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Impact of Refractive Errors on the Vision Related Quality of Life among Assiut University Students in Upper Egypt

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ABSTRACT

Background: There is a rise in the importance of evaluating the negative impact of illnesses on quality of life from the patient's perspective. The burdens of refractive error (RE) on perceived visual functions have not comprehensively explored among Egyptian youth. **Objective:** To determine the prevalence of self-reported RE and its association with perceived vision-related quality of life among Egyptian university students. **Methods:** A cross-sectional study was conducted on 821 students at Assiut University, Upper Egypt. Data was collected using a self-administered questionnaire. It included personal criteria, a self-report of RE and its type, the used visual aids for RE, and the visual function questionnaire (VFQ -25). Ishihara's test was used for the assessment of colour vision. **Results:** About 25% reported having a refractive error, and the most reported RE type was myopia. Among students with RE, nearly 76% used visual aids, and eyeglasses were used by most of students for their visual aid (90.6%). Adjusted by age and gender, RE significantly predicts low scores of perceived general health, ocular pain, mental health, dependency, role difficulties, both near and distant activities, and peripheral vision. No significant association was detected between RE and social functioning, driving ability or colored vision ($P > 0.05$). **Conclusions:** Refractive error is a prevalent illness especially myopia among Egyptian university students. RE negatively affects vision-related quality of life. Accurate correction of RE and provision of subsidized visual aids may help to mitigate the adverse effect of RE on the perceived visual functions.

INTRODUCTION

Vision is one of the most dominant human senses. It plays a crucial role in all aspects and stages of humans' lives. Visual impairment occurs when an eye condition affects the visual system and its vision functions.[1] The global minimum estimates of the population with near or distant vision impairment are 2.2 billion people, and at least 1 billion of this burden could be prevented or addressed. Refractive errors (RE) and cataracts are the main causes of vision impairment and blindness at the global level.[2]

Refractive errors are aberrations that decrease the ability of clear focusing of light onto the retina and consequently result in blurring of vision. The most frequent RE are myopia, hyperopia, astigmatism.[3] The

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results of meta-analysis studies reported the global estimated pooled prevalence of RE in adults was 12%,[4] myopia was 26.5%, hyperopia was 30.9%, and 40.4% for astigmatism.[5]

The value of assessing the burden of illnesses on quality of life (QOL) from the patients' perspective is widely recognized.[6] A qualitative exploration of the effect of refractive error on QOL revealed increases in the difficulties of performing basic daily activities, sports, and hobbies. In addition, people with refractive errors exhibit other concerns about their quality of life such as the cosmetic appearance of wearing glasses, complications of handling contact lenses and laser surgery, personal health especially ocular health, effect on personal safety, social roles, and work and finances.[7]

The American National Eye Institute developed the Visual Function Questionnaire (NEI VFQ-25) for quantitative assessment of quality of life specifically the vision-related functions. It is a valid and reliable English tool that evaluates the QOL of individuals with visual impairments from the patient-centered point of view.[8]

Refractive errors in adolescents and young adults negatively influence educational attainment, productivity, employment opportunities, mental health, and socialization.[1] Although RE is a major public health problem, there are few studies have demonstrated its prevalence among youth in Egypt. Moreover, great variations in the reported prevalence of RE among Egyptian university students were observed. The prevalence of RE among freshman students in Assiut University was 10.46%. While the prevalence of RE among students at Mansoura University was 66%.[9, 10]

The burdens of refractive error on the Egyptians' perception of visual functions have not yet been explored. The current study aimed to determine the prevalence of self-reported presence of RE and the impact on vision-related quality of life using the National Eye Institute Visual Function Questionnaire 25 (NEI VFQ-25) among students at Assiut University in Upper Egypt.

METHODS

A cross-sectional study was executed on 821 university students at Assiut University, Upper Egypt. Assiut University is a deeply rooted and the greatest University in Upper Egypt. Assiut University enrolls learners from all other governorates of Upper Egypt besides Asyut Governorate.

A random multistage sampling procedure was applied for the recruitment of the studied students. A proportionate sampling method was used for selecting the faculties with the number of students in each. Four faculties were selected as follows: Law, Engineering, Dentistry, and Nursing. A simple random sampling method was used for choosing the classes in the selected faculties. Lastly, all students in the selected classes who accepted participation in the study were included. The EPI info statistical package Version 7.2.01 was used for estimating the sample size. The minimum estimated sample size was 690 students. It was based on the following parameters: a previous estimate of the proportion of refractive errors among Egyptian university students of 0.66, [9] a confidence level of 95%, a margin of error of 5%, and a design effect 2 for attaining a higher sample size precision. The researchers added 15% of the sample as a nonresponse rate and the sample was raised to 805 students. The actual students who participated in the study were 821 students.

Data was collected during the academic year 2018-2019 using a questionnaire filled in by the students themselves and a clinical assessment of color vision defects was performed for each student. The questionnaire included personal characteristics, a self-report of RE and its type, the used visual aids for RE, and the visual function questionnaire (VFQ -25). Personal characteristics of students included age, sex, faculty type, and self-report of having refractive error and its type. Students who reported having RE were asked whether they use visual aids for correcting RE and the corrective method used. Evaluation of students' perception of their visual impairment in different domains of health such as general well-being, mental health, and visual functioning was done by the National Eye Institute 25-Item Visual Function Questionnaire (NEI VFQ-25) version 2000. RAND Health Care created the NEI VFQ-25 with a sponsorship of the American National Eye Institute in Maryland, United States. The questionnaire consists of 25 questions, a single question rates general health rating and eleven vision-targeted constructs. The vision-related dimensions rated general vision,

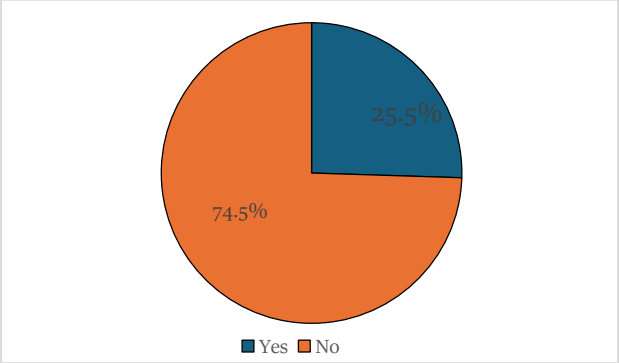

Figure 1: Self-reported refractive error among studied Assiut University students, Upper Egypt

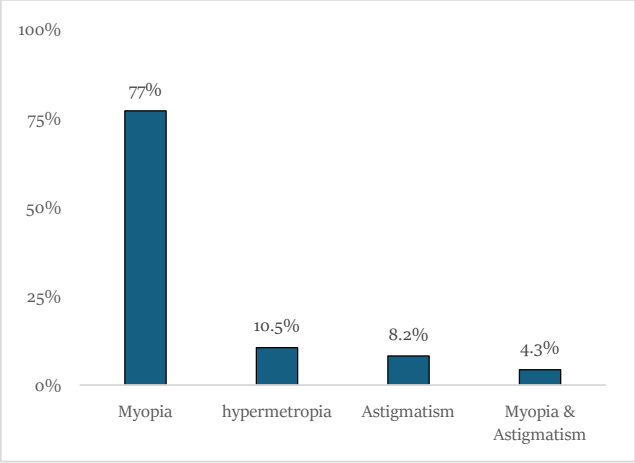

Figure 2: Type of refractive errors reported by the studied Assiut University students, Upper Egypt

difficulty with near activities or distance activities, limitations in social functioning due to vision, difficulties in roles due to vision, dependency on others, mental health symptoms due to vision, driving difficulties, ocular pain, limitations in peripheral and colored vision.[11] All items were scored so that a high score indicated a better perception of visual function. Items within each subscale were recorded from zero to 100 and then averaged to create the subscales' scores as stated by the scoring guide reported in the NEI VFQ-25 manual. RAND Health Care institution provides the survey as a public document without any charges. The authors used the VFQ-25 questionnaire in the Arabic language. The authors followed the basic guidelines for translating the survey as recommended by RAND Health Care. Forward and backward translations of the VFQ-25 English version were performed. A linguistic consultant and ophthalmologist professor revised and approved both the forward and backward versions of the questionnaire before its usage.[8] Evaluation of color vision was done using Ishihara's test of color deficiency (24-plate edition.[12] The students were evaluated individually. Simultaneous assessment of both eyes was done in a room that was lit adequately by natural daylight or an appropriate electrical light. The plates were held at approximately 70 centimeters from the student and tilted so that the paper plane was at a right angle to the line of vision. Each student was asked to read his/her impression on the plates of the test. Standard classification of students' color vision into either defective or normal was performed according to the guide of the chart.[13]

Statistical analysis: SPSS version 21.0 was used to analyze the data[14] The reliability of VFQ was tested and Cronbach's coefficient for the scale was 0.901. Descriptive statistics were used to display the participants' criteria and NEI VFQ 25 scores. Numerical data were described as the mean and standard deviation, while categorical data were presented as frequencies and percentages. Mean values of the scores for students with refractive errors and those with normal vision were statistically compared using the student t-test or Mann–Whitney U test after testing data normality. Kruskal Walls test was applied to compare the mean values of RE subscales between different studied faculties. A chi-squared test was used to compare the proportions of qualitative data. Adjusted multiple linear regression with age and gender was performed. The VFQ 25 subscales were used as dependent variables. The independent variable was a self-report of refractive error, considering the yes answer as a risk category and no as a reference category. The statistical significance level was set at 5%. The Microsoft Excel 2016 was used for constructing the graphs.

RESULTS

Figure 1 displays the status of self-reported refractive error, where nearly one-quarter of the studied students (25.5%) reported having refractive error defects. Figure 2 shows the distribution of RE type. Out of the students with RE (n=209), the most reported RE type was myopia (77 %), followed by hypermetropia (10.5) %, while students reported having astigmatism alone were 8.2%.

Table 1: Associations between personal criteria and self-reported refractive error among the studied Assiut University students; Upper Egypt

	Total	RE (n=209)	No RE (n=612)	P value
		N (%)	N (%)	
Age (mean ± SD, year)	21.02±1.33	20.95± 1.36	21.04±1.32	0.406#
Gender				
Male	341 (41.5)	80 (23.5)	261 (76.5)	0.268$
Female	480 (58.6)	129 (26.9)	351 (73.1)	
Type of faculty				
Dentistry	37 (4.5)	17 (45.9)	20 (54.1)	0.005$
Engineering	104 (12.7)	34 (32.7)	70 (67.3)	
Law	620 (75.5)	144 (23.2)	476 (76.8)	
Nursing	60 (7.3)	14 (23.3)	46 (76.7)	
Color vision defects				
Yes	53 (6.5)	18 (34.0)	35 (66.0)	0.142$
No	768 (93.5)	191 (24.9)	577 (75.1)	
Using visual aids (n=209)				
Yes		159 (76.1)		
No		50 (23.9)		
Type of visual aids (n=159)				
Eyeglasses		144 (90.6)		
Contact Lenses		3 (1.9)		
LASIK surgery		12 (7.5)		

Data were presented as number and percentage, unless mentioned otherwise. # Student t test, $ Chi square test

Table 1 displays the personal criteria of the studied university students. The age of students ranged from 18 to 25 years with a mean value of 21.02±1.33. Females represented nearly 59% of the study population. Nearly 27% of female students had refractive errors in comparison to 23.5% of males. However, this difference was not statistically significant (p=0.268). Significantly higher proportions of refractive error were reported in dentistry (45.9%) and engineering (32.7%) faculties compared to law (23.2%) and nursing faculties (23.3%) (P= 0.005). As regards color vision defects (CVDs), 6.5% of the total studied students were positive for CVDs test. color vision defect was not significantly associated with refractive error (P= 0.142). Among students with refractive error, nearly three-quarters (76.1%) were using visual aids. Eyeglasses were the most commonly used visual aid (90.6%), followed by LASIK surgery (7.5%), and a very small percentage (1.9%) were using contact lenses.

Table 2 shows the relation of self-reported refractive errors with perceived visual function among studied students. Compared to students with normal visual function, students with refractive error scored significantly lower mean values of VFQ 25 dimensions regards general health, ocular pain, near and distance activities, mental health, role difficulties, dependency, and peripheral vision (P < 0.001). No significant differences were detected in mean values of other dimensions of VFQ between students with refractive error and those with normal visual function.

Table 3 shows the differences between RE subscales among students from different faculties at Assiut University. No significant associations were detected between the type of faculty and all dimensions of VFQ 25.

Table 4 denotes the adjusted prediction of self-reported refractive error for VFQ subscales. Refractive error significantly predicts low scores of perceived general health, ocular pain, and both near and distant activities (P < 0.001). On the other hand, refractive error was not a significant risk factor for poor

Table 2: Associations of self-reported refractive error with perception of visual function among studied Assiut University students; Upper Egypt

Variables	RE(n=209) (Mean ± SD)	No RE(n=612) (Mean ± SD)	P-value *
General health	58.01± 24.48	66.17 ± 26.17	**< 0.001**
General vision	78.45± 19.74	79.74 ± 23.41	0.573
Ocular pain	74.70± 23.49	85.43 ± 17.62	**< 0.001**
Near activities	85.42± 16.64	92.23 ± 13.52	**< 0.001**
Distant activities	83.21 ± 17.39	91.16 ± 14.89	**< 0.001**
Vision specific			
Social functioning	90.14 ± 17.21	90.50 ± 16.54	0.312
Mental health	75.32 ±21.44	88.38 ± 14.02	**< 0.001**
Role difficulties	76.40 ± 29.31	86.19 ± 23.65	**< 0.001**
Dependency	87.12 ± 21.26	94.40 ± 15.21	**< 0.001**
Driving	79.89 ±20.23	86.11 ± 18.40	0.120
Color vision	91.11 ± 19.17	91.52 ± 18.38	0.777
Peripheral vision	86.27 ± 22.29	91.67 ± 17.25	**< 0.001**

**Mann-Whitney U test*

perception of general vision (ß = -1.146, 95% CI = -4.706: 2.414). As regards vision-specific domains, RE significantly negatively predicts the perception of mental health, role difficulties, dependency, and peripheral vision. While RE has no significant impact on social functioning, driving ability, and colored vision (P > 0.05).

DISCUSSION

Refractive errors are the most frequent ocular diseases that influence all age groups. They are considered a public health challenge. Uncorrected refractive errors contribute greatly to burdens of visual impairment and blindness.[5] They decrease employability, performance, and productivity, and compromise other different aspects of patients' life.[15] Limited data is available on the prevalence of refractive errors among Egyptian youth. The current study assessed the prevalence of RE among Assiut University students in Upper Egypt and it is the earliest study to explore the effect of RE on vision-related quality of life in Egypt.

According to the current study, the prevalence of self-reported presence of refractive error was 25.5%. Myopia was the most reported refractive error type (77 %), followed by hypermetropia (10.5 %), while students reported having astigmatism alone were 8.2%. This current prevalence of refractive errors was lower than that reported in previous studies conducted among students in Egyptian and Arabic Universities. Naasr et al, reported a lower prevalence of RE (10.46%) among students who were medically assessed before their enrollment at Assiut University in 2010. Naasr et al, assessed the uncorrected refractive error using a Landolt broken ring chart at 6 m and students with a visual acuity of 6/9 or less in either eye underwent objective refraction verification.[10] In Mansoura University, the prevalence of RE was 66% among students. The sample was recruited from those who attended Students' Hospital in 2019. Cycloplegic objective refraction was measured using an auto-refractometer with cyclopentolate 1%.

The observed differences in the prevalence of RE in the current study from those of other Egyptian studies may be attributed to the age of the studied population, the site of the recruited sample, and methods of RE assessment. Where Naasr et al study in Assiut University recruited newly enrolled students whose age was around 18 years and assessed RE using the clinical visual examination. Also, the higher prevalence of RE among Mansoura University students may be due to being a hospital-based study and obtaining the sample from the students' Hospital attendees.

The overall prevalence of RE among medical students in Saudia Arabi was 48.8%.[16] Visual examination was performed using an autorefractor test and cylindrical refraction. While a higher proportion of RE (75%) was

Table 3: Associations of faculty type with perception of visual function among studied Assiut University students; Upper Egypt

Variables	Dentistry	Engineering	Law	Nursing	P-value*
General health	59.45±25.92	64.66±22.74	64.63±26.48	60.41±26.15	0.541
General vision	82.16±15.48	79.80±19.99	78.73±23.70	81.33±17.60	0.975
Ocular pain	85.47±17.55	86.2981±17.02	82.05±20.47	81.45±18.48	0.225
Near activities	91.32±9.33	90.70±12.89	90.43±14.88	90.27±18.03	0.584
Distant activities	88.51±14.61	88.98±15.61	89.18±15.89	89.37±18.01	0.795
Vision specific					
Social functioning	91.89±14.49	92.03±14.15	90.75±17.23	93.33±16.67	0.543
Mental health	85.13±15.75	84.67±18.45	85.35±17.06	82.70±17.31	0.479
Role difficulties	85.13±26.16	83.65±25.12	82.45±25.89	82.50±27.34	0.880
Dependency	94.59±14.98	93.91±14.65	92.08±17.91	93.75±15.54	0.499
Driving	82.05±27.60	87.35±13.66	84.91±17.04	76.19±35.81	0.954
Color vision	93.24±17.32	90.04±18.30	91.39±18.45	92.91±21.139	0.237
Peripheral vision	89.86±14.97	92.54±17.37	89.98±19.03	90.00±20.68	0.408

**Kruskal Wallis test*

detected among medical students in Jordan. The RE was assessed through students' self-reporting using an electronic questionnaire.[17] These differences in the refractive error estimates may be attributed to the method of assessment of RE whether it is based on students' self-reporting or clinical examination. Although self-reporting of disease might provide valuable information, symptoms specific questionnaire followed by clinical examination is considered a better choice to avoid underestimating or overestimating the problem.[18] Moreover, the risk of RE increases with higher educational levels as studying medical science.[17] This could explain the significant increase in RE proportions among Dentistry and Engineering faculties in the current study.

The predominance of myopia in university students with RE in the current study was consistent with other Egyptian (51.5 %), Saudia (48%), and Chinese (83.2%) studies.[9, 16, 19] These results are consistent with the alarming rise in the prevalence of global myopia. This rise in myopia prevalence in young adults might increase the likelihood of visual disability in the future, especially complications threatening sight.[20]

In the current study, nearly 24% of students with refractive errors did not use any visual aid. Similarly, 17.7% of Jordani medical students with RE did not use any method for correcting their visual impairment.[17] This may be attributed to the students' sensation of stigma accompanied by wearing eyeglasses, students' concerns about contact lenses and laser surgery regards the affordability, and fear of the occurrence of any negative consequences.[7, 21]

No significant difference was detected in the proportion of RE between males and females in the current study. A similar result was reported where gender was not a significant predictor for developing myopia among Turkish medical students.[22] In the current study, the analysis of evaluating the gender influence was performed on general RE status. The other surveys explored the role of gender in RE and showed an evident variability in the distribution of RE among males and females when it was stratified by RE type. There were significant changes in patterns of RE distribution among a clinical sample of patients examined in an optometry clinic in South Africa. The males were significantly more myopic and astigmatic, while females were more hyperopic across the age groups.[23] On the other hand, the prevalence of RE among Saudi female medical students was significantly higher than that among males, also females were more myopic than males in Jazan University.[16] While, among freshman Saudia colleges in Imam Abdulrahman Bin Faisal University, the males exhibited higher hyperopic spherical equivalent refraction than those of the female gender (β= 0.59, P=0.013).[24] A Chinese survey performed among medical students showed that female subjects were significantly more myopic than male subjects .[19]

Table 4: Prediction* of refractive error for VFQ subscales adjusted by age and gender among Assiut University students, Upper Egypt

	ß	SE	95% CI	P-value
General Health	-8.047	2.056	-12.082: -4.012	**< 0.001**
General vision	-1.146	1.814	-4.706, 2.414	0.528
Ocular pain	-10.740	1.537	-13.756, -7.723	**< 0.001**
Near activities	-6.868	1.146	-9.118, -4.618	**< 0.001**
Distant activities	-7.962	1.246	-10.407, -5.516	**< 0.001**
Vision specific				
Social functioning	-1.348	1.343	-3.984, 1.287	0.316
Mental health	-13.032	1.302	-15.587, -10.476	**< 0.001**
Role difficulties	-13.599	2.017	-17.558, -9.641	**< 0.001**
Dependency	-7.278	1.361	-9.949, -4.606	**< 0.001**
Driving	-7.706	3.815	-15.256, -0.155	0.046
Color vision	-.395	1.496	-3.332, 2.541	0.792
Peripheral vision	-5.436	1.497	-8.375, -2.497	**< 0.001**

**Using adjusted linear regression models. Dependent variables: VFQ subscales. Independent variables: Self-report of refractive error, considering the yes answer as a risk category and no as a reference category. The presented results were adjusted for age and gender.*

There is an evident increase of myopia among future young women than males. lifestyle factors and education are strong drivers of myopia. They explain this paradigm shift and guide the future generations of young girls to be adherent to the protective behaviors.[25]

The American National Eye Institute recommended the eyeglasses as the simplest and safest way to correct the refractive error.[26] The current study revealed eyeglasses were used by most of the studied students to correct their RE. Similarly, the Jordani medical students reported the use of spectacles as the most preferable modality for fixing RE despite the advanced improvement and the growing rise of rates of Laser refractive surgery usage to correct RE.[17]

Although the mean ocular refraction and distribution of refractive error vary with age.[27] Studying the age distribution of refractive errors in an optometric clinical population showed that with increasing age, myopia decreases. While hyperopia, astigmatism, and anisometropia increase.[23] However, age was not significantly associated with RE In the present study. This difference could be attributed to the narrow age range (18-25 years) among the studied university students.

Optical quality of the eye has a role in the optimum visual performance.[28] The standard measurements of visual acuity do not adequately assess the substantial impact of refractive error on quality of vision and health-related quality of life.[29] National Eye Institute VFQ 25 is a valid instrument for the assessment of vision-related quality of life.

The present study investigated VR-QoL association with RE status among university students using NEI VFQ 25. After adjustment with age and gender, RE was a significant negative predictor of perceived general health, ocular pain, and both near and distant activities. On the other hand, refractive error was not a significant risk factor for poor perception of general vision (ß = -1.146, 95% CI = -4.706: 2.414). As regards vision-specific functions, RE significantly negatively predicts the perception of mental health, role difficulties, dependency, and peripheral vision. While refractive error has no significant impact on social functioning, driving ability, and colored vision (P > 0.05).

Refractive error is not significantly associated with CVDs.[30] Defective Color vision is mainly linked to family history and male gender.[12] This could explain the absence of significant influence of RE on perceived color function in the current study. Commonly RE might cause mild localized ocular pain and headache occasionally. They should not occur after full correction of RE. However, ocular pain and headache are aggravated by prolonged visual tasks at a distance or angle where visual impairment exists.[31] In the current study, ensuring the full corrective status of RE has not been assessed, this could explain the

significant reporting of ocular pain among students with RE.

Zhu et al, have explored the relation of vision-related quality of life with myopic status among Chinese high school students. Compared to non-myopic students, myopic subjects had significantly worse scores of general visions, near activities, distant activities, social functioning, mental health, role difficulties, dependency, color vision, and peripheral vision. No significant differences were found concerning general health or ocular pain in students in the myopic students and those without myopia.[32] On the other hand, visual impairment, and eye disease had a negative impact on vision-related quality of life among Mexican American subjects. Whereas those with uncorrected RE had significant declines in scores of all NEI VFQ 25 domains except general health, color vision, and peripheral vision.[33]

CONCLUSIONS

The current study revealed that refractive errors are a common problem among university students and myopia is the most prevalent reported RE type in Upper Egypt. Refractive errors have adverse effects on vision-related quality of life among university students. In a trial to mitigate the negative impact of RE on vision related QOL and to prevent future vision problems, a comprehensive health program targeting subjects with refractive errors should be conducted. It should embrace early screening of RE since childhood and provision of accurate correction of RE including different corrective services such as spectacle and surgical options. These corrective services should be provided with a subsided cost that is covered by students' health insurance. Further studies are needed to explore the negative effect of RE on students' academic achievement and whether it hampers their enrollment in certain faculties. Also, it is recommended to evaluate the impact of whether the provision of adequate correction would result in improvement in variable domains of vision-related quality of life.

Ethical Consideration

Official approval was obtained from the central administrative authorities in Assiut University and each of the studied facilities**.** The Ethical Committee of the Assiut Faculty of Nursing approved the study. Ethical considerations were followed during the study. Preservation of privacy and confidentiality of students' data was done. Ensuring students' voluntary participation through explaining the study aim, obtaining written informed consent from each student, and their right to refuse participation and withdraw from the study without any negative consequences.

The study obtained all required approvals from the Ethical Committee of the Assiut Faculty of Nursing approved the study (IRB number 1120240665)

Strengths and limitations: The key strengths of the current study include providing a snapshot of the impact of RE on the vision related QOL and its predictors among university students in one of the largest universities in Upper Egypt. In addition, the researchers used a standardized instrument on a large random sample that is likely to be representative of Assiut University students. However, this study has some limitations. First, it entirely depends on self-reporting of refractive error status from the participants rather than objective clinical diagnosis. Second, the current study is limited to students enrolled in the education at Assiut University. There is still an undeniable proportion of Egyptian youth who haven't access to university education and a need for a real representative sample of students from all Egyptian Universities. Third, there are still essential overlooked aspects that have not been measured as the negative impact of RE on the students' academic achievement and the hampering effect of RE on the choice and enrollment in certain faculties.

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Shimaa Abdelrhahim Khalaf: research idea, study designing, data collection, and revised paper writing; Safaa Rabea Osman: research idea, study designing, data collection, and revised paper writing; Dalia Mohamed El-Sebaity: research idea, study designing, and revised paper writing, Heba Gaafar Ali: data analysis, and paper writing.

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