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Original Research Article

Prevalence of myopia and its risk factors in elementary school students at coastal plain area of Nghe An province: A study in Viet Nam

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Abstract

Aim: To determine the prevalence of myopia in elementary school students in coastal areas and related factors
Materials and Methods: Cross-sectional descriptive study was conducted on students at 5 primary schools in the coastal area. Total of 4305 students in grades 1 to 5 (aged 6 to 10 years old), were examined for refraction; uncorrected visual acuity (UCVA), noncycloplegic autorefraction, pupilloscopy, best corrected visual acuity (BCVA), slit-lamp examination, ophthalmoscopy. The student's parents to complete a questionnaire, to assess the factors.
Results: Primary school students in coastal Nghe An province, Vietnam had a myopia rate of 26.2%, lowest in 6 year old and highest in 10 year (p<0,0001) and 57.32% did not wear glasses or wrong wear glasses. The odds of myopia were higher among students whose parents had refractive error (OR 1.72; 95% CI 1.30-2.27). Total near vision time at home more than 2 hours, the odds of myopia were higher (OR 1.56; 95% Cl 1.34-1.81). Students with a distance read books or watch tablets/smart phone (centimeter) less than 20cm have a higher risk of myopia than other students (OR 9.93; 95% CI 7.76-12.7). Participate in activities under the sun more than 2 hours/day were protective factors (OR 0.19; 95% CI 0.13- 0.27).
Conclusions: Research shows that coastal areas have a lot of sunshine, so the prevalence of myopia in elementary schools will be lower than in other areas.

Keywords: Myopia, Refractive errors, Elementary school.

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1. Introduction

Myopia is one of the most common refractive errors today. Myopia and the burden of diseases related to myopia affect the world worldwide. Many studies show that the rate of myopia increases rapidly in school age, and the older the age, the higher the rate of myopia.[1,2] Costs related to myopia include direct treatment costs and indirect costs due to loss of parents' work time when having to take children for regular check-ups. This is a large cost and is increasing day by day.[3,4] Myopia that progresses with age in children can cause many health problems as well as reduced learning ability in children.[5,6] In Asia, the rate of school myopia has been increasing rapidly each year, with East Asia and Southeast Asia having a high rate of myopia in the region.[7-9] Vietnam is one of the countries with a high rate of myopia, and the rate of myopia tends to increase rapidly, each different region will have a different rate of myopia.[10,11] This study aims to determine the rate of myopia and related factors in primary school students in coastal areas.

2. Materials and Methods

2.1. Ethics approval and consent to participate

We conducted this study in accordance with the Declaration of Helsink; approved by the Nghe An provincial education agency (No. 364/SGD dated February 27, 2023) and the Ethics committee of the Nghe An Eye Hospital (No. 112/TB-BVM dated March 09, 2023). The child's parents or legal guardians gave written informed consent.

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2.2. Subjects and sampling methods

The study was conducted at primary schools in 5 coastal districts of Nghe An province, Vietnam. The study period is conducted in September and October 2023. We used the sample size calculation formula according to the World Health Organization's guidelines. This guideline is used for many studies on refractive errors in children (RESC).[12-14] This research design can be used with students in the community and in schools in many different countries and ethnicities.[15-1] The minimum sample size was calculated according to the formula

$$N = \frac{(z(\propto/2))^2 x(1-P)xP}{(BxP)^2} xD$$

A previous study's estimated rate of myopia of 31% 10 was predicted for this study (P), a 15% error rate and 95% confidence interval, To increase reliability and avoid sample loss, we use a sample size adjustment factor of 2 (D). Minimum sample size was 796. In this Cross-sectional descriptive study, cluster sampling method was used. Schools were randomly selected for the study and all students were examined. A total 4305 students in our study 5 schools of 5 towns at coastal Nghe An province, Viet Nam were selected.

2.3. Inclusion criteria

Students from 6 to 10 years old (grades 1 to 5), Able to correct distance vision to 20/30 (Snellen) or better in both eyes, astigmatism ≤ 2D and normal eyeballs

2.4. Exclusion criteria

The student's family did not agree to participate in the study, have ever used contact lenses, bifocal lenses or had previous surgery.

2.4. Refractive examination procedure

In this cross-sectional school-based study of 4305 students from 5 primary schools who were examined for refraction. Refractive examinations are performed in the school's medical office. Students are tested for uncorrected visual acuity (UCVA) by Optometrists. Students with visual acuity < 20/32 (using a Snellen's eye chart) will have noncycloplegic autorefraction, pupilloscopy and best corrected visual acuity (BCVA) tested by Optometrists. Ophthalmologist was slit-lamp examination and ophthalmoscopy for students.

Refractive examination results will be converted to the spherical equivalent refraction (SER), SER from the worse eye was used for analysis and classified into 3 groups of myopia: low myopia (-3.0 D ≤ SER ≤-0.50 D), moderate myopia (-6.0 D ≤ SER <-3.0 D D) and high myopia (SER <-6.0 D), this myopia grouping method has been used in many studies.[8,21-24]

2.5. Questionnaires

We collected factors related to myopia using parent interview questionnaires. Parents will be asked to fill out a set of interview forms including the following contents. Student administrative information, medical history, sex, living area…Factors included. Whether the student's parents had a refractive error or not. This is shown by whether the student's parents wear glasses every day or not. Responses were recorded as both parents wear glasses, only one parent wears glasses, or no one wears glasses. Total near vision time at home outside of class includes reading, smartphones, and computers; Parents will estimate and fill in the amount less than 2 hours a day or more than 2 hours a day. Distance read books or watch tablets/smart phone is measured in centimeters, including groups less than 20 cm, from 20 to 30 cm and more than 30 cm. Outdoor time includes the total time students spend playing sports, field trips, and other activities, divided into 3 groups, less than or equal to 1 hour per day, from 1 to 2 hours per day and more than 2 hours per day. All options are pre-printed and parents can simply check the corresponding box

3. Results

Total of 44305 elementary students from 5 schools of 5 towns at coastal Nghe An province, Viet Nam, were enrolled into study. The elementary students grade 1 to grade 5. The mean (SD) of age was 8.07 (±1.47) years ranging from 6 to 10 years, with 2276 (52.86%) were boys and 2029 (47.99%) were girls; 3112 (72.29%) from urban schools. There are 1232 (28,62%) students whose visual acuity of the worse eye than 20/32, **Table 1**.

Of the total 4,305 students examined, there were 1120 students with myopia, accounting for 26.2%. Of the 1,120 myopia students, there were 721 (64.36 %) students with low myopia, 316 (28,22%) students with moderate myopia and 83 (7.42%) students with high myopia. All students had myopia, 57.32% did not wear glasses or wrong wear glasses, **Table 2**.

The prevalence of myopia is lowest in grade 1 (14.20%) and highest in grade 5 (32.42%), (p< 0.0001). The myopia rate between boys and girls students is similar (25.48%) and (26.02%). The prevalence of myopia in urban areas (31.27%) is higher than in rural areas (12.32%) (p< 0.0001), **Table 2**.

There are differences in myopia among students whose parents have refractive errors, the prevalence of myopia in students whose parents had not refractive errors were 23.22%, one of the parents had refractive errors were 31.62% and both parents had refractive errors were 34.27%. (P < 0.0001). Students whose parents both have refractive errors were 1.72 times more likely to be myopia (OR 1.72; 95% CI 1.30-2.27), students whose only parent had a refractive error were 1.53 times more likely to be myopia (OR 1.53; 95% CI 1.31-1.78), compared to

students whose parents do not have a refractive error, **Table 3**.

Total near vision time at home outside of class includes reading was significantly related (p<0.001) to the prevalence of myopia in students. The group more than 2 hours/ day had 28.82% myopia and the odds of myopia were higher (OR 1.56; 95% Cl 1.34-1.81) among the group under 2 hours/day. Distance read books or watch tablets/smart phone (centimeter) less than 20cm had 68.81% myopia; distance over 30 cm had 18.18% myopia (p<0.0001). The odds of myopia were higher among the students in group less than 20cm (OR 9.93; 95% CI 7.76-12.7) and group 20-30cm (OR 2.83; 95% CI 2.35; 3.41) as compared to group over 30cm, **Table 3**.

There is a significant difference (p < 0.0001) between the prevalence of myopia in students who spend time outdoors. Every day, the more total time a student spends doing activities such as picnics, sports activities, kite flying, even reading books, and painting outdoors, the lower the rate of myopia. From 29.96% of myopia in students who are active for less than 1 hour, down to 24% of myopia in students who are active for 1-2 hours outdoors (OR 0.71; 95% CI 0.60-0.85), and the rate of myopia is 14% for students who have more than 2 hours of outdoor activities (OR 0.19; 95% CI 0.13- 0.27), **Table 3**.

Table 1: Background characteristics of elementary school

Variable	**Boys (%)**	**Girls (%)**	**Total (%)**
Age (Mean ± SD: 8.07 ±1.47)	2276 (52.86)	2029 (47.99)	4305 (100.00)
6 - <7 years (Grade 1)	473 (10.99)	431 (10.01)	904 (21.00)
7 - <8 years (Grade 2)	426 (9.90)	369 (8.57)	795 (18.47)
8 - <9 years (Grade 3)	392 (9.11)	353 (8.20)	746 (17.31)
9 - <10 years (Grade 4)	442 (10.27)	375 (8.71)	817 (18.98)
10 - <11 years (Grade 5)	543 (12.61)	501 (11.64)	1043 (24.25)
Place of residence			
Rural	617 (14.33)	576 (13.38)	1193 (27.71)
Urban	1659 (38.54)	1453 (33.75)	3112 (72.29)
Presenting visual acuity of the worse eye			
≥ 20/32	1636 (38.00)	1437(33.38	3078 (71.38)
20/60 - < 20/32	360 (8.36)	308 (7.15)	668 (15.52)
20/200 - < 20/60	257 (5.97)	253 (5.88)	510 (11.85)
Worse than 20/200	23 (0.53)	32 (0.72)	54 (1.25)

SD: Standard Deviation

Table 2: Characteristics of myopia in elementary school students

Characteristic	**Myopia**		**Total n (%)**	**p value**
	No n (%)	Yes n (%)		
Overall	3185 (73.98)	1120 (26.02)	4305 (100.00)	
Spherical equivalent in the worse eye (Dioptres)				
-3.0 D ≤ SER ≤-0.50 D		721 (64.36)		
-6.0 D ≤ SER <-3.0 D		316 (28.22)		
SER <-6.0 D		83 (7.42)		
Wearing glasses				
No or wrong		642 (57.32)		
Yes		478 (42.68)		
Age (years)				
6 - <7 years (Grade 1)	745 (82.41)	159 (14.20)	904 (100.00)	< 0.0001
7 - <8 years (Grade 2)	593 (74.59)	202 (25.41)	795 (100.00)	
8 - <9 years (Grade 3)	561 (75.30)	184 (16.43)	745 (100.00)	
9 - <10 years (Grade 4)	581 (71.11)	236 (28.89)	817 (100.00)	
10 - <11 years (Grade 5)	705 (67.53)	339 (32.42)	1044 (100.00)	
Gender				
Boys	1696 (74.52)	580 (25.48)	2276 (100.00)	0.399
Girls	1489 (73.98)	540 (26.02)	2029 (100.00)	

Table 2 continued…				
Place of residence				
Rural	2139 (68.73)	937 (31.27)	3112 (100.00)	< 0.0001
Urban	1046 (87.68)	147 (12.32)	1193 (100.00)	

D: Dioptres

Table 3: Analyse risk factors for myopia in elementary school students

0	Myopia		Total n (%)	Univariate p value	Multivariate	
	No n (%)	Yes n (%)			Adjusted odds ratio (95%. CI)	p value
The student's parents had refractive error						
No	2265 (76.78)	685 (23.22)	2950 (100.00)	< 0.0001	1.00	
one of the parents	757 (68.38)	350 (31.62)	1107 (100.00)		1.53 (1.31-1.78)	< 0.0001
both parents	163 (65.73)	85 (34.27)	248 (100.00)		1.72 (1.30-2.27)	0.0001
Total near vision time at home						
≤2 hours per day	1165 (79.41)	302 (20.59)	1467 (100.00)	< 0.0001	1.00	< 0.0001
> 2 hours per day	2020 (71.18)	818 (28.82)	2838 (100.00)		1.56 (1.34-1.81)	
Distance read books or watch tablets/smart phone (centimeter)						
>30 cm	2660 (81.82)	591 (18.18)	3251 (100.00)	< 0.0001	1.00	
20-30 cm	399 (61.38)	251 (38.62)	650 (100.00)		2.83 (2.35-3.41)	< 0.0001
<20cm	126 (31.19)	278 (68.81)	404 (100.00)		9.93 (7.76-12.70)	< 0.0001
Outdoors						
≤1 hours per day	2006 (70.04)	858 (29.96)	2864 (100.00)	< 0.0001	1.00	
1 – 2 hours per day	740 (76.60)	226 (23.40)	966 (100.00)		0.71 (0.60-0.85)	0.0001
> 2 hours per day	439 (92.42)	36 (7.58)	475 (100.00)		0.19 (0.13-0.27)	< 0.0001

CI: Confidence interval

4. Discussion

With the goal of determining the difference in the rate of myopia in students in coastal areas compared to other regions in Vietnam, as well as understanding some related factors. We conducted a descriptive cross-sectional study on 4305 elementary school students, then conducted a case-control study between the myopic group and the non-myopic group to identify related factors. The rate of myopia in primary school students in coastal areas in our study was 26.2%, another study in the same age group in Vietnam in 2019 had a myopia rate of 24.6%, which shows an increase in the rate of myopia in elementary school students.[11] Our research results show that the rate of myopia is different from many countries in the region, the results are higher than research in India (6.4%)[25] in Shanghai, China (25.6%).[26] Meanwhile, many other studies show a higher rate of myopia such as at Kazakhstan (28.3%),[13] Singapore (35.5%),[27] Taiwan (36,4%),[6] weifang China (48.56 %).[28] However, our study has a larger sample size than other studies. Low myopia is the main problem in this study, and what is worrying is that the proportion of students who do not wear glasses or wear glasses incorrectly is very high (57.32%). This may lead to an increase in the rate of moderate myopia and high myopia in the future as students get older and spend more time studying.

Our research shows that the rate of myopia increases with educational level and in urban areas much higher than in rural areas, we believe that constant increase in educational workloads, the time spent studying increases with age and urban areas have higher learning pressure than rural areas.[13,15,26,27] There is no difference in the rate of myopia between boys and girls, similar to other studies.[13,25] Meanwhile, many studies show that myopia is more common in girls than in boys.[28-30]

Analysis of risk factors affecting myopia in students shows that students whose parents both have refractive errors are 1.72 times more likely to have myopia than students whose parents are not nearsighted. Meanwhile, if only one parent is nearsighted, the risk is 1.53 times higher than in the group without parents with refractive errors. This further shows that myopia is related to family factors.[26]

Modifiable factors affecting myopia in this study are: Near viewing distance, near viewing time; and outdoor activity time. Among these factors, near vision distance and increased near vision time after school are risk factors that increase the prevalence of myopia. Total near vision time of more than 2 hours after school time had a 1.56 higher risk of causing myopia than the group with near vision of less than 2 hours. Near viewing distance (Distance read books or watch tablets/smart phone (centimeter)) is also a factor that increases the risk of myopia. Near vision less than 20 cm has

a higher risk than near vision greater than 30 cm (OR: 9.93, p<0.0001). Many studies also show that the more time you spend near vision, the greater the risk of myopia.[31]

Outdoor time includes the total time students spend playing sports, field trips, and other activities in our study shows. Spending a lot of time outdoors reduces the rate of myopia. Spending a lot of time outdoors reduces the rate of myopia. Students who did spend playing sports, field trips, and other activities for more than 2 hours a day have a rate of myopia of 7.58% and the risk of myopia is 0.19 times compared to the group who did spend playing sports, field trips, and other activities for less than 1 hour/day. Many studies also show that increasing time spent outdoors helps reduce the rate of myopia in students.[32] The IMI facts and findings infographic is a useful public health communication tool and chairside reference of key myopia management evidence-based information easily accessed by practitioners,[32] Shows that children spending more than 2 hours/day outdoors was a factor in slowing the progression of myopia. It may also be because our study area was a coastal area with a lot of sunshine, so the general rate of myopia in this area was lower than other areas in Vietnam.[10,11]

5. Conclusion

Primary school students in coastal Nghe An province, Vietnam have a myopia rate of 26.2% in which myopia is lowest in 1st grade students (6 years old), highest in 5th grade students (10 years old) and 57.32% did not wear glasses or wrong wear glasses. There is no difference in myopia rate between boys and girls. There is a statistically significant difference between urban and rural areas. Risk factors for myopia are parents having refractive errors, time of near vision and distance of near vision. The protective factor against myopia is time spent in the sun.

6. Source of Funding

None.

7. Conflict of Interest

None.

8. Data Availability Statement

Data in this study will be contacted and provided by the corresponding author when reasonable.

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