RESEARCH PAPER

Prevalence and patterns of refractive errors among patients attending King Fahad Specialist Hospital, Buraidah (2022-2024).

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Abstract:

There are two key issues about uncorrected refractive errors: They are still a major cause of visual impurities around the world and they are preventable. In the last few decades, number of persons with refractive disorders has been steadily rising, according to estimates from the Global Burden of Disease. While there are epidemiological studies from Saudi Arabia that have done pooled estimates on hyperopia and astigmatism prevalence in Saudi School children, there is need to have up-to-date hospital based epidemiological data for Qassim region. This study investigated the prevalence of refractive errors of the patients who visited the optometry clinics of King Fahad Specialist Hospital (KFSH), Buraidah. To conclude the study, objective data regarding the prevalence of myopia, hyperopia and astigmatism were collected from patients attending KFSH between 2022-24 and compared with the data of the region and the world.

The design, setting, and participants: This is a retrospective analytical cross-sectional study that included all patient records in the KFSH optometry clinics from 1 January 2022, to 31 December 2024. Demographic and clinical characteristics such as age, gender, spherical and cylindrical refractive error, visual acuity, amblyopia, and squinting were collected from electronic medical records. Patients were grouped as myopes, hyperopes, simple astigmates, and without refractive error. This inclusion accounted for estimates of simple astigmatism, whereas astigmatism complicated by myopia or hyperopia was determined by the spherical-equivalent refractive category. Age was grouped as 0–18, 19–40, 41–60, and 60 years or older. Measurements were made using descriptive statistics, chi-square tests, and logistic regression models, with a p-value of less than 0.05 considered to be significant.

Results: 1010 patient records were analyzed: 56.9% female and median age was 15 years. Overall, 97.8% of patients had a refractive error. The most common abnormality was hyperopia (56.3%), which was followed by myopia (32.1%) and simple astigmatism (9.4%). Myopia tended to be more common in adults (19-40 years) while hyperopia tended to be more common in paediatric and adolescent populations (0-18 years). Refractive error type was significantly associated with age group ($\chi^2 = 92.1$, $p < 0.0001$) and gender ($\chi^2 = 11.4$, $p = 0.0096$). For logistic regression, the odds of hyperopia were lower (OR 0.18, $p < 0.001$), while the odds of myopia were higher (OR 3.90, $p < 0.001$) for the patients aged 19-40 years than those aged 0-18 years. Females were less likely to have hyperopia compared to males (OR 0.67, $p = 0.012$) and less likely to have myopia compared to males (no significant difference).

Conclusions: Refractive errors were found to be prevalent among patients who presented to the KFSH optometry clinics with hyperopia being the most common refractive diagnosis especially in children and adolescents. This observed pattern of myopia was generally similar to that seen in younger populations in other studies; and the high prevalence of hyperopia is probably related to the type of sample, many patients were referred patients at the hospital. – some regarding it as an atypical sample, though of uncertain validity. These should therefore be interpreted as data for hospital patients only and not as estimates of the prevalence in the Qassim region of the community. The results suggest that there is a need for early screening, prompt optical correction and additional population based studies.

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Introduction

Myopia is now widely recognized as an increasing global public health concern. A comprehensive meta-analysis reported that its prevalence increased substantially over recent decades, with projections suggesting that nearly half of the global population may be affected by 2050 [1]. The increase has been particularly marked in East and Southeast Asia, where myopia prevalence among adolescents and young adults is high in several urban populations [2]. Prolonged near-work, intensive schooling, digital device use, and reduced outdoor exposure have been

proposed as important contributing factors [3,4]. Hyperopia is more commonly reported in younger children and older adults, whereas astigmatism may occur either as an isolated refractive error or in association with myopia or hyperopia [5]. The epidemiology of refractive errors varies substantially by region. A recent systematic review and meta-analysis of Saudi schoolchildren reported pooled prevalence estimates of 3.6% for hyperopia and 7.7% for astigmatism, with considerable variation between provinces and study populations [6]. Studies from neighboring and international settings have reported a wide range of estimates, including lower pooled estimates among Indian children and variable rates in adult populations [7,8]. These differences highlight the need for local data that can inform eye-care planning and screening strategies. [29-31]

Saudi Arabia has experienced rapid urbanization, increasing digital exposure, and changes in educational and lifestyle patterns, all of which may influence refractive development. However, data from several regions of the Kingdom remain limited. In particular, the Qassim region lacks recent analytical studies describing the hospital-based distribution of refractive error and its demographic correlates. The association of refractive error with amblyopia and strabismus also remains clinically relevant, as both conditions can contribute to long-term visual morbidity if not detected and managed early [9-11]. This retrospective analytical study was therefore conducted using electronic medical records from the Optometry Department of KFSH, Buraidah. The primary objective was to describe the distribution of refractive error types among patients attending the hospital between 2022 and 2024. Secondary objectives were to examine associations with age, gender, amblyopia, and squint disorders.

We hypothesized that refractive error patterns would differ by age, with hyperopia more frequent in younger patients and myopia more frequent in adolescents and adults. We also hypothesized that demographic and associated ocular factors would help predict specific refractive error categories.

Methods

Designs and contexts of studies

It was a retrospective analytical Cross sectional study that was carried out in the optometry clinics of King Fahad Specialist Hospital (KFSH) in Buraidah, Qassim, Saudi Arabia. KFSH offers services to patients in Buraidah and other surrounding districts including optometric and ophthalmic services which is a tertiary-care. EMRs for patients who attended the clinic from 2022 to 2024 were examined.

Study population and sampling

Patient records were included if they had the demographic and refractive data available for analysis throughout the study period. Records were excluded if the age and/or gender and/or refraction were missing, if an ocular pathology was documented that likely would have altered refraction (such as keratoconus or previous cataract surgery) and if duplicate entries were found. There were 1,010 unique patient records after exclusions for analysis. Formal sampling was not necessary as all eligible records were included in the audit. A sample size for a 50% expected prevalence with 95% confidence and 3% absolute precision would be 1,067 participants using $n = Z^2p(1-p)/d^2$ to make comparisons to conventional prevalence precision estimates. The precision of the descriptive estimates in the final data set of 1,010 records was thus ample.

What is measured and how it is measured.The chalice in the sauna is measured by a variable.

Age & age group: Age at visit was obtained in years and divided into 0-18, 19-40, 41-60 and ≥ 70 years.

Gender: Male or Female.

Refractive status was classified according to spherical (Sph) and cylindrical (Cyl) error – Type of refractive error. Spherical equivalent (SE) = Sph + 0.5 x Cyl. Myopia was defined as SE <= -0.50 diopter (D), hyperopia as SE >= +0.50 D, and simple astigmatism as cylinder <= -0.50 D with SE between -0.50 D and +0.50 D. Simple astigmatism is the only form of astigmatism that was chosen for the astigmatism category for this analysis. Astigmatism of cases of myopia or hyperopia was counted in the respective refractive errors category (spherical equivalent) and not as astigmatism.

Amblyopia: Clinically diagnosed “yes” or “no” based on the best corrected visual acuity.

Type of Squint – Esotropia (ET), Exotropia (XT), Esophoria (EP), Exophoria (XP) and None.

Data collection procedures

Data were collected from the hospital EMR system in a de-identified fashion and then put in a spreadsheet. In addition, a 10% random sample of entries were double checked by two investigators. Continuous variables were screened for plausibility and for outliers. Categorical variables are expressed in terms of counts and percentages; continuous variables in terms of means and standard deviations or medians and interquartile ranges, whichever is appropriate.

Statistical analysis

Python (with pandas and statsmodels) was used for data analysis. Type of refractive error distribution was reported, overall and across age group and sex. Chi-square tests were used to test for association among categorical variables. As many multiplicative logistic regression models as refractive error categories have been fitted against the other refractive error categories to estimate potential parametric association with age

group and gender variables. Odds ratios (ORs) and 95% confidence intervals (CIs) are presented. A logistic regression model was also fitted to compare any refractive error with no refractive error and assessment of model fit was done using likelihood ratio test. Statistically significant results were set at a p value < 0.05.

Ethical considerations

The institutional review board (IRB #607-47-1971) of Regional Research Ethics Committee Qassim Province approved the study. Informed consent not required as data were anonymous retrospective from the study. All filming were kept confidential and available to the investigators only.

Results

Participant Characteristics

For final analysis, 1,010 different patient records were analyzed. Age was between early childhood to older adulthood with a mean age of 27.8 ± 23.7 years and a median age of 15 years (interquartile range [IQR] 9-49). The mean and median values do not differ significantly, which suggests a right-skewed distribution, due to the high percentage of younger patients in the group of patients seen at the clinic.

The majority of the sample was children and adolescents between the ages of 0-18 (56.7%, n = 572). Adults aged 19-40 years accounted for 13.9% (n = 140), those aged 41-60 years for 13.7% (n = 138), and patients aged >=60 years for 15.8% (n = 160). While all age groups were catered to, there were many younger patients who came in to attend.

There were 435 males (43.1%) and 575 females (56.9%), giving a female-to-male ratio of approximately 1.3:1. A small female preponderance might be due to variations in the utilization of health services or patient characteristics in the hospital centers.A large proportion of patients seen in the optometry clinic were refractive error (97.8%). Hyperopia was the most frequent refractive category (n = 569, 56.3%), followed by myopia (n = 324, 32.1%) and simple astigmatism (n = 95, 9.4%). Thus, hyperopia made up more than 50% of the total refractive diagnoses and it was about 1.8 times more prevalent than myopia among the hospital-based sample.Two hundred forty-four patients (24.2%) had amblyopia noted. Of the 1010 patients, 93 (9.2%) had their squint documented while 917 (90.8%) had no documentation of their ocular deviation. The most common subtype was esotropia (65 patients, 6.4%), exotropia (21 patients, 2.1%), exophoria (3 patients, 0.3%) and esophoria (4 patients, 0.4%).

The overall clinic profile is mainly paediatric population, a slight preponderance for females and high refractive error. This was the majority diagnosis with a considerable percentage also having amblyopia or squint. These data was used for subsequent analysis of demographic and clinical associations.

Table 1. Baseline demographic and clinical characteristics (n = 1010)

Variable	Category	n (%)
Gender	Male	435 (43.1)
	Female	575 (56.9)
Age group	0–18 y	572 (56.7)
	19–40 y	140 (13.9)
	41–60 y	138 (13.7)
	≥60 y	160 (15.8)
Refractive error	Hyperopia	569 (56.3)
	Myopia	324 (32.1)
	Astigmatism	95 (9.4)
	None	22 (2.2)
Amblyopia	Yes	244 (24.2)
	No	766 (75.8)
Squint	Present	93 (9.2)
	Absent	917 (90.8)

Overall Distribution of Refractive Error Types

Among the 1,010 patients included in the study, hyperopia was the most frequent refractive abnormality, affecting 569 patients (56.3%; 95% CI: 53.2-59.3). This finding indicates that more than half of the patients attending the optometry clinic had hyperopic refractive status during the study period. Hyperopia was approximately 1.8 times more common than myopia and almost six times more common than simple astigmatism.

Myopia was identified in 324 patients (32.1%; 95% CI: 29.2-35.0), representing nearly one-third of

refractive diagnoses. Although less frequent than hyperopia, myopia formed a substantial part of the clinic workload and remains clinically relevant because of its association with progressive visual impairment and long-term ocular complications. Simple astigmatism was observed in 95 patients (9.4%; 95% CI: 7.6-11.2). This estimate should be interpreted in light of the study definition: astigmatism associated with myopia or hyperopia was not counted separately but was classified according to the spherical-equivalent refractive category. Although simple astigmatism was less common than hyperopia or myopia, it remained clinically important because uncorrected astigmatism can affect visual acuity and quality of vision.

Only 22 patients (2.2%; 95% CI: 1.3-3.1) had emmetropia or refractive findings that were not clinically significant. Accordingly, 97.8% of the study population had a measurable refractive error, consistent with the referral-based nature of a hospital optometry clinic.

The predominance of hyperopia contrasts with many population-based studies in which myopia is often the leading refractive error, particularly among adolescents and young adults. This difference may reflect the younger age distribution of the present sample and the hospital-based setting, where symptomatic hyperopic children are more likely to be referred for visual complaints, amblyopia assessment, or strabismus evaluation.

The distribution of refractive categories is shown in Figure 1. The figure demonstrates the predominance of hyperopia, followed by myopia, simple astigmatism, and no refractive error.

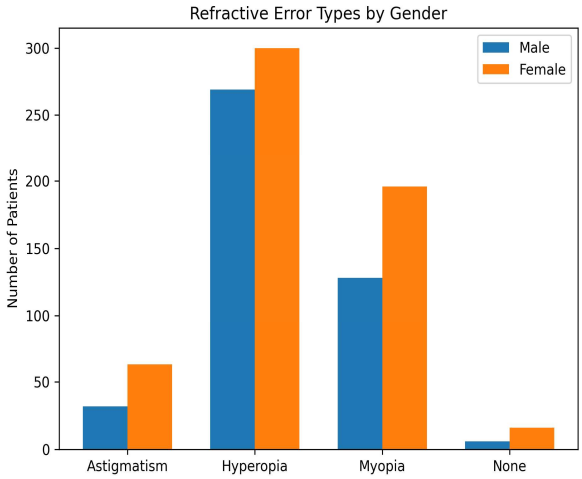
Table 2. Overall Distribution of Refractive Error Types (n = 1,010)

Refractive Error Type	Frequency (n)	Percentage (%)	95% Confidence Interval
Hyperopia	569	56.3	53.2–59.3
Myopia	324	32.1	29.2–35.0
Astigmatism	95	9.4	7.6–11.2
No Refractive Error	22	2.2	1.3–3.1

Gender Differences

Sex showed a statistically significant but modest association with refractive error pattern ($\chi^2 = 11.44$, $p = 0.0096$). Hyperopia was more frequent in males than females (61.8% vs 52.2%), whereas females had higher proportions of myopia (34.1% vs 29.4%) and astigmatism (11.0% vs 7.4%). This distribution is shown in Figure 2.

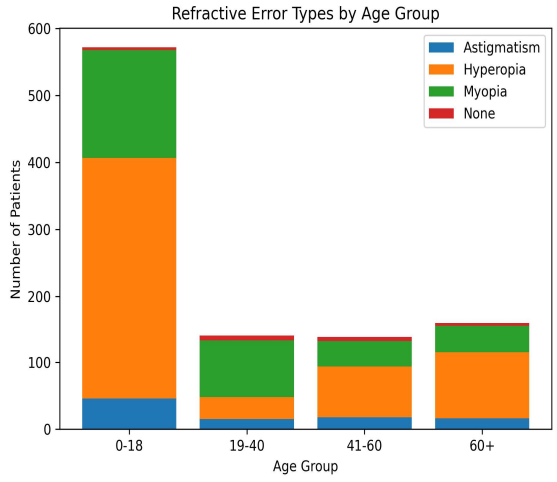
Figure 1



Age-Related Patterns

Age was the strongest factor associated with refractive error pattern ($\chi^2 = 92.07$, $p < 0.001$). Hyperopia was most frequent among children and adolescents aged 0-18 years (63.5%), whereas myopia was the leading refractive error among adults aged 19-40 years (49.7%). Hyperopia again became more frequent in older age groups (>=41 years). Figure 3 illustrates these age-specific trends.

Figure 2



Multivariable Logistic Regression

Logistic regression model was fitted for each refractive error category and the remaining refractive error categories and also sex and age adjustment was done separately. Compared with children aged 0-18 years, adults aged 19-40 years had substantially higher odds of myopia (aOR = 3.90; 95% CI: 2.75-5.54; p < 0.001) and lower odds of hyperopia (aOR = 0.18; 95% CI: 0.12-0.27; p < 0.001). Hyperopia (aOR = 0.67, 95% CI: 0.49-0.91, p = 0.012) was associated with female sex, but no significant association was found with myopia and/or astigmatism. These adjusted associations are plotted in Figure 3.

Figure 3

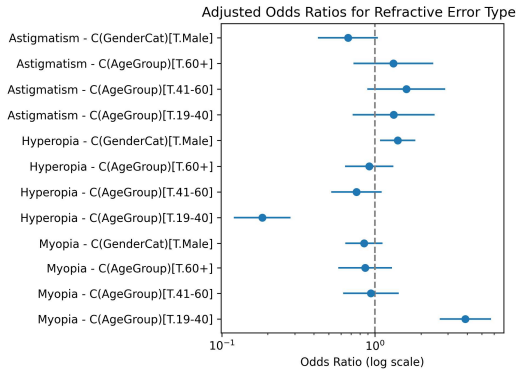


Table 3. Adjusted odds ratios (ORs) from logistic regression

Refractive Error	Predictor	OR	95 % CI	p-value
Myopia vs others	Age 19–40 y vs 0–18 y	3.90	2.75–5.54	<0.001
	Age 41–60 y vs 0–18 y	0.94	0.62–1.43	0.781
	Age ≥60 y vs 0–18 y	0.86	0.58–1.29	0.475
	Female vs male	1.18	0.89–1.56	0.250
Hyperopia vs others	Age 19–40 y vs 0–18 y	0.18	0.12–0.27	<0.001
	Age 41–60 y vs 0–18 y	0.76	0.52–1.11	0.155
	Age ≥60 y vs 0–18 y	0.92	0.64–1.32	0.649
	Female vs male	0.71	0.54–0.93	0.012
Astigmatism vs others	Age 19–40 y vs 0–18 y	1.33	0.72–2.46	0.369
	Age 41–60 y vs 0–18 y	1.60	0.89–2.88	0.113
	Age ≥60 y vs 0–18 y	1.32	0.72–2.40	0.366
	Female vs male	1.50	0.95–2.35	0.079

Discussion:

Thistudy describes the hospital-based pattern of refractive errors among patients attending the Optometry Department of KFSH, Buraidah. A clinically significant refractive error was recorded in 97.8% of patient records. Hyperopia was the most common refractive category, followed by myopia and simple astigmatism. Age-related differences were clear: hyperopia predominated in children and adolescents, while myopia was more frequent in young adults. These findings are consistent with the study hypothesis and with published evidence showing age-related variation in refractive status [2,5]. The high proportion of hyperopia (56.3%) is noteworthy. This figure is higher than estimates from population-based studies in Saudi Arabia and other regions. For example, a recent meta-analysis of Saudi schoolchildren reported pooled estimates of 3.6% for hyperopia and 7.7% for astigmatism, while European studies have generally reported lower hyperopia estimates depending on age and diagnostic criteria [6,12]. The difference is most likely explained by the hospital-based design of the present study. Patients attending a tertiary optometry clinic are more likely to be symptomatic or referred for specialist assessment. Hyperopic children may present with reduced visual performance, headaches, accommodative difficulty, esotropia, or amblyopia, which increases the likelihood of referral. The high proportion of paediatric patients in this cohort (56.7%) may also have contributed to the observed pattern.

The age-specific findings showed a transition from hyperopia in childhood to myopia in early adulthood. Hyperopia accounted for 63.5% of refractive errors in patients aged 0-18 years, whereas myopia was the dominant category among those aged 19-40 years. Logistic regression confirmed age as the main independent factor associated with refractive error type. Adults aged 19-40 years had almost four times the odds of myopia compared with children. This pattern is compatible with emmetropisation during childhood and with environmental influences that become more prominent during adolescence and adulthood. Similar age-related shifts have been reported from Asian populations, where educational

pressure, near-work, screen exposure, and reduced outdoor activity have been linked to rising myopia rates [2-4,13].

The overall proportion of myopia in this study (32.1%) falls within the range reported in several regional and international studies, although comparisons must account for differences in setting and diagnostic criteria. Population-based and school-based studies from India have reported variable myopia estimates among children, while studies in older students and young adults have generally reported higher rates [7,14]. The burden observed in the present hospital-based sample may reflect both biological susceptibility and environmental exposure. Because progressive myopia is associated with retinal detachment, glaucoma, cataract, and myopic maculopathy, the finding has practical implications for screening and follow-up [15,16, 30, 31]

Sex differences were statistically significant but small. Females had slightly higher proportions of myopia and astigmatism, while female sex was independently associated only with lower odds of hyperopia. Previous studies have produced mixed results regarding sex differences in refractive error, with some reporting higher myopia rates among females and others finding no independent association after adjustment for age and environmental factors [12,14]. In the present study, the effect size was modest, suggesting that age and environmental factors may be more important determinants than sex alone.

Amblyopia was present in 24.2% of patients, whereas squint was documented in 9.2%. These figures should be interpreted as clinic-based frequencies, not community prevalence estimates. The burden of amblyopia and squint likely reflects the referral pattern of a tertiary optometry service. Hyperopic patients had the greatest co-occurrence of esotropia, consistent with the known relationship between uncorrected hyperopia, accommodative effort, and binocular vision problems. Although no significant independent association was found between refractive error type and amblyopia or squint, these conditions remain clinically important because delayed correction during the sensitive period of visual development may result in persistent visual loss or impaired binocular function [9-11].

The predominance of esotropia among hyperopic patients is clinically plausible. Hyperopic children often require increased accommodation to maintain clear vision, which may drive accommodative convergence and lead to esotropia. Previous paediatric ophthalmology studies have shown that moderate-to-high hyperopia increases the risk of esotropic deviation. Early recognition and correction of hyperopia may therefore help reduce the risk of strabismus and amblyopia. The absence of a statistically significant association in the present multivariable analysis suggests that other factors, including genetic predisposition, age at onset, binocular sensory status, and adherence to treatment, may also contribute [17-20].

These findings should also be considered against the wider global burden of refractive error. Uncorrected refractive errors remain a major cause of visual impairment worldwide, and the absolute number of affected individuals continues to rise because of population growth, ageing, urbanisation, and changing patterns of work and education [21-24]. The high burden observed in this hospital-based sample reinforces the need for local strategies that improve access to refractive services and reduce avoidable visual impairment. [33,34]

Taken together, the results indicate that refractive errors are a major reason for attendance at KFSH optometry clinics. The predominance of hyperopia among children, the shift toward myopia in young adults, and the presence of associated amblyopia and strabismus support the value of comprehensive eye-care services [25]. School vision screening, early refractive assessment, public awareness, and timely optical correction may help reduce visual morbidity in the Qassim region [26-28, 29,32].

Conclusion

This retrospective analytical study found a high hospital-based burden of refractive error among patients attending the Optometry Department of King Fahad Specialist Hospital, Buraidah. Hyperopia was the most frequent refractive diagnosis, followed by myopia and simple astigmatism. Clear age-related differences were observed, with hyperopia more common in children and adolescents and myopia more common in young adults. In multivariable analysis, age was an independent predictor of refractive error pattern, while associations with gender were limited. Amblyopia and squint were also recorded among clinic attendees, although neither showed a significant association with refractive error subtype. These findings support early detection, school-based screening, timely refractive correction, and public awareness measures. Importantly, the reported figures are based on hospital patient records from KFSH optometry clinics and should not be interpreted as community-based prevalence estimates for the Qassim region. Further population-based studies are needed to estimate the true community burden and guide regional eye-health planning.

Limitations and Future Directions

This study has several limitations. First, its retrospective design relied on routinely collected electronic medical records, which may have resulted

in incomplete documentation of some variables. Second, the study was conducted at a single tertiary-care hospital; therefore, the findings reflect a hospital-based population and should not be generalized to the wider Qassim population. Third, information regarding refractive error severity, family history, screen exposure, outdoor activity, and socioeconomic factors was not consistently available and could not be evaluated. Despite these limitations, the study provides valuable contemporary data on refractive error patterns among patients attending a major referral center in the Qassim region.

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