• Investigation •

Prevalence of heterophoria, tropia, and near point of convergence abnormality in a high school student population in Erbil city center

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Abstract

● **AIM:** To determine the prevalence of tropia, phoria, and abnormality of near point of convergence (NPC), along with associated ocular symptoms, in high school students.

● **METHODS:** This cross-sectional study was conducted in Erbil, Iraq. The target population consisted of high school students selected through a multi-stage cluster sampling method. Comprehensive visual examinations were performed for all students, including measurement of uncorrected and corrected visual acuity, objective and subjective refraction, and distance and near cover tests. NPC was evaluated using a single 6/12 visual target mounted on a centrally positioned Gulden fixation stick. Ocular symptoms were investigated through interviews.

● **RESULTS:** Of the 996 selected students, 921 participated in the study. Of them, 543 (58.96%) were female, and their ages ranged from 13 to 22y. The prevalence of tropia was 3.58% [95% confidence interval (CI): 2.38%–4.78%], observed in 3.44% of males and 3.68% of females. Exotropia (1.95%, 95%CI: 1.06%–2.85%) was more common than esotropia (1.52%, 95%CI: 0.73%–2.31%). The 15.42% (95%CI: 13.09%–17.75%) of students had phoria. Exophoria (13.79%, 95%CI: 11.56%–16.02%) was significantly more prevalent than esophoria (1.63%, 95%CI: 0.81%–2.45%). The prevalence of NPC abnormality in the total study population was 24.97% (95%CI: 22.18%–27.77%). It was 26.72% (95%CI: 22.26%–31.18%) in males and 23.76% (95%CI: 20.18%–27.34%) in females (P=0.307). The most common symptom in phoria was headache (86.62%, 95%CI: 81.02%–92.22%), followed by tired or sore eyes (61.97%, 95%CI: 53.99%–69.96%). The most common symptoms in tropia were blurry vision (93.94%, 95%CI: 79.77%–99.26%) and difficulty concentrating (87.88%, 95%CI: 76.74%–99.01%).

● **CONCLUSION:** Among Erbil's high school students, the prevalence of strabismus, particularly the exodeviation type, is relatively high, and a significant percentage of students have NPC abnormalities. Addressing and correcting these binocular vision problems, due to their associated visual symptoms, can lead to an improvement in students' quality of life and academic performance.

● **KEYWORDS:** tropia; phoria; binocular vision; cross-sectional study; student

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INTRODUCTION

Strabismus is one of the most significant visual challenges in children[1]. Amblyopia is the leading cause of visual impairment in children, with a substantial proportion of amblyopia cases resulting from strabismus[2-3]. Common treatments for strabismus include surgery, refractive lenses, and vision therapy[4-5]. Heterophorias are also binocular vision problems, more common than tropias, and present with different symptoms[6]. Tropia, besides causing visual disturbances for the child, can also lead to issues related to appearance. In cases of heterophoria, due to the involvement of fusional mechanisms to maintain binocular vision and prevent diplopia, individuals often experience severe fatigue[7].

Recent studies have shown that strabismus has psychological and social effects, including reduced quality of life, increased psychological disorders such as depression and anxiety, and decreased self-confidence, which are major psychological issues for children with strabismus. Studies have also shown that these problems affect an individual's employment and social relationships[8-9]. Furthermore, its economic burden, including the cost of glasses, orthoptic methods, and surgery, is an issue that, particularly in developing countries, leads to an increase in uncorrected visual impairment due to lack of treatment[10].

These binocular vision disorders have been extensively studied in epidemiological research, especially in children[11-24]. A review article by Hashemi *et al*[25] showed that the global prevalence of strabismus is 1.93%, with the lowest prevalence reported in African countries (approximately 0.42%) and the highest in American countries (2.86%). A review study in Pakistan also indicated a prevalence of approximately 0.7%[23]. The ratio of esotropia to exotropia has been reported differently in various countries, with some attributing this variation to race and ethnicity. Numerous studies have been conducted worldwide; however, most have focused on childhood strabismus, particularly tropia[25].

Given the documented influence of ethnicity[11-24], healthcare infrastructure, and access to early vision screening on the epidemiology of strabismus and in light of the absence of similar studies in the Erbil region this study was conducted to determine the prevalence of strabismus and related some binocular vision disorders among adolescents in Erbil city. The findings of this study can help address the existing data gap for the Middle East and more clearly highlight the geographical and demographic contribution of this research.

PARTICIPANTS AND METHODS

Ethical Approval The study protocol was approved by the Ethics Committee of the Erbil Polytechnic University. Helsinki Declaration were observed in this study. After selecting the targeted schools, written informed consent was obtained from the students and their parents for participation in the study.

The present study was conducted as a cross-sectional study in Erbil, Iraq. The target population, who was high school students, was selected through a multi-stage cluster sampling method. Following enrollment, each participant was interviewed, and then comprehensive vision examinations were performed.

Visual examinations included visual acuity measurement, refraction, and cover test. For all individuals, uncorrected visual acuity (UCVA) was first measured using a E chart LED (Smart LC 13, Medizs Inc., Korea) at a distance of 6 m. Objective refraction was then recorded using an auto refractometer/keratometer, ARK-1 (Nidek Co. LTD, Aichi, Japan), and refined using a Retinoscope BETA 200 (HEINE Optotechnik, Herrsching, Germany). If a student already wore glasses, their lenses were checked using an auto Lensmeter LM-600PD (Nidek Co., LTD, Aichi, Japan). Subsequently, subjective refraction was performed for students who did not have perfect UCVA. Binocular vision indices of all individuals were measured through their the best-corrected lenses.

Cover test was conducted at two distances in the primary position, specifically at 6 m and 50 cm, utilizing an accommodative target. Initially, the unilateral cover test was executed. To control accommodation and fixation, a row of optotypes one line above the acuity of the weaker eye was presented to the student. After confirming stable fixation, the right eye was occluded while both eyes remained open to monitor any compensatory movement of the left eye, which would indicate the presence of tropia. Subsequently, the cover was removed from the right eye, a brief pause was observed, and the procedure was replicated for the left eye. Manifest deviations were documented as esotropia (outward movement), exotropia (inward movement), or vertical movements. To identify latent deviations, or phorias, the alternate cover test method was employed. This procedure was akin to the previous one, with the exception that immediately after the cover was removed from the right eye, it was placed over the left eye. During the transfer of the occluder from one eye to the other, the movement of the uncovered eye was carefully observed. The eye movement that aligned with the direction of the cover's movement implied exophoria, while movement in the opposite direction signified esophoria. A prism bar was used to assess the magnitude of the deviations. For this purpose, the prism bar was positioned in front of the observer's eye with the correct base orientation (base-in for exo deviations and base-out for eso deviations). In instances of tropia, the prism was positioned in front of the deviated eye, and the primary angle of deviation was recorded. In cases of phoria, the prism was placed in front of the right eye. The power of the prism was gradually increased until the fixational movement was neutralized. The bracketing method (which involves increasing the prism until the reversal point is reached) was employed to enhance the precision of the measurement.

Following the cover test, the near point of convergence (NPC) was assessed using a 6/12 single optotype placed on a Gulden fixation stick positioned at the midline. The target was gradually moved from the distance of 40 cm at eye level toward the subject's eyes at a standard speed of 1 cm per second. The individual was instructed to indicate when the first sustained diplopia occurred. Measurement was recorded either when the subject reported double vision (subjective endpoint) or when the examiner observed a breakdown in binocular alignment (objective endpoint). The distance from the target to the spectacle plane or to the lateral canthus in cases where no glasses were worn was recorded. To enhance reliability, the NPC test was repeated five times, and the mean value of these trials was used for further analysis.

Tropia was characterized by a constant unilateral or alternating horizontal misalignment (either exotropia or esotropia) observed at both distant and near fixation points. For phoria

Table 1 The prevalence of tropia and phoria according types and gender and logistic regression results

Parameters	Female, % (95%CI)	Male, % (95%CI)	Total, % (95%CI)	OR (female/male; 95%CI)	*P*
Exotropia	1.84 (0.71–2.97)	2.12 (0.67–3.57)	1.95 (1.06–2.85)	0.87 (0.34–2.22)	0.767
Esotropia	1.66 (0.58–2.73)	1.32 (0.17–2.47)	1.52 (0.73–2.31)	1.26 (0.42–3.78)	0.683
Hypertropia	0.18 (0.005–1.02)[a]	0	0.11 (0.02–0.32)	2.09 (0.08–51.52)	0.651
All tropia	3.68 (2.1–5.27)	3.44 (1.6–5.28)	3.58 (2.38–4.78)	1.07 (0.53–2.19)	0.845
Exophoria	14.18 (11.25–17.11)	13.23 (9.81–16.64)	13.79 (11.56–16.02)	1.08 (0.74–1.59)	0.680
Esophoria	1.1 (0.23–1.98)	2.38 (0.84–3.92)	1.63 (0.81–2.45)	0.46 (0.16–1.30)	0.142
All phoria	15.29 (12.26–18.31)	15.61 (11.95–19.27)	15.42 (13.09–17.75)	0.96 (0.68–1.40)	0.894

[a]The 95%CI was calculated by Binomial exact method. OR: Odds ratio; CI: Confidence interval.

Table 2 The percentage of various symptoms in individuals with phoria and tropia and logistic regression results

Symptoms	Phoria, % (95%CI)	Tropia, % (95%CI)	OR (tropia/phoria; 95%CI)	*P*
Headache	86.62 (81.02–92.22)	84.85 (72.62–97.08)	0.86 (0.30–2.52)	0.790
Diplopia	2.11 (0.44–6.05)[a]	36.36 (19.95–52.78)	26.48 (6.89–101.70)	<0.001
Tired or sore eyes	61.97 (53.99–69.96)	54.55 (37.56–71.53)	0.74 (0.34–1.58)	0.433
Blurry vision	45.07 (36.89–53.25)	93.94 (79.77–99.26)[a]	18.89 (4.35–81.97)	<0.001
Difficulty concentrating	23.24 (16.29–30.19)	87.88 (76.74–99.01)	23.95 (7.85–73.07)	<0.001
Squinting	1.41 (0.17–4.99)[a]	75.76 (61.14–90.38)	218.75 (43.86– 1090.97)	<0.001
Closing or rubbing an eye	18.31 (11.95–24.67)	39.39 (22.72–56.07)	2.90 (1.28–6.57)	0.011
Dizziness	12.68 (7.2–18.15)	57.58 (40.71–74.44)	9.35 (3.99–21.85)	<0.001

[a]The 95%CI was calculated by Binomial exact method. OR: Odds ratio; CI: Confidence interval.

assessment, only deviations considered abnormal based on the criteria outlined by Scheiman and Wick[26] were included. Specifically, exophoria was deemed abnormal if it exceeded 3 prism diopters (PD) at distance or 6 PD at near[27]. Far esophoria was defined as a deviation of 1 PD or more, while any degree of esophoria at near was considered abnormal[27].

In this study, an abnormal NPC was defined as a distance greater than 5 cm[28]. During the interview, symptoms such as headache, diplopia, tired or sore eyes, blurry vision, difficulty concentrating, squinting, closing or rubbing an eye, and dizziness were investigated.

Finally, for all students, cycloplegic refraction was performed using 1% cyclopentolate eye drops. The drops were instilled twice, with a 5-minute interval between doses. Cycloplegic refraction was then measured using an autorefractometer and retinoscopy 30min after the last drop.

In this study, data analysis was performed using STATA software. The prevalence of strabismus and its types was reported as a percentage with a 95% confidence interval (CI). Logistic regression was performed to examine the association between strabismus (and its subtypes) and gender, reporting odds ratios (OR) with 95%CI. The same method was used to analyze the relationship between ocular symptoms and the presence of tropia or phoria.

RESULTS

In this study, 996 students were selected using cluster sampling, of whom 921 participated. Of these, 543 students (58.96%) were female, and the mean age of participants ranged from 13 to 22y. Table 1 presents the prevalence of tropia, phoria, and their types, categorized by type. The prevalence of tropia was 3.58% (95%CI: 2.38%–4.78%). Tropia was observed in 3.44% of males and 3.68% of females; this difference in prevalence between genders was not statistically significant (P=0.845).

Our findings showed that exotropia (1.95%, 95%CI: 1.06%–2.85%) was slightly more common than esotropia (1.52%, 95%CI: 0.73%–2.31%). As seen in Table 1, the prevalence of tropia and its types showed no statistically significant difference between genders. Based on the findings of this study, 15.42% (95%CI: 13.09%–17.75%) of students had phoria. Exophoria, with a prevalence of 13.79% (95%CI: 11.56%–16.02%), was significantly higher than esophoria, which was 1.63% (95%CI: 0.81%–2.45%). The prevalence of phoria types also showed no difference between genders. One case of hypertropia was also observed in a female student.

The prevalence of NPC abnormality in the total study population was 24.97% (95%CI: 22.18%–27.77%). NPC abnormality was 26.72% (95%CI: 22.26%–31.18%) in males and 23.76% (95%CI: 20.18%–27.34%) in females (OR=0.85; 95%CI: 0.63%–1.15%; P=0.307).

Table 2 shows the percentage of various symptoms in individuals with phoria and tropia. As seen, the most common symptom in individuals with phoria was headache

Table 3 Summary of the results of studies conducted on strabismus in the age group close to our study

First author	Place	Age, y	*n*	Tropia			Phoria		
				All	Exo	Eso	All	Exo	Eso
Hamidi[29]	Iran	4.21±1.08	1100	0.36%	NA	NA	22.9%	19.4%	
Hashemi[30]	Iran	21±3	726	1.5%	1.2%	0.3%	12.9%	11.7%	1.2%
He[31]	China	6.83 ± 0.46	1856	3.66%	2.32%	0.43%	NA		
Abdelrahman[32]	Egypt	5.5 to 7	584	1.4%	NA	0.5%	NA	0.5%	0.3%
Chibueze[33]	Nigeria	14.21±2.081	360	1.90%	NA	NA	NA	NA	NA
Paduca[34]	Moldova	<17	861682	1.3%	4.9%	16.7%	NA	NA	NA
Ullah[35]	Pakistan	8.10±2.3	2288	1.3%	NA	NA	NA	NA	NA
Su[20]	Xizang, China	6.82±0.46	1852	NA	NA	NA	22.89%	4.21%	0.43%
Hong[16]	China	12.35±0.61	2145	NA	NA	NA	22.66%	NA	NA
Zhang[24]	Hong Kong, China	7.61±0.98	4273	3.11%	2.74%	0.28%	NA	NA	NA
Tegegne[21]	Ethiopia	12.3±3.25	611	5.0%	19%	81%	NA	NA	NA
Mohney[36]	Minnesota	10.6	1000	5.7%	NA	NA	13%	NA	NA
Biruktawit[37]	Ethiopia	6±5.6	784	3.1%	33%	58.3%	NA	NA	NA
Pineles[38]	United States	NA	10759066	3.2%	1.5%	1.7%	NA	NA	NA
Njambi[19]	Tanzania	NA	3600	5.9%	24%	63.3%	NA	NA	NA
Belamkar[12]	India	NA	1551	NA	43.8%	42.41%	NA	NA	NA
Akowuah[3]	Africa	NA		0.8%	0.2%	0.5%	NA	NA	NA
Miyata[39]	Japan	NA	125708000	2.154%	67.3%	26.0%	NA	NA	NA
Natung[40]	India	27.16±15.71	7222	1.52%	70%	26.36%	NA	NA	NA
Hegde[15]	India	10.07±2.88	955	1.04%	6%	5%	NA	NA	NA

NA: Not available; Exo: Exoptropia/exophoria; Eso: Esotropia/esophoria.

(86.62%, 95%CI: 81.02%–92.22%), followed by tired or sore eyes (61.97%, 95%CI: 53.99%–69.96%). The least reported symptom in individuals with phoria was squinting (1.41%, 95%CI: 0.17%–4.99%). The most commonly reported symptoms in individuals with tropia were blurry vision (93.94%, 95%CI: 79.77%–99.26%) and difficulty concentrating (87.88%, 95%CI: 76.74%–99.01%).

As shown in Table 2, logistic regression analysis revealed that individuals with tropia had significantly higher odds of experiencing symptoms such as diplopia, blurry vision, difficulty concentrating, squinting, closing or rubbing an eye, and dizziness compared to those without tropia.

DISCUSSION

The present study is one of the few conducted in the Erbil region to investigate the prevalence of strabismus problems and some binocular vision indices in high school-aged individuals. As previously shown, strabismus can significantly impact students' social relationships, making attention to its prevalence very important. Based on our findings, 3.58% of the students in this study had tropia. The study by Hashemi *et al*[25] showed that the global prevalence of strabismus is 1.93%, which is considerably lower than our study. Hashemi *et al*[25] also showed that the highest prevalence of strabismus is in American countries and the lowest in African countries. However, the prevalence obtained in our study is even higher than the prevalence of strabismus reported in American countries (2.8%). A summary of studies conducted in the last five years (Table 3) shows that the prevalence of strabismus has been reported variably from less than 1% to about 8% in different regions of the world[3,12,15-16,19-21,24,29-40].

The highest prevalence of strabismus has been reported in Tanzania (5.9%), Minnesota (5.7%), and Ethiopia (5%), while the lowest prevalence (0.36%) has been reported in one of the cities in Iran (Table 3). It appears that various factors influence the diversity of existing findings. In addition to racial and genetic factors and even the age groups studied, factors related to the health system of each country should also be considered. First, different diagnostic criteria may cause some countries to report a higher prevalence of strabismus. Also, in some countries, because children have been screened for upon entering school, their timely identification and treatment have resulted in a lower reported prevalence of strabismus in older ages. Nevertheless, the results of our study indicate that the prevalence of strabismus in this study is not low, and attention should be paid to high school students so that this eye problem does not affect their quality of life, academic performance, and social relationships[6,8,41].

As we saw, exotropia was slightly more common than esotropia in our study. As seen in Table 3, the results of studies on this subject are highly contradictory. In some studies, such as Fieß *et al*[41] from Germany, esotropia is significantly more common than exotropia (0.8% *vs* 1.6%). Paduca *et* *al*[34] also showed that in children aged 3mo to 17y, esotropia is significantly more common than exotropia, while Zhang *et al*[24] from Hong Kong, China showed that the prevalence of exotropia is significantly higher than esotropia (2.74% *vs* 0.28%). Chen *et al*[13] from China also showed a higher prevalence of exotropia than esotropia. Therefore, it seems that ethnic factors can influence this finding, such that in East Asian countries, exotropia is more common, while in European countries, esotropia is more common. Hashemi *et al*[25] also showed that in Europe, esotropia is more common than exotropia (2.17% *vs* 1.53%), while in Western Pacific countries, exotropia is significantly more common than esotropia.

No difference was observed between genders in the prevalence of tropia and its types in the present study. A review of previous studies also confirms this finding, indicating that gender is not a significant factor for tropia[23,27,42-44].

As seen, 15.42% of students had phoria, with the prevalence of exophoria at 13.79% and esophoria at 1.63%. Fewer studies worldwide have addressed the prevalence of phoria compared to tropia. Phoria has been reported in 33% of 7-year-old Iranian children[42], 26% by Aring *et al*[45], and 34.79% by Yekta *et al*[44] in Shiraz. Previously, a significantly higher prevalence of phoria has also been reported from Australia[45]. It should be noted that different studies have used different diagnostic criteria for defining abnormal phoria, which can cause differences in prevalence rates. In the present study, we used the Scheiman and Wick[26] guideline for defining phoria, which is an accepted reference in this field.

It should be noted that our definition of abnormal esophoria at near considering any amount as abnormal follows the criteria proposed by Scheiman and Wick[26].While this approach is clinically conservative and aligns with certain orthoptic guidelines, it is more stringent than definitions used in other epidemiological studies, which may require a minimum threshold (*e.g.*, ≥1–2 PD) to classify esophoria as abnormal. Consequently, our reported prevalence of esophoria may appear higher than in studies employing less restrictive criteria. This methodological difference should be taken into account when comparing our findings with those from other populations.

It seems that in addition to ethnic and racial factors, factors such as the measurement method and the skill of the examiner are effective in determining phoria; therefore, part of this discrepancy may be due to the method of measuring phoria. However, given that studies in this regard are scarce, no definitive judgment can be made. An important point is that in this study, we observed a higher prevalence of exodeviations compared to esodeviations in both tropia and phoria; therefore, attention should be paid to differences arising from muscle insertion, orbital shape, or refractive errors, which may occur due to genetics and ethnicity. Chew[46] have shown that factors such as maternal age at pregnancy and smoking during pregnancy are effective factors in deviations and their types.

Although fewer studies have been conducted on phoria, due to the importance of its associated symptoms such as headache, reduced stereopsis (depth perception), and reading difficulties more research is needed in this area. An important point regarding phoria is the potential for it to progress to decompensated phoria. Timely diagnosis and treatment of phoria can reduce the risk of its progression to decompensated phoria and its consequences. Clinical experience shows that intermittent exotropia and intermittent esotropia may result from severe decompensated exophoria and esophoria, respectively. Given the risk of phoria progressing to tropia and the scarcity of studies conducted in this area, further research is essential to reduce its prevalence through appropriate treatments.

As seen, based on this study, one in every four students had an NPC abnormality. NPC abnormality can cause symptoms such as headache, eye fatigue, blurred vision, and diplopia during near work (such as reading) and can cause severe visual symptoms for the individual. One of the main characteristics of convergence insufficiency is an abnormal NPC[47]. The prevalence of convergence insufficiency in the general population varies between 1.7% and 33%[48-54], Although the prevalence of NPC abnormality in our study cannot indicate the prevalence of convergence insufficiency, it shows that 25% of students are at risk of convergence insufficiency, which should be carefully monitored given the potential visual complications. Various studies have shown that NPC abnormality is associated with academic decline, primarily due to difficulty performing near work and studying. One study even demonstrated the role of NPC abnormality in reading comprehension to be similar to that of attention-deficit/hyperactivity disorder (ADHD)[48-55]. Although the measurement method and target timing are very important, these students should undergo vision therapy treatments to experience fewer visual symptoms during study.

However, it is crucial to recognize that while an abnormal NPC is a hallmark of convergence insufficiency, it is not pathognomonic. A receded NPC may also result from other binocular or accommodative disorders. For example, accommodative insufficiency (AI) characterized by an inability to sustain adequate amplitude of accommodation for near demands can secondarily impair convergence due to the tight neuroanatomical and functional coupling between accommodation and convergence [the accommodative-convergence over accommodation (AC/A ratio)]. When accommodation is inadequate, the associated convergence stimulus is reduced, leading to a functional convergence deficit that mimics convergence insufficiency. Similarly, generalized binocular instability, such as poor fusional vergence reserves or impaired motor fusion, may manifest as difficulty maintaining convergence at near, even in the absence of true convergence insufficiency.

Therefore, while our findings highlight a substantial proportion of students at risk for convergence insufficiency, they also underscore the necessity of a comprehensive binocular vision assessment before initiating targeted interventions such as vision therapy. Such an evaluation should include measurement of near heterophoria, positive and negative fusional vergence ranges, accommodative amplitude and facility, AC/A ratio, and refractive error. Only through this detailed workup can clinicians reliably differentiate true convergence insufficiency from other etiologies of NPC abnormality and ensure that management strategies whether optical correction, vision therapy, or accommodative training are appropriately tailored to the underlying cause. Early identification and individualized treatment are essential not only to alleviate visual symptoms but also to support academic success and overall visual well-being in this vulnerable population.

This study has several strengths and limitations that warrant consideration. The primary strength lies in providing prevalence estimates for binocular vision disorders in a relatively large, representative sample of adolescents in Erbil, using a multi-stage cluster sampling design a scale and methodology not previously employed in this region. However, certain limitations should be acknowledged. First, the small number of participants with tropia resulted in wide convergence insufficiencys for some symptom prevalence estimates (*e.g.*, diplopia), which may limit the precision and clinical utility of these specific findings. Future studies with larger samples are needed to refine these estimates. Second, we were unable to stratify our results by specific age groups. Unfortunately, due to a data entry error during study implementation, exact ages were inaccurately recorded; therefore, we only reported the overall age range (13–22y) and did not include age as a variable in our final analyses. Given that binocular vision parameters such as phoria magnitude, NPC, and fusional reserves can evolve considerably during adolescence due to ocular growth, refractive changes, and neural maturation, the inability to stratify our findings by narrower age bands (*e.g.*, early *vs* late adolescence) represents a notable limitation. This restricts our capacity to detect potential age-related trends in the prevalence of binocular disorders. Although this issue stems from an inadvertent data entry error and cannot be rectified retrospectively, we acknowledge its impact on the granularity of our conclusions and emphasize the need for age-specific analyses in future studies in this population.

In conclusion, among Erbil's high school students, the prevalence of strabismus, particularly the exodeviation type, is relatively high, and a significant percentage of students have NPC abnormalities. Furthermore, the findings of this study underscore the need for proactive public health action. Educational and healthcare authorities should implement timely vision screening programs in schools to enable early identification of students with strabismus and binocular vision disorders. Such early detection is crucial to prevent significant secondary consequences, including academic underachievement and reduced quality of life.

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