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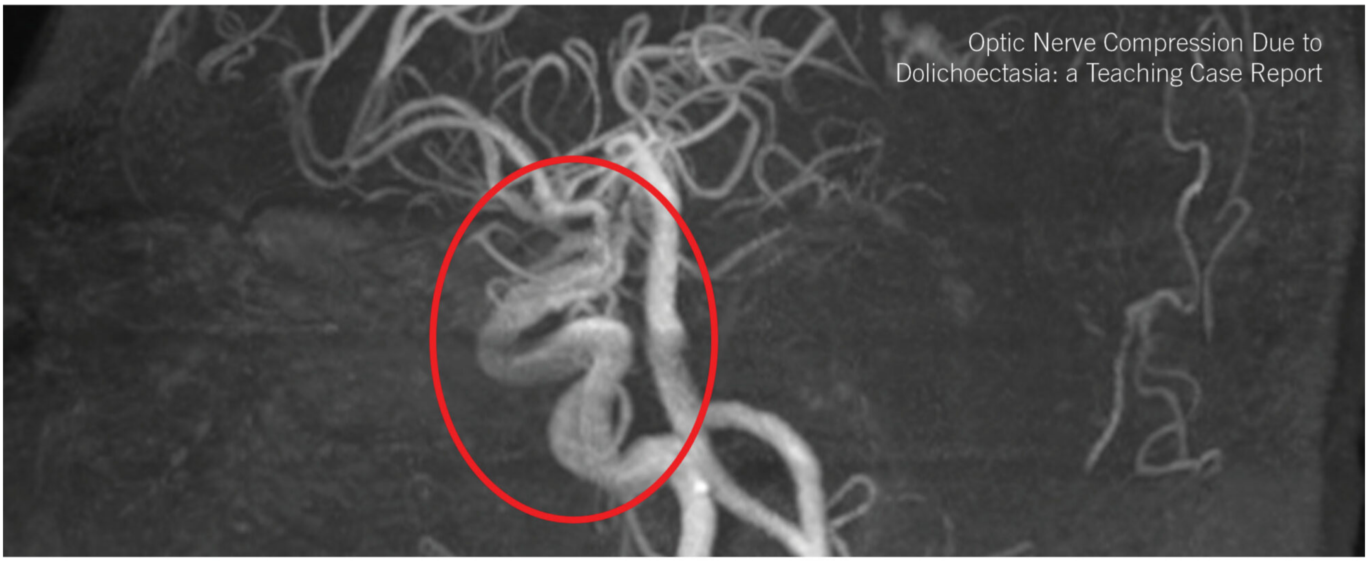

Optic Nerve Compression Due to Dolichoectasia: a Teaching Case Report

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PEER REVIEWED

Assessing COVID-19 Sleep Patterns in Optometry Students: Implications for Learning

Matt Valdes, OD, FAAO, Deidre Rios, MS, PhD, AHIP, Sandra Fortenberry, OD, FAAO, Christina Bahn, OD, and Lizette Martinez, OD | Optometric Education: Volume 48 Number 2 (Winter-Spring 2023)

Abstract

This study evaluated the impact of COVID-19 lockdowns on student sleep patterns. Sleep data collected in a cohort of third-year optometry school students (OPT III) were compared with sleep data from a similar cohort (OPT III) during the same time frame, 1 year prior (summer 2019). During lockdown, subjects averaged 30 more minutes of sleep per night (7:37 vs. 7:07, p = 0.03), with the greatest difference observed on weekdays (7:37 vs. 6:41, p < 0.001). Weekday average wake time shifted significantly later in 2020 (7:57 a.m. vs. 7:14 a.m., p = 0.01). Increased sleep duration was attributed to delayed wake times and may play a role in improved learning and memory processing.

Key Words: *accelerometer, activity tracker, COVID-19, learning, lockdown, sleep, students, learning, sleep logs*

Introduction

As many countries began implementing restrictions aimed at reducing the transmission of COVID-19, there was concern these measures may have unintended consequences on the mental and physical health of affected populations. Disruptions in sleep patterns and mental health issues had previously been linked with restriction of movement, psychological distress, limited social engagement and modified daily routines.[1-3] Chronic sleep issues can eventually develop into sleeping disorders resulting from the body's inability to regulate its natural sleep mechanism and negatively impact learning and memory.[4-5] Through this research, we looked to better understand changes in sleep/wake behavior as a result of the COVID-19 lockdowns among a cohort of optometry school students.

Circadian rhythm, the body's biological clock, is responsible for controlling the sleep/wake cycle corresponding to the 24-hour light/dark phases of the Earth.[6-7] In addition, it can be influenced by physiological changes, diet, social/physical activity and artificial lighting.[7-9] The COVID-19 lockdowns dramatically altered daily structure and daily routines, leaving no aspect untouched. This led to an abrupt convergence of personal and professional life as "work from home" and remote learning responsibilities intersected with caregiving and self-care needs.[10] This unexpected shift in daily activities requires further analysis to determine whether such changes affect individual sleep behavior and learning potential.

Sleep metrics such as time to bed (TTB), wake time (WAKE) and duration (DUR) have often been utilized to quantify sleep quality and differentiate between sleeping disorders.[11] These values are closely connected to societal pressures (e.g., meal times, work responsibilities, social events, etc.) and are generally synchronized with the body's sleep-wake rhythm.[12-13] Earlier sleep research found less WAKE variability during the week among college-aged students, corresponding to the start of the academic day.[14] Would home confinement, growing anxiety and less daily structure lead to the development of abnormal sleep patterns and potentially impact student learning?

Methods

Participants

This longitudinal study was conducted during the summer semester of 2020 during a period of remote learning at University of the Incarnate Word Rosenberg School of Optometry. Seventeen full-time (greater than 16 credit hours) optometry students in their third year (OPT III) were recruited using flyers placed in their school mailboxes and in common-use areas. Participation was voluntary and had no impact on students' grades. No compensation was provided beyond participants being allowed to keep their activity trackers upon completion of the study. Enrollment required students to complete a pre-study questionnaire and wear a wrist-based accelerometer (WBA) for 30 days (21-day minimum). Exclusion criteria included pregnancy or nursing.

Study approval

This study was approved by the Institutional Review Board and was in compliance with the Declaration of Helsinki. All subjects provided written informed consent.

Data collection

Two sets of passively recorded sleep data, from summer 2019 (n_{19} = 34) and summer 2020 (n_{20} = 15), were analyzed and compared. All subject data were de-identified, and unique identification numbers were used to track each participant. No subjects were duplicates in the 2019/2020 cohorts. Data were stored on password-protected cloud systems.

Pre-study questionnaire

Pre-study questions included demographics, perceived sleep patterns, subjective sleep quality and various social behavior metrics (e.g., meal regularity, caffeine consumption and exercise). Only gender and age were considered in this assessment of WBA-based data.

Wrist-based accelerometers

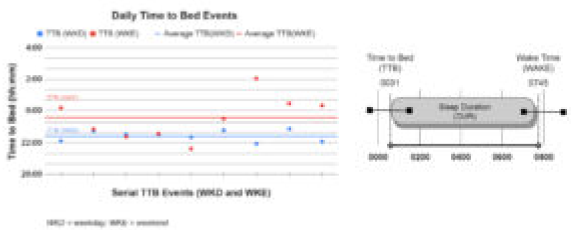

Figure 1. Example of serial (i.e., does not correspond to a specific date) WKD and WKE sleep event data (time to bed) collected using wrist-based accelerometers (left) for a single subject, including average TTB WKD (blue line) and average TTB WKE (red line). The information was used to create subject and cohort sleep profiles (right). Click to enlarge

Participants were provided a WBA, commonly referred to as an activity tracker. The WBAs (Xiaomi Mi Band 2, Taipei, TW) in this study utilized movement and heart rate to measure TTB, DUR and WAKE events for all subjects.[15] All participants were encouraged to wear the WBA throughout the day and night for the duration of the study. Passive data collection was then used to create sleep profiles for each participant and cohort **(Figure 1)**.

Statistical analysis

The data were collected and analyzed using Google Sheets (Mountain View, CA) and XLMiner Analysis ToolPak (Incline Village, NV). Jarque-Bera test was applied to confirm the data were normally distributed, and F-test was used to confirm equal variance ($p > 0.05$ for all data sets). Therefore, an unpaired t-test was utilized for comparison with a similar cohort (OPT III) during the same time frame, 1 year prior (summer 2019). Findings were considered statistically significant if the p-value was less than the pre-specified alpha of 0.05 for the various categories.

Results

Twenty subjects (out of 68) completed the pre-study questionnaire, of which 15 (2 male and 13 female; mean [SD] age, 25.3 [1.6] years) successfully wore the WBA and tracked their sleep for 30 days (minimum: 25 days, average: 28.8 days). The data were then compared to a cohort of 45 (out of 61) students, of which 34 (13 males and 21 females; mean [SD] age, 25.6 [1.9] years) successfully completed the study during summer 2019 (in-person learning), using the same method described above.

Mean sleep duration

TABLE 1
Mean Sleep Metrics 2019 vs. 2020

Event	2019	2020	Diff	p-value
DUR WKD	6h41m±57m	7h37m±44m	+56m	<.001*
DUR WKE	8h05m±58m	7h35m±40m	-30m	0.05*
DUR Avg	7h07m±44m	7h37m±40m	+30m	0.03*
TTB WKD	00:33±74m	00:20±65m	-13m	0.53
TTB WKE	01:19±90m	00:48±57m	-31m	0.17
TTB Avg	00:43±72m	00:31±60m	-12m	0.57
WAKE WKD	07:14±43m	07:57±54m	+43m	0.01*
WAKE WKE	09:24±86m	08:23±63m	-61m	0.01*
WAKE Avg	07:50±52m	08:08±55m	+18m	0.28

** indicates a statistically significant change during lockdown*

Table 1. Summary sleep metrics comparing the 2019 and 2020 cohorts (mean±SD). Click to enlarge

WBA data showed mean [SD] DUR to be 7h37m [40m] during the lockdown **(Table 1)**. The 2020 subjects received significantly more sleep than the 2019 subjects (7:07 [44m] vs. 7:37 [40m], $p = 0.03$). WBAs allowed for differentiating between weekday (WKD – Sunday, Monday, Tuesday, Wednesday, Thursday) and weekend (WKE – Friday and Saturday) sleep patterns. Each measure consisted of the night they fell asleep (TTB) and their WAKE. For example, Friday sleep data would consist of TTB Friday evening and WAKE Saturday morning. Mean WKD DUR was 56 minutes more than pre-pandemic values (6h41m [57m] vs. 7h37m [44m]). Mean WKE DUR was 30 minutes less than pre-pandemic values (8h05m [58m] vs. 7h35m [40m]). Students were getting significantly more sleep during the week ($p < 0.001$), significantly less sleep during the weekend ($p = 0.05$) and significantly more sleep overall ($p = 0.03$) as compared to 2019 sleep data **(Figure 2)**.

Time to bed

WBA data showed the overall mean [SD] TTB to be 00:31 [60m], which was 12 minutes earlier than in 2019 (00:43 [72m]). WKD TTB was measured to be 00:20 [65m], which was 13 minutes earlier than in 2019 (00:33 [74m]) and not statistically significant ($p = 0.53$). Subjects went to bed 29 minutes earlier during the WKE with TTB being 01:19 [90m] and 00:48 [57m] in 2019 and 2020, respectively ($p = 0.17$).

TTB metrics were consistent between cohorts with no statistically significant differences for WKD, WKE or overall average as compared to 2019 sleep data **(Figure 3)**.

Wake time

WBA data showed an overall mean [SD] WAKE of 07:50 [52m] and 08:08 [55m] in 2019 and 2020, respectively (p = 0.28). WKD WAKE was delayed by 43m (07:14 [43m] vs. 07:57 [54m], p = 0.01) in 2020 compared to 2019. Conversely, WKE WAKE was earlier (09:24 [86m] vs. 08:23 [63m], p = 0.01) during the pandemic as compared to 1 year prior. Students' WAKE was significantly later during the week, significantly earlier during the weekend and held steady on average as compared to 2019 sleep data **(Figure 4)**.

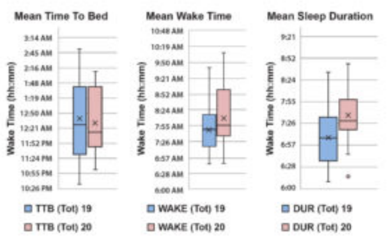

Figure 2. Mean TTB (left), WAKE (middle) and DUR (right) sleep metrics comparing 2019 with 2020. Students had earlier mean bedtimes (p = 0.57), later wake times (p = 0.28) and received significantly more sleep (p = 0.03) during the pandemic. The "x" represents the mean, the solid line denotes the median, the "?" represents potential outliers and the whiskers indicate the maximum and minimum range for each data set. Click to enlarge

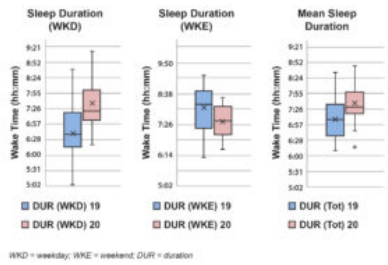

Figure 3. Compared to the 2019 cohort, students in the 2020 cohort were getting significantly more sleep during the week (p < 0.001), significantly less sleep during the weekend (p = 0.05) and significantly more sleep overall (p = 0.03). The "x" represents the mean, the solid line denotes the median, the "?" represents potential outliers and the whiskers indicate the maximum and minimum range for each data set. Click to enlarge

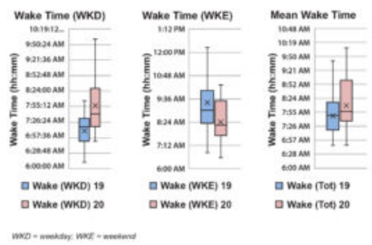

Figure 4. Compared to 2019, students' wake time in 2020 was significantly later during the academic week (p = 0.01), significantly earlier during the weekend (p = 0.01) and held steady overall (p = 0.28). The "x" represents the mean, the solid line denotes the median and the whiskers indicate the maximum and minimum range for each data set. Click to enlarge

Discussion

To the best of our knowledge, this is the first study to examine sleep patterns in optometry students during the COVID-19 lockdowns through passive means over an extended period. To better understand how lockdowns affected optometry school students, we observed an increase in DUR, a delay in WAKE and consistent TTB compared to pre-pandemic sleep patterns. This contrasts with prior studies that found declined sleep quality, elevated levels of stress and insomnia among other university student populations during the COVID-19 pandemic.[16-17]

Sleep duration

Overall DUR during the lockdown was longer and more in line with the recommended 7-8 hours of sleep per night.[18] The greatest increase was observed in WKD DUR as students increased their average sleep time by 56 minutes compared to pre-pandemic values. This was accompanied by a WKE DUR sleep decrease of 30 minutes. This shift between WKD and WKE DUR was likely due to a lack of sleep debt accrual during the academic week.

Time to bed vs. wake time

Studies have also found sleep timing events (TTB and WAKE) to be important metrics in overall sleep quality that correlate with academic performance.[13-15] Minimal change was observed in overall TTB from 2019 to 2020, with TTB being slightly more consistent in 2020. Observed increases in DUR were primarily attributed to shifts in WKD and WKE WAKE. The observed delay in WAKE WKD and advanced WAKE WKE were both statistically significant and consistent with prior research looking into the benefits of delayed school start times.[19] Watson et al. found no significant change in bedtimes but an increase in overall sleep duration as a result of delayed wake times.[19] The American Academy of Sleep Medicine has since stated its support of delayed academic start times for adolescents to reduce sleep deprivation and improve mental health.[19-20] These findings could be used to help guide future discussions related to academic start times and best practices for optimal learning among optometry school students.

Learning and memory processing

The implications for this sleep study go beyond simple behavioral differences. Prior studies have linked sleep duration and consistency with better academic performance.[11-12] Although the mechanism is not well-understood, it is believed the act of sleeping facilitates information restructuring, memory processing and information retrieval.[21] Better sleep has also been linked to stress management, which is a common issue in various health professions.[22] Future efforts to create a well-rounded approach to academic success should incorporate positive sleep habits.

Pandemic's disparate impact

From the outset, public health officials have had concerns around the unequal challenges facing various populations during the COVID-19 pandemic. Depending on one's vocation, socio-economic and pre-pandemic sleep quality status, the impact may differ significantly.[20, 23-24] The first step in managing the potential problems facing optometry students was to evaluate what changes were taking place during this time. Quantitatively, it would appear our subjects improved in some sleep metrics (e.g., TTB and DUR), which have previously been linked to better mental health and a reduction in stress/anxiety during a highly stressful time.[25]

Limitations

These findings should be considered within the context of the following limitations. As with many sleep studies, reliance on proprietary algorithms that have not been validated introduces a degree of systematic error for all measurements. Sleep onset, duration and wake events are calculated through heart rate and movement, which may not consistently differentiate being "in bed" from being "asleep." Unequal sample sizes were also considered as it may limit the statistical power. We look to compare more equal cohorts in future studies. Additionally, the WBAs used in our study were also unable to capture naps, which may have played a larger role during the pandemic due to fewer daytime constraints, as one study suggests.[16]

Conclusion

This study was able to highlight a significant shift in wake times for optometry school students during the COVID-19 lockdowns. The observed increase in sleep duration can be directly correlated with the delayed wake times, most likely due to the flexibility of virtual learning (i.e., asynchronous lectures and increased productivity) and lack of commuting time. Future studies are needed to investigate the relationship between increased sleep duration and academic performance.

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PEER REVIEWED

Impact of Clinically Centered Microbiology and Immunology Coursework on Student Perceptions and Learning Outcomes

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Abstract

With the expanding medical scope of optometric practice, a strong foundational understanding of microbiology and immunology is crucial for optometrists entering the profession. We designed an interdisciplinary curriculum taught by microbiologists, immunologists and clinical optometric faculty that vertically integrated clinical content with basic science concepts. Learning outcomes and student interest were evaluated utilizing survey and summative assessment data. Students had a greater prior background in microbiology than in immunology. Integration of the subjects was well-received and correlated with final grades. Students believed these subjects were important to their careers. This design could serve as a model for other optometry programs.

Key Words: *microbiology, immunology, curriculum, clinical integration, vertical integration, interdisciplinary, basic sciences, optometry, education*

Introduction

For learners entering programs in health professions who have limited or no clinical exposure to patient care, the knowledge gained through the basic science courses is difficult to connect to clinical scenarios. This challenge can be overcome by linking basic science concepts to clinical problems, often through patient-based or case-based learning.[1] Medical schools have realized the importance of including clinical tasks early in the curriculum and have termed the mixing of basic and clinical sciences as *vertical integration.*[2] In a similar fashion, some optometry programs have moved away from the conventional mode of teaching preclinical didactic courses followed by clinical instruction to interlinking the clinical and basic sciences within the curriculum.[3,4]

Infections by a variety of microorganisms are a common etiology of eye diseases encountered in optometric clinical care.[5] Optometrists must be knowledgeable in basic sciences[6] and the recognition of the symptoms and signs of ocular infections by a variety of pathogens. On occasion, optometrists may need to collect specimens from the ocular surface and prepare them for delivery to a lab for analysis.[7] In addition, optometrists develop care plans to eradicate the offending microorganisms, promote tissue healing by taking into account the patient's immunological status, educate the patients and their families, and effectively communicate with other members of the healthcare team. Optometric clinics, as outpatient settings, must comply with infection prevention guidelines to minimize the spread of infectious agents.[8] The study of medical microbiology and immunology allows optometry students in their pre-clinical preparation to appreciate the various pathogens responsible for ocular infections as well as to understand the body's immune responses against the infectious processes.

Two ways microbiology and immunology are taught in optometry programs are as a standalone course, such as the one offered by Nova Southeastern University's College of Optometry (NOVA), or as topics within an integrated curriculum.[3,4] Despite the importance of understanding microbiology and immunology as a foundation for other basic sciences and clinical concepts, some programs have reduced the number of hours for microbiology and immunology. NOVA has similarly seen a decrease in the number of hours for didactic lectures, with microbiology reduced from a 3-credit-hour course to a 2-credit-hour course during the 2019-2020 academic year. Considering the reduction in didactic hours or a reduced number of integrated hours of microbiology and immunology within a systems-based curriculum, it is becoming increasingly necessary for basic science course instructors to include vertically integrated, clinically focused course material in a very limited time frame to deliver a high-yield curriculum.

To emphasize the importance of microbiology and immunology to our pre-clinical optometry students, our goal was to integrate clinically correlated concepts and material into the course. We sought to design a clinically rich, standalone medical microbiology and immunology course that integrated clinical cases into didactic lectures and examinations.[9] In addition, we collaborated with clinical optometric faculty to design co-lectures dedicated to the clinical application of microbiology and immunology to demonstrate the significance of the basic sciences to patient encounters. The clinical application of the basic science topics was assessed in summative examinations, and student satisfaction and perception were monitored by surveys. To the best of the authors' knowledge, no published studies have examined the impact of vertical integration of clinical application in a medical microbiology and immunology course for optometry students.

Methods

Course structure and exams

Microbiology is a required 2-credit-hour first-year optometry course at NOVA. The course covers the basic immunology of the human body and the biology of microorganisms, incorporating a general medical approach to ocular diseases. In the Fall 2020 administration, the course content was delivered by a total of two microbiology, one immunology and two clinical lecturers. The microbiology and immunology lectures were delivered as didactic PowerPoint presentations with and without polling questions for engagement, depending on the lecturer and the topic. Foundational science material was presented covering basic concepts in immunology or microbiology with an overall emphasis on its clinical relevance and application of basic science to diseases using case studies and examples. A series of eight clinical co-lectures (CCLs) and case presentations were delivered by the clinical optometric faculty throughout the course and covered two topics each in immunology, bacteriology, virology and mycology **(Table 1)**. These CCLs integrated foundational science information with clinical course and case presentations to highlight the application of microbiology and immunology body-wide, with an emphasis on the ocular region.

TABLE 1
Clinical Topics Covered in the Microbiology Course

Foundational Science Block	Clinically Integrated Topics		Clinical Correlation Co-lecture Topics
1 Immunology (Exam 1)	Rheumatoid arthritis (Type III/IV hypersensitivity) Macular degeneration Allergic conjunctivitis (Type I hypersensitivity) Vernal keratoconjunctivitis (Type I hypersensitivity) Atopic keratoconjunctivitis (Type I/IV hypersensitivity) Dermatitis (Type I/IV hypersensitivity)	Drug and antibiotic hypersensitivities Giant papillary keratoconjunctivitis Mooren ulcer Ocular immune privilege Sympathetic ophthalmia immunizations	Marginal keratitis Peripheral ulcerative keratitis Sjogren syndrome
2 Bacteriology (Exam 2)	Haemophilus Streptococcus Staphylococcus Neisseria Pseudomonas Chlamydia Corynebacterium Proteus	Mycobacterium Bacillus Treponema Actinomyces Moraxella Klebsiella Enterobacteriaceae	S. aureus infections of eye and adnexa Bacterial keratitis (Pseudomonas)
3 Virology (Exam 3)	Human papillomavirus Molluscum contagiosum virus Influenza virus Human herpesvirus 1-8 Adenovirus Coxsackievirus A Measles virus	Mumps virus Rubella virus Hepatitis A virus Hepatitis B virus Hepatitis C virus Human immunodeficiency virus Coronavirus	Adenoviral conjunctivitis Herpetic eye infections (HHV-1, 2, 3)
3 Mycology (Exam 3)	Candida Fusarium Aspergillus Histoplasma	Pneumocystis Cryptococcus Coccidioides Paecilomyces	Fungal keratitis Ocular histoplasmosis

Table 1. Click to enlarge

Student performance was assessed by three written examinations of 40 multiple-choice questions per assessment, covering lecture presentations, assigned reading material and integrated clinical lectures. These examinations included questions that assessed students' ability to integrate foundational information with clinical scenarios. The first examination tested immunology material (block 1) and contained six case-based questions, two of which came directly from the CCLs. The second examination tested bacteriology material (block 2) and contained 11 case-based questions, two of which came directly from the CCLs. The third examination tested virology and mycology material (block 3) and contained 12 case-based questions, two of which came directly from the CCLs.

Survey and exam administration

Institutional Review Board approval was granted for this study, which employed quantitative methods using surveys to assess student perception of course material as well as multiple-choice examinations to assess understanding and retention of the learning objectives. While class attendance and examinations were a course requirement, completion of the educational surveys as part of this study was not mandated, and students had the option to decline to answer each of the survey questions without penalty. Recruitment was restricted to the 129 students currently enrolled in the microbiology course in Fall 2020. Announcements to participate were made both during class and via the course page on the Canvas Learning Management System,[10] making it clear that participation was entirely voluntary. No incentives were offered to participate. To minimize any potential feelings of coercion, it was announced that data would not be examined or analyzed in any fashion until the final grades for the course were released. All data were de-identified prior to analysis to protect student privacy.

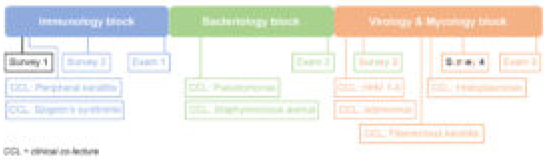

Figure 1. Relative timing of surveys, exams and clinical co-lectures throughout the three blocks of the course. Black text = introductory and concluding surveys before and after blocks; Blue text = block 1 material and survey; Green text = block 2 material and survey; Orange text = block 3 material and survey. Click to enlarge

Between August 2020 and December 2020, 129 students were enrolled in the microbiology course. Of these, 93 were female (72%) and 36 were male (28%). **Figure 1** describes the relative timeline of events for the study. Surveys were designed and administered on ExamSoft, a secure testing digital platform.[11] The first survey was administered at the beginning of the course to gauge students' interest in microbiology and immunology and assess their prior knowledge of the subjects. The following three surveys were given after the delivery of the corresponding clinical correlate lectures and asked students' perspectives on the course material, delivery of course content and perceived relevance to their careers. The second survey covered the perception of immunology (block 1). The third survey combined topics from bacteriology and virology (blocks 2 and 3), while the fourth survey was a concluding survey containing topics from mycology (block 3) as well as questions pertaining to students' experiences with the course overall. In an attempt to lessen student survey fatigue, survey questions for block 3 were divided between the final two surveys, thereby eliminating the need for an additional survey to be administered. All surveys ranged from six to nine questions and were used to assess students' perceptions of the importance and relevance of the subject matter and clinical correlation lectures to their future careers. Surveys used either multiple-choice time-frame options (0, 1, 2, 3, 4, or more semesters) or a Likert scale with four options (strongly agree, agree, disagree, and strongly disagree). Responses to four prompts were assessed: (1) How many semesters of microbiology did you take before starting in the College of Optometry? (2) How many semesters of immunology did you take before starting in the College of Optometry? (3) Medical immunology is important to my future career (4) Medical microbiology is important to my career.

Three multiple-choice examinations of 40 questions each were administered using ExamSoft throughout the semester. Exam questions based on the clinical lectures and case-based foundational lectures were administered as part of the regular examinations that assessed student understanding of the course learning objectives. One hundred and twenty total multiple-choice questions were administered over the course of the semester. Of those, six clinical case-style questions assessing the material presented during the case-based and clinical lectures were administered as part of the immunology exam, 11 as part of the bacteriology exam, and 12 as part of the virology and mycology exam. There were eight multiple-choice questions from a total of 120 exam questions based on the material delivered by clinical faculty – two from immunology, two from bacteriology, two from virology, and two from mycology. Table 1 lists the integrated topics covered on each exam.

Data analysis

Data were analyzed and graphed using GraphPad Prism version 9.1.1.[12] Simple linear regression was performed on the raw data. A p value < 0.05 was considered significant. Simple descriptive statistics and tables were constructed using Microsoft Excel version 16.50.

Results

To determine whether the microbiology semester-long course redesign met the objectives of our study, four surveys were administered over the course of the semester (Figure 1). Data reported in this study were drawn from questions present on surveys 1, 2 and 4. Data from all other survey questions were inconclusive (data not shown). Not all students took all four surveys, and out of those who took the surveys, not all answered all questions. At the beginning of the course, 110 students responded to the questions “Medical immunology is important to my future career” and “Medical microbiology is important to my career” using a Likert scale with four options: strongly agree, agree, disagree, and strongly disagree (survey 1; 110 respondents, 85%). Students were then asked the same questions once the immunology (survey 2; 101 respondents, 78%) and microbiology (survey 4; 88 respondents, 68%) subjects were delivered.

Overall student response rate to microbiology course redesign

Anecdotally, there was noticeable excitement and increased engagement from students after each clinical lecture. Students voluntarily returned the surveys in large numbers. Survey 1, the pre-course survey, had 110 respondents (85%), survey 2 had 101 respondents (78%), and survey 4, the post-course survey, had 88 respondents (68%). Additionally, students performed well overall in the course with a class average of 82%.

Prior student experience in microbiology and immunology coursework

TABLE 2
Students' Previous Experience with Microbiology and Immunology

	0	1	2	3	4	> 4
How many semesters of microbiology did you take before starting in the College of Optometry?	1 (1%)	**95 (86%)**	10 (9%)	3 (3%)	0 (0%)	1 (1%)
How many semesters of immunology did you take before starting in the College of Optometry?	**73 (66%)**	35 (32%)	2 (2%)	0 (0%)	0 (0%)	0 (0%)

Table 2. Click to enlarge

Most students reported having some background in microbiology, with a majority of responding students (86%) reporting taking one semester of microbiology prior to matriculating in the College of Optometry. Fewer students had an immunology background, with a majority (66%) having never taken immunology, and 32% having taken only one semester of immunology prior to starting the optometry program **(Table 2)**.

Assessment of students' perceptions of the importance of microbiology and immunology

The results of the pre- and post-course survey question regarding student perception of the importance of medical immunology to their career indicated most students had a positive association and either agreed or strongly agreed **(Figure 2)**. In total, there were 110 respondents to this question on survey 1 and there were 88 respondents to this question on survey 4. There were no statistically significant differences between the pre- and post-surveys (paired t test, $p > 0.05$) for this question. Perception of medical microbiology as important to their career also indicated that most students had a positive association and either agreed or strongly agreed **(Figure 3)**. In total, there were 110 respondents to this question on survey 1 and there were 88 respondents to this question on survey 4. There were no statistically significant differences between pre- and post-surveys for this question (paired t test, $p > 0.05$).

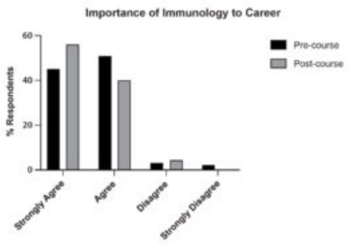

Figure 2. Student responses to the question "Medical immunology is important to my future career" given at the beginning (pre-course) or end (post-course) of the microbiology and immunology course.
Click to enlarge

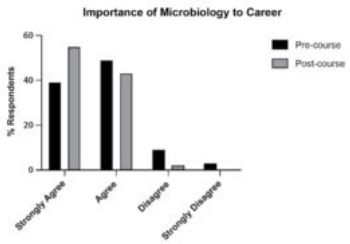

Figure 3. Student responses to the question "Medical microbiology is important to my future career" given at the beginning (pre-course) or end (post-course) of the microbiology and immunology course.
Click to enlarge

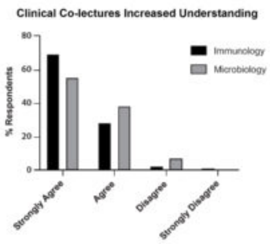

Figure 4. Student responses to the question "I feel incorporating clinical correlation into the medical immunology/microbiology section of this course is helpful to my understanding of the course material and how it will apply to my future career as an optometrist."
Click to enlarge

Students were assessed at the conclusion of the immunology (block 1) and microbiology sections (blocks 2 and 3) of the course about their opinions on the usefulness of integrating clinical correlations into the medical microbiology and immunology material with the questions "I feel incorporating clinical correlation into the medical immunology section of this course is helpful to my understanding of the course material and how it will apply to my future career as an optometrist" (survey 2) and "I feel incorporating clinical correlation into the medical microbiology section of this course is helpful to my understanding of the course material and how it will apply to my future career as an optometrist" (survey 3). Among 104 respondents, 97% responded positively to the statement that incorporating clinical correlation into the medical immunology section of the course was helpful to their understanding of the course material, with 69% strongly agreeing **(Figure 4)**. Similar results were observed regarding the medical microbiology section with 93% of respondents responding positively to the statement and 55% strongly agreeing out of a total of 100 respondents (Figure 4).

Clinical case-style exam questions based on the clinical lectures and case-based foundational lectures were used to assess students' understanding and appreciation of the clinical integration in this course. A total of 29 case-style questions were used. As students answered more clinically correlated questions throughout the course correctly, their final grades in the course increased in a linear fashion **(Figure 5)**. Simple linear regression of the relationship is well-represented in a line of best fit with the equation Y = 1.975*X + 35 with a goodness of fit (R^2) = 0.9527. This slope of the resulting regression line is significantly different from zero ($p < 0.0001$). Increased understanding of clinical application overall appears to increase understanding of all the material, including foundational material, indicating an increase in learning outcomes overall.

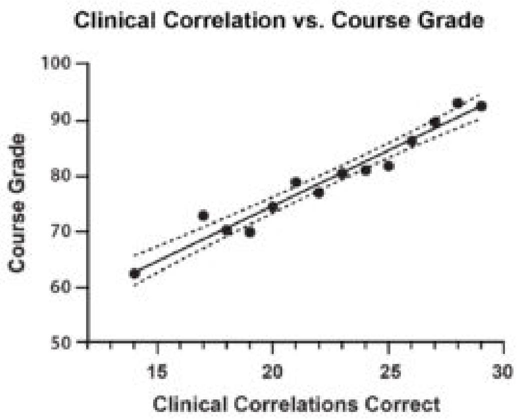

Figure 5. The plot of average course grade earned vs. the number of all clinical correlation questions from the course that students got correct on exams. Linear correlation was observed with a line of best-fit Y = 1.975*X + 35 with a goodness of fit (R2) = 0.9527 (n=129). The dotted lines show 95% confidence intervals. Click to enlarge

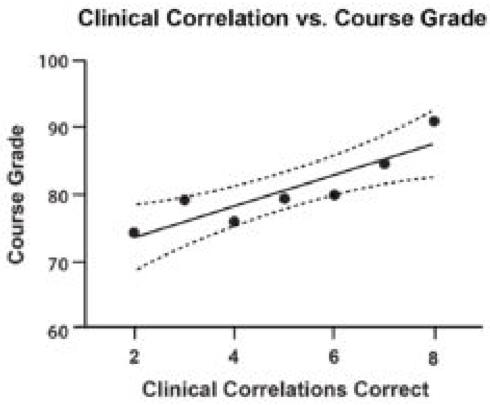

Figure 6. The plot of average course grade earned vs. the number of clinical correlation questions specific to the clinical co-lectures that students got correct on exams. Linear correlation was observed with a line of best fit Y = 2.343*X + 68 with a goodness of fit (R2) = 0.7961 (n=129). The dotted lines show 95% confidence intervals. Click to enlarge

Further analysis of the questions strictly arising from the CCLs was also predictive of overall success in the course. Eight multiple-choice questions over the semester were based on the clinical faculty co-lecture material. Success on these eight questions was highly predictive of overall success in the course as measured by the exam average **(Figure 6)**. Simple linear regression of the relationship is well-represented in a line of best fit with the equation Y = 2.343*X + 68 with a goodness of fit (R^2) = 0.7961. This slope of 2.343 is significantly different from zero ($p < 0.0001$). Thus, using the number of correct responses to the clinical correlate questions exclusively as a proxy for increased understanding of the material is reasonable and objectively validates student feelings towards the clinical co-lecture material (Figure 4).

Discussion

This study is the first to elucidate the relevance of an integrated microbiology and immunology curriculum adapted to teach optometry students the knowledge necessary for their clinical practice. Previous studies have looked at integrating clinical education in microbiology coursework for medical students[13]; however, optometry students require clinical education in the classroom that matches their area of specialization. The overarching goal of our course design was to enhance student perception and performance within the course itself, which our data suggest was a success.

By introducing clinical material early in pre-clinical education, we sought to enhance our optometry students' clinical knowledge. We believe this is particularly important given that with the aging U.S. population, optometric practices are likely to become more medically oriented and will play a larger role in the diagnosis and management of ocular infectious diseases.[14] In addition, the knowledge gained through microbiology and immunology coursework is vital in complying with infection prevention guidelines and understanding how to protect optometrists, staff and patients from infections commonly spread in optometry practices.

The most current curriculum comparison of U.S. optometry schools was published in 2003 and discussed a reduction in the number of hours for didactic studies in the 2001-2002 school year when compared with previous years (1991-92 and 1995-96).[15] Our program has seen a similar shift. We believe one way to make a standalone microbiology and immunology course successful and meaningful to optometric student education is to mimic the vertical integration seen in programs that use systems-based curricula. Therefore, we used a two-pronged approach in the design of our microbiology and immunology course.

This study incorporated a quantitative approach, which allowed course instructors to evaluate students' perceptions of the usefulness of the integrated model to learning through survey-based questions and student feedback as well as quantitative evaluation through exam scores. Survey responses gave insight into students' perceptions of the relevance of the coursework. This metric was important to evaluate because it has been shown that when students perceive what they are learning matches their goals, they are more likely to engage with the material presented to them.[16] Students found the clinical integration useful, and this was reflected in the individual exam scores that increased linearly with increased performance on clinical lecture-based questions. Thus, introducing clinical lectures into microbiology and immunology coursework appears to improve student engagement and performance in the course. It is important to note that this was achieved without any additional resources or budget as clinical optometric faculty are commonly employed by optometric programs. There is a cost associated with faculty time devoted to providing clinical lectures. However, in our program, clinical faculty are given service hours to the college that allowed them to participate in the course.

According to the 2020 Association of Schools and Colleges of Optometry's "Optometry A Career Guide," microbiology, but not immunology, is a common prerequisite course for admission to U.S. optometry programs.[14] Therefore, most students enter optometry programs, including ours, with a baseline knowledge of microbiology. In our study, students' prior knowledge of microbiology was not quantitatively assessed before the start of the course; therefore, it is possible that their previous level of exposure to microbiology could impact their perception of the relevance of the coursework and their performance on assessments in the course. Results of the pre- and post-course survey question regarding students' perception of the importance of medical immunology to their career in our study were not significantly different from each other (paired t test, $p > 0.05$) in large part due to an overwhelmingly positive agreement to the question. However, it was notable that while overall student perception of the importance of medical immunology to their career was 95% (pre-course) and 96% (post-course) positive, the course increased the number of students who "strongly agreed" by 11% and eliminated all answers of "strongly disagree."

The perception of medical microbiology as important to the students' career was also not significantly different before and after the course (paired t test, $p > 0.05$) due in large part to a strong positive response to the question with 88% of students either agreeing or strongly agreeing. However, there was a 10% increase in positive perception to 98% of total respondents who were asked if medical microbiology was important to their career after the course. Among positive respondents, 16% more "strongly agreed" after the course, and there were no longer any students who "strongly disagreed."

Future studies should address this concern. The relative dearth of research articles regarding optometric curricula also appears to echo this lack of emphasis. At the same time, there is a wealth of research articles regarding microbiology and immunology in other health professions, particularly regarding clinical correlations of the material.[13,17] In addition, the current study was limited in scope to one class in one optometry program in the United States. It would be illustrative to see the results of a longitudinal study in multiple programs across the country to see whether these results remain consistent and are widely applicable.

Conclusions

At the beginning of our course, most students had prior experience taking microbiology courses, while few had the same previous experience taking immunology courses. Irrespective of that prior experience, most students believed both subjects were important to their future career as optometrists. Vertical integration of clinical content throughout the foundational course in microbiology and immunology was well-received by the students. In addition, students' course performance was positively impacted by the clinical integration as measured by performance on examinations. While not directly assessed, our results suggest that a clinically focused microbiology and immunology course in an optometric program, and not simply prerequisite microbiology, can positively impact students' learning experience in their preclinical years. It remains to be seen whether this success carries over into subsequent, more clinically focused courses as well as students' careers as optometrists.

Given our results, a multi-institutional, longitudinal study looking at the impact of clinically focused microbiology and immunology courses in optometric programs vs. only pre-requisite microbiology on academic and clinical performance is warranted. Future studies may also consider different clinically based integrations, such as case-based, team-based and problem-based learning approaches to promote discussion, invite questioning and encourage self-directed student learning.

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Features

Announcement

Call for Papers: Theme Edition to Focus on Global Optometric Education

| *Optometric Education: Volume 48 Number 2 (Winter-Spring 2023)*

We are pleased to announce a theme edition of the journal that will be dedicated to global optometric education. We welcome manuscript submissions that highlight research, curricula, pedagogy, public health initiatives and other projects that align with the theme edition's mission of sharing ongoing efforts to advance the profession of optometry worldwide.

You may submit your manuscript in the customary format [https://journal.opted.org/publication-guidelines/] or as an informational report or article. Content-specific reviewers will be assigned to support atypical submissions.

The submission deadline for this theme edition is January 31, 2024. Send your cover letter with an intact and blind copy of your manuscript to submissions@opted.org. Email *Optometric Education* Editor Keshia Elder, OD, MS, MS, FAAO, if you have any questions about the theme edition.

Editorial

It is Time to Take a Hard Look at Student Entitlement

Aurora Denial, OD, FAAO, DAAO (OE) | Optometric Education: Volume 48 Number 2 (Winter-Spring 2023)

Aurora Denial, OD, FAAO, DAAO (OE)

In my tenure as Editor of *Optometric Education*, I have never been as compelled to pursue a topic in this editorial as I am to pursue the topic of student academic entitlement. Since my previous editorial on the subject,[1] I have spoken with numerous faculty and administrators in various graduate and undergraduate settings who overwhelmingly expressed frustration and anger about the issue as well as their perception of a lack of administrative support.

Causes and Effects

My previous editorial touched on several aspects of student entitlement, including how it has been defined, probable causes ? a repercussion of narcissism and a shift toward the idea of student as consumer ? and consequences.[1] To the list of potential causes, Rinsley adds the theory that entitlement is related to the failures of family, schools and government to prepare young people for the responsibilities of being part of a society and a result of growing threats to attaining future goals, diminishing purchasing power and uncertainties related to the environment, world stability or financial success.[2] These factors, he suggests, led to a model of instant gratification with a theme of “success without effort and income without productivity.”[2]

As far back as 1986, Dubovsky pointed to the student-as-consumer mindset when he reported what he observed as five features of entitlement in medical education: 1). “Knowledge is a right that should be delivered with minimal exertion and discomfort on the part of the consumer.” 2) “A passivity associated with the expectation that others will provide all the education that will be necessary.” 3) “Problems in learning are due to the inadequacies of the teacher, the course, the system, rather than the student’s own shortcomings.” 4) “One should receive equal recognition and reward regardless of individual effort and ability.” 5) “The entitled student is justified in feeling good by making others feel bad, for example by addressing grievances through hostile and disrespectful behavior. Discussion of the student’s behavior is thought to generate stress.”[3]

Others have described the student/consumer concept as a belief held by some students that because they are paying for their education, they deserve to be treated as consumers.[4,5] Further, as consumers, they expect to be able to participate in the education process according to their preferences and be catered to.[5]

The negative effects of student entitlement are many and include grade inflation, disruptive student behavior in the classroom, faculty changing their teaching methods in ways they would rather not, and decreased faculty morale.[4] Additionally, students' expectation of personal excellence may decline, especially if it involves personal sacrifice.[3] This is compounded by the avoidance of any situation perceived as difficult or anxiety-producing.[3]

I have personally encountered student entitlement several times in the past year. On multiple occasions, students who had missed a deadline and consequently lost points emailed me to explain and request the points. While their emails were respectful and polite, and I was sympathetic to their circumstances, I explained why it was important to stick to the criteria outlined in the syllabus. The repeated emails and personal requests made the temptation to concede difficult to resist. Frankly, the situation felt emotionally exhausting.

How Can We Approach the Current Reality?

I found Dubovsky's 1986 description of student entitlement applicable to today. It is interesting that he reported on student entitlement that long ago, yet most of the recently published papers on the subject associate its characteristics with the Millennial generation (born 1981-1996) and Gen Z (born 1997-2010). In 1986, Millennials were very young or not born. It may be that changes in the world and in academia have empowered students in ways not possible in the 80s, making our experience with entitlement more pronounced. Technology, which enables on-demand communication, information and social connectivity, has likely contributed to the desire for instant gratification and made the entitlement mindset more common. Also, tuition at colleges and graduate schools has increased, and many institutions are tuition-dependent. In many instances, previous education experiences have set a precedent of supporting student demands, which further enables entitlement.

While it is potentially informative to ponder how the problem rose to this level, the reality is we must deal with the current cohort of students who have a growing sense of academic entitlement. Certainly paying tuition does not buy students the right to dictate to faculty and administrators the course of the education experience and ultimate granting of a degree. Faculty and administrators should be viewed as the experts in both the content and delivery of education. But why do faculty and administrators feel pressure to give way to the demands of entitled students? In addition to the emotional stress, faculty face the threat of unwarranted negative course evaluations from students, and administrators likely fear negative public reviews of their institutions and have concerns about the sustainability of programs and ability to recruit the most qualified students.

Students, most of whom take their responsibilities seriously, are an important source of information regarding their education experience. However, the view that anything that makes learning difficult is an unfair imposition should not be tolerated.[3] We need to find a way to support and work with students while maintaining a high level of expectations and requirements. Giving in to all student demands is not a responsible approach and sends a message that entitled attitudes and behavior are OK.

The journal welcomes hearing about your experiences with student academic entitlement and any recommendations you have for dealing with this important issue.

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