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Factors associated with uncorrected refractive errors in school-going adolescents in Kakamega County, Kenya

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ABSTRACT

BACKGROUND: Uncorrected refractive errors (URE) present an enormous burden on children in Kenya. The study investigated factors associated with URE in school-going adolescents in Kakamega County, Kenya.

MATERIAL AND METHODS: An observational, cross-sectional study with multistage sampling was conducted with randomly selected secondary school students in forms one to four. Comprehensive clinical examinations conducted by optometrists were used to determine participants' URE types and dioptric strength. Structured pre-validated questionnaires were administered to participants to elicit information on their sociodemographic and socioeconomic statuses.

RESULTS: A total of 165 students, aged 17.45 ± 1.44 years, with URE classified into myopia, hyperopia, and astigmatism, participated in the study. There were more males (57%) than females in this study, and most participants had astigmatism (52%). The study found no-to-weak association between predefined factors and URE. While males had decreased odds [odds ratio (OR): 0.557, 95% confidence interval (CI): 0.211–1.470] for myopia than astigmatism, the converse was true for hyperopia (OR: 1.165, 95% CI: 0.385–3.524) compared with astigmatism. Even though participants from families with lower affluence and living in rural settings had up to 18 times increased odds (OR: 18.699, 95% CI: 0.840–416.442) for myopia than astigmatism and hyperopia, significant dioptric power was less likely to be present in those with myopia (OR: 0.529, 95% CI: 0.165–1.698) and hyperopia (OR: 0.011, 95% CI: 0.001–0.192).

CONCLUSIONS: URE may not be significantly associated with school-going adolescents' sociodemographic and socioeconomic statuses. However, myopia and astigmatism are increasingly likely to be present among participants from families with lower affluence and living in rural settings.

KEY WORDS: school-going adolescents; sociodemographic; socioeconomic; uncorrected refractive error; vision impairment

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INTRODUCTION

Vision impairment resulting from uncorrected refractive error (URE) has become an important issue of global public health concern affecting over 2.3 billion people [1], particularly in developing countries [2]. Although URE is not the number one cause of blindness [2], it still remains, as per global estimates, the number one cause of vision impairment (VI) globally [3]. In children, the impact of UREs cannot be over emphasized. These impacts range from interference with education [4], leading to a significant reduction in employment opportunities, social stigmatization, and lowered opportunities to earn a living [5–7]. The broader consequence of UREs in children is an increased economic burden on the larger society [8]. In all countries worldwide, URE in children remains a condition that is easily correctable with simple and cost-effective strategies [9]. Despite this, over six million of the global population having VI due to URE are from Africa alone [10, 11]. Most of them are children and persons living in poor and rural communities. This creates the need for cost-effective and sustainable public health strategies [12].

Various risk factors have been associated with URE. Studies [13, 14] have found racial and socioeconomic disparities to be possible risk factors for URE in adults and children elsewhere. In a Northern Ireland study [15], the medical history of the biological parent(s) was shown to play a role in significant refractive error (RE), particularly myopia, development in children. In Nigeria, age was a key factor relating to the increasing prevalence of blindness and VI, while females were shown to be at greater risk for blindness and VI [16]. In South Africa, Naidoo et al. established that the critical cause of VI in up to 64% of school-going children of African descent was RE. The study noted short-sightedness to be more prevalent with an onset of 14 years, with an increasing prevalence by the age of 15 years [17].

Furthermore, parental level of education was found to be associated with significant short-sightedness but not long-sightedness [17]. In an Ethiopian study [18], while noting vision loss as an essential issue of public health concern, it was found that many of the common causes of low vision and blindness among children, like URE, were either easily avoidable or treatable. Females and persons from rural settings were identified to be at the most risk of vision loss [18]. In Kenya, the trend of severe vision loss and blindness in children resulting from URE, was reported to be largely influenced by socio-cultural, socioeconomic dynamics, and genetic factors [19]. Many of the common causes, while being reported to be avoidable, were also noted to leave a more significant burden among rural and poorer communities [20].

From a Kenyan perspective, while these studies have provided some understanding of the prevalence and pattern of REs in the country, very limited knowledge has been provided on factors associated with URE in school-going adolescents in this country. Despite the fact that the increasing prevalence of refractive errors has been variously reported to range from 5.2% [21] to 17.2% [22] and "accounting for more than two-thirds of all causes of vision impairment in children in Kenya" [21], no study until now has investigated the risk factors associated with URE. URE is still reported to impact heavily on the academic performance of school-going children in Kenya [23] and globally. It is also reported to expose affected children to a lifetime of poverty and other socioeconomic-related challenges [8]. This knowledge gap, therefore, creates the need to understand better the factors influencing UREs in school-going adolescents. Therefore this study aimed to investigate the factors associated with UREs among school-going adolescents of Kakamega County, in the western region of Kenya.

MATERIAL AND METHODS

This study employed an observational cross-sectional design to elicit factors associated with URE in school-going adolescents of Kakamega County. A multistage sampling methodology was applied in this study. All secondary school students in Kakamega County (aged 13 to 25 years), who constituted the population for this study, according to their sub-counties, were purposively selected and placed in clusters. Out of these, four clusters were selected using simple random sampling. A total of 138 secondary schools comprising 40,577 students formed the target population, and those schools that included both day scholars and boarding facilities, as well as a mix of gender, were identified for inclusion. Only 19 schools met these criteria; thereafter, one-third of the 19 schools were selected by simple balloting. Using proportionate sampling, 2,821 students were selected, and all students who gave permission/consent were screened by research assistants who were optometrists. This was done to identify the presence of URE and determine the dioptric strength and subtype of RE classified as myopia, hyperopia, and astigmatism. Those identified with URE were provided with structured pre-validated questionnaires to identify possible factors that may be associated with the distribution of UREs in line with the study objectives. A power analysis conducted for this study determined a minimum of 150 participants with URE was required to elicit 80% power for a 2-tailed test hypothesis at α = 0.05 to detect a 10% difference in mean responses to the study objectives.

Data collected were categorized according to participants' URE subtypes. These were captured into MS Excel (2013), cleaned, coded, and exported into Statistical Package for Social Sciences (SPSS) (v.25) for appropriate analyses. Possible associations between the various URE subtypes with pre-defined socio-demographic and socioeconomic variables were explored using logistic regression. Adjustments were made for the different URE sub-types to determine the strength and extent of association with the defined factors using a multinomial logistic regression model, at α = 0.05 and 95% confidence interval (CI).

For this study, ethical approvals were obtained from the Institutional Ethics Review Committee of Masinde Muliro University (MMU/COR: 403009/VOL. 62) and the Kenyan National Commission for Science, Technology, and Innovation (NACOSTI/P/17/33921/18996). All ethical guidelines consistent with the Helsinki declaration, including respect for participants' rights to either refuse or withdraw from further participation in the study, were adhered to.

RESULTS

A total of 165 students met the criteria for inclusion in this study. The uncorrected refractive errors were classified as myopia, hyperopia, and astigmatism (Tab. 1). Data collected from the 165 participants, which were normally distributed (Fig. 1), were elicited from 94 male students (57%) and 71 female students (43%), as shown in Table 1, with a mean age of 17.45 ± 1.438 (Fig. 1). Astigmatism (52%) was found to be most com-

Table 1. Participants' sociodemographic distribution by uncorrected refractive error (URE) type

Sociodemographic variables	Distribution of URE (n = 165)			
	Freq. (% share)	Freq. (% share)	Freq. (% share)	Total (% share)
	Myopia: 41 (25.0)	Hyperopia: 38 (23.0)	Astigmatism: 86 (52.0)	165 (100%)
Age				
< 18 years	23 (26.1)	24 (27.3)	41 (46.6)	88 (53.3)
≥ 18 and Above Years	18 (23.4)	14 (18.2)	45 (58.4)	77 (46.7)
Gender				
Male	20 (21.3)	23 (24.5)	51 (54.3)	94 (57.0)
Female	21 (29.6)	15 (21.1)	35 (49.3)	71 (43.0)
Family religion				
Christian	38 (25.0)	34 (22.4)	80 (52.6)	152 (92.1)
Muslim	3 (25.0)	4 (33.3)	5 (41.7)	12 (7.3)
ATR	0 (0.0)	0 (0.0)	1 (100.0)	1 (0.6)
Parents' marital status				
Single	4 (36.4)	4 (36.4)	3 (27.3)	19 (11.5)
Separated	3 (20.0)	4 (26.7)	8 (53.3)	120 (72.7)
Married	26 (21.7)	27 (22.5)	67 (55.8)	15 (9.1)
Widowed	8 (42.1)	3 (15.8)	8 (42.1)	11 (6.7)
Family size (no. of children)				
< than 3 children (small)	4 (9.8)	2 (5.3)	5 (5.8)	11 (6.7)
3–6 children (moderate)	18 (43.9)	20 (52.6)	40 (46.5)	78 (47.3)
7–10 children (large)	18 (43.9)	15 (39.5)	38 (44.2)	71 (43.0)
>10 children (very large)	1 (2.4)	1 (2.6)	3 (3.5)	5 (3.0)

→

Table 1. Participants' sociodemographic distribution by uncorrected refractive error (URE) type

Sociodemographic variables	Distribution of URE (n = 165)			
	Freq. (% share)	Freq. (% share)	Freq. (% share)	Total (% share)
	Myopia: 41 (25.0)	Hyperopia: 38 (23.0)	Astigmatism: 86 (52.0)	165 (100%)
Parent education				
Never been to school	1 (12.5)	1 (12.5)	6 (75.0)	8 (4.8)
Primary	16 (32.7)	10 (20.4)	23 (46.9)	48 (29.1)
Secondary	23 (24.5)	23 (24.5)	48 (51.1)	93 (56.4)
College	1 (33.3)	0 (0.0)	2 (66.7)	5 (3.0)
Tertiary	0 (0.0)	4 (36.4)	7 (63.6)	11 (6.7)
Parent occupation				
Unemployed	20 (29.0)	16 (23.2)	33 (47.8)	69 (41.8)
Artisan	3 (18.8)	5 (31.3)	8 (50.0)	16 (9.7)
Self-employed	6 (22.2)	9 (33.3)	12 (44.4)	27 (16.4)
Professional self-employed	1 (33.3)	0 (0.0)	2 (66.7)	3 (1.8)
Trading	7 (25.0)	6 (21.4)	15 (53.6)	27 (16.4)
Profession public service	0 (0.0)	0 (0.0)	0 (0.0)	1 (0.6)
Public services	2 (16.7)	2 (16.7)	8 (66.7)	12 (7.3)
Paid/private-company Employed	2 (20.0)	0 (0.0)	8 (80.0)	10 (6.1)
Domiciliation				
Rural	40 (27.4)	33 (22.6)	73 (50.0)	146 (88.5)
Urban	1 (5.3)	5 (26.3)	13 (68.4)	19 (11.5)

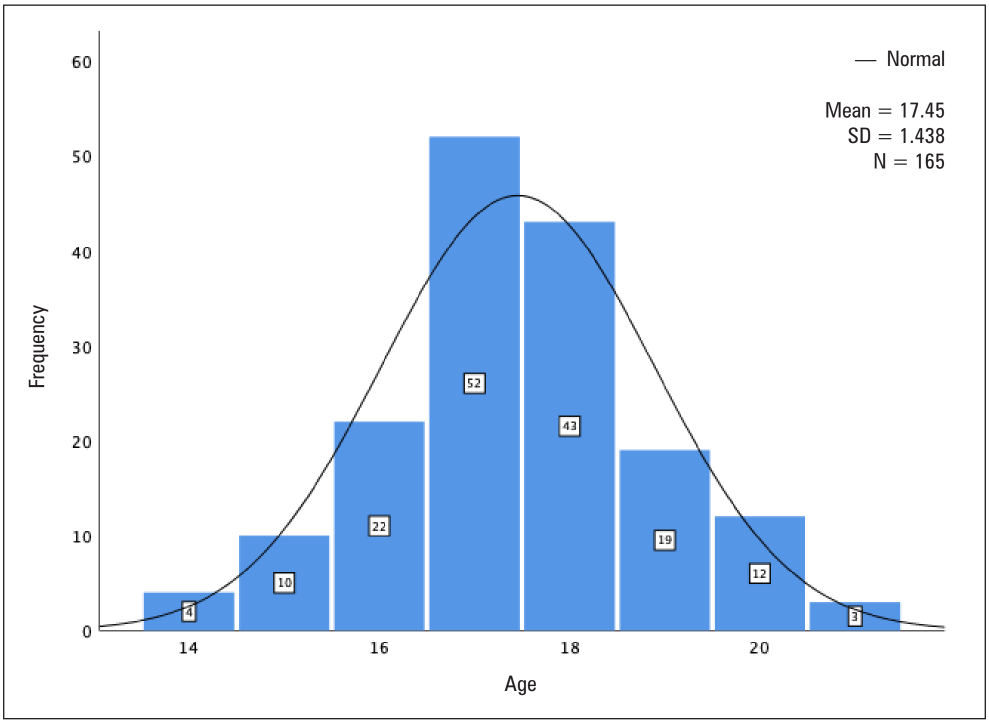

FIGURE 1. Histogram showing normal distribution of data from 165 participants with uncorrected refractive errors (URE) aged 17.45 ± 1.438. SD — standard deviation

mon, followed by myopia (25%) and hyperopia (23%). With regards to dioptric strength, of all the URE identified, only 26.7% were found to be significant (Tab. 2).

Table 2. Measure of association between participants' sociodemographics and socioeconomic factors with uncorrected refractive errors (URE)

Variables	Refractive error status			Total freq. (%)	X^2-test	p-value	Cramer's V
	Myopia Freq. (%)	Hyperopia Freq. (%)	Astigmatism Freq. (%)				
Age							
< 18 years	23 (56.1)	24 (63.2)	41 (47.7)	88 (53.3)	2.706	0.258	0.128
≥ 18 years	18 (43.9)	14 (36.8)	45 (52.3)	77 (46.7)			
Gender							
Male	20 (48.8)	23 (60.5)	51 (59.3)	94 (57.0)	1.509	0.470	0.096
Female	21 (51.2)	15 (39.5)	35 (40.7)	71 (43.0)			
Family religion							
Christian	38 (92.7)	34 (89.5)	80 (93.0)	152 (92.1)	1.761	0.780	0.073
Muslim	3 (7.3)	4 (10.5)	5 (5.8)	12 (7.3)			
ATR	0 (0.0)	0 (0.0)	1 (1.2)	1 (0.6)			
Parent's marital status							
Widowed	8 (19.5)	3 (7.9)	8 (9.3)	19 (11.5)	6.868	0.333	0.144
Married	26 (63.4)	27 (71.1)	67 (77.9)	120 (72.7)			
Separated	3 (7.3)	4 (10.5)	8 (9.3)	15 (9.1)			
Single/never married	4 (9.8)	4 (10.5)	3 (3.5)	11 (6.7)			
Family size (no. of children)							
Small	4 (9.8)	2 (5.3)	5 (5.8)	11 (6.7)	1.405	0.966	0.065
Moderate	18 (43.9)	20 (52.6)	40 (46.5)	78 (47.3)			
Large	18(43.9)	15 (39.5)	38 (44.2)	71 (43.0)			
Very Large	1 (2.4)	1 (2.6)	3 (3.5)	5 (3.0)			
Parent's education							
Never been to school	1 (2.4)	1 (2.6)	6 (7.0)	8 (4.8)	9.504	*0.302*	0.170
At most primary education	16 (39.0)	10 (26.3)	22 (25.6)	48 (29.1)			
At most secondary education	23 (56.1)	23 (60.5)	47 (54.7)	93 (56.4)			
Tertiary or more education	1 (2.4)	0 (0.0)	4 (4.7)	5 (3.0)			
College/Tech./Voc. education	0 (0.0)	4 (10.5)	7 (8.1)	11 (6.7)			
Parent's occupation							
Unemployed	20 (48.8)	16 (42.1)	33 (38.4)	69 (41.8)	9.817	*0.775*	0.172
Artisan/skilled labour	3 (7.3)	5 (13.2)	8 (9.3)	16 (9.7)			
Self-employed (non-professional)	6 (14.6)	9 (23.7)	12 (14.0)	27 (16.4)			
Professional but self-employed	1 (2.4)	0 (0.0)	2 (2.3)	3 (1.8)			
Trading	7 (17.1)	6 (15.8)	14 (16.3)	27 (16.4)			
Professional in public service	0 (0.0)	0 (0.0)	1 (1.2)	1 (0.6)			
Non-professional in public service	2 (4.9)	2 (5.3)	8 (9.3)	12 (7.3)			
Paid in private employment	2 (4.9)	0 (0.0)	8 (9.3)	10 (6.1)			
Place of regular domiciliation							
Rural setting	40 (97.6)	33 (86.8)	73 (84.9)	146 (88.5)	4.510	0.105	0.165
Urban setting	1 (2.4)	5 (13.2)	13 (15.1)	19 (11.5)			
Refractive error significance							
Significant URE	13 (31.7)	1 (2.6)	30 (34.9)	44 (26.7)	14.728	0.001	0.299
Non-significant URE	28 (68.3)	37 (97.4)	56 (65.1)	121 (73.3)			
Family affluence status							
Low	28 (68.3)	29 (76.3)	52 (60.5)	109 (66.1)	4.151	0.386	0.112
Middle	11 (26.8)	9 (23.7)	30 (34.9)	50 (30.3)			
High	2 (4.9)	0 (0.0)	4 (4.7)	6 (3.6)			

X^2 test of association at $\alpha = 0.05$

Factors associated with uncorrected refractive errors in school-going adolescents

Factors pre-identified to interact with URE subtypes were grouped into sociodemographic variables, including age, gender, family religion, parent's marital status, family size (measured in terms of the number of children in each household), and parent's highest level of education, main occupation, and place of regular domiciliation. Socioeconomic factors, on the other hand, were measured in terms of family affluence status, defined as low, middle, and high family affluence (Tab. 2). The findings for test analyses conducted for each identified variable interacting with the URE types, as shown in Table 2, found no association between refractive error types and sociodemographic and socioeconomic factors. The strength of association was also measured to justify the finding of "no association" as determined by the Cramer's V test of the strength of association for asymmetric nominal variables. The results further showed a no-to-very weak association between the identified factors and URE types amongst school-going adolescents. Only the test analysis to explore the relationship between RE types and the significance of their dioptric strength showed an association (p = 0001). However, this was weak (Cramer's V = 0.299), as shown in Table 2.

Further analysis conducted to interrogate the within-group interaction of each pre-defined variable, adjusted for myopia, with astigmatism as a reference category is shown in Table 3. Our findings indicate that for age, although not significant, there is about a 23% decreased likelihood for myopia than astigmatism [odds ratio (OR): 0.773, 95% CI: 0.506–1.182) for every unit increase in age amongst the study participants. For gender, we found that males have about 44% less likelihood than females to have myopia than they would for astigmatism (OR: 0.557, 95% CI: 0.211–1.470). Additionally, we found that participants from small families, compared to those from very large families, have nearly four times greater odds of myopia than astigmatism. However, the difference was not significant (p = 0.456). Although participants whose parents were widowed, compared to those whose parents were either single or never married, had nearly two times greater odds for myopia than astigmatism, the difference, however, was not significant (p = 0.437). Other factors of interest to the objective of this study found to interact with refractive error subtypes were parental occupation, place of regular domicile, and family affluence status. We found that being professional but in self-employment had greatest odds of myopia than astigmatism (OR: 5.323, 95% CI: 0.093–305.441). In addition, living in rural settings presented participants in this study with about 18 times greater odds for myopia than astigmatism (OR: 18.699, 95% CI: 0.840–416.442) when compared with those from urban settings. However, these findings were not significantly different (p > *0.05*). For family affluence status, we found that coming from a family with low-to-middle affluence had 93% to 95% less likelihood for myopia, compared to astigmatism, than those from families with high affluence. Further to the myopia-astigmatism comparison, we compared the level of refractive error significance for the myopia-astigmatism relationship. The results (Tab. 3) showed that significant refractive error was about 47% (OR: 0.529, 95% CI: 0.165–1.698) less common for myopia than astigmatism. This, however, was not statistically significant (p = 0.285).

Analysis was also conducted to interrogate the within-group interaction of each factor, adjusted for hyperopia, again with astigmatism as a reference category. The findings in Table 4 indicate that the participants had a 23% (OR: 0.774, 95% CI: 0.522–1.147) decreased likelihood of having hyperopia, compared with astigmatism, with every unit increase in age. However, compared to females, males had about 17% (OR: 1.165, 95% CI: 0.385–3.524) increased odds of having hyperopia than astigmatism. In addition, being from a widowed home had about 39% (OR: 0.609, 95% CI: 0.046–8.077) less likelihood for hyperopia than astigmatism, while those from small families had 10% (OR: 0.104, 95% CI: 0.002–6.529) increased odds for hyperopia than astigmatism. Nonetheless, in all cases, the differences were not significant for hyperopia-astigmatism comparison. This, however, did not hold for the area of regular domiciliation, where living in a rural setting had about 33% (OR: 0.674, 95% CI: 0.119–3.810) fewer odds for hyperopia compared with astigmatism. Finally, and as shown in Table 4, significant refractive power (diopter) was about 99% (OR: 0.011, 95% CI: 0.001–0.192) less likely to be present among participants with hyperopia than in those with astigmatism. The difference was found to be highly significant (p = 0.002).

Table 3. Influence of participants' sociodemographics and socioeconomic factors adjusted for myopia

Refractive error status	Variables interactions	Beta coef.	Wald test	p-value	OR	95% CI for OR	
						Lower bound	Upper bound
Myopia	Age	–0.257	1.410	0.235	0.773	0.506	1.182
	Gender						
	Male	–0.585	1.398	0.237	0.557	0.211	1.470
	Female	–	–	–	–	–	–
	Family religion						
	Christian	18.509	0.000	0.998	109232730	0.000	UD
	Muslim	18.365	0.000	0.998	94540517	0.000	UD
	ATR	–	–	–	–	–	–
	Family size (no. of children)						
	Small	1.589	0.555	0.456	4.898	0.075	320.657
	Moderate	0.260	0.020	0.889	1.297	0.034	49.293
	Large	0.440	0.056	0.812	1.553	0.041	58.486
	Very large	–	–	–	–	–	–
	Parent marital status						
	Widowed	0.899	0.604	0.437	2.456	0.255	23.676
	Married	–0.798	0.601	0.438	0.450	0.060	3.388
	Separated	–0.553	0.201	0.654	0.575	0.051	6.442
	Single/never married	–	–	–	–	–	–
	Parent Level of Education						
	Never been to school	15.273	0.000	0.993	4293278	0.000	UD
	At most primary education	17.539	0.000	0.992	41418708	0.000	UD
	At most secondary education	17.480	0.000	0.992	39052922	0.000	UD
	Tertiary or more education	18.126	0.000	0.992	74471421	0.000	UD
	College/Tech./Voc. education	–	–	–		–	–
	Parent occupation						
	Unemployed	1.543	1.352	0.245	4.677	0.347	62.948
	Artisan/skilled labour	0.459	0.092	0.762	1.583	0.081	30.738
	Self-employed (non-professional)	0.568	0.166	0.684	1.766	0.114	27.276
	Professional but self-employed	1.672	0.655	0.418	5.323	0.093	305.441
	Trading	0.911	0.457	0.499	2.486	0.177	34.833
	Professional in public service	–17.481	0.000	0.998	2.558E–8	0.000	UD
	Non-professional in public service	1.289	0.654	0.419	3.630	0.160	82.536
	Paid in private employment	–	–	–	–	–	–
	Place of regular domiciliation						
	Rural setting	2.928	3.421	0.064	18.699	0.840	416.442
	Urban setting	–	–	–	–	–	–
	Refractive error significance						
	Significant URE	–0.636	1.145	0.285	0.529	0.165	1.698
	Non-significant URE	–	–	–	–	–	–
	Family affluence atatus						
	Low	–2.721	2.844	0.092	0.066	0.003	1.555
	Middle	–2.943	3.262	0.071	0.053	0.002	1.285
	High	–	–	–	–	–	–

Multinomial logistic regression at $\alpha = 0.05$ and 95% CI; Reference category = Astigmatism; UD — undefined output due to missing data; OD — odds ratio; CI — confidence interval

Table 4. Influence of participants' socio-demographics and socioeconomic factors adjusted for hyperopia

Refractive error status	Variables interactions	Beta coef.	Wald test	p-value	OR	95% CI for OR	
						Lower bound	Lower bound
Hyperopia	Age	–0.256	1.628	0.202	0.774	0.522	1.147
	Gender						
	Male	0.153	0.073	0.786	1.165	0.385	3.524
	Female	–	–	–	–	–	–
	Family religion						
	Christian	17.425	273.086	0.000	36951963	4678299	291868321
	Muslim	19.295	–	–	239604851	239604851	239604851
	ATR	–	–	–	–	–	–
	Family size (No. of children)						
	Small	–2.265	1.149	0.284	0.104	0.002	6.529
	Moderate	–1.892	1.069	0.301	0.151	0.004	5.443
	Large	–1.927	1.172	0.279	0.146	0.004	4.770
	Very Large	–	–	–	–	–	–
	Parent marital status						
	Widowed	–0.496	0.141	0.707	0.609	0.046	8.077
	Married	–1.006	0.839	0.360	0.366	0.042	3.148
	Separated	–1.327	0.989	0.320	0.265	0.019	3.625
	Single/never married	–	–	–	–	–	–
	Parent level of education						
	Never been to school	–5.532	6.402	0.011	0.004	5.447E–5	0.287
	At most primary education	–3.204	4.771	0.029	0.041	0.002	0.720
	At most secondary education	–2.829	4.167	0.041	0.059	0.004	0.893
	Tertiary or more education	–18.819	0.000	0.995	6.716E–9	0.000	UD
	College/Tech./Voc. education	–	–	–	–	–	
	Parent occupation						
	Unemployed	17.521	0.000	0.992	40669980	0.000	UD
	Artisan/Skilled labour	18.306	0.000	0.992	89133893	0.000	UD
	Self-employed (non-professional)	18.154	0.000	0.992	76561685	0.000	UD
	Professional but self-employed	0.722	0.000	1.000	2.058	0.000	UD
	Trading	17.552	0.000	0.992	41937308	0.000	UD
	Professional in public service	18.257	0.000	0.998	84884104	0.000	UD
	Non-professional in public service	17.691	0.000	0.992	48205985	0.000	UD
	Paid in private employment	–	–	–	–	–	–
	Place of regular domiciliation						
	Rural setting	–0.394	0.199	0.656	0.674	0.119	3.810
	Urban setting	–	–	–	–	–	–
	Refractive error significance						
	Significant	–4.488	9.600	0.002	0.011	0.001	0.192
	Non-significant	–	–	–	–	–	–
	Family affluence atatus						
	Low	18.661	0.000	0.994	127225970	0.000	UD
	Middle	16.680	0.000	0.994	17544507	0.000	UD
	High	–	–	–	–	–	

Multinomial logistic regression at α = 0.05 and 95% CI; Reference category = Astigmatism; UD — undefined output due to missing data; OR — odds ratio; CI — confidence interval

DISCUSSION

Factors pre-defined in this study to interact with myopia, hyperopia, and astigmatism were classified as socio-demographics and socioeconomic. The study mainly found no convincing evidence (Tab. 2) of associations between refractive error types and the pre-defined factors. In addition, where some level of association did exist, the strength of association as measured by the Cramer's V test results for asymmetric nominal variables showed a very weak association. Only tests conducted on the measure of association between refractive error types and the significance of their refractive power (measured in diopters), showed an association (p = 0001). However, this again was weak (Cramer's V = 0.299). The implication of these findings is that having uncorrected refractive errors, regardless of type, may not be associated with a school-going adolescent's sociodemographic or socioeconomic statuses. However, where some association does exist, as with the dioptric power of each respective refractive error type, they may likely be weak (Tab. 2). While our study found no comparable Kenyan study on factors associated with URE in school-going children and adolescents, it, however, noted that its finding of no-to-weak association between URE and pre-defined factors were not consistent with an Ethiopian study conducted among primary school children, where gender was found to be significantly associated with URE in school-going children [24].

Furthermore, the interclass analysis adjusted for URE types showed that while with every unit increase in age, the odds for myopia and hyperopia than astigmatism decreased, males were more likely to have hyperopia while females had an increased likelihood for myopia than astigmatism. Nonetheless, these likelihoods were weak and not significant. Additionally, while being from small families, widowed parents, with poor to no education, poorly employed or in petty trading, living in rural settings and of low economic status presented for the participants greater risk of myopia compared with astigmatism, the converse was true for hyperopia compared with astigmatism. The implication of this finding is that although the study found no-to-weak association between the pre-defined (sociodemographic and socioeconomic) factors and URE, still, school-going adolescents from homes with disadvantaged social background and of low family affluence had increased odds for myopia and reduced odds for hyperopia, than for astigmatism. In a study to determine factors influencing myopia, O'Donoghue et al. [25] found that the odds for myopia were not significantly associated with urbanization but were influenced by gender, family size, and the economic background of school-going Northern Ireland children. The study further noted that while girls and children from the less economically deprived background were more likely to be myopic, the converse was true for children from large family size [25]. In this current study, we also found that females and being of smaller family size increased the odds of myopia in school-going adolescents.

In addition, a Chinese study by Li et al. [26] did not find the likelihood of myopia in children to be influenced by parental education or occupation. However, with domiciliation, Nyamai [22, Li et al. [26], and Tay et al. [27], all working in different social-demographic and geographical settings, found that the likelihood of myopia in school-going children was increased in children from urban settings than for those in rural settings. This was justified on the grounds of increased near-related activities in urban settings than in rural settings. These findings were not true for our study, as we found children from rural settings to have increased odds of myopia than astigmatism and hyperopia. The implications of the findings in our research are that, while URE, specifical myopia, is known to significantly impact childhood education, resulting in an increased burden in school-going children [28], the focus has primarily been reported on those in urban and high socioeconomic settings [22, 26, 27].

Therefore, our findings draw attention to school-going adolescents from low affluence and rural settings. The study found an increased odds for myopia than astigmatism and hyperopia, though not significant. Nonetheless, our study found that significant dioptric power of refractive error was less likely to be present in adolescents with myopia and hyperopia than in those with astigmatism. This alludes to the importance of low-grade refractive errors, particularly myopia, in influencing the burden of UREs in school-going adolescents, hence the need for early provision of spectacles in schools. This finding is consistent with previous studies on the impact of refractive errors in school-going children and the need for early spectacle interventions [28, 29].

CONCLUSION

While this study aimed to bridge the knowledge gap on the factors associated with URE among school-going adolescents in Kakamega County, Kenya, our findings did not show significant associations between URE and any of the factors pre-defined to influence URE in school-going adolescents. In as much as URE was either not or was weakly associated with pre-defined socio-demographic and socioeconomic factors, where they existed, males were more likely to have hyperopia. In contrast, females had an increased likelihood of myopia. In addition, the study found that although participants from families with low affluence and living in rural settings had increased odds for myopia than astigmatism and hyperopia, significant dioptric power of refractive errors were less likely to be present in adolescents with myopia and hyperopia than in those with astigmatism. Finally, the study notes that contrary to findings elsewhere where myopia was mainly found among those in urban and affluent settings, the converse was true in this study. The implication of our results, therefore, is that while having URE of any type may not be significantly influenced by participants' socio-demographic and socioeconomic factors, efforts and strategies to alleviate URE, particularly myopia and astigmatism, through increased spectacle uptake among school children in rural and settings of low socioeconomic means, needs to be intensified.

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Conflict of interests

The authors have no competing interests to declare for the study conducted and in the writing and publication of this paper.

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