

Prevalence and Progression of Ametropias in Medical Students

Gustavo Costa Santos,¹ Rafael Cunha de Almeida,² Willany Veloso Reinaldo,¹ Fernando Rocha Oliveira,³ Shaun Schofield,⁴ Roberto Conde Santos,⁵ Gláucia Luciano da Veiga,⁶ Fernando Luiz Affonso Fonseca,⁶ Vagner Louduca Lima,⁷ Renato Galão Cerquinho Leça.⁷

Abstract

Background: Uncorrected refractive errors (Myopia, Hyperopia and Astigmatism) are one of the main causes of poor vision, attributing to 43% of vision deficiencies. Myopia is the most common visual disorder in the world and can progress up until the age of 20-25, when many people are in university. The etiological factors that cause myopia are still unclear and deserve to be studied. Our aim was to identify the prevalence of ametropias and self-perception of ophthalmic health in medical students at the Centro Universitário Saúde ABC/FMABC. **Methods:** This is a cross-sectional study with data collected at Centro Universitário Saúde ABC/FMABC from medical students. A total of 232 students participated in the survey, from the 1st to the 4th year of study. Data was obtained through a questionnaire, which evaluates ophthalmologic health, ametropia, and self-perception. **Results:** It was observed that 74.57% of the students had some type of ametropia, myopia being the most recurrent (59.05%). The study shows significant data of an increase in the grade of students from 1st to 4th grade throughout college. It was observed that the average daily study time of the students was 9.68 hours and abuse in the use of electronic devices. **Conclusion:** This study presented a high prevalence of ametropias among medical students at the Centro Universitário ABC/FMABC, in addition to a high prevalence of multifactorial myopia and an increased need to update their diopters (degrees) during the course of university.

Key Words: Refractive errors; Medical students; Brazil. (Source: MeSH-NLM).

Introduction

The promotion of eye health is a basic principle in increasing the quality of life because a better visual capacity allows the development of capabilities, improvement in school performance, and full participation in society.¹ According to the World Health Organization (WHO),² uncorrected refractive errors (Myopia, Hyperopia and Astigmatism) are one of the main causes of low vision, attributing 43% of vision deficiencies.³

Myopia is the visual disorder that deserves to be highlighted in this scenario. It is a pathology in which the image is focused before it reaches the retina, causing distant images to be visualized with low clarity. It is estimated that by 2020 the prevalence of myopia will be 23% in the world population, and by 2050 that prevalence will be about 50%.⁴ In Brazil, this prevalence varies from 11% to 36%, representing approximately a population between 22 and 72 million people.⁵

Despite the high prevalence in the population, the development of refractive errors is still an unclear issue, mainly regarding the possible etiological factors.⁶ As much as heredity is known as the main factor influencing the development of a refractive disorder, lifestyle appears to be a factor of great attention for ophthalmologic studies. The excessive utilization of vision for studies, which includes frequent and regular reading, in addition to studies with a continuous focus, apparently also constitute a risk factor.⁷⁻⁸

Thus, studies describe a high prevalence of refractive errors in students from various fields.⁹ Among the most prevalent groups are medical students, who due to a lifestyle with intensive studies for several years, constitute a group at risk for myopia and worsening of vision after the beginning of the study.⁹⁻¹⁰ Thus, the present work aims to identify the

prevalence of ametropias (refractive error) and self-perception of ophthalmic health in medical students of the Centro Universitário Saúde ABC/FMABC, in the metropolitan region of São Paulo, Brazil.

Methods

This is a cross-sectional study of medical students at the Centro Universitário ABC/FMABC, carried out from July 2017 to July 2020. The study was approved by the Ethics Committee of Centro Universitário ABC/FMABC (protocol number 2.391.695) and is in line with Resolution 466/12 of the National Health Council.

Selection and Description of Participants

The sample consists of 232 medical students from the first to the fourth year, without restrictions regarding gender or age. Data was obtained through a self-administered questionnaire structured by the researcher himself, consisting of twelve dissertation questions.¹¹ Oral or written consent was obtained from study participants.

Administration of the questionnaire occurred during the class period. The students were identified by the following information: initials, age, sex, type of visual disorder (Myopia, Hyperopia and Astigmatism), methods of correction used, interest in refractive surgery, daily time devoted to studies, daily time spent using technology, and heredity. This study was carried out in accordance with the relevant guidelines and regulations/ethical principles of the Declaration of Helsinki.

Statistics

Descriptive statistics were used to describe and summarize the data set, presenting distributions in measures of central tendency and variability, mean, and standard deviation. Age comparison was

¹ MD, Disciplina de Oftalmologia, Centro Universitário ABC, Santo André, Brasil.

² MD, MSc, Disciplina de Oftalmologia, Centro Universitário ABC, Santo André, Brasil.

³ MD, Laboratório de Delineamento de Estudos e escrita científica Centro Universitário ABC, Santo André, Brasil.

⁴ MD, Utah Valley University, Orem, United State of America, United States.

⁵ MD, Universidade Federal de Alfenas, Alfenas, Brasil.

⁶ MSc, PhD, Laboratório de Análises Clínicas, Centro Universitário ABC, Santo André, Brasil.

⁷ MD, PhD, Disciplina de Oftalmologia, Centro Universitário ABC, Santo André, Brasil.

About the Author: Gustavo Costa Santos is an MD up to 1 year after graduation in Centro Universitário ABC/FMABC, Santo André, Brazil. He is now an MD in the Brazilian military service.

Correspondence:

Gláucia Luciano da Veiga

Address: Av. Lauro Gomes, 2000 - Vila Sacadura Cabral, Santo André, Brazil

Email: grlveiga@gmail.com

Editor: Paul Morgan

Student Editors: Anđan Mujanovic, Anup Chalise

Copyeditor: Ciara Egan

Proofreader: Madeleine Jemima Cox

Layout Editor: Francisco J. Bonilla-Escobar

Submission: Oct 28, 2020

Revisions required: Dec 14, 2020, Jan 26, 2021

Received in revised form: Dec 18, 2020, Jan 26, 2021

Acceptance: Apr 6, 2021

Publication: Jun 30, 2021

Process: Peer-reviewed

performed by Kruskal-Wallis test. To assess the sample normality, the Shapiro-Wilk test was performed, and the variables were considered normal for p -value > 0.05 . For qualitative variables, the absolute and relative frequency were calculated. For qualitative variables, the Chi-Square test was used. To define the sample number the GPower software version 3.1 was used. The significance level adopted was 5%. The statistical program used was Stata® version 12.

Results

Our sample consisted of 232 students, with the majority female at 157 (68%) students and the average age of the students at 22 ± 2 years old. Among the self-declared changes were astigmatism, both hyperopia and astigmatism; myopia; and astigmatism.

The time that students spend in front of electronic devices daily deserves to be highlighted. Only 26% of students spend less than one hour in front of electronic media, with 47% between 1-5 hours, 22% between 6-11 hours, and 4% for more than eleven hours a day. (Table 1).

Among the sample, 173 (75%) students reported some type of ametropia and 59 (25%) reported no type of ametropia. In relation to ametropias, myopia presented a higher prevalence followed by astigmatism and hyperopia (Table 2). When analyzing the ametropias among the students according to the year of course, there was no statistically significant difference. In relation to age, a significant difference was observed between the years of the course, the fourth year with the highest mean age.

Table 3 shows the increase in the grade (diopeters) of students throughout the medical course ($p < 0.001$). There is a strong trend in the perception of worsening vision of the students during the course

Table 2. Distribution of the Ametropias According to Year of the Course.

Variable	1st Year	2nd Year	3rd Year	4th Year	Total	p-value
Age, mean (SD)	19.8±2.1	21.1±2.0	22.2±2.2	23.1±2.4		<0.001**
Ametropia, n (%)						
Yes	33 (63.46)	40 (81.63)	33 (73.33)	67 (77.91)	173 (74.57)	0.157
No	19 (36.54)	9 (18.37)	12 (26.67)	19 (22.09)	59 (25.43)	
Astigmatism, n (%)						
Yes	19 (36.54)	26 (53.06)	20 (44.44)	41 (47.67)	106 (45.69)	0.393
No	33 (63.46)	23 (46.94)	25 (55.56)	45 (52.33)	126 (54.31)	
Hyperopia, n (%)						
Yes	6 (11.54)	5 (10.20)	1 (2.22)	7 (8.14)	19 (8.19)	0.366
No	46 (88.46)	44 (89.80)	44 (97.78)	79 (91.86)	213 (91.81)	
Myopia, n (%)						
Yes	26 (50.00)	31 (63.27)	28 (62.22)	52 (59.77)	137 (59.05)	0.497
No	26 (50.00)	18 (36.73)	17 (37.78)	34 (39.53)	95 (40.95)	

Legend: * Chi-square $p < 0.05$; **Kruskal-Wallis $p < 0.05$; SD- Standard Deviation

Discussion

This study found a high prevalence of ametropias among students. The results of the study show significant differences in relation to the grade increase reported by students since entering the course.

It was observed that 75% of the students of the Medicine course at Centro Universitário ABC/FMABC (FMABC) from the first to the fourth academic year had some ametropia, with myopia being the most recurrent in 59% of the cases. This prevalence is higher than the average of the world population, which estimates that 22% of the world population has myopia.⁴

It is believed that the highest prevalence of myopia is observed in adults in Southeast Asia.¹² A study carried out with populations of average age similar to the current one, with a sample of 15 to 25 years

Table 1. Population Demographics.

Variable	n (%)
Sample	232 (100)
Age, mean (SD)	21.8±2.5
Sex	
Female	157 (67.67)
Male	75 (32.33)
Graduation Year	
1st Year	52 (22.41)
2nd Year	49 (21.12)
3rd Year	45 (19.40)
4th Year	86 (37.07)
Self-declared Ametropias Changes	
Astigmatism	17 (7.33)
Hyperopia	5 (2.16)
Hyperopia and Astigmatism	14 (6.03)
Myopia	62 (26.72)
Myopia and Astigmatism	75 (32.33)
None	59 (25.43)

($p=0.06$). Furthermore, the time spent in front of electronics daily was one of the factors that may have influenced the worsening of vision of the participants. Table 4 illustrates the ophthalmological characteristics of the students with ametropias, according to the year of the course. No statistically significant difference was observed between any variables studied.

Table 3. Student Characteristics in Relation to Health Habits and Perception According to Year of Course.

Variable	1st year	2nd year	3rd year	4th year	Total	p-value
Average hours of study, mean±SD	9.9±1.8	9.4±1.8	9.8±1.7	9.5±1.8	9.7±1.8	0.330
Frequency of ophthalmology visits, n (%)						
At least one consultation a year	25 (48.08)	28 (57.14)	28 (62.22)	57 (66.28)	138 (59.48)	0.383
Every two or more years	9 (17.31)	9 (18.37)	4 (8.89)	9 (10.47)	31 (13.36)	
When you believe it is necessary	18 (34.62)	12 (24.49)	13 (28.89)	20 (23.26)	6 (27.16)	
There's been an increase in your grade (diopters) since you went to college, n (%)						
Yes	3 (9.09)	18 (45.00)	18 (54.55)	37 (55.22)	76 (43.93)	<0.001*
No	21 (63.64)	15 (37.50)	13 (39.39)	26 (38.81)	75 (43.35)	
Does not know	9 (27.27)	7 (17.50)	2 (6.06)	4 (5.97)	22 (12.72)	
Do you believe your vision has gotten worse since you went to college, n (%)						
Yes	22 (42.31)	17 (34.69)	9 (20.00)	37 (43.02)	85 (36.64)	0.066
No	29 (55.77)	32 (65.31)	36 (80.00)	46 (53.49)	143 (61.64)	
Does not know	1 (1.92)	0 (0.00)	0 (0.00)	3 (1.92)	4 (1.72)	
Do you believe your eye prescription needs updating, n (%)						
Yes	9 (17.31)	9 (18.37)	6 (13.64)	22 (26.51)	46 (20.18)	0.246
No	40 (76.92)	37 (75.51)	36 (81.82)	61 (73.49)	174 (76.32)	
Does not know	3 (5.77)	3 (6.12)	2 (4.55)	0 (0.00)	8 (3.51)	
Time spent in front of the electronic media daily, n (%)						
Less than 1 hour	15 (28.85)	12 (24.49)	9 (20.00)	25 (29.07)	61 (26.29)	0.053
1h-5h	27 (51.92)	19 (38.78)	19 (42.22)	45 (52.33)	110 (47.41)	
6h-10h	9 (17.31)	12 (24.49)	15 (33.33)	15 (17.44)	51 (21.98)	
11h-15h	1 (1.92)	6 (12.24)	2 (4.44)	1 (1.16)	10 (4.31)	
Daily study time, n (%)						
6h-10h	38 (73.08)	34 (69.39)	27 (60.00)	62 (72.09)	161 (69.40)	0.596
11h-15h	13 (25.00)	15 (30.61)	18 (40.00)	23 (26.74)	69 (29.74)	
Greater than or equal to 16	1 (1.92)	0 (0.00)	0 (0.00)	1 (1.16)	2 (0.86)	

Legend: * Chi-square $p < 0.05$; **Kruskal-Wallis $p < 0.05$; SD- Standard Deviation.

Table 4. Ophthalmological Characteristics of Students with Ametropias, According to the Year of the Course.

Variable	1st year	2nd year	3rd year	4th year	Total	p-value
Age the ametropia was diagnosed, n (%)						
1-5 years	4 (9.52)	0 (0.00)	1 (3.33)	3 (4.62)	8 (4.65)	0.261
6-10 years	6 (14.29)	9 (25.71)	4 (13.33)	8 (12.31)	27 (15.70)	
11-15 years	12 (28.57)	12 (34.29)	11 (36.67)	28 (43.08)	63 (36.63)	
16-20 years	16 (38.10)	11 (31.43)	11 (36.67)	24 (36.92)	62 (36.05)	
21-25 years	1 (2.38)	1 (2.86)	3 (10.00)	2 (3.08)	7 (4.07)	
Does not know	3 (7.14)	2 (5.71)	0 (0.00)	0 (0.00)	5 (2.91)	
Uses glasses, yes [n (%)]	38 (92.68)	34 (94.44)	24 (85.71)	61 (91.04)	157 (91.28)	0.648
No	3 (7.32)	2 (5.56)	4 (14.29)	6 (8.96)	15 (8.72)	
Uses lenses, yes [n (%)]	18 (43.90)	16 (44.44)	15 (53.57)	26 (38.81)	75 (43.60)	0.621
No	23 (56.10)	20 (55.56)	13 (46.43)	41 (61.19)	97 (56.40)	
Eye surgery, yes [n (%)]	1 (2.44)	1 (2.78)	0 (0.00)	1 (1.49)	3 (1.74)	0.835
No	40 (97.56)	35 (97.22)	28 (100.00)	66 (98.51)	169 (98.26)	
Does your father have ametropia, yes [n (%)]	39 (75.00)	39 (79.59)	36 (80.00)	71 (82.56)	185 (79.74)	0.899
No	9 (17.31)	8 (16.33)	6 (13.33)	9 (10.47)	32 (13.79)	
Does not know	4 (7.69)	2 (4.08)	3 (6.67)	6 (6.98)	15 (6.47)	
Does your mother have ametropia, yes [n (%)]	37 (71.15)	40 (81.63)	38 (84.44)	61 (70.93)	176 (75.86)	0.458
No	11 (21.15)	7 (14.29)	4 (8.89)	20 (23.26)	42 (18.10)	
Does not know	4 (7.69)	2 (7.69)	3 (6.67)	5 (5.81)	14 (6.03)	
Does your brother/sister have ametropia, yes [n (%)]	25 (48.08)	26 (53.06)	26 (57.78)	38 (57.78)	115 (49.57)	0.774
No	23 (44.23)	21 (42.86)	16 (35.56)	43 (50.00)	103 (44.40)	
Does not know	4 (7.69)	2 (4.08)	3 (6.67)	5 (5.81)	14 (6.03)	

Legend: * Chi-square $p < 0.05$.

Although the prevalence of ametropias between school years is similar and all of them are high, the current study shows significant data regarding an increase in the grade (diopters) of students from the first to the fourth year of college. To find out the reasons for this increase in diopters in medical students at FMABC, the average time in which students studied and/or read throughout the day was analyzed.

An average study time of 10 hours was obtained, and of this, 7 hours (maximum time of their classes throughout the day) represented the period spent in the classroom. There was an association between the time dedicated to daily studies / readings and a high prevalence of myopia (in addition to the increase in the degree of myopia throughout college).

In a systematic review done in Australia,¹⁶ young people with low time of outdoor activities and high time of use of vision for activities of approximate reading were more likely to be nearsighted. Moreover, it was found that individuals who participate in outdoor activities are more likely to have myopia. In Saudi Arabia,¹⁷ a study regarding the presence of myopia included 504 medical students aged between 18 and 27 years (mean of 21 years), and a high prevalence of myopia was also observed among medical students.

Studies show that myopic young people tend to spend more time on computers, whether reading or writing, during periods outside the work or school environment, than non-myopic young people.¹⁸ The use of computers and electronic averages (at 4hr/day) may be associated with a longer axial ocular length,¹⁹ suggesting that each activity has a unique effect and different mechanism to affect myopia. An association between a higher level of education and the use of electronics (since education involves several types of close work, such as reading and using the computer) could be a factor in the development of myopia.^{20,21}

With regard to heredity, the prevalence of ametropias in parents of the students in the current study was observed, with 80% of fathers having some ametropia and 76% of mothers. However, it is worth mentioning

that presbyopia appears as a highlight in this absolute value, and it is not possible to analyze only the prevalence value of myopia in the parents of the participants, since the majority of students did not know what type of ametropia their parents had. Heredity is considered as the main influencing factor for the appearance of a refractive disorder.⁶⁻⁸ In a study carried out in young people with one or two myopic parents, their risks were two to eight times higher of developing myopia compared to those without myopic parents.²²

The study, by means of a self-reported questionnaire, may underestimate the prevalence of ametropias. Thus, it is possible to say that the prevalence of myopia and the increase in the diopters of medical students at FMABC could be even higher, since 20% of respondents with ametropia(s) stated that they believe that their grade needed updating. In addition, 13% of students usually go to the ophthalmologist every two or more years and 27% when they believe it is necessary.

The limitation of this study included the lack of discrimination between the Medical School years studied, given the possibility that there is a difference in exposure to reading and/or electronic equipment use between the different medical school years. Finally, we could be still apply an analysis of the optical correction method of students with ametropia, remembering that many have both contact lenses and glasses to wear on different occasions; only 2% of respondents have already had refractive surgery, which is understandable, since the minimum average age for indication of refractive surgery is twenty years (according to the First Brazilian Census on Refractive Surgery).²³

The current study shows us a high prevalence of ametropias among medical students at FMABC, especially myopia, when compared to studies in the literature with a similar target population. There is significant data regarding an increase in the grade (diopters) of students from the first to the fourth year throughout college, in addition to a need to update their grade during the course. In the present study, it is worth mentioning the time used for daily study and reading and the abusive use of high-tech electronic devices.

References

- Júnior A, Pinto G, Oliveira D, Holzmeister D, Portes A, Neurauder R. Prevalence of ametropias and ophthalmopathies in preschool and school children in favelas in Alto da Boa Vista, Rio de Janeiro, Brazil. *Rev Bras Oftalmol.* 2007 Oct; 66(5): 304-8.
- World Health Organization. Global magnitude of visual impairment caused by uncorrected refractive errors in 2004 World Health Organization - WHO. Available from: <https://www.who.int/bulletin/volumes/86/1/07-041210/en/>. Last updated August 20, 2020; cited Jan 03, 2021.
- Schiefer U, Kraus C, Baumbach P, Ungewiß J, Michels R. Refractive errors. *Dtsch Arztebl Int.* Oct 2016;113(41):693-702.
- Holden BA, Fricke TR, Wilson DA, et al. Global Prevalence of Myopia and High Myopia and Temporal Trends from 2000 through 2050. *Ophthalmology.* May 2016;123(5):1036-42.
- Wong TY, Ferreira A, Hughes R, Carter G, Mitchell P. Epidemiology and disease burden of pathologic myopia and myopic choroidal neovascularization: an evidence-based systematic review. *Am J Ophthalmol.* Jan 2014;157(1):9-25.e12.
- Holden BA, Wilson DA, Jong M, et al. Myopia: a growing global problem with sight-threatening complications. *Community Eye Health.* 2015;28(90):35.
- Alsaif BA, Aljindan MY, Alrammah HM, Almulla MO, Alshahrani SS. Refractive errors among Saudi college students and associated risk factors. *Clin Ophthalmol.* 2019 Feb 27;13:437-43.
- Lin Z, Vasudevan B, Mao GY, et al. The influence of near work on myopic refractive change in urban students in Beijing: a three-year follow-up report. *Graefes Arch Clin Exp Ophthalmol.* Nov 2016;254(11):2247-55.
- Muhamedagic L, Muhamedagic B, Halilovic EA, Halimic JA, Stankovic A, Muracevic B. Relation between near work and myopia progression in student population. *Mater Sociomed.* Apr 2014;26(2):100-3.
- Mirshahi A, Ponto KA, Hoehn R, et al. Myopia and level of education: results from the Gutenberg Health Study. *Ophthalmology.* Oct 2014;121(10):2047-52.
- Cumberland PM, Chianca A, Rahi JS, Consortium UBEaV. Accuracy and Utility of Self-report of Refractive Error. *JAMA Ophthalmol.* Jul 2016;134(7):794-801.
- Hashemi H, Fotouhi A, Yekta A, Pakzad R, Ostadimoghaddam H, Khabazkhoob M. Global and regional estimates of prevalence of refractive errors: Systematic review and meta-analysis. *J Curr Ophthalmol.* 2017 Sep 27;30(1):3-22.
- Sherwin JC, Mackey DA. Update on the epidemiology and genetics of myopic refractive error. *Expert Rev Ophthalmol.* 2013;8(1):63-87.
- Vitale S, Sperduto RD, Ferris FL. Increased prevalence of myopia in the United States between 1971-1972 and 1999-2004. *Arch Ophthalmol.* Dec 2009;127(12):1632-9.
- Ferraz FH, Corrente JE, Opromolla P, Padovani CR, Schellini SA. Refractive errors in a Brazilian population: age and sex distribution. *Ophthalmic Physiol Opt.* Jan 2015;35(1):19-27.
- Pan CW, Ramamurthy D, Saw SM. Worldwide prevalence and risk factors for myopia. *Ophthalmic Physiol Opt.* Jan 2012;32(1):3-16.
- Almalki NM, Alrajhi AA, Alharbi AH, Mahfouz MS. Prevalence of Refractive Errors and its Associated Risk Factors among Medical Students of Jazan University, Saudi Arabia: A Cross-sectional Study. *Middle East Afr J Ophthalmol.* 2021 Jan 19;27(4):210-7.

18. Khader YS, Batayha WQ, Abdul-Aziz SM, Al-Shiekh-Khalil MI. Prevalence and risk indicators of myopia among schoolchildren in Amman, Jordan. *East Mediterr Health J.* 2006 May-Jul 2006;12(3-4):434-9.
19. Lee YY, Lo CT, Sheu SJ, Lin JL. What factors are associated with myopia in young adults? A survey study in Taiwan Military Conscripts. *Invest Ophthalmol Vis Sci.* Feb 2013;54(2):1026-33.
20. Konstantopoulos A, Yadegarfar G, Elgohary M. Near work, education, family history, and myopia in Greek conscripts. *Eye (Lond).* Apr 2008;22(4):542-6.
21. Wu HM, Seet B, Yap EP, Saw SM, Lim TH, Chia KS. Does education explain ethnic differences in myopia prevalence? A population-based study of young adult males in Singapore. *Optom Vis Sci.* Apr 2001;78(4):234-9.
22. Ip JM, Huynh SC, Robaei D, et al. Ethnic differences in the impact of parental myopia: findings from a population-based study of 12-year-old Australian children. *Invest Ophthalmol Vis Sci.* Jun 2007;48(6):2520-8.
23. Victor G, Urbano A, Marçal S, et al. [First Brazilian refractive surgery survey]. *Arq Bras Oftalmol.* 2005 Nov-Dec 2005;68(6):727-33.

Acknowledgments

None

Conflict of Interest Statement & Funding

The Authors have no funding, financial relationships or conflicts of interest to disclose.

Author Contributions

Formal analysis, data curation, writing the main manuscript, preparation of the figures, review and editing: GCS and RCA. Data curation, writing, review and editing: GCS, WVR. Data curation, formal analysis, preparation of the figures, review and editing: WVR, SS, and RCS. Data curation. and Data curation and editing: GL, FLAF, VLL and RGCL. All authors reviewed the manuscript.

Cite as

Santos GC, Almeida RCd, Reinaldo WV, Rocha Oliveira F, Schofield S, Santos RC, et al. Prevalence and Progression of Ametropias in Medical Students. *Int J Med Students.* 2021 May-Jun;9(2):112-6.

This work is licensed under a [Creative Commons Attribution 4.0 International License](https://creativecommons.org/licenses/by/4.0/)

ISSN 2076-6327

This journal is published by the [University Library System](https://www.library.pitt.edu/), [University of Pittsburgh](https://www.library.pitt.edu/) as part of the [Digital Publishing Program](https://www.library.pitt.edu/) and is co-sponsored by the [University of Pittsburgh Press](https://www.library.pitt.edu/).

