Original Article

Prevalence of Refractive Errors in Iranian University Students in Kazerun

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Abstract

Purpose: To determine the prevalence of refractive errors and visual impairment and the correlation between personal characteristics, including age, sex, weight, and height, with different types of refractive errors in a population of university students in the south of Iran.

Methods: In this cross-sectional study, a number of university majors were selected as clusters using multi-stage sampling in all universities located in Kazerun (27 clusters of 133 clusters). Then, proportional to size, a number of students in each major were randomly selected to participate in the study. Uncorrected and corrected visual acuity, non-cycloplegic objective refraction and subjective refraction were measured in all participants.

Results: The prevalence and 95% confidence interval (CI) of presenting visual impairment and blindness was 2.19% (1.48–3.23) and 0.27% (0.12–0.62), respectively. Refractive errors comprised 75% of the causes of visual impairment. The prevalence (95% CI) of myopia [spherical equivalent (SE) ≤ –0.5 D], hyperopia (SE ≥ 0.5 D), and astigmatism (cylinder power < –0.5 D) was 42.71% (39.71–45.77), 3.75% (2.85–4.51), and 29.46% (27.50–31.50), respectively. Totally, 49.03% (46.39–51.68) of the participants had at least one type of refractive error. There was a positive association between weight and myopia (1.01; 95% CI: 1.01–1.02), anisometropia (1.03; 95% CI: 1.01–1.06), and refractive errors (1.01; 95% CI: 1.01–1.02). In comparison with the age group 18–19 years, the odds ratio (OR) of astigmatism in the age group 26–27 years was 1.64 (95% CI: 1.03–2.61), and the OR of anisometropia in the age group ≥ 30 years was 0.21 (95% CI: 0.04–0.98).

Conclusions: The prevalence of refractive errors, especially myopia, is higher in university students than the general population. Since refractive errors constitute a major part of visual impairment, university students should receive special services for providing corrective lenses and glasses to reduce the burden of these disorders.

Keywords: Astigmatism, Hyperopia, Myopia, Student, Visual impairment

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Introduction

Refractive errors are the most common type of eye disorders, the leading cause of visual impairment, and the second cause of visual loss worldwide.[1,2] The prevalence of refractive errors is on the rise worldwide, and some studies have predicted that the number of myopic patients will increase from 1406 million in 2000 to 4758 million people in 2050. On the other hand, about 101 million people became visually impaired, and 6.8 million people became blind due to uncorrected refractive errors in 2010.[1-3]

Evidence suggests that both personal and environmental factors affect refractive errors. According to available evidence, tall

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people are at higher risk of myopia due to a longer axial length, longer vitreous chambers, and deeper anterior chambers[4,5] while the risk of hyperopia is higher in heavy subjects due to higher sphere and shorter vitreous chambers.[4-6]

However, according to different studies, the most important factors contributing to the increased prevalence of myopia in recent years include little outdoor activity, high education, and increased use of the computer and electronic devices, collectively known as near work.[7-9] Different studies have evaluated refractive errors in the general population as well as certain populations.[8-26] One of these populations is university students that have certain characteristics. University students are usually 18–30 years of age, have a high IQ, and are selected through entrance exams.[9] They are usually prone to adult-onset myopia because they have many of the risk factors[8,9] like increased near work and use of electronic devices.[27] On the other hand, they usually have little outdoor and physical activity, which increases the risk of myopia.[7,9]

The prevalence of refractive errors and myopia in university students has been evaluated in different studies.[8-10,28,29] One study showed that the prevalence of myopia increased from 5.1% to 9.4% in a population of Portuguese students after 3 years follow-up.[10] The prevalence of myopia has been reported 18% in Norwegian[8] and 37.5% in Californian students.[30]

Increased prevalence of myopia during education suggests the importance of the academic environment in increasing refractive errors through near work and study. Although several studies have examined this relationship in other countries,[7,9,10,28,29] little information is available from Iran.[11] According to available reports, there are about 5 million university students in Iran (about 6% of the country's population) whose visual status is unknown. Lack of adequate information on the prevalence of refractive errors in students for comparison with other countries and the importance of this information to design interventions for providing eye care services to this high risk group made us conduct a study in all university students residing in Kazerun, Fars Province, Iran to enhance the existing knowledge of the visual status of university students.

Methods

This study was conducted between February and May 2017 in Kazerun, Fars Province, in the south of Iran, which is the second most populated city of the province after Shiraz, the capital with a population of 266217 people [Figure 1]. In this population-based cross-sectional study, multi-stage sampling was applied to select participants from all students of Kazerun universities. Each university was considered a stratum (there are 4 universities in Kazerun). Then a list of all academic majors available in each university was extracted, and each major was considered a cluster. Among all majors (133 clusters), 27 were selected, and a list of students in each selected major was prepared. In the next step, a number of students in each major were randomly selected proportional

Figure 1: Location of Kazerun in Iran

to the size of the major [Figure 2]. The Ethics Committee of Mashhad University of Medical Sciences approved the study protocol. The study adhered to the tenets of the Declaration of Helsinki. All participants signed a written informed consent.

Sample size

The main outcome of the study was refractive errors. The prevalence of myopia was selected to reach a maximum sample size. According to similar studies[11] and considering a prevalence of 41%, type I error of 0.05, and precision of 0.04, a sample size of 580 was estimated. With regards to the sampling method, a design effect of 2.5 was also considered, and after adding 10% to the calculated sample size, the final sample size was 1595 participants.

Examinations

After the interview and measurement of height (using a measuring tape) and weight (using a digital scale), the participants underwent optometric and ophthalmic examinations. Distance visual acuity and near visual acuity in some special cases like presbyopia were measured using a Snellen chart bearing the tumbling E optotype distanced at 6.0 m from the examinee. Then lensometry (Topcon LM 800, Topcon Corporation, Tokyo, Japan) was done in subjects wearing glasses. Refraction was measured in all participants using the Topcon RM8800 auto refractometer (Topcon Corporation, Japan), followed by non-cycloplegic refraction using a retinoscope (HEINE BETA 200 retinoscope, HEINE Optotechnic, Germany). Finally, the best corrected visual acuity (BCVA) was determined. Subjects with a corrected visual acuity worse than 20/20 were referred to the ophthalmologist for complete eye examination and detection of the cause of decreased visual acuity. Eye exams were done by an ophthalmologist and included slit-lamp biomicroscopy (Slit Lamp Haag-Streit BM 900, Haag-Streit,

Bern, Switzerland), measurement of intraocular pressure, and ophthalmoscopy. Moreover, the corneal surface and palpebral status were examined in all subjects.

Definitions

We used the spherical equivalent (SE) based on non-cycloplegic retinoscopy to determine refractive errors in this study.[7,9,11] Myopia and hyperopia were defined as a SE equal to or worse than -0.5 D and + 0.5 D, respectively. A subject with a refractive error in at least one eye was considered a refractive case. If a patient was myopic in one eye and hyperopic in the fellow eye, (s)he was considered myopic. In this study, similar to previous studies,[13,31] myopia in one eye and hyperopia in the fellow eye was considered myopia. Astigmatism was defined as a cylinder power worse than 0.5 D in at least one eye.[11,32] Anisometropia was defined as a SE difference of at least 1 D between two eyes. With the rule (WTR) and against the rule (ATR) astigmatism were defined as an astigmatism axis 0˚±30 ˚and 90˚±30˚, respectively. Other axes were considered oblique astigmatism.

In the present study, an eye was considered amblyopic if there was a unilateral/bilateral BCVA of 20/30 or less or at least two Snellen acuity lines difference between the two eyes without any apparent pathology. In this study, corneal opacity was defined through examination of the entire cornea at various depths of different zones to observe non-transparent areas, ranging from superficial to deep opacities, which could be in the center or perisher of the cornea. Nystagmus was defined as involuntary regular oscillatory and repetitive ocular movements in one or more visual areas.

Keratoconus was defined as vision loss not due to refractive errors, amblyopia, corneal opacity, nystagmus, or lens opacity if the patient had astigmatism of at least 1 diopter and also showed signs such as scissor reflex, Vogt striae, and Fleischer's ring on the examination or definite awareness of the patient of his/her keratoconus condition based on previous records.

Moreover, we defined visual impairment similar to other articles. In addition, in the present study, visual impairment was defined based on presenting visual acuity (PVA). The term "low vision" wasappliedto individuals with a PVA of 20/60 to 20/400 in the better eye. Furthermore, "blindness" was defined as a PVA worse than 20/400 in the better eye. If the patient had more than one cause for visual impairment or each eye had a different underlying cause for visual impairment, the more correctable cause was considered as the reason for visual impairment.

Statistical analysis

The prevalence of refractive errors and their 95% confidence interval (CI) were calculated. Multiple logistic regression was applied to determine the factors affecting different refractive errors. The cluster effect was considered for accurate estimation of the standard error. The level of significance was set at 0.05. The Stata software version 11 (Stata Corp, College Station, TX, USA) was used to conduct all analyses.

Results

Of 1595 invited individuals, 1462 participated in the study (response rate: 91.66%). The mean age of the study population was 22.81 ± 3.18 years (range, 18-48 years), and 1073 subjects (73.4%) were female. The prevalence of visual impairment was 2.19% (95% CI: 1.48-3.23) in the study population, 1.92% (95% CI: 1.27-2.88) of whom had low vision, and 0.27% (95% CI: 0.12-0.62) were blind. The cause of visual impairment was refractive errors in 75% of the cases. The status of other causes is presented in Figure 3.

The mean ± standard deviation (SD) SE in subjects with emmetropia, myopia, and hyperopia was -0.04 ± 0.12 D, -1.68 ± 1.53 D, and 0.97 ± 1.20 D, respectively. Table 1 presents the prevalence of different refractive errors by age and sex. In total, 49.03% (95% CI: 46.39-51.68) of the study

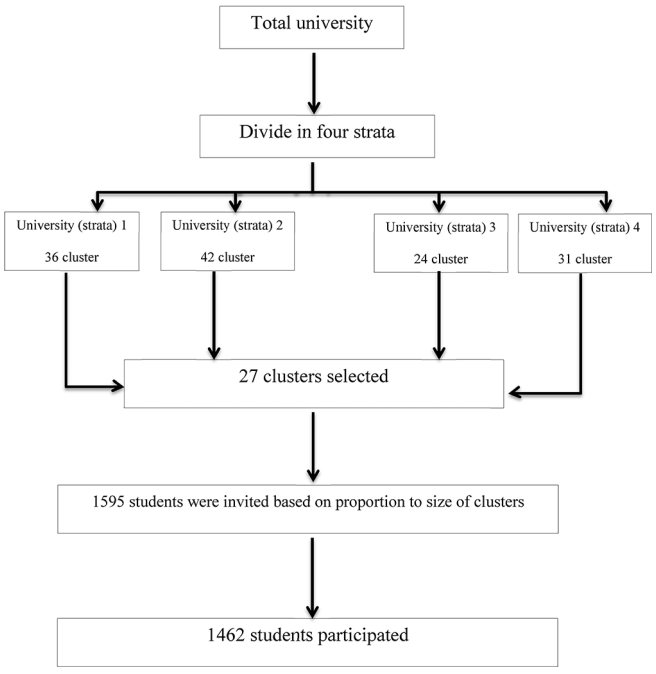

Figure 2: General flow of study

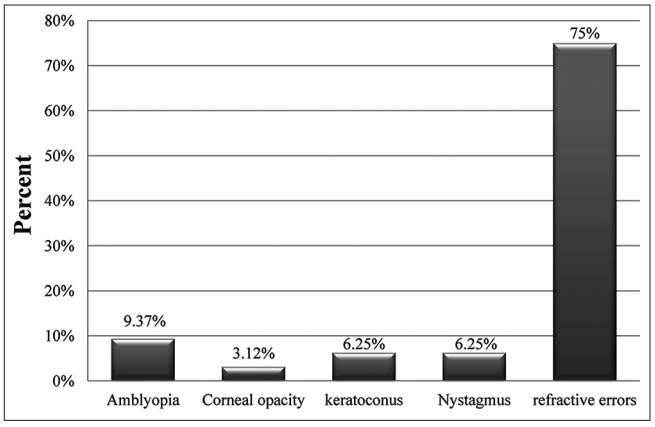

Figure 3: Causes of visual impairment in Kazerun university students, Iran 2017

population had at least one refractive error. The most common refractive error was myopia (42.71%; 95% CI: 39.71-45.77), followed by astigmatism (29.46%; 95% CI: 27.50-31.50). The prevalence (95% CI) of WTR, ATR, and oblique astigmatism was 15.59% (13.82-17.54), 10.73% (9.25-12.43), and 3.21% (2.42-4.25), respectively. Evaluation of refractive errors in different age groups showed the highest and lowest prevalence of myopia was seen in the age group 28-29 years (52.63%; 95% CI: 37.80-67.01) and 22-23 years (40.77%; 95% CI: 36.51-45.18), respectively. The highest and lowest prevalence of hyperopia was seen in the age group 18–19 years (5.55%; 95% CI: 1.94-14.88) and 24-25 years (1.47%; 95% CI: 0.45-4.60), respectively. Students aged 26–27 years had the highest, and those aged 28-29 years had the highest prevalence of astigmatism. According to the astigmatic axis, the prevalence (95% CI) of WTR, ATR, and oblique astigmatism was 15.59% (13.82-17.54), 10.73% (9.25-12.43), and 3.21% (2.42-4.25), respectively. The prevalence of WTR was 16.61% (12.85-20.20) and 15.37% (13.33-17.66) in men and women, respectively. The prevalence of ATR was 9.76% (7.18-13.14) and 11.09% (9.34-13.11), and the prevalence of oblique astigmatism was 4.11% (2.53-6.61) and 2.88% (2.03-4.08) in male and female students, respectively. Except for myopia which had a higher prevalence in female students, hyperopia, anisometropia, and astigmatism were more prevalent in male students.

Table 2 presents the results of multiple logistic regression analysis on the relationship between refractive errors and study variables. Although myopia has no correlation with age, sex, and height, it had a direct correlation with weight: an increase in weight by 10 kg increased the odds of myopia by 10%. No association was found between hyperopia and age, sex, height, and weight.

In comparison to 18-19 year-old students, the prevalence of astigmatism was higher in 26-27 year-old students, and the prevalence of anisometropia was higher in students over 30 years of age. We found no significant association between sex and astigmatism, refractive errors, and anisometropia.

Except for weight that had a direct relationship with WTR [odds ratio (OR) = 1.02; 95% CI: 1.01–1.03], no

Table 1: The prevalence of refractive errors by age and sex in Kazerun university students, Iran, 2017

Category	*n*	Prevalence percentage (95% CI)				
		Myopia	Hyperopia	Astigmatism	Anisometropia	Refractive error
Age group						
18-19	90	42.22 (30.69-54.66)	5.55 (1.94-14.88)	32.22 (26.33-38.73)	5.55 (2.10-13.85)	52.22 (43.50-60.80)
20-21	441	43.40 (35.96-51.16)	2.50 (1.16-5.27)	27.27 (21.84-33.47)	2.95 (1.74-4.97)	48.86 (41.49-56.27)
22-23	546	40.77 (36.51-45.18)	2.02 (1.09-3.72)	28.59 (24.59-32.96)	2.76 (1.63-4.65)	47.41 (42.62-52.25)
24-25	205	44.60 (35.23-54.37)	1.47 (0.45-4.60)	28.43 (22.03-35.83)	3.92 (2.07-7.27)	49.01 (39.97-58.12)
26-27	77	49.35 (40.30-58.43)	2.59 (0.67-9.51)	44.15 (35.06-55.66)	9.09 (5.23-15.33)	59.74 (51.43-67.52)
28-29	38	52.63 (37.80-67.01)	2.63 (0.31-18.82)	26.31 (13.43-45.11)	7.89 (2.25-24.11)	55.26 (41.28-68.45)
≥30	65	35.38 (21.47-52.29)	1.53 (0.19-11.10)	35.38 (22.47-50.85)	1.53 (0.20-10.44)	43.07 (27.63-59.99)
Sex						
Female	1073	44.15 (40.71-47.64)	2.15 (1.28-3.58)	29.18 (27.06-31.40)	3.27 (2.20-4.83)	49.95 (46.64-53.26)
Male	389	38.75 (34.26-43.45)	2.84 (1.82-4.39)	30.23 (25.95-34.88)	4.39 (2.85-6.69)	46.51 (42.66-50.40)
Total	1462	42.71 (39.71-45.77)	2.33 (1.58-3.43)	29.46 (27.50-31.50)	3.57 (2.82-4.51)	49.03 (46.39-51.68)

CI: Confidence interval

Table 2: Multiple logistic regression between refractive errors with study variables in Kazerun university students, Iran, 2017

	Myopia		Hyperopia		Astigmatism		Anisometropia		Refractive errors	
	OR (95% CI)	*P*	OR (95% CI)	*P*	OR (95% CI)	*P*	OR (95% CI)	*P*	OR (95% CI)	*P*
Sex (0=female)	0.71 (0.47-1.04)	0.081	1.82 (0.68-4.84)	0.218	1.11 (0.72-1.70)	0.620	1.20 (0.42-3.45)	0.719	0.81 (0.54-1.21)	0.298
Age group[a]										
18-19	1		1		1		1		1	
20-21	1.08 (0.52-2.25)	0.815	0.46 (0.94-2.27)	0.331	0.79 (0.54-1.16)	0.230	0.57 (0.17-1.89)	0.346	0.90 (0.52-1.55)	0.695
22-23	0.96 (0.57-1.61)	0.874	0.37 (0.07-1.77)	0.204	0.84 (0.58-1.22)	0.361	0.52 (0.15-1.78)	0.287	0.83 (0.57-1.22)	0.344
24-25	1.12 (0.56-2.24)	0.724	0.25 (0.06-1.01)	0.051	0.83 (0.51-1.33)	0.430	0.70 (0.21-2.33)	0.556	0.88 (0.49-1.59)	0.675
26-27	1.41 (0.81-2.46)	0.209	0.43 (0.06-2.80)	0.370	1.64 (1.03-2.61)[b]	0.036	1.77 (0.62-5.01)	0.267	1.40 (0.87-2.25)	0.151
28-29	1.52 (0.85-2.72)	0.145	0.38 (0.03-4.48)	0.429	0.72 (0.30-1.71)	0.443	1.32 (0.20-8.54)	0.762	1.09 (0.73-1.63)	0.649
≥30	0.71 (0.29-1.72)	0.44	0.20 (0.03-1.39)	0.102	1.09 (0.49-2.39)	0.814	0.21 (0.04-0.98)[b]	0.048	0.63 (0.27-1.47)	0.282
Height	0.99 (0.97-1.01)	0.406	0.94 (0.89-1.01)	0.086	0.98 (0.97-1.01)	0.192	0.96 (0.91-1.01)	0.156	0.98 (0.96-1.01)	0.144
Weight	1.01 (1.01-1.02)[b]	0.003	1.02 (99-1.05)	0.056	1.01 (0.99-1.01)	0.348	1.03 (1.01-1.06)[b]	0.005	1.01 (1.01-1.02)[b]	0.001

[a]Baseline=18-19 years, [b]Significance at 0.05. CI: Confidence interval, OR: Odds ratio

significant relationship was observed between other variables and WTR, ATR, and oblique astigmatism. Each 10 kg increase in weight increased the odds of anisometropia and refractive errors by 30% and 10%, respectively [Table 2].

Discussion

Due to the role of refractive errors as the most important cause of visual impairment worldwide,[1,33] different studies have evaluated the status of refractive errors in the world[8-10,12,18-20,23] and Iran[11,13-17,21,22,24,25] [Table 3] and proposed strategies to reduce its prevalence at an international level.[34,35] However, more attention is paid to students and people above 40 years of age, while the population aged 18–40 years old has received little attention. The reason for lack of extensive studies in this age group is that the incidence of refractive errors is rather stable in them; nonetheless, because many of them are university students, the prevalence of refractive errors, especially myopia, is high in this population due to increased near work. Therefore, it seems that university students are a forgotten group in optometric and ophthalmic studies.

Despite our extensive search, we found no study on visual impairment in university students for comparison; hence, we used the results of previous domestic studies in similar age groups. In one study, the prevalence of visual impairment, low vision, and blindness using PVA was 0.56%, 0.53%, and 0.09% in an urban population aged 20-39 years[36] and 4.3%, 2.9%, and 1.4% in a rural population, respectively.[37] In our study, the prevalence of visual impairment, low vision, and blindness was 2.19%, 1.92%, and 0.27%, respectively. In other words, more than 2 in 100 university students had visual impairment, which is higher than the urban and lower than the rural population. Although other studies[36,38-40] have also introduced refractive errors as the main cause of visual impairment, the contribution of refractive errors to the development of visual impairment was much higher in our study (75% in our study, 33.6% in Fotouhi *et al*.,[36] 24.68% in Van Newkirk *et al*.,[40] and 45.8% in Dandona *et al*.[38]). It seems that the higher proportion of refractive errors in the development of visual impairment in university students is because many students do not feel comfortable with glasses[40] and the refractive error that is developed during adolescence[36] remains untreated. This point is important because refractive errors is one the most treatable eye disorders.[36]

As we expected, the prevalence of refractive errors in our study was much higher than similar studies[11,36] as about 50% of the students had a refractive error. Evaluation of refractive errors by age showed that its prevalence increased by up to 28 years of age and then decreased although the trend was not significant. Moreover, no inter-gender difference was observed for refractive errors.

Among refractive errors, myopia is important in university students because many studies have shown that the prevalence of myopia is higher in educated people due to increased near activities like studying and little outdoor activity.[7,9,27] Studies suggest that the prevalence of myopia increases with an increase in the educational level.[8] Our results also confirmed these reports, as the prevalence of myopia was 42.71% in our study population that is higher than the prevalence reported in the general young[13,15,22,24] and old[26] population.

Our findings were different from the results of some studies conducted in students. The prevalence of myopia was similar

Table 3: Summary of studies on refractive errors in Iran and other countries

	Study	Age	Size	Place	Refraction	Refractive errors		
						Myopia	Hyperopia	Astigmatism
Iran	Yekta *et al*.[24]	7-15	1872	Shiraz	Non-cycloplegic	4.35	5.04	11.27
	Rezvan *et al*.[22]	6-17	1551	Bojnourd	Cycloplegic	4.3	5.4	11.5
	Yekta *et al*.[25]	>50	1367	Mashhad	Non-cycloplegic	27.2	51.6	37.5
	Fotouhi *et al*.[32]	7-18	5542	Dezful	Cycloplegic refraction	3.4	16.6	18.7
	Hashemi *et al*.[11]	18-32	1431	Mashhad	Non-cycloplegic	41.7	7.8	25.6
	Ostadimoghaddam *et al*.[21]	>5	2813	Mashhad	Non-cycloplegic	17.09	41.38	25.64
	Hashemi *et al*.[16]	13-83	2635	Khaf	Non-cycloplegic	28	19.2	11.5
	Yekta *et al*.[25]	>55	937	Sari	Non-cycloplegic	19.7	39.5	23.6
	Hashemi *et al*.[15]	14-21	438	Aligoudarz	Non-cycloplegic refraction	29.3	21.7	20.7
	Hashemi *et al*.[14]	>1	4354	Tehran	Cycloplegic	17.2	56.6	30.3
	Yekta *et al*.[24]	7	4072	All of Iran	Cycloplegic	3.04	6.20	17.43
	Current study	18-48	1462	Kazerun	Non-cycloplegic	42.71	2.33	29.46
World	Kinge and Midelfart[8]	20.6	192	Norway	Cycloplegia	48	25.50	26.56
	Jorge *et al*.[10]	20.6±2.3	118	Portugal	Cycloplegia	27.1	39.8	-
	Lin *et al*.[19]	18-21	345	Taiwan	Cycloplegic	92.8	-	-
	Sun *et al*.[9]	20.2±2.8	5060	China	Non-cycloplegic	95.5	-	-
	Lewallen *et al*.[18]	28±5.3	1044	Malawi	Cycloplegic	2.5	-	-
	Bin *et al*.[12]	12.9-17.6	1839	China	Cycloplegic	82.7	7.5	-
	Mashige *et al*.[20]	35-90	1939	South Africa	Non-cycloplegic	-	37.7	25.7
	Yared *et al*.[23]	4-24	1852	Ethiopia	Non-cycloplegic	2.3	-	1.3

in Norwegian university students,[8] lower in Portuguese university students,[10] and higher in Chinese university students[9] in comparison with our results. These differences may result from differences in study populations since studies have shown a higher prevalence of myopia in East Asian countries, like China, due to their ocular shape and longer axial length.[19,41]

The prevalence of hyperopia was 2.33% in our study, which was lower than the reported prevalence in the Iranian youth[15,17,22,24] and elderly[16,25,26] populations, and lower than the prevalence of hyperopia in the Iranian university students,[11] Norwegian university students,[8] and Portuguese university students,[10] indicating that hyperopia is not an important issue in Iranian students. However, part of the low prevalence of hyperopia is due to myopic shift that occurs at these ages, causing negative refraction.[8] Nonetheless, the prevalence of hyperopia in our study was too low to be attributed only to myopic shift. We believe that another factor contributing to the low prevalence of hyperopia was the use of non-cycloplegic refraction because several studies have shown that measurement of non-cycloplegic refraction, especially in people aged 18-30 years, leads to underestimation of hyperopia.[42]

According to several domestic studies, the prevalence of astigmatism ranges from 11–20% in the general youth[15,16,22,24] and 23-37% in the general elderly population.[25,26] The prevalence of astigmatism was 29.46% in our study, which is rather similar to its prevalence in the elderly population. Other studies have also reported a high prevalence of astigmatism in people with higher education.[38,43] The high prevalence of astigmatism in our study may be explained by the fact that astigmatism is correlated with myopia, and myopia has a direct relationship with higher education.[38] However, some studies have shown that incyclotorsion during near work causes astigmatism.[44]

There was no significant association between sex and myopia, hyperopia, astigmatism, anisometropia, and refractive errors. Although some studies in children found no association between gender and myopia,[17,21,22,24] studies in the elderly population have shown a higher prevalence in men.[25,26] We expected a higher prevalence of myopia in male students due to their longer axial length;[11] however, the reason for this finding may be more hours spent on reading and studying by female students, which is a proxy of near work. More studies are warranted in this regard.

Studies have shown that with aging, due to structural changes in the eye, especially the axial length, the refraction of the eye changes and a myopia shift occurs, which is the reason why myopia is the most common ocular disorder in the middle-aged population.[4,5,11,14,22,26,45] However, we found no significant change in hyperopia and myopia with age. An explanation for this finding may be that the structure of the eye does not change after the age of 20 years, and the myopic shift that occurs during these ages mostly results from environmental factors and near activities.[11]

There is extensive inconsistency about the association of refractive errors with height and weight. According to different studies in the elderly population[46] and children,[6] the prevalence of myopia is higher in taller people due to the longer axial length, deeper anterior chamber, and longer vitreous chamber.[4,5] Therefore, we expected an increase in the prevalence of myopia with an increase in height but we did not observe such an association. On the other hand, studies have shown a direct relationship between hyperopia and weight[6,46] but our results did not confirm this relationship. The results of different studies regarding myopia are inconsistent; for example, we found a direct association between myopia and weight while some studies have reported a reverse relationship,[47] and some others have failed to show a relationship.[48,49] Therefore, no definite conclusion can be drawn in this regard, and more powerful studies, like meta-analysis, are required.

A large sample size, meticulous supervision over the examinations, and conducting the study in university students were the strong points of our study. One of the major limitations of our study was that we did not use cycloplegic refraction. Although cycloplegic refraction is recommended in children, some reports indicate that its results are still more valid in adolescents and young adults. Therefore, our results may be associated with overestimation of myopia and underestimation of hyperopia. It also causes major errors in SE calculation. Moreover, due to the cross-sectional nature of the study, the observed correlations cannot be considered as causality.

Finally, it can be concluded that the prevalence of refractive errors, especially myopia, is higher in university students than the general population due to more reading as a proxy of nearwork activity. On the other hand, refractive errors are a major cause of visual impairment; therefore, satisfying the visual needs of this population should be a health priority. It is recommended that university students receive special services for providing corrective lenses or glasses to reduce the burden of these disorders.

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Conflicts of interest

There are no conflicts of interest.

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