to reveal that the U.S. population is indeed more multiracial or multiethnic than initially thought. The 2020 race and ethnicity data showed that the two-part questionnaire allowed for a more authentic representation of how the U.S. population self-identifies. The largest gain noted was in the Multiracial population, which increased by 276% from 2010 to 2020.[20-21] The Hispanic or Latino population grew from 16.3 % of the U.S. population in the 2010 Census to 18.7% in the 2020 Census. The Black or African American alone population remained somewhat stationery at 12.6% in 2010 to 12.4% in 2020. However, the Black or African American population in combination with another race such as White or Asian grew by 88.7% from the 2010 Census. Overall, all races in combination with another group, i.e., Multiracial, were captured more accurately and showed an increase over the race-alone categories when compared

with 2010 Census data. Efforts to further improve the next decennial Census include utilizing a single combined question for race and ethnicity, which the Census Bureau believes will enable an even more accurate representation of how the U.S. population self-identifies.

There were a few limitations to this study. The first, which impacted the ability to perform a statistical analysis, was the size of the datasets. Due to the low number of individuals contained in some of the racial/ethnic category groups (< 5), a valid analysis could not be conducted with each individual category. This limited the ability to conduct and interpret the statistical analysis without combining groups. Second, the racial/ethnic categories between the ACGME and ORMatch data were not the same for the 2020-2021 year, which limited some of the direct comparisons that could otherwise be made. Third, the ORMatch data did not include individuals who matched in the post-match process, leading to an incomplete representation of the optometry residency data. Lastly, this study only utilized 2 years of data, which limited the ability to evaluate longitudinal trends and draw conclusions about diversity among each of the professions and comparatively.

Based on these findings, the following recommendations may assist in further determining the race and ethnicity trends among ophthalmology and optometry residents:

- Use consistent categories in both professions for collecting race/ethnicity data
- Allow choosing of multiple racial/ethnic categories for the ORMatch data to accurately and specifically document those who identify as mixed race, rather than using the category of “More than One Race” or “Multiple Race/Ethnicity”
- Include race/ethnicity post-match data in the ORMatch published data

Conclusion

As the U.S. population becomes more diverse, there is value in evaluating the current racial/ethnic trends in healthcare trainees. These trainees will go on to become the workforce providing much needed health care to an aging and more racially diverse population. Thoughtful consideration must be given to establishing measures that attract URM students and residents to consider pursuing subspecialties in which there are diversity gaps. Eyecare professions have significant URM under-representation in both clinical and academic medicine. Continued efforts to evaluate existing URM representation in eye care and measures to improve gaps in the diversity of eyecare professionals are not only required but necessary for the future visual well-being of our increasingly diverse nation. To our knowledge, this study is the first of its kind to compare the racial/ethnic diversity trends among optometry and ophthalmology residents. Future reports that include longitudinal data and consistent use of racial/ethnicity categories will allow for better understanding of URM representation in optometry and ophthalmology and inform diversity initiatives related to eyecare professionals.

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Experiences and Attitudes of Optometry Students Regarding Online Learning During the COVID-19 Pandemic

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Introduction

Coronavirus disease 2019 (COVID-19), which is caused by a severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), was the cause of a lengthy global pandemic.[1] The novel virus was identified in Wuhan, Hubei Province, China, in December 2019. The World Health Organization declared COVID-19 a public health emergency on Jan. 30, 2020, and a pandemic on March 11, 2020.[2] Since the outbreak of COVID-19, variants of the virus have emerged and become dominant in many countries.[3] As of July 9, 2023, more than 691 million cases and 6.8 million deaths caused by COVID-19 have been confirmed worldwide, making it one of the deadliest pandemics in history.[4] Several countries adopted national lockdowns and implemented social distancing and isolation protocols to stop the spread of the virus.[5,6] South Africa started its lockdown on March 26, 2020. The social distancing regulations during the period of lockdown led to suspension and/or restrictions of social, religious and political gatherings and had a profound impact on academic activities at all levels of the education system.[7]

The COVID-19 pandemic resulted in temporary closures and unprecedented adjustments in the way in which academic activities were implemented in schools and higher education institutions around the world.[8,9] This has had a devastating impact across all levels from basic to higher education with 75% of school learners in grades 1 to 12 in South Africa reported to be a full year behind where they should be.[10] Rotational attendance and sporadic closure of education institutions resulted in students losing 54% of learning time.[10] Globally, approximately 220 million students in the higher education sector were affected by disruptions caused by COVID-19 leaving institutions with the challenge of how to implement remote learning to save academic years, recover educational losses and ensure that no students were left behind.[8] Many higher education institutions had to quickly devise alternative methods to continue with academic activities and this included adopting distance and remote learning.[11,12] Online learning, also referred to as e-learning or web-based learning, is a type of distance learning that uses electronic resources. It is different from traditional face-to-face learning as teachers and students use technology platforms such as video and audio messages, discussion forums and webinars as opposed to conventional in-person discourse to interact with each other.[13] As a result, various socio-economic factors — including access to digital devices and technology, stable internet connection, availability of electricity, personal study space, technological knowledge and digital literacy skills — may influence the online learning process.[9,14]

Some studies have reported on undergraduate students' experiences and perspectives of online learning during the COVID-19 pandemic.[13,15-19] Such information from students is necessary to identify areas of strength and best practice for online learning as well as areas where improvements need to be made for more effective online learning.[20] Sharma et al.[15] investigated medical students' (n = 434) satisfaction with online learning and noted that more than half were satisfied with online classes. In contrast, Adnan and Anwar reported that students from a higher education institution in Pakistan (n = 126) believed face-t--face learning was more beneficial than online learning for effective learning experiences. In addition, Adnan and Anwar reported that limited access to the internet, reduced interaction with teachers, delayed response times and reduced classroom socialization were major challenges that impeded online learning. Maqableh and Alia investigated humanities, science and health science students' perceptions and satisfaction with online learning and reported that more than one-third were dissatisfied with online learning experiences because of technological and connectivity challenges as well as time management issues.[17] As there are limited studies that have focused on optometry students, this study evaluated the experiences and attitudes of optometry students regarding online learning during the COVID-19 pandemic.

Methods

Research design and study population

This study used a case study research design and was conducted at the University of KwaZulu-Natal (UKZN). Ethical approval was obtained from the Humanities and Social Science Research Ethics Committee (HSSREC/00002846/2021), and all participants provided electronic informed consent prior to participating. The study participants included all eligible optometry students at UKZN. During the 2021 academic year, all 240 registered optometry students were invited to participate in the

study through links sent via WhatsApp class groups. A reminder was sent after the initial invite to achieve a better response rate. At the time of data collection during the 2021 academic year, optometry students at UKZN were still engaging in 100% online learning.

Data collection

Participants answered an online questionnaire that focused on their experiences, attitudes and concerns regarding online learning **(Appendix A)**. The questionnaire was adapted from a previous study[18] and modified for relevance in the South African context. Puljak et al. reported that the questionnaire was developed by subject experts in psychology, pedagogy, medical education and research methodology and piloted before being used.[18] The online questionnaire was created through Google Forms and was available from Aug. 14 to Oct. 10, 2021. The anonymous online questionnaire, which took an average of 10 to 15 minutes to complete, consisted of three sections. Section 1 contained the study information and consent to participate; section 2 contained questions related to demographic information; section 3 contained questions that explored students' experiences, attitudes and concerns regarding online learning. The items in section 3 focused on general satisfaction with online learning and comparison to traditional face-to-face learning, experience and engagement with online learning, information technologies skills and availability of devices to participate in online learning, efforts invested by UKZN for online learning, structure, implementation and organization of online learning, perceptions related to lack of practical education and continuation of education during the pandemic. Overall, participants responded to 53 questions in the online questionnaire using either a 5-point Likert scale (completely disagree, disagree, neutral, agree and completely agree) or closed-ended responses. Prior to data collection, the questionnaire was piloted on seven students who were also undertaking online learning with a similar demographic profile. Based on the responses of the pilot study, no further amendments were made to the questionnaire.

Data analysis

Data from only fully completed and submitted questionnaires were captured on Microsoft Excel and analyzed using the Statistical Package for Social Sciences version 27. Data were analyzed using descriptive statistics including means, standard deviations, frequency counts and percentages. For the results, the Likert scale responses of "completely disagree" and "disagree" were combined and reported as disagreement, while responses of "completely agree" and "agree" were combined and reported as agreement.

Results

Student characteristics

A total of 159 participants, 123 females and 36 males, completed the survey yielding a response rate of 66.3%. The sample was multiracial of which the majority self-reported as Black (n = 111, 69.8%), followed by Indian (n = 45, 28.3%), Coloured or Caucasian (n = 3, 1.9%). Regarding the level of study, 29 (18.2%) were in first year, 47 (29.6%) were in second year, 53 (33.3%) were in third year and 30 (18.9%) were in fourth year. Just more than half of the sample (n = 83, 52.2%) used university-provided data to undertake online learning, while the other participants used either uncapped Wi-Fi (n = 46, 28.9%), capped Wi-Fi (n = 20, 12.6%) or personal cellular data (n =10, 6.3%). The majority of participants used laptops for online learning (n = 139, 87.4%), while a small proportion used either smartphones (n = 19, 11.9%) or desktop computers (n = 1, 0.6%).

Satisfaction with online learning and comparison to traditional face-to-face learning

Approximately half of the participants (n = 78, 49.1%) were satisfied with online learning, followed by 58 who provided a neutral opinion (neither satisfied nor dissatisfied) and 23 who were dissatisfied. The average satisfaction score and standard deviation for online learning, which was assessed using a scale of 1 to 5 (maximum), was 3.4 ± 0.9. When comparing traditional face-to-face learning with online learning, 51 participants felt that online learning was better, 46 found that it was worse, while 62 provided a neutral response of neither better nor worse. Most of the participants reported they were equally motivated to participate (n = 75, 47.2%) and attend (n = 89, 56.0%) online learning when compared with face-to-face learning. In terms of time, most participants (n = 92, 57.9%) found that online learning required more time compared with face-to-face learning, while other participants reported that it required less time (n = 28, 17.6%) or the time required was the same (n = 39, 24.5%). More than two-thirds of participants reported that for future theory courses they would prefer a combination of online and face-to-face learning (n = 116, 73.0%) followed by a small proportion of those who preferred face-to-face learning only (n = 26, 16.4%) and online learning only (n = 17, 10.7%).

Experience and engagement with online learning

The majority of participants (n = 91, 57.2%) reported they were satisfied with how fast they had adjusted to online learning **(Table 1)**. More than half of the sample indicated that they missed classroom lessons (n = 81, 50.9%) and in-person communication with teachers (n = 92, 57.9%). Even though most participants disagreed with the statement that online learning is a complete waste of time for optometry students (n = 85, 53.5%), many felt that online learning cannot compensate for practical education, such as supervised and self-directed sessions in the laboratory and clinical settings and seminars (n = 99, 62.3%). There was no predominant response concerning student participation in the form of questions and comments in online courses as 60 participants indicated that they agreed, while 62 participants indicated that they disagreed with this statement (Table 1).

Personal resources (skills and equipment) and efforts invested by UKZN for online learning

When asked about information technology skills and equipment to undertake online learning, more than half of the participants indicated they had sufficient skills (n = 111, 69.8%), internet access (n = 92, 57.9%), a computer (n =109, 68.6%) and other equipment (n = 83, 52.2%) to participate in online learning without disruption **(Table 2)**. The majority of participants felt that UKZN had quickly adapted to online learning (n = 87, 54.7%), organized online learning adequately (n = 88, 55.3%) and provided student support in the form of training (n = 83, n = 52.2%) and available technical problem-solving services (n = 77, 48.4%) for online learning. Furthermore, most participants agreed with the statements that UKZN provided timely information regarding the provision of online learning (n = 87, 54.7%) and expressed willingness to aid students with equipment needed for engaging in online learning (n = 86, 54.1%).

TABLE 1
Frequency of Responses for Experiences and Engagement with Online Learning (n = 159)

Item	Completely Disagree n (%)	Disagree n (%)	Neutral n (%)	Agree n (%)	Completely Agree n (%)
I am satisfied with how fast I have adjusted to online learning	19 (11.9)	21 (13.2)	28 (17.6)	69 (43.4)	22 (13.8)
I participate in the course with questions and comments, just like during regular classes	19 (11.9)	43 (27.0)	37 (23.3)	51 (32.1)	9 (5.7)
I miss classroom lessons	17 (10.7)	22 (13.8)	39 (24.5)	45 (28.3)	36 (22.6)
I miss in-person communication with teachers	11 (6.9)	19 (11.9)	37 (23.3)	53 (33.3)	39 (24.5)
Online learning is a complete waste of time for optometry students	33 (20.8)	52 (32.7)	57 (35.8)	10 (6.3)	7 (4.4)
Online learning cannot compensate for practical education and seminars	13 (8.2)	18 (11.3)	29 (18.2)	61 (38.4)	38 (23.9)

Table 1. *Click to enlarge*

TABLE 2
Frequency of Responses for Personal Resources and Efforts Invested by UKZN for Online Learning (n = 159)

Item	Completely Disagree n (%)	Disagree n (%)	Neutral n (%)	Agree n (%)	Completely Agree n (%)
Information Technologies Skills and Availability of Equipment at Home					
I have sufficient information technology skills to participate in online learning independently	11 (6.9)	16 (10.1)	21 (13.2)	78 (49.1)	33 (20.8)
I have internet at home, which enables me to participate in online learning without interruption	18 (11.3)	28 (17.6)	21 (13.2)	65 (40.9)	27 (17.0)
I have a computer at home that I can use without interruption for online learning	19 (11.9)	12 (7.5)	19 (11.9)	76 (47.8)	33 (20.8)
I have other equipment at home, besides a computer, that enables me to participate in online learning	26 (16.4)	26 (16.4)	24 (15.1)	54 (34.0)	29 (18.2)
Efforts Invested by UKZN					
UKZN quickly adapted to online learning	12 (7.5)	25 (15.7)	34 (22.0)	67 (42.1)	20 (12.6)
UKZN organized online learning adequately	11 (6.9)	15 (9.4)	45 (28.3)	65 (40.9)	23 (14.5)
UKZN provided students with training about the teaching tools and software used for online learning	9 (5.7)	22 (13.8)	45 (28.3)	67 (42.1)	16 (10.1)
UKZN is providing timely information regarding the provision of online learning	10 (6.3)	12 (7.5)	50 (31.4)	72 (45.3)	15 (9.4)
For solving possible technical problems related to online learning, an information technologies office or another service is at our disposal at UKZN	9 (5.7)	18 (11.3)	55 (34.6)	68 (42.8)	9 (5.7)
UKZN expressed willingness to help students in provision of equipment needed for participation in online learning	8 (5.0)	14 (8.8)	51 (32.1)	62 (39.0)	24 (15.1)

Personal resources = skills and equipment; UKZN = University of KwaZulu-Natal

Table 2. *Click to enlarge*

Perceptions related to lack of practical education and continuation of education during the pandemic

More than 40% of participants felt deprived (n = 65, 40.9%) and were concerned (n = 79, 49.7%) about the lack of practical education in online learning **(Table 3)**. In the same way, just less than half of the sample felt that it would not be possible to compensate for missed practical education during their studies (n = 75, 47.2%) and agreed that the lack of practical education will have permanent consequences on their job preparedness for the future (n = 73, 45.9%). In terms of continuation of education during the pandemic, the majority of participants agreed that practical education should be organized for students (n = 115, 72.3%). Participants also agreed with the statement that online learning needs to be improved for the continuation of education during the pandemic (n = 98, 61.6%).

Structure, implementation and organization of online learning

Table 4 shows responses concerning the structure, implementation and organization of online learning for the 159 participants. Participants reported that they received timely feedback from their teachers (n = 99, 62.3%) and agreed that teachers had organized and adapted well to online learning (n = 115, 72.3%). In terms of the implementation, most participants agreed that teachers were giving instructions tailored to online learning (n = 115, 72.3%), making an effort for students to follow (n = 116, 73.0%), verifying that students understood lessons by probing for questions and providing feedback (n =123, 77.4%), finding ways to motivate students to participate in online learning (n = 103, 64.8%) and providing

tasks/activities for students to better understand the course (n = 124, 78.0%). Furthermore, many participants indicated that teachers provided adequate teaching materials (n = 109, 68.5%) and video lessons (n = 128, 80.5%) for online learning and were holding classes according to the official schedule (n = 131, 82.4%), following the curriculum (n = 136, 85.5%) and using software chosen by UKZN for online learning (n = 134, 84.3%). When asked if they felt left to their own devices during online learning, 70 (44.0%) participants agreed, 34 (21.4%) participants disagreed, while 55 (34.6%) participants provided a neutral response (Table 4).

TABLE 3

Frequency of Responses for Lack of Practical Education and Continuation of Education During the Pandemic (n = 159)

Item	Completely Disagree n (%)	Disagree n (%)	Neutral n (%)	Agree n (%)	Completely Agree n (%)
Concerns Regarding the Lack of Practical Education					
I feel deprived because of the lack of practical education	16 (10.1)	36 (22.6)	42 (26.4)	40 (25.2)	25 (15.7)
I am concerned about the lack of practical education	13 (8.2)	32 (20.1)	35 (22.0)	48 (30.2)	31 (19.5)
I am afraid that it will not be possible to compensate for the lack of practical education during my studies	13 (8.2)	25 (15.7)	46 (28.9)	51 (32.1)	24 (15.1)
I am afraid that the lack of practical education will have permanent consequences in terms of my future job preparedness	14 (8.8)	26 (16.4)	46 (28.9)	44 (27.7)	29 (18.2)
Continuation of Your Education During the Pandemic					
Despite the pandemic, practical education needs to be organized for students	8 (5.0)	4 (2.5)	32 (20.1)	70 (44.0)	45 (28.3)
Students should have suitable practical roles in health care, so they can help resolve the current pandemic	6 (3.8)	5 (3.1)	32 (20.1)	75 (47.2)	41 (25.8)
Students working on final year research projects should immediately make alternative plans that can be completed under the current circumstances	7 (4.4)	4 (2.5)	34 (21.4)	70 (44.0)	44 (27.7)
Online learning needs to be improved	7 (4.4)	6 (3.8)	46 (30.2)	57 (35.8)	41 (25.8)

Table 3. *Click to enlarge*

TABLE 4

Frequency of Responses for Structure, Implementation and Organization of Online Learning (n = 159)

Item	Completely Disagree n (%)	Disagree n (%)	Neutral n (%)	Agree n (%)	Completely Agree n (%)
I receive timely feedback from the majority of teachers	3 (1.9)	20 (12.6)	37 (23.3)	76 (47.8)	23 (14.5)
The instructions given by the majority of teachers (e.g., about participation in lessons, modes of examination, solving tasks or writing a seminar) are tailored to online learning	6 (3.8)	7 (4.4)	31 (19.5)	100 (62.9)	15 (9.4)
Most of the teachers are making an effort to enable me to follow online learning more easily, for example, by highlighting the key elements of the lecture or highlighting the transition to new content	8 (5.0)	11 (6.9)	24 (15.1)	88 (55.3)	28 (17.6)
The majority of teachers verify whether we have understood the lessons by seeking feedback or encouraging us to ask questions	5 (3.1)	13 (8.2)	18 (11.3)	90 (56.6)	33 (20.8)
The majority of teachers find a way to motivate us to participate in lessons under these distance-learning conditions	11 (6.9)	8 (5.0)	37 (23.3)	75 (47.8)	27 (17.0)
The tasks and activities that teachers provide during lessons or for homework usually help me to understand the course material better	8 (5.0)	5 (3.1)	22 (13.8)	97 (61.0)	27 (17.0)
Teaching materials are adequate for the technical demands of online learning	4 (2.5)	18 (11.3)	26 (17.6)	91 (57.2)	18 (11.3)
The majority of teachers provide video lessons	6 (3.8)	6 (3.8)	19 (11.9)	89 (56.0)	39 (24.5)
Most of the teachers hold classes according to the official schedule	4 (2.5)	6 (3.8)	18 (11.3)	100 (62.9)	31 (19.5)
Most of the teachers are following the official curriculum	5 (3.1)	5 (3.1)	13 (8.2)	104 (65.4)	32 (20.1)
Some teachers mostly do not hold online lectures, but send students a presentation instead	13 (8.3)	14 (8.8)	34 (21.4)	75 (47.8)	25 (15.7)
Most of the teachers of classes use software that UKZN chose for online learning (MoodleLearn)	5 (3.1)	4 (2.5)	16 (10.1)	81 (50.9)	53 (33.3)
I feel left to my own devices during online learning	10 (6.3)	24 (15.1)	55 (34.6)	59 (37.1)	11 (6.9)
Teachers have generally organized themselves and adapted well to online learning	5 (3.1)	7 (4.4)	32 (20.1)	84 (52.8)	31 (19.5)
My expectations related to online learning in these circumstances have been fulfilled	11 (6.9)	14 (8.8)	55 (34.6)	61 (38.4)	18 (11.3)
I am satisfied with how fast adjustment to online learning occurred	15 (9.4)	20 (12.6)	33 (20.8)	74 (46.5)	17 (10.7)

UKZN = University of KwaZulu-Natal

Table 4. *Click to enlarge*

Discussion

As a result of the COVID-19 pandemic, changes in teaching and learning practices were implemented by higher education institutions globally, which significantly altered how teachers and students interacted.[5] For 2 years, most higher education institutions provided educational activities to students via digital platforms to ensure continuity of academic activities.[9,13] Online learning refers to an interactive learning process where materials, activities, discussions and assessments are accessed using online platforms and learning management systems. Furthermore, online learning is student-centered and provides more flexible and accessible opportunities for students to engage with learning materials and activities.[9,13,20] Despite these advantages, there are challenges with online learning and an enhanced understanding of students' experiences and attitudes can be used to strengthen and further develop online learning. As optometry education programs worldwide were affected by the COVID-19 pandemic,[21] this study explored the experiences and attitudes of optometry students as such information can be used to improve and better develop the online learning process.

In this study, most participants were equally motivated to participate in and attend online learning when compared with face-to-face learning. Similar results were reported by Schlenz et al. as more than half of their sample of dental students felt motivated to learn using online platforms.[5] In contrast, Adnan and Anwar reported that 71.4% of their sample of students in a higher education institution in Pakistan felt that learning in the traditional classroom was more motivating than online learning.[16] The mean satisfaction score with online learning was 3.4, and this is higher than the middle point in the Likert scale and the score (2.85) reported in a previous study.[20] The results of the present study were encouraging. Despite all participants not being completely satisfied with online learning, they were equally motivated to study using the online method compared with the traditional face-to-face method of learning. These findings could be explained by the desire of optometry students to learn and contribute to their professional development irrespective of the method of learning. Elkins et al. asserted that supporting students with appropriate knowledge and skills for online learning improves their self-efficiency, experiences and satisfaction regarding online learning.[22] Therefore, it is possible that optometry students in this study felt motivated to participate in online learning owing to support and interaction from their teachers and institution.[20]

The findings related to students' adjustment to and experiences in online learning were interesting. In the present study, more than half of the sample were satisfied with how fast they adjusted to online learning, which is similar to findings in previous studies.[6,18] In contrast, undergraduate students in Turkey were dissatisfied with their adaptation to online learning owing to inadequate teacher support and interactions as well as poor learning resources and methods for online learning.[20] Similarly, students in an American higher education institution were also dissatisfied with their adaptation to online learning because of poor student-teacher interactions, poor organization of courses, unhelpful learning materials and unrealistic teacher expectations. In the present study, approximately half of the sample reported that they missed face-to-face lessons and in-person communication with teachers during online learning. The finding is important because positive teacher-student interactions promote self-efficacy in students particularly when using blended teaching and flipped-classroom methods that are commonly employed in the online learning process. Consequently, it is recommended that optometry teachers use more effective communication strategies when using online learning platforms to improve student-teacher interactions and compensate for the lack of in-person communication.

In the current study, most students felt that online learning required more time, corroborating results from Coman et al. showing that students felt they had less free time with online learning than with traditional face-to-face learning.[13] Different results have been noted in other studies in which students reported that online learning required less time.[5,9,20] For example, Thapa et al. reported that 64.7% of their sample of nursing students felt that online learning helped to save time needed for learning.[9] Giray noted that their sample of engineering students felt online learning required less travel time and therefore was perceived as more time efficient.[20]

Most participants would prefer theoretical courses to include online learning in the future, which is consistent with the results noted by Schlenz et al.[5] However, Adnan and Anwar reported that although students could effectively manage online learning, 50.8% did not prefer courses to be completed online.[16] Similarly, Coman et al. reported that most of their students would prefer future courses using the traditional face-to-face method rather than online learning.[13] Most students in the present study felt that online learning could not replace practical sessions and seminars, and this finding is consistent with other studies.[6,19] Alsoufi et al. noted that 54.8% of their sample agreed that online learning cannot be used for clinical aspects of medical education.[19] This highlights the concern that practical and clinical education, which are more dependent on supervision and mentoring in a skills laboratory and/or clinical setting, have been adversely affected with the use of online learning.[6,13] This is because without appropriate simulation and/or patient engagement in a clinical setting, practical and clinical techniques are more difficult to teach using online learning.[9] This suggests that online learning has more value for theoretical education rather than practical education particularly in healthcare training undergraduate programs.[5,6]

More than half of the sample indicated that they had sufficient skills, internet access and computers to participate in online learning. Similar results have been reported by other researchers[5,16,19] concerning digital devices and skills that are critical for online learning. For example, Adnan and Anwar noted that most of their participants had adequate access to the internet and proficient computer and information technology skills to engage in online learning.[16] In contrast to these results, lack of adequate devices and poor internet connectivity were reported as major challenges to successful engagement in online learning for students in Romania,[13] Turkey[20] and Nepal.[9] The challenge with access to the internet was also highlighted by Pather et al. who found that even though most students (98.8%) had access to digital devices, 15.7% reported that their devices were unable to connect to the internet.[12] The difference in findings between the present study and the Pather et al. study[12] may be explained by the times at which these studies were undertaken. Pather et al.[12] surveyed students very early in the national lockdown period in South Africa. Thus, both students and institutions may have had little time to adjust and prepare for the transition to online learning and/or secure devices and resources needed to engage in online learning. Nevertheless, higher education institutions, particularly those in the developing countries like South Africa, need to consider the digital divide and inequalities in access to digital devices and/or resources for students when planning online learning.[12]

Many participants in this study felt that UKZN had quickly adapted and organized online learning adequately as well as provided support in the form of training and technical problem-solving services for online learning. Moreover, participants agreed that UKZN had provided timely information regarding the provision of online learning and showed willingness to help students with equipment needed for engaging in online learning. Similar results were reported by Puljak et al. and Etajuri et al. in their studies involving health science students regarding institutional support and adjustment for effective online learning.[6,18] In contrast, students in Romania felt that their higher education institutions were inadequately prepared for online learning owing to lack of technical skills, support and platforms needed for optimal online learning processes.[13] Thapa et al. noted that students in a higher education institution in Nepal reported poor support from their institution because of inadequate technology and online learning training programs to improve students skills for online learning.[9]

Almost half of the sample were concerned about the lack of practical education and being unable to compensate for missed practical education. Furthermore, many participants felt that the lack of practical education will have permanent implications for their job preparedness. These findings suggest that students recognize the importance of practical education in

undergraduate programs for vocationally oriented professions such as optometry. These findings are expected as both preclinical and clinical education and training are indispensable for the development of future healthcare professionals. Other studies[5,6,18] have also reported that future healthcare professionals expressed more concern regarding their practical education when engaging with online learning. Furthermore, nursing students from Nepal felt that reduced patient interactions was perceived as a major disadvantage of online learning.[9] Dental students from Malaysia reported that insufficient practical training was a major concern, and almost all students (98.6%) were worried about their levels of preparedness for their clinical competency examinations.[6] Other healthcare students also expressed concern about their level of practical preparation during the pandemic and felt uncomfortable about future practice.[5] In contrast to these findings, Alsoufi et al. reported that 45.4% of medical students felt that COVID-19 had no impact on their career and future specialty training.[19] Most of the students in the study by Alsoufi et al. served as volunteer allied healthcare workers during the pandemic and felt that medical faculty had provided adequate guidance.[19] Consequently, students in the study by Alsoufi et al. may have been less affected by the lack of practical training during the pandemic and its implications for future clinical practice.[19]

When asked about the structure, implementation and organization of online learning, most students in the present study had a positive response. Most participants felt that teachers were organized, held classes according to the schedule, adapted well and gave tailored instructions for online learning. Furthermore, participants reported that teachers provided adequate materials, tasks/activities and feedback and ensured that students were motivated. Similar results were noted in the study by Puljak et al. where students felt that they received timely feedback and that the online learning lectures and activities helped them to understand materials better.[18] Schlenz et al. reported that their sample felt they were able to follow the content and that online learning courses were well structured.[5] Different results were noted by Coman et al. where one-third of their sample felt that teachers did not follow the schedule as classes did not start or end at the scheduled times.[13] Furthermore, Coman et al. noted that teachers did not clearly indicate course requirements, failed to offer support with problems, did not adapt their teaching styles or interact with students in the online environment.[13] Elkins et al. reported that most of their students felt that the learning materials provided were unhelpful and did not contribute to their development.[22] It is also possible that the teachers being evaluated in the studies by Coman et al. and Elkins et al. did not receive training for online learning or were unable to adequately adapt their teaching styles and courses as the transition to online learning happened unexpectedly and rapidly.[13,22] Thus, teachers in these studies[13,22] may have been unable to develop technical skills or adapt their courses and/or materials for effective online learning. This is different than the present study where teachers at UKZN were provided with training workshops and support services for adjusting and implementing online learning.

When comparing traditional face-to-face learning with online learning, only 32.1% of participants reported that online learning was better. Furthermore, 61.6% of participants agreed that online learning needs to be improved for the continuation of education during the pandemic. Possible reasons for this may be that optometry students may be more familiar with traditional face-to-face learning and in-person contact with their teachers and/or patients in clinical/skills laboratory settings. Other studies involving health science students[9,18] have reported similar findings regarding the comparison of online and traditional learning. For example, Puljak et al. noted that only 39.6% of their sample found online learning better than traditional learning.[18] Thapa et al. reported that only 34% of their sample felt that online learning was as effective as traditional learning with the majority preferring traditional face-to-face learning.[9] Even students in non-health science programs perceived that traditional face-to-face learning was better than online learning.[20] The lack of satisfaction with online learning, the low proportion of students perceiving online learning to be better than traditional face-to-face learning and majority of students perceiving that online learning needs to be improved is concerning as higher satisfaction is related to better academic performance and increased motivation as students need to self-regulate their learning and motivation particularly in online learning.[18] Furthermore, the development and incorporation of technology into education has revolutionized the teaching and learning process and is likely going to remain in optometry education programs in the post COVID-19 era.[9,21] Consequently, future studies should use qualitative research designs and data collection methods to explore reasons for the low proportion of optometry students perceiving that online learning is better than traditional face-to-face learning. These studies should also focus on better understanding students' perceptions of online learning needing to be improved and possibly explore suggestions and recommendations on how this can be achieved.

Strengths of this study included that the experiences and attitudes of optometry students after engaging with online learning for approximately 1 year were investigated. Overall, the response rate was relatively good and thus may be representative of the experiences and attitudes of optometry students regarding online learning at UKZN. Participants responded to the questionnaire anonymously, and all students could access the questionnaire during the study period using either data provided by the institution or personal data. The questionnaire was adapted from a previous study[18] that assessed student perceptions regarding online learning and was piloted prior to data collection. As the sample only included optometry students from one institution, the study findings may not be generalized to other student populations. Thus, it would be useful to extend the study to the three other institutions in South Africa that train optometry students to better understand the experiences of these students and make comparisons across the institutions. Future longitudinal studies would also be useful to assess how optometry students have adapted to online learning and if their experiences and/or attitudes regarding online learning change

over time.

Conclusion

This study investigated the experiences and attitudes of optometry students regarding online learning during the COVID-19 pandemic. Findings showed that a majority of participants were satisfied with their adjustment to online learning and the way it was implemented by the institution and their teachers. Challenges with the lack of practical education, particularly in a vocationally oriented program like optometry, is concerning and should be addressed using supplementary programs to enhance practical and clinical competencies. The use of blended learning approaches in optometry education programs has the potential to enhance the learning process for optometry students. Consequently, this information should be used by optometry curriculum developers and educators to strengthen online learning together with face-to-face learning to achieve better outcomes and have a more positive impact on student learning. Such changes would be critical for a robust optometry curriculum particularly if online learning continues effectively in the post COVID-19 era for the training of future optometrists who are fit for purpose.

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APPENDIX A

Experiences and Attitudes of Optometry Students Regarding Online Learning During the COVID-19 Pandemic

Demographic characteristics

Age: 18-20 years; 21-23 years; 24-26 years; over 26 years
Gender: male; female
Race: Black; Caucasian; Indian/Asian; mixed
Level of study: 1st year; 2nd year; 3rd year; 4th year
How do you primarily (most commonly) access the internet for online learning? university data; personal data; uncapped WiFi; capped WiFi
What type of device do you primarily (most commonly) use to engage in online learning? laptop; desktop computer (in LAN or private); smartphone

General satisfaction with online learning and comparison to traditional face-to-face learning

Rate your general satisfaction with the overall online learning that has been provided thus far:
1 – completely dissatisfied
2 – dissatisfied
3 – neither satisfied nor dissatisfied
4 – satisfied
5 – completely satisfied

How would you rate the online learning you have had so far, compared to the classic classroom learning you had before? Online learning is:
1 – much worse
2 – worse
3 – neither better nor worse
4 – better
5 – much better

Compared to classroom lessons, I attend online learning (less frequently, equally, more frequently)
The longer the online learning continues, my motivation to participate in such lessons (increases, remains equal, decreases)
Compared to classroom learning, during online learning I am connected with my colleagues and teachers (more, equally, less)
Regarding time, compared to classic classroom lessons, online learning requires (more time, equal time, less time)
Compared to classroom lessons, I am motivated to participate in online learning (more, equally, less)

Please rate these statements regarding your experience and engagement with online learning

1 – completely dissatisfied
2 – dissatisfied
3 – neither satisfied nor dissatisfied
4 – satisfied
5 – completely satisfied

I am satisfied with how fast I have adjusted to online learning
I participate in the course with questions and comments, just like during regular classes
I miss classroom lessons
I miss in-person communication with teachers
Online learning is a complete waste of time for health sciences students
Online learning cannot compensate for practical education and seminars

Please rate your level of agreement with the following statements, related to the possibility of your participation in online learning, based on your information technologies skills and availability of equipment at home

1 – completely dissatisfied
2 – dissatisfied
3 – neither satisfied nor dissatisfied
4 – satisfied
5 – completely satisfied

I have sufficient information technology skills to participate in online learning independently
I have internet at home, which enables me to participate in online learning without interruption
I have a computer at home that I can use without interruption for online learning
I have other equipment at home, besides a computer, that enables me to participate in online learning

Please state your agreement with the following statements related to the efforts invested by University of KwaZulu-Natal (UKZN) in order to enable you to participate in online learning

1 – completely dissatisfied
2 – dissatisfied
3 – neither satisfied nor dissatisfied
4 – satisfied
5 – completely satisfied

UKZN quickly adapted to online learning
UKZN has organized online learning adequately
UKZN has provided students with training about the teaching tools and software used for online learning
UKZN is providing timely information regarding the provision of online learning
For solving possible technical problems related to online learning, an information technologies office or another service is at our disposal
UKZN has expressed willingness to help students in provision of equipment needed for participation in online learning

Please rate your level of agreement with the following statements related to the structure, implementation and organization of online learning

1 – completely dissatisfied
2 – dissatisfied
3 – neither satisfied nor dissatisfied
4 – satisfied
5 – completely satisfied

I receive timely feedback from the majority of teachers
The instructions given by the majority of teachers (e.g., about participation in lessons, modes of examination, solving tasks, or writing a seminar) are tailored to online learning
Most of the teachers are making an effort to enable me to follow online learning more easily, for example, by highlighting the key elements of the lecture or highlighting the transition to new content
The majority of teachers verify whether we have understood the lessons by seeking feedback or encouraging us to ask questions
The majority of teachers find a way to motivate us to participate in lessons under these distance-learning conditions
The tasks and activities that teachers provide during lessons or for homework usually help me to understand the course material better
The teaching materials are adequate for the technical demands of online learning
The majority of teachers provide video lessons
Most of the teachers hold classes according to the official schedule
Most of the teachers are following the official curriculum
Some teachers mostly do not hold online lectures, but send students a presentation instead
Most of the teachers of classes use software that UKZN chose for online learning (Moodle/Learn)
I feel left to my own devices during online learning
Teachers have generally organized themselves and adapted to online learning well
My expectations related to online learning in these circumstances have been fulfilled
I am satisfied with how fast adjustment to online learning occurred

Please state your level of agreement with the following statements related to possible concerns you might have regarding the lack of practical education during online learning due to the COVID-19 pandemic

1 – completely dissatisfied
2 – dissatisfied
3 – neither satisfied nor dissatisfied
4 – satisfied
5 – completely satisfied

I feel deprived because of the lack of practical education
I am concerned about the lack of practical education
I am afraid that it will not be possible to compensate for the lack of practical education during my studies
I am afraid that the lack of practical education will have permanent consequences in terms of my future job preparedness

Please rate your level of agreement with the following statements about the continuation of your education during the pandemic

1 – completely dissatisfied
2 – dissatisfied
3 – neither satisfied nor dissatisfied
4 – satisfied
5 – completely satisfied

Despite the pandemic, practical education needs to be organized for students
Students should have suitable practical roles in health care, so they can help resolve the current pandemic
Students working on final year research projects should immediately make alternative plans that can be completed under the current circumstances
Online learning needs to be improved
Considering the experience with online learning, what would you prefer in the future for theoretical education? (classical classroom lessons; online learning; a combination of both)

Appendix A. *Click to enlarge*

Adult-onset Foveomacular Vitelliform Dystrophy: a Teaching Case Report

Deepak Sharma, OD, FAAO, and Jonathan Hamilton, OD, FAAO | Optometric Education: Volume 49 Number 2 (Winter-Spring 2024)

Background

Adult-onset foveomacular vitelliform dystrophy (AOFVD) is one of the five autosomal pattern dystrophies.[1] It typically presents in the fourth to sixth decades of life and is characterized by bilateral, asymmetric, solitary, round to oval subretinal lesions in the fovea or perifovea on fundoscopic evaluation.[1,2] It can initially present asymptomatically or with mild blurred vision.[1,2] Potential visual complications include choroidal neovascularization (CNV), geographic atrophy and outer retinal atrophy.[3] Ancillary imaging modalities such as optical coherence tomography (OCT), fundus autofluorescence (FAF), indocyanine green angiography (ICGA) and fluorescein angiography (FA) are useful in confirming the diagnosis.[2] Treatment and management depend on whether CNV is present and compromising central visual acuity and can include anti-vascular-endothelial-gro-th-factor (anti-VEGF) injections.[1]

This report describes the case of a patient who presented with symptoms of mild metamorphopsia and a history of previously diagnosed dry age-related macular degeneration (AMD) with subsequent discovery of a presumed AOFVD. Detection of AOFVD would allow a more proper treatment and management protocol and potentially reduce the need for unnecessary treatment burden with the correct diagnosis. For third- and fourth-year optometry students, optometry residents and practicing optometrists, this case report highlights the importance of exploring alternative diagnoses to AMD when presented with abnormal macular findings. It also explains ancillary testing used to confirm the diagnosis and treatment approach.

Case Description

A 69-year-old male presented with a chief complaint of blurred and wavy vision in his right eye (OD) after being scratched by his dog 3 days earlier. The patient had a pertinent medical history of hypertension and hyperlipidemia. Medications included simvastatin for the hyperlipidemia and an anti-hypertensive medication the name of which the patient could not recall. The patient had an ocular history of dry AMD in both eyes (OU), mild cataracts OU, a large chorioretinal scar OD and prior radial keratotomy for refractive correction OU. He was last seen 7 months prior at his annual eye exam. No family history of macular degeneration, glaucoma or other eye-related disease was reported. Social history was positive for alcohol use socially but negative for tobacco and recreational drug use.

The patient reported that he was experiencing blurred, wavy vision with or without spectacle correction, which did not change upon blinking and began 3 days prior OD only. He attributed the blurred and wavy vision to being scratched by his dog OD, which occurred the same day the vision problems began. The patient initially noted ocular pain and discomfort OD only; however, he noted that the ocular pain and redness had subsided by the time he came in for the visit. Entering visual acuity with his habitual spectacle prescription was 20/70 OD and 20/50 left eye (OS) with improvement on pinhole to 20/40+1 OD and 20/30 OS. His visual acuity 7 months prior was best-corrected to 20/30 OD and 20/25 OS, which was attributed to the dry AMD and cataracts. Confrontation visual fields were full to finger counting OU. Pupils were equal, round and reactive to light without an afferent pupillary defect. Extraocular muscle motilities were full without restriction, diplopia or pain OU. The patient reported metamorphopsia OD only on the Amsler grid. Anterior segment evaluation revealed normal appearance of the eyelids, lashes and conjunctiva OU. Both corneas were clear without any sign of acute corneal abnormality, including no abrasion and no infiltrate with or without fluorescein staining. Stable corneal scars from the previous radial keratotomy refractive surgery were noted. Intraocular pressure measured with Goldmann applanation tonometry was stable at 21 mmHg OD and 19 mmHg OS at 4:33 p.m.

Given the lack of anterior segment findings correlating with the reported eye scratch and decreased vision, the pupils were dilated for further assessment. On dilated fundus exam, the cup to disc ratio measured 0.35 horizontally and vertically, and the optic nerves were pink and healthy without disc edema OU. In the macula OD, a large central yellow deposit and a separate yellow deposit inferior temporal to the optic nerve were noted **(Figure 1A)**. OS, a small central yellow deposit in the macula and multiple yellow deposits in a 360-degree ring-like formation were noted **(Figure 1B)**. There were no appreciable clinical signs of subretinal fluid or hemorrhages on funduscopic exam. The retinal periphery was intact 360 degrees without retinal holes, breaks or detachments OU. A presumed stable inactive toxoplasmosis scar was noted nasally OD.

Figure 1A. *Fundus image of the right eye documenting yellow deposits, including a central deposit, in the macular region.*
Click to enlarge

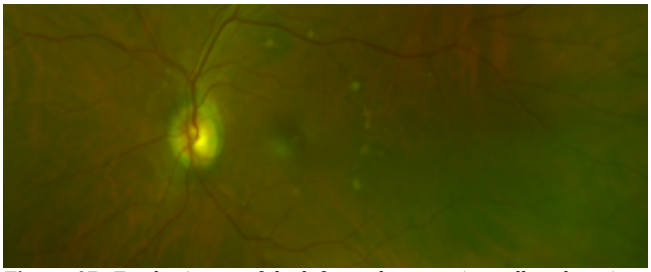

Figure 1B. *Fundus image of the left eye documenting yellow deposits in the macular region. Note the ring-like appearance of some of the deposits. Click to enlarge*

Due to the slight decrease in vision along with newly noted metamorphopsia, OCT of the macula was performed the same day. The scans revealed bilateral large subretinal deposits centrally and a slightly attenuated photoreceptor integrity line and no evidence of intraretinal or subretinal fluid **(Figures 2A, 2B and 3)**.

Given the patient's decreased vision and onset of metamorphopsia without any other correlating ocular or retinal abnormality, the cause was presumed to be related to the progression of subretinal deposits. Given the OCT results and lack of drusen-like findings or family history, the presumptive diagnosis was bilateral AOFVD. The patient was referred to a local retina specialist for further evaluation, including possible FA and/or FAF, and was given an Amsler grid for home monitoring. He has not yet gone to see the retina specialist.

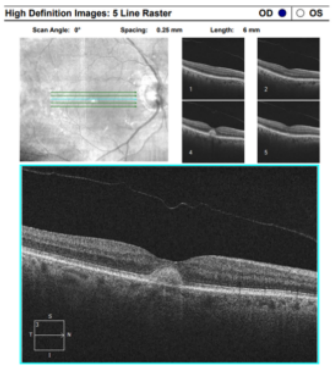

Figure 2A. *Five-line raster macular OCT scan of the right eye revealing large subretinal deposits centrally with a slightly attenuated photoreceptor integrity line and no evidence of intraretinal or subretinal fluid. Click to enlarge*

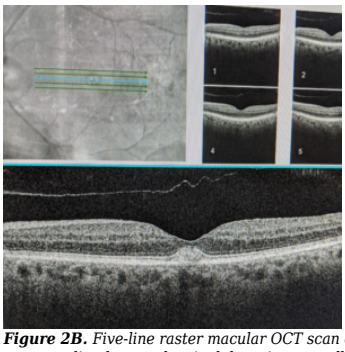

Figure 2B. *Five-line raster macular OCT scan of the left eye revealing large subretinal deposits centrally with a slightly attenuated photoreceptor integrity line and no evidence of intraretinal or subretinal fluid. Click to enlarge*

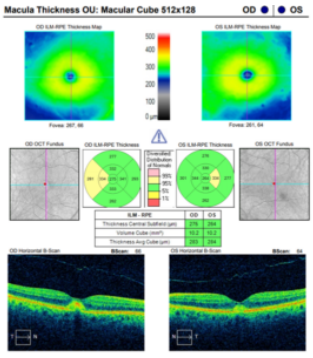

Figure 3. *Macular cube OCT scan of both eyes revealing large subretinal deposits centrally with a slightly attenuated photoreceptor integrity line and no evidence of intraretinal or subretinal fluid.*
Click to enlarge

Education Guidelines

Learning objectives

1. Understand pertinent differential diagnoses of AOFVD
2. Know signs and symptoms of AOFVD
3. Describe useful diagnostic testing for AOFVD
4. Understand treatment and management of AOFVD
5. Understand the different types of pattern dystrophies

Key concepts

1. Ocular signs and symptoms of AOFVD
2. Diagnostic testing for AOFVD
3. Treatment and management of AOFVD

Discussion questions

1. Critical knowledge and background information for critical review of this case

a. What are the ocular signs and symptoms of AOFVD?

2. Differential diagnosis

a. What are key differentials for AOFVD?
b. How does AOFVD differ from Best disease?

3. Diagnostic testing

a. Describe useful diagnostic testing for aiding diagnosis of AOFVD and expected findings

4. Treatment and management

a. What treatment options are available for management of AOFVD?

Discussion

Teaching instructions

All participants should read each question and consider how they would respond before reading the appropriate text. This can be done individually or in small groups to facilitate critical thinking on each question. Assessments can be done based on participants' responses.

What are the ocular signs and symptoms of adult-onset vitelliform dystrophy?

AOFVD is an uncommon macular disease that generally presents in the fourth to sixth decades of life.[1,5] It is part of the autosomal dominant pattern dystrophy group,[1] which also includes butterfly-shaped pigment dystrophy, reticular dystrophy of the retinal pigment epithelium (RPE), multifocal pattern dystrophy simulating fundus flavimaculatus, and fundus pulverulentus **(Table 1)**. Due to variable expression of a mutation in the peripherin-2 (PRPH2) gene, autosomal dominant pattern dystrophies differ in onset, impact on vision and rate of occurrence.[1]

Butterfly-shaped pigment dystrophy presents with yellow and melanin pigmentation in the fovea typically in a triradiate or butterfly wing-like pattern.[1] Reticular dystrophy of the RPE presents with a network of pigmented lines in the posterior pole that can resemble a fishnet or chicken wire.[1,3] Multifocal pattern dystrophy simulating fundus flavimaculatus is characterized by many irregular yellow lesions that are widely distributed in the arcades and posterior pole.[1] This is a differentiating characteristic because fundus flavimaculatus and Stargardt disease are more dispersed, including outside the arcades.[1] Fundus pulverulentus presents with macular pigment mottling.[1]

Patients with AOFVD typically complain of mild blurring of vision, small central or paracentral scotomas or mild metamorphopsia.[1,2,9] The typical presentation is bilateral, asymmetric foveal or perifoveal subretinal lesions that are yellow, solitary, round to oval and elevated, often with central pigmentation from one-third to one-half disc diameter in size.[2,6,9,10] The disease can quite often be confused with other macular diseases and is most often misdiagnosed as AMD or Best disease. The effect on visual acuity is generally mild with an average of 20/50.[1] A study of 85 patients with AOFVD found that 43% of the eyes had visual acuity better than or equal to 20/80; however, only 20% of eyes maintained this level of acuity after 4 years of follow-up.[9] Vision-threatening complications of AOFVD include CNV, geographic atrophy and outer retinal atrophy.[1,9] Subfoveal CNV has been reported to occur in 11.7% of cases.[9] AOFVD typically presents without subretinal fluid or hemorrhage when there is no CNV.[1,9]

What are key differential diagnoses for adult-onset vitelliform dystrophy?

AMD is a key differential as it is the most significant cause of irreversible vision loss among older adults worldwide.[1,4] It typically presents after age 50, bilaterally with drusen, hyperpigmentation or hypopigmentation of the RPE, geographic atrophy, RPE detachment and/or CNV.[2,4] In dry AMD, OCT shows sub-RPE deposits and alterations. Loss of RPE and photoreceptors is seen in more advanced stages such as geographic atrophy.[1,2,3,4] In wet AMD, OCT shows subretinal or intraretinal fluid or pigment epithelial detachments PEDs.[1,2] The PEDs in wet AMD can appear with variable internal reflectivity on OCT and have been described as either fibrovascular, drusenoid or serous in nature.[1,2]

FAF in dry AMD exhibits hypofluorescence due to RPE loss and lipofuscin leading to a region with a high-contrast transition between areas of viable and non-viable retina.[2,5] FA can confirm the presence of CNV in wet AMD. In dry AMD, FA demonstrates hypofluorescence due to drusen masking the background fluorescence, or hyperfluorescence due to a window defect from the atrophy of the overlying RPE.[3,5] The patient in the case described here had a history of dry AMD noted for at

least the past 3 years.

Another main differential is Best disease or vitelliform macular dystrophy. Similar to AOFVD, Best disease occurs when lipofuscin accumulates in the central macula causing progressive vision loss.[1] It differs from AOFVD in that Best disease presents early in life.[1,6] Genotypically, Best disease is an autosomal dominant macular dystrophy linked to mutations in the bestrophin 1 (BEST1) gene.[1,6] The exact mechanism for how BEST1 gene mutation leads to accumulation of lipofuscin has not been definitively proven.[6] Best disease presents during childhood with bilateral yellow yolk-like macular lesions with a diameter ranging from a few hundred micrometers to a few millimeters.[2,6] As the patient ages with Best disease, the lesion will eventually scar and atrophy leading to a more difficult diagnosis later in life.[2] Multiple stages of evolution have been noted for Best disease.[1,6,7,8] Stage 1 or pre-vitelliform stage is characterized by lower-than-expected electro-oculography (EOG) in an asymptomatic infant or child with a normal fundoscopic appearance.[6,7] Stage 2 is vitelliform and occurs from infancy to early childhood and does not impede visual acuity.[1,6,7] It presents with a circumscribed delineated macular lesion described as "sunny side up egg yolk" with size varying from 0.5-2 disc diameters.[6,7] At this stage, the dystrophy may be unilateral or appear asymmetric between the two eyes.[6,7,8] Stage 3 is pseudohypopyon described as "scrambled egg."[6,7,8] Stage 4 is vitelliruptive when the lesion breaks up and visual acuity declines.[6,7] Stage 5 is atrophy when all pigment has disappeared leaving an atrophic scar of the RPE.[6,7] A sixth stage can occur in which CNV may develop and lead to a subretinal bleed, subretinal fibrosis and further decline in visual acuity.[6,7]

Ancillary diagnostic testing is useful in Best disease. A patient with Best disease has an Arden or light to dark ratio of less than 1.5 with EOG testing, and electroretinogram (ERG) can sometimes show a reduced C-wave.[1,6,8] Importantly, this is the only disease with a relatively normal ERG with an abnormal EOG.[6,8] OCT reveals dome-shaped, hyper-reflective and homogenous lesions located below the hyper-reflective photoreceptor layer.[3] In the earlier stages, visual acuity can remain good; however, as the lesion atrophies, vision typically drops to the 20/200 range.[1] As with AOFVD, there is a rare chance of CNV development.[1] Though this patient's fundoscopic and OCT findings correlated to Stage 2 or the vitelliform stage of Best disease, Stage 5 or the atrophic stage would be expected if he had Best disease given his age of 69 years. Stage 5 of Best disease typically occurs after age 40.[6]

A third differential is multifocal vitelliform lesions without Best disease. This is when multifocal vitelliform lesions, similar to those in Best disease, are seen around the macular vascular arcades and optic disc.[1] Differing from Best disease this occurs initially in adult life.[1] In addition, EOG is normal and family history is negative.[1] It is important to note that genetically confirmed Best disease can present with multifocal lesions.[1]

The fourth differential for AOFVD is multifocal pattern dystrophy. This presents with multiple scattered irregular yellow lesions or flecks like those in fundus flavimaculatus and typically presents between the fourth and sixth decades of life.[1] OCT demonstrates multiple hyper-reflective areas between the RPE and ellipsoid zone.[1,3] FA shows hyperfluorescence of the flecks, and the choroid would not be dark compared to fundus flavimaculatus.[1]

How does adult-onset vitelliform dystrophy differ from Best disease?

AOFVD differs from Best disease as AOFVD has a later onset, typically from age 30-50 years, presents with mild to moderate symptoms, and can have a normal or mildly subnormal EOG with an Arden ratio of less than 1.7.[5] In Best disease, the onset is typically early, before age 30, and is associated with an abnormal EOG.[6] The subretinal lesions tend to be larger in Best disease, from 1-5 mm compared to one-third to one-half disc diameters in AOFVD.[6] AOFVD occurs when there is insult to the RPE with focal loss of photoreceptors in the area of atrophic RPE damage.[6] Pigmented material can be found between the retina and Bruch's membrane.[9] Genetically, Best disease is caused by a mutation in BEST1. Some forms of AOFVD have been linked to mutations in BEST1 and PRPH2 (formally known as retinal degeneration slow [RDS]) though the causative gene for AOFVD has not been discovered.[5,6,7]

Describe useful diagnostic testing to aid in diagnosis of adult-onset vitelliform dystrophy and expected findings

Imaging that can be helpful includes macular OCT, FAF, FA and/or ICGA. Macular OCT can help differentiate the layer the lesion impacts, such as subretinal for AOFVD or sub-RPE for more drusenoid changes. OCT shows the vitelliform material as a highly reflective dome-shaped lesion located between the photoreceptor layer and the RPE.[1,2,7] In this patient, the sub-RPE macular deposits seen on OCT were more suggestive of vitelliform lesions than drusen. OCT is also useful for classifying AOFVD into four different stages.[9] The vitelliform stage is characterized by a dome-shaped subretinal lesion between the RPE and ellipsoid zone.[9] In the pseudohypopyon stage, a hyporeflective area is seen with a hyper-reflective area containing the remaining vitelliform material corresponding to the disassociation of the lesion.[9] In the vitelliruptive stage, the lesion is flattened, meaning the fluid has subsided and atrophy of the outer retina and RPE is made apparent.[9] The vitelliruptive stage of AOFVD would demonstrate atrophy of the ellipsoid zone, outer nuclear layer and RPE.[9] FAF is another useful imaging modality

that can show increased autofluorescence within foveal yellow lesions due to accumulation of lipofuscin within the deposit.[9] When atrophy occurs, the lesion presents with hypofluorescence.[9] FA can demonstrate an early central hypofluorescence corresponding to the yellow lesion with a surrounding ring of hyperfluorescence.[1,9] The hypofluorescence is due to the vitelliform material and pigment, which can be surrounded by an area of atrophic RPE.[1,9] In late phases, the entire lesion shows hyperfluorscence, which can cause confusion with CNV. This may require ICGA for confirming the presence of CNV.[9]

What treatment options are available for management of adult-onset vitelliform dystrophy?

Treatment and management of AOFVD is dependent on whether CNV or subretinal fluid develops.[1,9] There is no treatment available to prevent the development of a vitelliform lesion.[9] Several studies evaluated photodynamic therapy (PDT) or anti-VEGF therapy for patients with AOFVD without CNV and did not yield favorable results.[9] Therefore, these treatments are not recommended in cases without CNV. Gene therapy is being investigated for possible prevention of vitelliform lesion development.[9] If CNV develops from AOFVD, anti-VEGF treatment can be used.[9] Similar efficacy has been noted with bevacizumab and ranibizumab injections in AMD and AOFVD patients with CNV.[9] PDT may result in RPE atrophy and poorer visual outcomes in AOFVD associated CNV and is generally avoided in favor of anti-VEGF injections.[9] When vision loss caused by AOFVD interferes with a patient's ability to perform activities of daily living, referral to a low vision specialist can be useful.

The patient in this case report had relatively good visual acuity, no family history of macular disorders, and no personal history of macular or retinal abnormality prior to the past 3 years. This suggested late onset and supported the presumptive diagnosis of AOFVD rather than the original diagnosis of AMD. In addition, his macular deposits were sub-RPE, which is more consistent with AOFVD than with AMD. EOG could be beneficial in differentiating Best disease from AOFVD; however, the patient's advanced age, the level of retinal presentation and the near normal visual acuity suggested AOFVD rather than Best disease.

Conclusion

This case report highlights AOFVD as an uncommon macular disorder that should be considered in patients with macular lesions that do not follow the typical AMD appearance or course. The conditions have different treatment and management approaches and can influence family members' ocular health risk. Clinicians should also be aware of the importance of differentiating AOFVD from Best disease due to potential genetic counseling that would be pertinent in Best disease. In addition to dilated fundus examination, ancillary imaging such as OCT, FAF, FA or ICGA is critical in differentiating AOFVD from other macular disorders. If CNV develops as a complication of AOFVD, standard of care involves intravitreal injection of anti-VEGF agents to prohibit angiogenesis and vascular permeability. Whenever a patient with AOFVD encounters difficulty performing activities of daily living, low vision examination and/or rehabilitation is appropriate for determining whether a higher reading add, magnifiers, telescopes, video magnifiers or auditory devices may be necessary for meeting vision-related goals.

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What's on Your Mind?

Keshia S. Elder, OD, MS, MS, FAAO | Optometric Education: Volume 49 Number 2 (Winter-Spring 2024)

As I continue settling into my new role as Editor of *Optometric Education*, I want to hear more about what is on the minds of the journal readership.

Keshia Elder, OD, MS, MS, FAAO

Pertaining to the journal itself, in addition to the peer-reviewed research papers published in each issue, would you like to see articles or recurring features that address a specific topic or topics, and what would those topics be? Over the years, the journal has presented many recurring features on specific topics, such as technology in optometric education, teaching theories and methods and book reviews. We are always open to considering your ideas for guest editorials and installments of Educator's Podium, too.

I am also interested in knowing what you feel are the most pressing challenges and issues you face as you navigate through your daily responsibilities as teachers and doctors. We of course face some overriding issues that are already matters of national conversation and solution-seeking, but we may also have more subtle observations and experiences that feel as if they may become overriding issues.

Is the Student-Teacher Relationship Shifting?

I've been thinking more lately, for example, about our need as optometric educators to compartmentalize. Given the multiple roles we fill, the need has always been there. But I feel it is becoming much more necessary. I wonder if this is at least partly due to students wanting to have a more personal connection to their faculty and administrators, as was found in a Student Voice survey by Inside Higher Ed and College Pulse.[1] In that survey, approximately one-third of students indicated that professors taking more of an interest in getting to know them would promote their success. Certainly, considering more holistically what students need has its benefits, such as a better understanding of their overall well-being, but how far from the traditional, strictly professional rapport is prudent? Should we be accepting invitations to connect on social media platforms that we also use personally? (My policy has been to connect, if asked, only on LinkedIn. Once a student graduates, I'm open to connecting on other platforms.) Does the kind of tie students seem to be seeking further complicate already difficult conversations about their academic successes and failures? As far as compartmentalizing, how can we be the teachers our students need us to be, the doctors our patients need us to be, and still maintain a part of ourselves?

Drop Me a Line

What do you think? Is it time to move past some traditional boundaries when it comes to the teacher-student relationship or perhaps set some new ones? Let's share thoughts and potential strategies. I welcome your insights on this and any topic that is on your mind. Email address below.

Reference

1. Flaherty C. What Students Want (and Don't) From Their Professors, March 23, 2023 [Internet]. Washington, DC: Inside Higher Ed; c2024 [cited March 8, 2024]. Available from: https://www.insidehighered.com/news/2023/03/24/survey-facult--teaching-style-impedes-academic-success-students-say