• Clinical Research •

Relative peripheral refraction and its role in myopia onset in teenage students

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Abstract

● **AIM:** To characterize peripheral refraction and its relationship with myopia development in a selected group of male teenage Chinese students.

● **METHODS:** This 2-year prospective cohort study randomly enrolled 85 non-myopic boys (age, 14-16y) from the Experimental Class of Air Force in China. Cycloplegic peripheral refraction was examined at 0°, ±10°, and ±20° along the horizontal visual field in the right eye at the baseline and 2-year follow-up.

● **RESULTS:** The incidence of myopia at the 2-year follow-up was 15.29% (13/85). The baseline central refraction (CR) and peripheral refraction at ±10° were significantly lower in students who developed myopia than in those who did not (P<0.05). Relative peripheral refraction (RPR) did not differ between students with and without myopia (P>0.05). At the 2-year follow-up, the RPR at ±10° and 20° nasal was significantly more hyperopic in the myopic group than in the non-myopic group. Multiple linear regression analysis indicated that the change in CR was significantly correlated with the changes in RPR at 20° nasal, 10° nasal, and 20° temporal. Multivariate Logistic regression analysis indicated that the baseline CR [odds ratio (OR): 0.092, 95% confidence interval (CI): 0.012-0.688, P=0.020] and the baseline RPR at 10° nasal (OR: 0.182, 95%CI: 0.042-0.799, P=0.024) were significantly correlated with incident myopia (Omnibus test, χ^2=10.20, P=0.006).

● **CONCLUSION:** CR change is significantly correlated with changes in RPR, and students who develop myopia have more relative peripheral hyperopia. More baseline CR and relative peripheral hyperopia at 10° nasal are protective of myopia onset.

● **KEYWORDS:** relative peripheral hyperopia; peripheral refraction; incident myopia; schoolchildren
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INTRODUCTION

Myopia is an important and widespread public health problem, especially in Asia[1-2]. Although myopia is known to be caused by both genetic and environmental factors, the ocular components, such as the axial length, cornea, and crystalline lens, are regarded as the primary determinants of refractive error and are also related to myopia incidence and progression[3-4]. Our previous studies show that the incidence of myopia in high school students remains high and is related to low outdoor time and high near-work time[5-6]. It is necessary to predict the incidence of myopia in advance; however, reliable indicators of this condition are lacking.

Currently, the role of peripheral refraction in incident myopia and myopic progression has been the focus of much research[7-8], and myopic eyes have been found to exhibit relative peripheral hyperopia when compared with non-myopic eyes[9-10]. Several animal studies have supported the role of peripheral refraction in myopia incidence. The studies in monkeys by Smith *et al*[11-12] found that the peripheral retina contributed to emmetropization and myopia onset; even when the central retina was blocked or ablated by a laser, emmetropization was able to progress in young monkeys, but if a lens was applied to induce relative peripheral hyperopia, central myopia occurred. However, contradictory findings to those of the above animal studies have been reported by

studies about the relationship between peripheral refraction and myopia development in humans. Atchison *et al*[13] claimed that there was no significant difference in the initial peripheral hyperopia between eyes that developed myopia and those that remained non-myopic after 2y in 7-year-old and 14-year-old Chinese children. The authors concluded that relative peripheral hyperopia does not predict the progression of myopia. Mutti *et al*[14] found that relative peripheral hyperopia at the 30° nasal visual field angle had little effect on the risk of myopia onset during the next 5y in 9-year-old children. A study conducted by Sng *et al*[15] in 7-year-old Singaporean Chinese children revealed that emmetropic children who did not develop myopia during the next 15mo had relative peripheral myopia. Furthermore, a similar study in 6- to 9-year-old Chinese children found that the baseline relative peripheral refraction had no significant correlation with myopic central refractive changes during 12mo of follow-up[16].

Despite the strong evidence for the role of peripheral refraction in myopia onset in animal experiments, clinical studies have revealed only a weak effect of the peripheral retina. Moreover, few studies have explored the peripheral refractive status in non-myopic children over the age of 14y, by which time it is believed that the progression of myopia will be slower. Therefore, the purpose of this study was to identify the peripheral refraction characteristics and determine the role of peripheral refraction in myopia development in a group of selected male senior high school children aged 14 to 16y over a 2-year follow-up period.

SUBJECTS AND METHODS

Ethical Approval The study protocol was approved by the Ethics Committee of Air Force Medical Center and adhered to the provisions of the Declaration of Helsinki. The purpose and content of the study were explained to the students and their parents and written and oral consent was obtained from the students and their parents.

Study Population We randomly enrolled 85 participants aged 14-16y from a selected group of male teenage Chinese students in the Experimental Class of the Air Force[5-6] in November 2017 and followed them up for 2y until November 2019. The inclusion criteria were as follows: uncorrected Snellen visual acuity 20/20 or better in both eyes and spherical equivalent refraction (SER) between -0.25 and +2.00 D and cylindrical refraction not more than 1.00 D in both eyes. The SER was calculated as the spherical power plus half of the cylindrical power after cycloplegia. The exclusion criteria were a history of ocular surgery, ocular trauma, or an ocular disease that affected the vision.

Measurements In this longitudinal study, all participants were examined at the baseline and at a follow-up visit 2y later. Peripheral refraction was measured with an open-field autorefractor (WAM5500; Grand Seiko, Hiroshima, Japan)[13,17]. The pupils were dilated by instilling one drop of 0.5% tropicamide-phenylephrine ophthalmic solution (Mydrin-P; Santen, Osaka, Japan) every 5min for 20min in both eyes[5]. The peripheral refraction examination was performed 20min after the drug administration. Peripheral refraction was measured in the horizontal meridian at 0°, ±10°, and ±20°; central refraction was tested first, followed by nasal and temporal peripheral refraction. Only the right eyes of the participants were included in the analysis.

Classification Myopia was defined as a central SER of -0.50 D or less, while -0.50 D<SER<+0.50 D indicated emmetropia, and SER≥+0.50 D indicated hyperopia. At the baseline, 30 students were hyperopic, and 55 students were emmetropic. Students were considered to have incident myopia if they were found to have developed myopia at the follow-up examination; non-myopic students were those who remained non-myopic at the follow-up examination.

For further analysis, the participants were divided into four subgroups: students who were hyperopic or emmetropic at the baseline but were myopic at 2y (incident myopia), students who were hyperopic at the baseline but were emmetropic at 2y (H0-E2), students who remained hyperopic at 2y (H0-H2), and students who remained emmetropic at 2y (E0-E2).

Statistical Analysis Statistical analyses were performed using the Statistical Package for the Social Sciences for Windows software, version 24.0 (SPSS Inc., Chicago, IL, USA). Continuous variables were presented as mean±standard deviation (SD) or 95% confidence intervals (95%CI). Peripheral refraction and relative peripheral refraction values were compared using repeated-measures analysis of variance, followed by Bonferroni post hoc tests. The Spearman rank test was performed to analyze the correlation between the changes in relative peripheral refraction and the changes in central refraction. Multiple linear regression analyses were conducted to investigate the association between the changes in relative peripheral refraction and the changes in central refraction. Multivariate Logistic regression analysis was performed to assess the correlation of incident myopia with the baseline central refraction and the baseline relative peripheral refraction. All *P* values were two-sided and were considered statistically significant when less than 0.05.

RESULTS

General Information We enrolled 89 participants aged 14-16y in November 2017. Four students did not complete the peripheral refraction examination at the 2-year follow-up. Thus, a total of 85 male students with a mean age of 15.47±0.57y were included in this study. The average central refraction of the students was 0.23±0.36 D at the baseline and 0.08±0.45 D at the 2-year follow-up, and there was no significant difference

Table 1 Peripheral refraction of myopic and non-myopic students at the baseline and the 2-year follow-up

Visual field angle	Peripheral refraction (D), mean±SD (95%CI)		*P*
	Baseline	2y	
Students with incident myopia			
20° T	-0.72±0.85 (-1.26 to -0.18)	-0.40±0.84 (-0.90 to 0.11)	0.21
10° T	-0.39±0.32 (-0.58 to -0.19)	-0.67±0.29 (-0.85 to -0.50)	0.007
0°	-0.12±0.25 (-0.26 to 0.03)	-0.71±0.16 (-0.81 to -0.61)	0.0001
10° N	-0.22±0.41 (-0.47 to 0.03)	-0.57±0.39 (-0.80 to -0.34)	0.0001
20° N	-0.20±0.68 (-0.63 to 0.23)	-0.10±0.78 (-0.57 to 0.38)	0.65
Non-myopic students			
20° T	-0.51±0.94 (-0.73 to -0.28)	-0.12±0.78 (-0.30 to 0.07)	0.0001
10° T	0.15±0.46 (0.04 to 0.26)	0.12±0.38 (0.03 to 0.21)	0.11
0°	0.30±0.34 (0.22 to 0.38)	0.23±0.32 (0.15 to 0.30)	0.0001
10° N	0.11±0.45 (0.005 to 0.22)	0.08±0.50 (-0.04 to 0.19)	0.15
20° N	0.12±0.73 (-0.06 to 0.29)	0.08±0.70 (-0.08 to 0.24)	0.26

SD: Standard deviation; 95%CI: 95% confidence interval; T: Temporal visual field angle; N: Nasal visual field angle.

Table 2 Relative peripheral refraction of myopic and non-myopic students at the baseline and follow-up

Visual field angle	Relative peripheral refraction (D), mean±SD (95%CI)		*P*
	Baseline	2y	
Students with incident myopia			
20° T	-0.63±0.94 (-1.23 to -0.03)	0.32±0.87 (-0.21 to 0.85)	0.0001
10° T	-0.27±0.30 (-0.45 to -0.09)	0.04±0.26 (-0.12 to 0.20)	0.002
10° N	-0.11±0.32 (-0.30 to 0.09)	0.14±0.40 (-0.10 to 0.39)	0.004
20° N	-0.11±0.71 (-0.55 to 0.34)	0.62±0.79 (0.14 to 1.09)	0.0001
Non-myopic students			
20° T	-0.81±0.92 (-1.03 to -0.58)	-0.34±0.81 (-0.53 to -0.15)	0.0001
10° T	-0.14±0.39 (-0.23 to -0.05)	-0.11±0.35 (-0.19 to -0.02)	0.34
10° N	-0.18±0.41 (-0.28 to -0.08)	-0.15±0.40 (-0.24 to -0.06)	0.13
20° N	-0.18±0.71 (-0.35 to -0.01)	-0.14±0.62 (-0.29 to 0.003)	0.38

SD: Standard deviation; 95%CI: 95% confidence interval; T: Temporal visual field angle; N: Nasal visual field angle.

in cylindrical refraction between baseline (0.39±0.30 D) and 2-year follow-up (0.42±0.28 D, *P*=0.44). Of the 85 students, 13 were found to have developed myopia at the follow-up examination.

Differences Between Myopic and Non-myopic Students Among the myopic students, the central refraction and peripheral refraction at ±10° along the horizontal visual field changed significantly from the baseline to the follow-up examination (*P*<0.01), while among the non-myopic students, the central refraction and peripheral refraction at 20° temporal visual field angle (denoted as 20° T) changed significantly from the baseline to the follow-up assessment (*P*<0.01; Table 1). The relative peripheral refraction of the non-myopic students only changed significantly from the baseline to the follow-up at 20° T (*P*<0.01), while that of the myopic students changed significantly at both ±20° and ±10° (*P*<0.01). Moreover, the non-myopic students showed relative peripheral hyperopia at the 20° nasal visual field angle (denoted henceforth as 20° N; Table 2). Among students who became myopic, the peripheral refractions at 0° and ±10° were significantly more myopic than those of the non-myopic students, at both the baseline and during follow-up (*P*<0.01; Figure 1A, 1B). The relative peripheral refraction at the baseline did not significantly differ between the myopic and non-myopic students (*P*>0.05; Figure 1C), while that at ±20° and 10° N at the 2-year follow-up was significantly more hyperopic in the myopic students than in the non-myopic students (*P*<0.05; Figure 1D).

Differences Among the Four Subgroups Non-myopic students were divided into the following three subgroups: H0-H2 (*n*=17), H0-E2 (*n*=13), and E0-E2 (*n*=42). Tables 3 and 4 show the peripheral refraction and relative peripheral refraction in these three subgroups at the baseline and the 2-year follow-up. In the H0-H2 group, neither the peripheral refraction nor the relative peripheral refraction significantly differed between the baseline and follow-up (*P*>0.05). In the E0-E2 group, the peripheral refraction and relative peripheral refraction significantly differed between the baseline and follow-up only at 20° N (*P*<0.01). In the H0-E2 group, however, peripheral

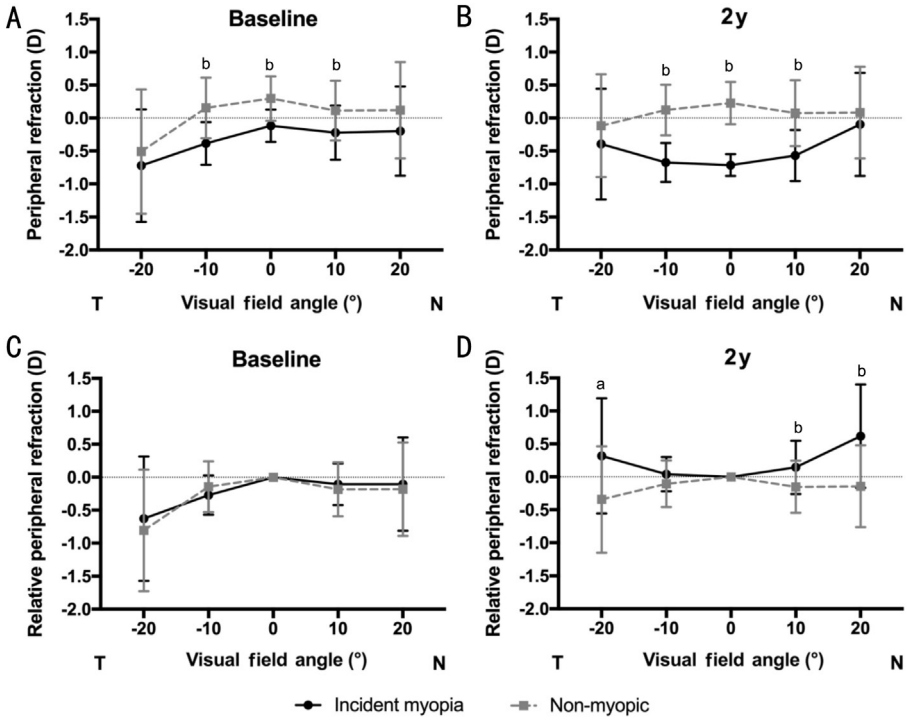

Figure 1 Peripheral refraction and relative peripheral refraction in myopic and non-myopic students at the baseline and follow-up Plots are presented with means and standard deviations. [a]*P*<0.05, [b]*P*<0.01.

Table 3 Peripheral refraction in the three subgroups of non-myopic students at the baseline and follow-up

Visual field angle	Peripheral refraction (diopter), mean±SD (95%CI)		*P*
	Baseline	2y	
E0-E2 subgroup			
20° T	-0.63±0.88 (-0.91 to -0.35)	-0.13±0.75 (-0.37 to 0.10)	0.0001
10° T	0.009±0.31 (-0.09 to 0.11)	-0.006±0.31 (-0.10 to 0.09)	0.76
0°	0.08±0.21 (0.02 to 0.15)	0.07±0.23 (-0.002 to 0.14)	0.59
10° N	-0.03±0.32 (-0.13 to 0.07)	-0.05±0.40 (-0.17 to 0.08)	0.58
20° N	-0.04±0.57 (-0.22 to 0.14)	-0.02±0.52 (-0.18 to 0.15)	0.77
H0-E2 subgroup			
20° T	-0.64±1.01 (-1.25 to -0.04)	-0.17±0.76 (-0.63 to 0.28)	0.008
10° T	0.41±0.37 (0.19 to 0.64)	0.12±0.35 (-0.09 to 0.33)	0.008
0°	0.61±0.28 (0.44 to 0.77)	0.15±0.17 (0.05 to 0.26)	0.0001
10° N	0.27±0.41 (0.02 to 0.52)	0.08±0.50 (-0.22 to 0.38)	0.034
20° N	0.19±0.66 (-0.21 to 0.59)	0.01±0.62 (-0.36 to 0.38)	0.16
H0-H2 subgroup			
20° T	-0.06±0.98 (-0.60 to 0.49)	-0.03±0.91 (-0.50 to 0.44)	0.34
10° T	0.32±0.69 (-0.05 to 0.69)	0.44±0.41 (0.23 to 0.65)	0.61
0°	0.60±0.21 (0.49 to 0.71)	0.67±0.14 (0.60 to 0.74)	0.30
10° N	0.36±0.63 (0.02 to 0.70)	0.38±0.62 (0.06 to 0.69)	0.76
20° N	0.48±1.03 (-0.09 to 1.04)	0.39±1.02 (-0.13 to 0.91)	0.62

SD: Standard deviation; 95%CI: 95% confidence interval; T: Temporal visual field angle; N: Nasal visual field angle.

refraction changed significantly from the baseline to the follow-up at 0°, ±10°, and 20° T (*P*<0.05), while the relative peripheral refraction changed significantly at ±20° and 10° N (*P*<0.05).

The peripheral refraction at 0° and ±10° significantly differed between the myopic students and the three subgroups of non-myopic students at both the baseline and follow-up (*P*<0.01; Figure 2A, 2B). The baseline central refraction in the myopic and E0-E2 groups was significantly more myopic than that in the H0-E2 and H0-H2 groups (*P*<0.05). At the 2-year follow-up, the peripheral refraction at 0° and ±10° was significantly lower in the myopic group than in the E0-E2, H0-E2, and H0-

Table 4 Relative peripheral refraction in the three subgroups of non-myopic students at the baseline and follow-up

Visual field angle	Relative peripheral refraction (diopter), mean±SD (95%CI)		*P*
	Baseline	2y	
E0-E2 subgroup			
20° T	-0.72±0.87 (-0.99 to -0.44)	-0.20±0.75 (-0.44 to 0.03)	0.0001
10° T	-0.07±0.29 (-0.17 to 0.02)	-0.07±0.29 (-0.17 to 0.02)	0.96
10° N	-0.11±0.31 (-0.21 to -0.02)	-0.12±0.32 (-0.21 to -0.02)	0.90
20° N	-0.12±0.57 (-0.31 to 0.06)	-0.09±0.47 (-0.23 to 0.06)	0.57
H0-E2 subgroup			
20° T	-1.25±1.00 (-1.85 to -0.65)	-0.33±0.80 (-0.81 to 0.16)	0.0001
10° T	-0.19±0.24 (-0.34 to -0.05)	-0.04±0.36 (-0.26 to 0.18)	0.11
10° N	-0.34±0.40 (-0.58 to -0.10)	-0.08±0.36 (-0.29 to 0.14)	0.005
20° N	-0.42±0.65 (-0.81 to -0.02)	-0.14±0.47 (-0.43 to 0.14)	0.047
H0-H2 subgroup			
20° T	-0.67±0.94 (-1.19 to -0.15)	-0.70±0.89 (-1.16 to -0.24)	0.59
10° T	-0.28±0.62 (-0.61 to 0.05)	-0.24±0.46 (-0.47 to 0.0002)	0.85
10° N	-0.24±0.60 (-0.56 to 0.07)	-0.29±0.57 (-0.59 to 0.0007)	0.61
20° N	-0.13±1.03 (-0.70 to 0.44)	-0.28±0.97 (-0.78 to 0.22)	0.30

SD: Standard deviation; 95%CI: 95% confidence interval; T: Temporal visual field angle; N: Nasal visual field angle.

Table 5 Relative peripheral refraction and central refraction changes of four subgroups in 2y mean±SD (95%CI)

Refraction change	Incident myopia	E0-E2 subgroup	H0-E2 subgroup	H0-H2 subgroup	*P*
Central refraction	-0.60±0.28 (-0.77 to -0.43)	-0.01±0.26 (-0.09 to 0.07)	-0.45±0.29 (-0.63 to -0.28)	0.08±0.22 (-0.04 to 0.20)	0.0001
Peripheral refraction					
20° T	0.87±0.77 (0.38 to 1.36)	0.51±0.57 (0.33 to 0.69)	0.92±0.77 (0.46 to 1.39)	0.03±0.46 (-0.22 to 0.29)	0.0009
10° T	0.31±0.40 (0.07 to 0.55)	0.00±0.29 (-0.09 to 0.09)	0.16±0.42 (-0.10 to 0.41)	0.03±0.38 (-0.17 to 0.24)	0.038
10° N	0.25±0.26 (0.09 to 0.41)	-0.003±0.33 (-0.11 to 0.10)	0.26±0.27 (0.10 to 0.42)	-0.04±0.36 (-0.23 to 0.15)	0.008
20° N	0.70±0.48 (0.39 to 1.01)	0.04±0.53 (-0.13 to 0.21)	0.27±0.45 (-0.0002 to 0.54)	-0.19±0.39 (-0.41 to 0.02)	0.0001

SD: Standard deviation; 95%CI: 95% confidence interval; T: Temporal visual field angle; N: Nasal visual field angle.

H2 groups (P<0.01). No significant differences were found between the E0-E2 and H0-E2 groups at all visual field angles (P>0.05).

At the baseline, the relative peripheral refraction in the myopic group did not significantly differ from that in the E0-E2, H0-E2, and H0-H2 groups (P>0.05; Figure 2C). At the follow-up examination, the relative peripheral refraction at 20° N was significantly more hyperopic in the myopic group than in the E0-E2, H0-E2, and H0-H2 groups (P<0.01), while the relative peripheral refraction at 10° N was significantly more hyperopic in the myopic group than in the H0-H2 group (P<0.01; Figure 2D). The relative peripheral refraction at ±10° and ±20° did not significantly differ among the E0-E2, H0-E2, and H0-H2 groups (P>0.05).

Changes in Peripheral and Central Refraction and Their Related Factors Relative peripheral refraction and central refraction changes of four subgroups in 2y were shown in Table 5. In general, the changes in relative peripheral refraction at different visual field angles increased as the changes in central refraction increased (Figure 3). The amplitudes of central refractive changes in the myopia and H0-E2 groups were significantly higher than those in the E0-E2 and H0-H2 groups (P<0.05); however, the differences between these changes in the myopia and H0-E2 groups were not significant (P>0.05). The amplitude of relative peripheral refraction change at 20° N was significantly higher in the myopia group than in the E0-E2 group (P=0.001) and the H0-H2 group (P=0.0001). The amplitude of relative peripheral refraction change at 20° T was significantly higher in the myopia group than in the H0-H2 group (P=0.0001), while that at 10° T was significantly higher in the myopia group than in the E0-E2 group (P=0.039). The amplitudes of relative peripheral refraction changes at ±20° were significantly higher in the H0-E2 group than in the H0-H2 group (P=0.006 and 0.0001, respectively).

The change in central refraction was significantly correlated with the changes in the relative peripheral refraction at 20° N (r=-0.58, P=0.0001), 20° T (r=-0.47, P=0.0001), 10° N (r=-0.46, P=0.0001), and 10° T (r=-0.30, P=0.006). Multiple linear regression analysis indicated that the change in the central refraction was significantly correlated with the changes in the relative peripheral refraction at 20° N, 10° N, and 20°

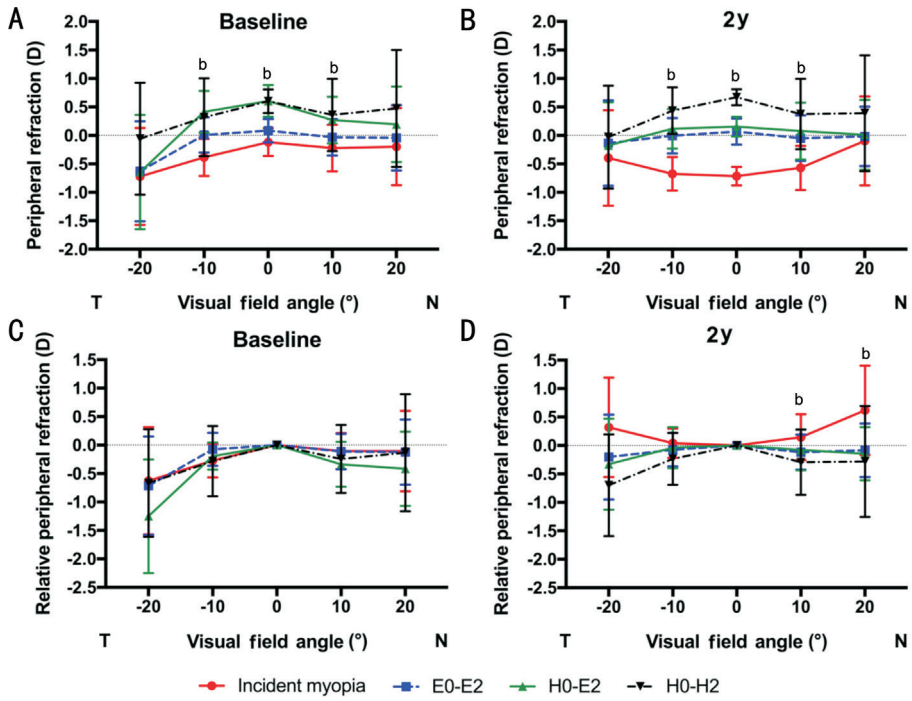

Figure 2 Peripheral refraction and relative peripheral refraction in myopic students and three subgroups of non-myopic students at the baseline and follow-up Plots are presented with means and standard deviations. $^{b}P<0.01$.

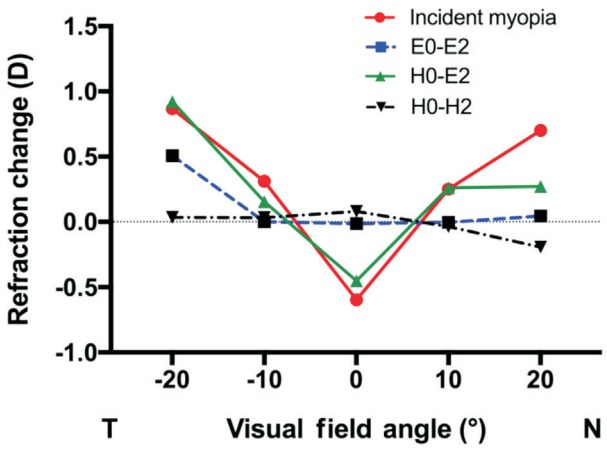

Figure 3 Changes in relative peripheral refraction and changes in central refraction during 2y The values at 20° T, 10° T, 10° N, and 20° N are the changes in relative peripheral refraction; the values at 0° are the changes in central refraction. Plots are presented with means only. T: Temporal visual field angle; N: Nasal visual field angle.

T (central refraction change=-0.42×20° N relative peripheral refraction change -0.22×10° N relative peripheral refraction change -0.25×20° T relative peripheral refraction change, where central refraction is the central refraction and relative peripheral refraction is the relative peripheral refraction; R^2=0.47, F=16.39, P=0.0001). Multivariate logistic regression analysis indicated that the baseline central refraction [odds ratio (OR)=0.092, 95%CI: 0.012-0.688, P=0.020)] and the baseline relative peripheral refraction at 10° N (OR=0.182, 95%CI: 0.042-0.799, P=0.024) were significantly correlated with incident myopia (Omnibus test, χ^2=10.20, P=0.006).

DISCUSSION

This study explored the characteristics of peripheral refraction and relative peripheral refraction in a group of selected male Chinese children aged 14 to 16 years old and tested the hypothesis that relative peripheral hyperopia predicts myopia onset. Our results showed that there was no significant difference in relative peripheral refraction between myopic eyes and non-myopic eyes at the baseline. After 2y, the relative peripheral refractions of students who became myopic turned hyperopic and those of non-myopic students remained relatively myopic or emmetropic. The relative peripheral refraction at 10° T, 10° N, and 20° N significantly differed between the myopic and non-myopic groups. These results are consistent with previously reported data[13-14,18], which showed that relative peripheral hyperopia might correlate with myopia onset; however, it is unclear if this relationship is causal or merely a correlation, at least in our 2-year follow-up study.

Our study showed that in all non-myopic eyes, the relative peripheral refraction only increased at 20° T in 2y, of which H0-H2 and E0-E2 subgroups had comparable variation in central refraction and a similar trend in relative peripheral refraction change. While H0-E2 group had comparable variation in central refraction and a similar trend of relative peripheral refraction change in 2y with myopic group. Our findings indicated that changes in relative peripheral refraction increased as the changes in central refraction increased, which was similar to the study by Atchison *et al*[13] that significant differences in relative peripheral refraction were found between the H1-H2 and H1-E2 subgroups at follow-up, inferring that

relative peripheral hyperopia also accompanied a decrease in central hyperopia. However, our study did not find a significant difference in relative peripheral refraction between the H0-H2 and H0-E2 subgroups, probably because of the small sample size, which is a limitation of this research, similar to previous reports[18-19].

Our study also found that the relative peripheral refraction at 20° N showed the most obvious difference between eyes that became myopic and the eyes in the three non-myopic subgroups, which is similar to some other studies[13,20]. And relative peripheral refraction at 20° N also increased remarkably and became relative hyperopia at the 2-year follow-up. It has been reported that the eyeball shape of myopic people tends to change to a long oval, while the eyeball shape in emmetropic people is generally spherical[19]. MRI studies have shown that changes in peripheral refraction are related to the depth of the vitreous cavity and the shape of the posterior eyeball, and thus, peripheral refraction can be affected by changes in eye shape and retina shape, which have an important influence in the development and progression of myopia[21]. The above studies might explain why peripheral refraction varied most at the more distant part of the peripheral retina rather than at the more central part of the peripheral retina, but the differences of nasal and temporal relative peripheral refraction change need further study.

Recently, many clinical trials have shown that reverting the peripheral refraction to relative myopia by means of a multifocal soft contact lens or orthokeratology could retard the progression of myopia[8,22]. However, to our knowledge, recent studies have found little evidence that baseline relative peripheral hyperopia is related to myopia onset and progression[13-14]. Nevertheless, Mutti *et al*[14] did show that the association between a more hyperopic RPR and the risk of myopia onset varied by ethnic group, and Asian children with more relative peripheral hyperopia had a higher risk of developing myopia. However, our study of Chinese children did not find that myopic eyes were more likely to have relative peripheral hyperopia at the baseline, which is similar to the findings of a study conducted on Chinese children by Atchison *et al*[13]. Considering the higher risk of myopia onset and progression in Asian children, which has been established by many epidemiological research studies[23-25], we speculate that among children who go on to develop myopia, Asian children might have more relative peripheral hyperopia at the baseline (*i.e.*, before myopia onset) than children from some other ethnicities, such as African-American children and white children[26]. Furthermore, our research found that more baseline relative peripheral hyperopia at 10° N was protective against myopia onset, which has not been mentioned in other studies. In our study, in univariate Logistic regression analysis, both baseline peripheral refraction and baseline central refraction at 10° N were significantly correlated with incidental myopia, and baseline relative peripheral hyperopia at 10° N was significantly correlated with baseline peripheral refraction at 10° N (data not shown), indicating that baseline relative peripheral hyperopia at 10° N may be an indicator of baseline central refraction, and may explain why baseline relative peripheral hyperopia at 10° N is significantly correlated with myopia onset. In the future, we will expand our sample size and further verify our conclusion by investigating the relationship between changes in the relative peripheral hyperopia and myopia onset and progression.

There are some concerns and limitations about our research. First, it has a small sample size. Second, there was no additional follow-up during the 2-year period, so further multicenter research with additional follow-up assessments is already being considered. Third, accommodation might also be a factor related to peripheral refraction[27-28], and the effects of accommodation of the peripheral retina on myopia onset and progression remain to be studied.

Our results here are in line with those of other studies on peripheral refraction and reveal hyperopic changes in relative peripheral refraction in children who became myopic[7,15,18,20,29]. Our findings suggested that relative peripheral hyperopia at 10° N may predict the occurrence of myopia in 14 to 16-year-old Chinese students, although the exact reason was unknown.

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