Epidemiology characteristics for non-myopic Chinese children aged 6 to 12 years in Jiangsu Province

Xiyan Zhang
Jiangsu Province Center for Disease Control and Prevention
Yonglin Zhou
Jiangsu Province Center for Disease Control and Prevention
Jie Yang
Jiangsu Province Center for Disease Control and Prevention
Yan Wang
Jiangsu Province Center for Disease Control and Prevention
Wenyi Yang
Jiangsu Province Center for Disease Control and Prevention
Liuwei Gao
Southeastern University
Yao Xiang
Jiangsu Province Center for Disease Control and Prevention
Fengyun Zhang (434908934@qq.com)

Research article

Keywords: non-myopia, epidemiology, children, alert values, Jiangsu Province

Posted Date: November 5th, 2019

DOI: https://doi.org/10.21203/rs.2.16778/v1

Version of Record: A version of this preprint was published on November 7th, 2020. See the published version at https://doi.org/10.1186/s12886-020-01709-1.

Abstract

Background: We aimed to present epidemiology characteristics including SE value, age, BMI, sex for non-myopic Chinese children after indicating the prevalence of myopia among children aged six to twelve . Based on these we were trying to develop alert values for predicting the future onset of myopia.

Methods: All students took part in the ophthalmic examination filled in a questionnaire to provide basic demographic information. We used an autorefractor applying with cycloplegia to obtain spherical equivalent value, and part of their parents filled in a questionnaire of factors related to myopic among children.

Results: We finally had 3900 non-myopic observations from 6362 students, and the prevalence of myopia is 38.0% for boys and 39.5% for girls respectively. The average values for SE were 0.5±0.7 for boys and 0.6±0.8 for girls respectively. The mean SE decreased with age in children, and the value of height and BMI took on a stable trend. Alert values for myopia could be set as follows, for children aged six years of age, 0.4-0.6 D for boys and 0.8-1.0 D for girls respectively. For children aged seven years of age, 0.4-0.6 D for boys and 0.3-0.5 D for girls respectively, for children aged eight years, 0.2-0.4 D for boys and 0.3-0.5D for girls, for children aged nine years, 0.2-0.4 D for boys and 0.3-0.4D for girls, 0.1-0.3 D for boys aged ten and 0.3D for girls aged ten years, 0.10-0.3 D for boys aged eleven and -0.3-0.3 D for girls aged eleven years, and for children aged twelve ,-0.1-0.1 D for boys and -0.3-0.1 D for girls aged twelve years. Father's myopia (OR:1.22,95%CI:1.01-1.48), near work on weekends (OR:2.56,95%CI:1.17-5.61) and outdoor activities (OR:0.68,95%CI:0.54-0.86) had an impact to non-myopic students with myopic alerting.

Conclusion: Our study presented an epidemiology description for non-myopic students in Jiangsu Province, and we proposed a series of alert values to provide early warning reference for Chinese children aged six to twelve years. We draw a nomograph to predict the probability of myopia onset and found that family, near work and outdoor activities, had an impact on non-myopic students with myopic alerting.

Background

There is a dramatic increase in the prevalence of myopia in Eastern Asia. In China, a great increase was also seen in the young generation, indicating the importance of prediction of early-onset myopia among juveniles[1–3]. When it comes to the intervention of myopia, people often pay more attention to treatment such as optical or pharmaceutical methods to slow down eye growth, and thus retard the progression of myopia[4]. However, from a public health perspective, it is more desirable for non-myopic students to develop an early warning comprehensive system to predict and prevent the onset of myopia.

Holden et al stated the future development trends of myopia from a macroscopic view, predicting that nearly half of the world's population may be myopic by 2050, with as much as 10% having highly myopic[4]. However, the prediction of myopia on an individual level is urgent and relevant research is limited. Karla Zadnik et al noted that spherical equivalent (SE) refractive error is the best single predictor of future myopia, comparing to other factors such as parental myopia, near work, and outdoor

activities[6]. In Beijing three-year follow-up eye study, researchers found that children aged 6 to 7 years showed significant SE decrease, AL increase, CCT thickening, ACD deepen, LT thinning, and AL/CR increase. These findings may be an early warning signal of myopia development[7]. BMI is a good indicator of risk, growth, and childhood related disease such as obesity, elevated blood pressure, and so on[8, 9]. Obese children aged 7 to 9 years would more likely to have poor visions comparing to those without obesity, and such influence could last to 12 years of age among boys[10]. A nomogram or nomograph is a form of line chart showing scales for all variables involved in a formula, it is a rule functioned as a simple calculator[11]. Currently, there is a growing application of the nomogram model using rational risk factors in predicting the probability of occurrence, progression or prognosis of an individual's disease[12–14]. Therefore, it is essential to predict the myopia onset based on factors such as sex, age, BMI, and SE.

This study aimed to explore the epidemiology characteristics, including age, BMI, sex, and SE value, among non-myopic Chinese children. Alert values were proposed to predict future myopia and the associations between these values and factors associated with myopia were addressed.

Methods

Study sites and populations

This study was based on the program "Surveillance for common disease and health risk factors among students, sub-program: ophthalmological investigation" during the 2018–2019 academic year in Jiangsu Province. We enrolled 26,461 students from 12 regions in Jiangsu Province (Supplement figure1) in this program, and A total of 6,363 students were aged from 6 to 12.5, participated in sub-program: ophthalmological physical examination.

Data collection and ethics statement

Myopia was defined as –0.50 diopters(D) in the worse eye and the worse eye was defined as the eye with the greater absolute value of refractive error (spherical equivalent). All students took part in this sub-program were required to provide basic demographic information including name, sex, regional, and some of their parents filled in questionnaires concerning myopic related questions including family, near work, sleep duration and outdoor activities. An autorefractor (Topcon RM–8900 or KR–800; Topcon Co., Tokyo, Japan) was applied with cycloplegia, and the spherical equivalent of the refractive error was calculated as the spherical value of refractive error plus one half of the cylindrical value.

The study protocol was approved by the Institutional Review Board of Ethics committee of Jiangsu Province, and detailed information can be found in the previous article[10]. We used an autorefractor with cycloplegia under parents' informed consent.

Statistical analysis

Statistical analyses were performed with R software (www.R-project. Org, version 3.5.3) with additional rms package[15] and Microsoft office ware. The age-specific spherical equivalent values were calculated for the percentiles of 5th, 10th, 25th,50th,75th,90th and 95th, and age-specific BMI were calculated for the percentiles of 25th, 50th,75th for boys and girls. We then performed a logistic model to select variables fit for nomogram model. Nomograph was drawn by R software with rms packages. Continuous variables were presented as the mean with standard deviation (SD).

Results

Baseline characteristics of this study

The prevalence of myopia for children aged 6 to 12 was 38.0% for boys and 39.5% for girls. We eventually obtained 3,900 non-myopic students, and the ratio of male to female was 1.16. The mean SE decreased with age in children, and the value of height and BMI took on a stable trend. (Table1)

Myopic boys or girls had higher values of BMI or height than these of non-myopic boys or girls. (Supplement table1)

Alert values of spherical equivalent value for non-myopic students according to percentiles of BMI and SE

Table2 showed the 25th, 50th, 75th percentiles for BMI value by age (6–12.5) for both sexes, and presented two different 5th, 10th, 25th,50th,75th,90th and 95th percentiles for SE value. Figure1 showed a comparison of two alert values for non-myopic students, and both of them indicated the same trend. We set cut-off points as: for children aged 6 years of age, 0.4–0.6 D for boys and 0.8–1.0 D for girls respectively. For children aged 7 years of age, 0.4–0.6 D for boys and 0.3–0.5 D for girls respectively, For children aged 8 years, 0.2–0.4 D for boys and 0.3–0.5D for girls, For children aged 9 years, 0.2–0.4 D for boys and 0.3–0.4D for girls, 0.1–0.3 D for boys aged 10 and 0.3D for girls aged 10 years, 0.10–0.3 D for boys aged 11 and −0.3–0.3 D for girls aged 11 years, and for children aged 12, −0.1–0.1 D for boys and −0.3–0.1 D for girls aged 12 years.

Nomograph for predicting childhood myopia onset

We selected 50th percentiles for both SE and BMI to create a nomogram model. Total points ranged from 64 to 93 corresponding to risk probability of future myopia onset in half-year ranged from 0% to 100%. When SE value ranged from −0.6 to 2, the corresponding points ranged from 100 to 0. Observation's age increased (from 6 to 12.5) with the corresponding points decreased (25 to 0). Sex seemed to have little impact on future myopia onset: male and female are corresponding to 0 and4 points respectively.

Relationship between BMI and points can be presented as 8–0 points, 12–1 points, 16–2 points, 20–3 points, 24–4 points,and 30–5 points. (Figure2)

Relationship between myopic alerting for non-myopic students and myopia associated factors

Non-myopic students with alerting had a higher proportion of their myopic father. (P 0.05) A family which had more than one kid is a protective factor for non-myopic students to prevent the onset of myopia. After school homework especially on weekends had higher OR values for students with no myopia. (OR: OR:2.56,95%CI:1.17–5.61). Sleep and outdoor activities also had more impact on non-myopic students with alerting. (Table3, Figure3)

Discussion

This is the first study using age, BMI, and sex to propose alert values and predict myopia onset among children aged 6 to 12 years in the world. It is also the first time using a nomogram model to predict risk of myopia onset among children. Moreover, we firstly addressed the epidemiology characteristics for non-myopic Chinese children aged 6 to 12 years in Jiangsu Province, China.

The prevalence of myopia among children aged 6 to 12 years was 38.0% for boys and 39.5% for girls, which was higher than Chinese adults. The prevalence of myopia for definitions of SE of <−0.50 was reported to be 22.9% (95%CI: 21.7–24.2) in the Beijing Eye Study (n = 4439, aged 40–90 years)[16]. Both values of height and BMI for myopic children were higher than those without myopia.

Hirsch et al firstly noted that the refractive error had the ability to predict later myopia onset (children aged 6 years)[17]. Thirty years later, Zadniket et al developed the first model to predict the onset of myopia among children[18]. Karla Zadnik et al concluded that SE refractive error was the single best predictor[6] and set cut-off points as +0.75 D for children aged 6 years, +0.50 D for children aged 7 to 8 years, +0.25 D for children aged 9 to 10 years, and +0.0 D for children aged 11 years. The trend of cut-off points is similar to our alert values, but the detailed information might be different. Larger datasets and longer follow-up are needed to better predict the cut-off points.

Heredity, outdoor activities, and near work had a great influence on the onset and progression of myopia[19]. In this study, these factors also had a significant impact on non-myopic children. Nomograms may be valuable tools to estimate the likelihood of diseases in the future[18]. Based on alert values, we built up a nomogram model to give warnings to children with alerting.

There were some limitations in this study. First, cut-off points were built based on a cross-sectional study. Therefore, a long-term cohort study is needed to improve the accuracy of this study. Second, higher sensitive factors associated with myopia required further analysis for better forecasting.

Conclusion

This study presented the epidemiology description among non-myopic students in Jiangsu Province, China. A series of alert values were proposed to provide early warning reference for Chinese children aged 6 to 12 years. Heredity, near work, and outdoor activities had an impact on non-myopic students with myopic alerting.

References

1. He M, Zheng YF: Prevalence of myopia in urban and rural children in mainland China. Optometry & Vision Science 86:40-44, 2009
2. Mingzhi Z, Liping L, Lizhen C, et al: Population density and refractive error among Chinese children. Invest Ophthalmol Vis Sci 51:4969-4976, 2010
3. Bo LY, Tien Yin W, Ping SL, et al: Refractive errors in a rural Chinese adult population the Handan eye study. OPHTHALMOLOGY 116:2119-2127, 2009
4. Huang J, Wen D, Wang Q, et al: Efficacy Comparison of 16 Interventions for Myopia Control in Children: A Network Meta-analysis. OPHTHALMOLOGY 123:697-708, 2016
5. Holden BA, Fricke TR, Wilson DA, et al: Global Prevalence of Myopia and High Myopia and Temporal Trends from 2000 through 2050. OPHTHALMOLOGY 123:1036-1042, 2016
6. Zadnik K, Sinnott LT, Cotter SA, et al: Prediction of Juvenile-Onset Myopia. JAMA OPHTHALMOL 133:683, 2015
7. Min WU, Ning-Dong LI, Guo Y, et al: Three-year cohort study on the changes of ocular biological parameters of school children. Ophthalmology in China, 2016
8. Freedman DS, Sherry B: The validity of BMI as an indicator of body fatness and risk among children. PEDIATRICS 124:23-34, 2009
9. Group DS, Nyamdorj R, Qiao Q, et al: BMI compared with central obesity indicators in relation to diabetes and hypertension in Asians. OBESITY 16:1622-1635, 2012
10. Zhang X, Zhang F, Yang J: Prevalence of overweight and obesity among primary school-aged children in Jiangsu Province, China, 2014-2017. PLOS ONE 13, 2018
11. Grimes DA: The nomogram epidemic: resurgence of a medical relic. ANN INTERN MED 149:273-275, 2008
12. Shariat SF, Kattan MW, Vickers AJ, et al: Critical review of prostate cancer predictive tools. FUTURE ONCOL 5:1555-1584, 2009
13. Rochester MA, Pashayan N, Matthews F, et al: Development and validation of risk score for predicting positive repeat prostate biopsy in patients with a previous negative biopsy in a UK population. BMC UROL 9:7, 2009

14. Mazouni C, Spyratos F, Romain S, et al: A nomogram to predict individual prognosis in node-negative breast carcinoma. EUR J CANCER 48:2954-2961, 2012
15. Harrell JF: Rms: regression modeling strategies. R package version 4.3-1
16. PAN CW, RAMAMURTHY D, SAW SM: Worldwide prevalence and risk factors for myopia. Ophthalmic & Physiological Optics 32:3-16, 2011
17. Hirsch MJ: PREDICTABILITY OF REFRACTION AT AGE 14 ON THE BASIS OF TESTING AT AGE 6–INTERIM REPORT FROM THE OJAI LONGITUDINAL STUDY OF REFRACTION. American Journal of Optometry & Archives of American Academy of Optometry 41:567, 1964
18. Zadnik K, Mutti DO, Friedman NE, et al: Ocular predictors of the onset of juvenile myopia. Invest Ophthalmol Vis Sci 40:1936, 1999
19. Mutti DO, Mitchell GL, Moeschberger ML, et al: Parental myopia, near work, school achievement, and children's refractive error. Invest Ophthalmol Vis Sci 43:3633-3640, 2002

Tables

Table1 Characteristics of non-myopic students from Jiangsu Province

ers of non-c students	Prevalence of myopia, %		SE, D		Height, cm		BMI kg/m2	
Boys	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls
232	9.3	4.9	0.6±0.8	0.9±0.9	122.0±6.1	119.5±5.7	17.4±3.0	16.3±2.1
123	15.3	8.2	0.7±0.7	0.7±0.7	124.1±6.9	123.7±7.4	17.4±2.8	16.6±2.0
206	17.1	15.9	0.7±0.8	0.5±0.6	126.8±5.6	124.9±5.1	17.4±2.7	16.8±2.7
268	15.4	16.5	0.7±0.7	0.8±1.0	125.6±6.4	124.7±7.2	17.4±2.9	16.6±2.4
218	29.7	26.6	0.5±0.9	0.5±0.8	133.2±6.2	132.4±6.5	17.9±3.2	17.0±2.8
192	22.1	25.6	0.5±0.6	0.6±1.0	132.0±6.4	129.2±6.2	18.2±3.3	17.3±2.7
86	44.6	49.4	0.5±0.7	0.5±0.8	138.0±6.8	138.0±6.3	18.9±3.5	17.9±3.6
174	35.9	38.5	0.5±0.7	0.5±0.8	136.5±6.6	135.5±6.8	18.5±3.5	17.5±2.9
88	60.8	53.2	0.3±0.5	0.4±0.7	143.5±6.7	143.8±7.4	19.9±4.3	18.6±3.5
71	52.1	61.4	0.4±0.6	0.4±0.7	142.9±7.9	143.1±6.8	19.4±3.6	18.2±3.4
24	68.8	82.1	0.4±0.7	0.3±0.6	148.8±8.2	151.5±8.5	20.8±5.0	19.6±4.3
52	67.5	74.1	0.4±0.8	0.5±0.9	149.9±9.5	148.8±6.5	21.5±4.4	18.9±3.1
35	74.7	78.0	0.3±0.5	0.3±0.8	153.6±8.1	153.6±6.3	19.8±3.8	19.8±3.3
35	73.8	78.7	0.2±1.5	0.2±0.5	156.0±9.2	154.6±7.2	20.3±3.4	19.7±3.8
1804	38.0	39.5	0.5±0.7	0.6±0.8	132.7±11.2	130.9±11.3	18.3±3.5	17.2±2.9

Tables2 Percentiles of spherical equivalent value for boys and girls by age and height for primary students from Jiangsu Province Eye study

Age	SE value	BMI percentiles for boys				BMI percentiles for girls			
		25th	≥25th	≥50th	≥75th	25th	≥25th	≥50th	≥75th
6	95th	-0.2	-0.2	-0.1	0.0	-0.2	-0.2	0	0
	90th	+0.0	+0.0	+0.0	0.0	0.0	-0.1	0	0
	75th	+0.0	+0.0	+0.0	+0.3	+0.1	0.1	0.5	0.2
	50th	+0.4	+0.4	+0.4	+0.6	+0.8	0.9	1	0.8
	25th	+1.1	+1.0	+0.9	+1.1	+1.4	1.3	1.5	1.3
	10th	+1.8	+1.5	+1.2	+1.6	+1.9	1.8	1.9	1.5
	5th	+2.3	+1.7	+1.6	+2.0	+2.7	2	2.6	1.8
6.5	95th	-0.2	-0.2	-0.2	-0.3	-0.2	-0.2	0	-0.2
	90th	+0.0	-0.1	-0.1	-0.2	0.0	-0.1	0	0
	75th	+0.1	+0.0	-0.1	+0.3	0.0	0.1	0.2	0.2
	50th	+0.4	+0.4	+0.4	+0.6	+0.4	0.4	0.5	0.5
	25th	+1.1	+0.9	+0.9	+1.0	+1.1	1.2	1.2	0.9
	10th	+1.5	+1.4	+1.1	+1.4	+1.5	1.7	1.9	1.5
	5th	+1.5	+1.5	+1.3	+1.8	+1.9	1.8	2	1.6
7	95th	-0.2	-0.3	-0.4	-0.3	-0.2	-0.2	-0.4	-0.3
	90th	0.0	-0.1	-0.2	-0.2	+0.0	-0.1	-0.3	-0.2
	75th	+0.1	+0.0	-0.1	+0.0	+0.0	0	0	0.1
	50th	+0.4	+0.4	+0.4	+0.6	+0.3	0.4	0.5	0.5
	25th	+1.0	+0.9	+0.9	+1.0	+0.9	0.8	1	0.9
	10th	+1.2	+1.4	+1.1	+1.5	+1.1	1.2	1.2	1.5
	5th	+1.5	+1.5	+1.3	+1.8	+1.7	1.4	1.4	1.6
7.5	95th	-0.2	-0.3	-0.4	-0.3	-0.3	-0.2	-0.4	-0.3
	90th	+0.0	-0.1	-0.2	-0.2	-0.1	-0.1	-0.3	-0.2
	75th	+0.1	+0.0	-0.1	+0.0	+0.0	0	0	0.1
	50th	+0.4	+0.4	+0.4	+0.6	+0.3	0.4	0.5	0.5
	25th	+0.9	+0.9	+0.9	+1.0	+0.9	0.8	1	0.9
	10th	+1.2	+1.4	+1.1	+1.5	+1.1	1.2	1.2	1.5
	5th	+1.5	+1.5	+1.3	+1.6	+1.7	1.4	1.4	1.6
8	95th	-0.3	-0.2	-0.4	-0.4	-0.3	-0.3	-0.4	-0.3
	90th	-0.3	-0.1	-0.3	-0.2	-0.1	-0.1	-0.3	-0.2
	75th	+0.0	0.0	-0.1	+0.0	+0.0	0	0	0.1
	50th	+0.3	+0.4	+0.3	+0.2	+0.3	0.4	0.4	0.5
	25th	+0.6	+0.8	+0.8	+0.8	+0.9	0.8	0.8	0.9
	10th	+1.0	+1.3	+1.1	+1.3	+1.1	1.2	1.2	1.5
	5th	+1.4	+1.5	+1.3	+1.6	+1.5	1.4	1.4	1.6
8.5	95th	-0.3	-0.3	-0.4	-0.4	-0.3	-0.3	-0.4	-0.3
	90th	-0.3	-0.1	-0.3	-0.2	-0.1	-0.1	-0.3	-0.2
	75th	0.0	+0.0	-0.1	+0.0	0.0	0	0	0
	50th	+0.3	+0.4	+0.3	+0.2	+0.3	0.4	0.4	0.5
	25th	+0.6	+0.8	+0.8	+0.8	+0.9	0.8	0.8	0.9
	10th	+1.0	+1.0	+1.0	+1.3	+1.1	1.2	1.1	1.4
	5th	+1.4	+1.3	+1.3	+1.6	+1.5	1.4	1.4	1.6
9	95th	-0.3	-0.3	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4
	90th	-0.3	-0.1	-0.3	-0.2	-0.3	-0.3	-0.3	-0.3
	75th	+0.0	0.0	+0.1	+0.0	-0.1	0	0	0
	50th	+0.3	+0.4	+0.3	+0.2	+0.3	0.3	0.4	0.4
	25th	+0.6	+0.8	+1.0	+0.6	+0.4	0.7	0.8	0.9
	10th	+1.0	+1.0	+1.6	+1.0	+0.8	1.2	1.1	1.4
	5th	+1.1	+1.3	+2.8	+1.1	+0.9	1.3	1.4	1.6
9.5	95th	-0.3	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4
	90th	-0.3	-0.3	-0.3	-0.2	-0.3	-0.3	-0.3	-0.3

	75th	+0.0	+0.0	+0.0	0.0	-0.1	0	0	0
	50th	+0.3	+0.3	+0.3	+0.2	+0.3	0.3	0.4	0.4
	25th	+0.6	+0.6	+0.9	+0.6	+0.4	0.7	0.8	0.9
	10th	+1.0	+1.0	+1.2	+0.9	+0.8	1.1	1.1	1.2
	5th	+1.1	+1.2	+1.6	+1.0	+0.9	1.3	1.4	1.4
10	95th	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4
	90th	-0.4	-0.4	-0.1	-0.2	-0.3	-0.3	-0.3	-0.4
	75th	-0.3	0.0	0.0	0.0	-0.1	-0.2	-0.2	-0.2
	50th	+0.1	+0.3	+0.3	+0.2	+0.3	0.3	0.3	0.3
	25th	+0.6	+0.6	+0.5	+0.6	+0.4	0.6	0.4	0.5
	10th	+0.9	+0.8	+0.6	+0.9	+0.8	1.1	1	1
	5th	+0.9	+0.9	+0.8	+1.0	+0.9	1.3	1.4	1.4
10.5	95th	-0.1	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4
	90th	-0.1	-0.3	-0.1	-0.4	-0.4	-0.3	-0.3	-0.4
	75th	-0.3	-0.1	0.0	-0.3	-0.1	-0.2	-0.2	-0.2
	50th	+0.1	+0.1	+0.3	+0.2	+0.3	0.3	0.3	0.1
	25th	+0.8	+0.5	+0.5	+0.6	+0.4	0.6	0.4	0.5
	10th	+0.9	+0.8	+0.6	+0.9	+0.8	1.1	1	1
	5th	+0.9	+0.9	+0.8	+1.0	+0.9	1.3	1.4	1.4
11.0	95th	-0.3	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4
	90th	-0.2	-0.4	-0.1	-0.4	-0.4	-0.4	-0.3	-0.4
	75th	-0.3	-0.3	0.0	-0.3	-0.3	-0.3	-0.2	-0.2
	50th	+0.1	+0.1	+0.3	+0.2	+0.2	-0.3	0.3	0.1
	25th	+0.7	+0.3	+0.5	+0.6	+0.4	-0.1	0.4	0.5
	10th	+0.8	+0.5	+0.6	+0.7	+0.8	0.8	1	1
	5th	+0.9	+0.6	+0.8	+0.9	+0.9	1.3	1.1	1.1
11.5	95th	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4
	90th	-0.4	-0.4	-0.2	-0.4	-0.4	-0.4	-0.3	-0.4
	75th	-0.3	-0.3	-0.1	-0.3	-0.3	-0.3	-0.2	-0.2
	50th	+0.1	+0.1	-0.1	+0.2	+0.1	-0.3	0.3	0.1
	25th	+0.6	+0.3	+0.1	+0.6	+0.4	-0.1	0.4	0.5
	10th	+0.8	+0.5	+0.5	+0.7	+0.8	0.8	1	1
	5th	+0.9	+0.6	+0.8	+0.9	+0.9	1.3	1.1	1.1
12	95th	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4
	90th	-0.4	-0.4	-0.3	-0.4	-0.4	-0.4	-0.4	-0.4
	75th	-0.3	-0.3	-0.1	-0.3	-0.3	-0.3	-0.2	-0.2
	50th	+0.1	+0.1	-0.1	+0.1	+0.1	-0.3	0	0
	25th	+0.5	+0.3	+0.1	+0.6	+0.5	-0.1	0.1	0.1
	10th	+0.8	+0.5	+0.5	+0.7	+0.9	0.8	0.2	0.4
	5th	+0.8	+0.6	+0.8	+0.9	+0.9	1.3	0.3	0.7
12.5	95th	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4
	90th	-0.4	-0.4	-0.3	-0.4	-0.4	-0.4	-0.4	-0.4
	75th	-0.3	-0.3	-0.1	-0.3	-0.3	-0.3	-0.2	-0.2
	50th	+0.1	+0.0	-0.1	+0.0	0.0	-0.3	0	0
	25th	+0.5	+0.2	+0.1	+0.3	+0.3	-0.1	0.1	0.1
	10th	+0.6	+0.5	+0.5	+0.6	+0.4	0.8	0.2	0.4
	5th	+0.8	+0.6	+0.6	+0.7	+0.5	1.2	0.3	0.6

Table3 Relationship between myopic alertion for non-myopic students and myopia associated factors

	Non-myopic students with no-alertion (%/mean±SD)	non-myopic students with alertion (%/mean±SD)	P
Father is myopia?	31.5(404/1284)	35.9(260/725)	0.048
Mother is myopia?	34.7(446/1284)	38.9(282/725)	0.062
Have brothers or sisters?	42.9(551/1284)	36.6(265/725)	0.005
After school homework on working days?	34.1(138/405)	46.9(98/209)	0.002
(From 17:00-19:00) After school homework on weekends?	1.0(11/1098)	2.5(15/594)	0.015
(From 20:00-22:00) Sleep duration on working days	9.68±0.75	9.60±0.82	0.004
Outdoor activities on weekends?	84.2(1081/1284)	78.3(568/725)	0.001

Figures

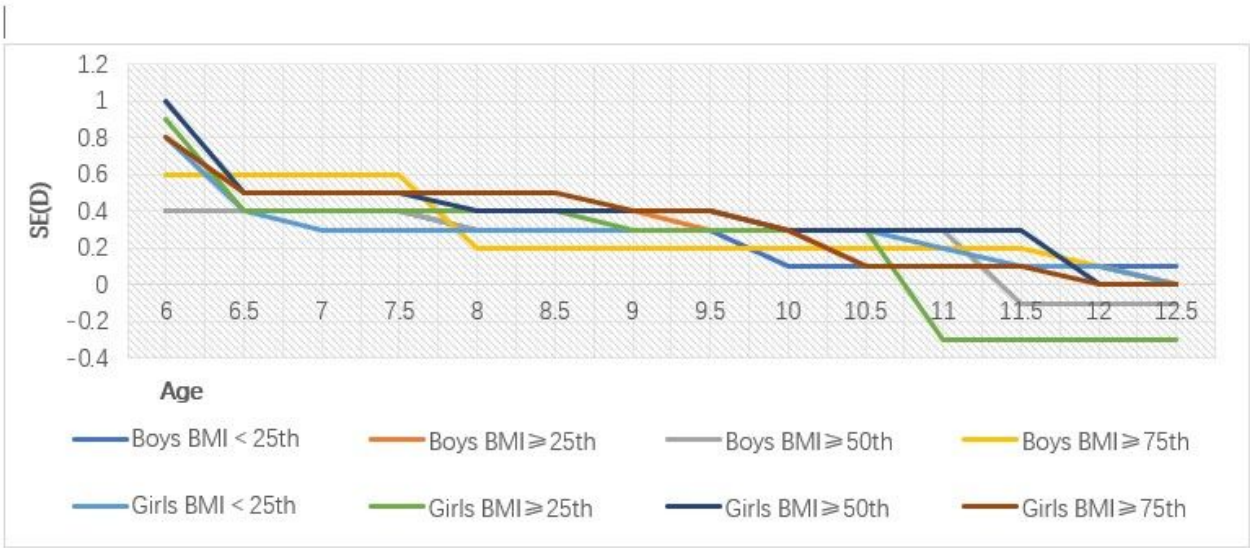

Figure1 Cut-off points for predicting future myopia: The 50th percentiles for spherical equivalent value for both boys and girls

Figure 1

Cut-off points for predicting future myopia: The 50th percentiles for spherical equivalent value for both boys and girls

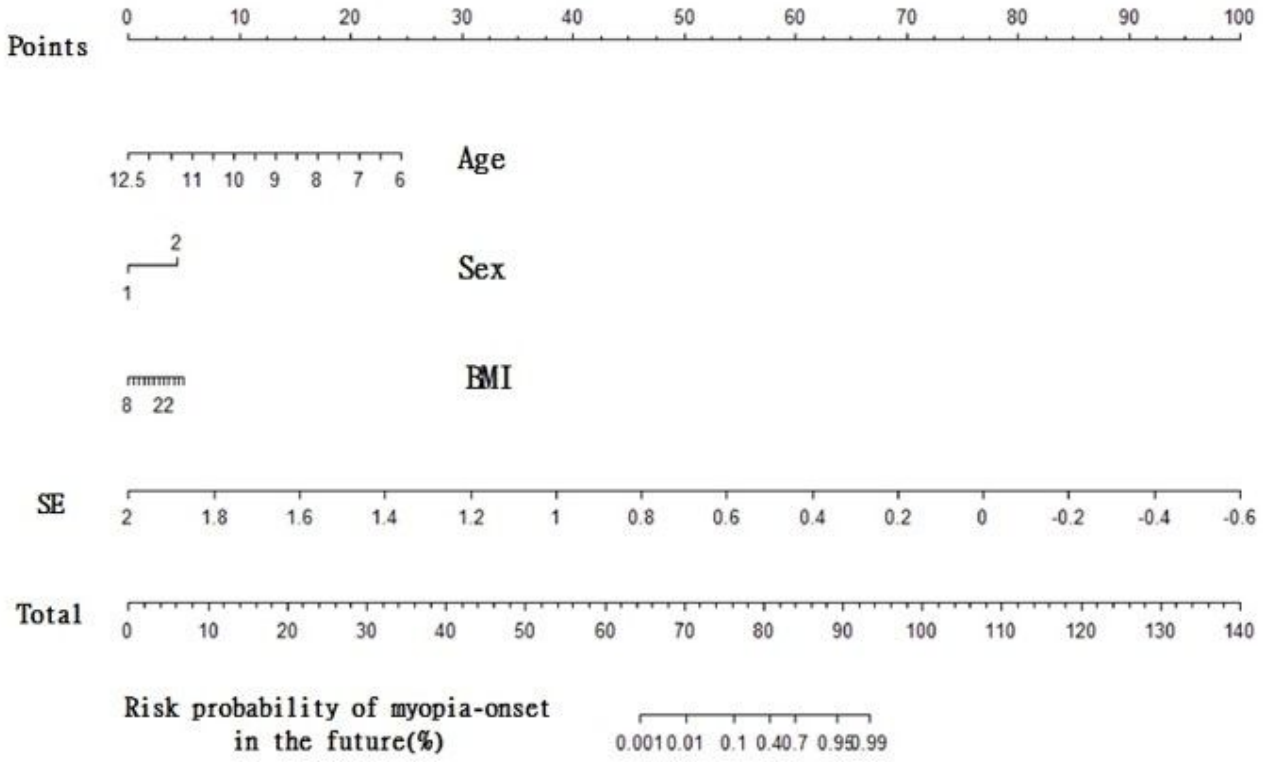

Figure2 Nomogram for predicting childhood myopia onset

Figure 2

Nomogram for predicting childhood myopia onset

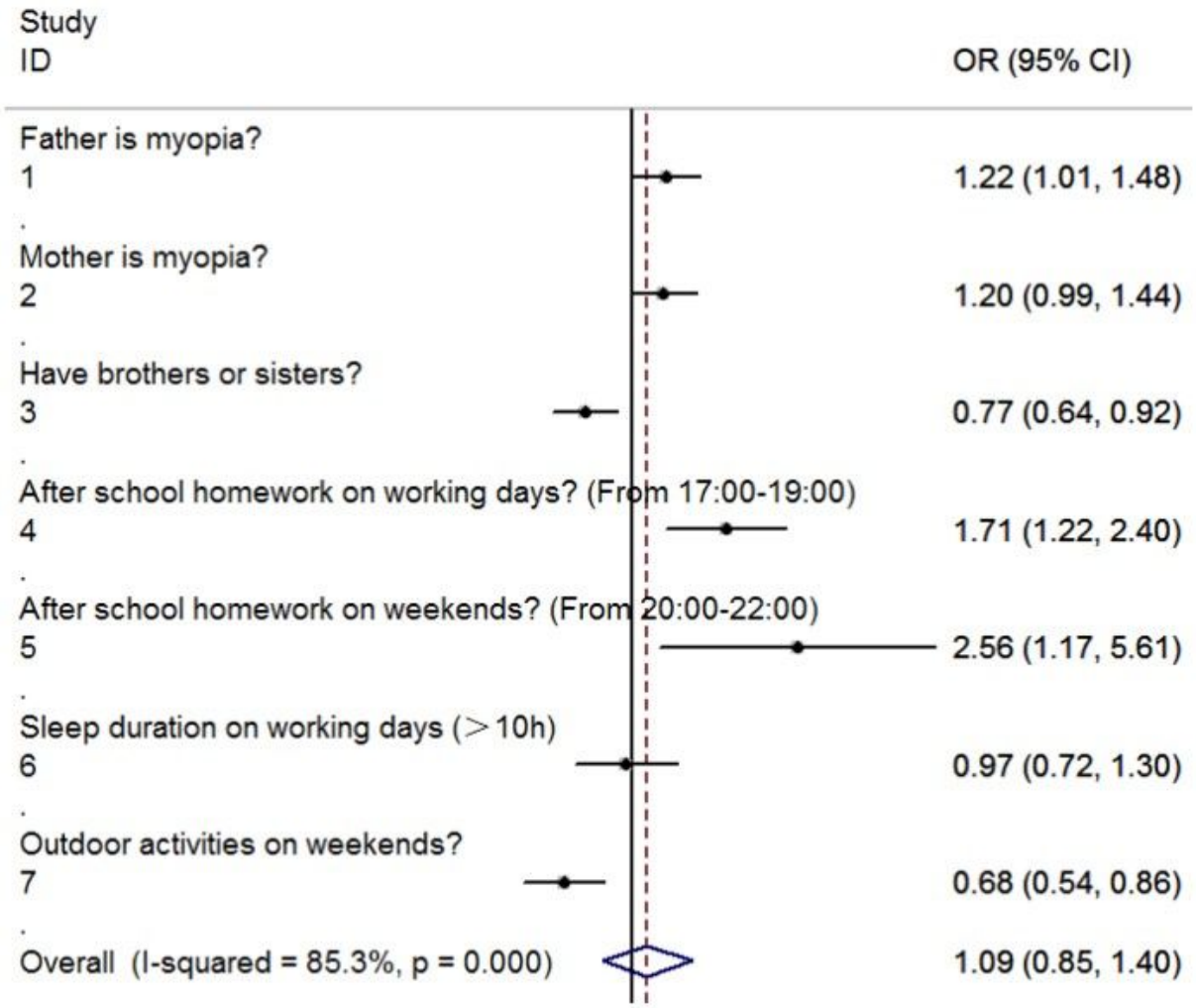

Figure3 Forest graph of relationship between alert values for non-myopic students and myopic factors

Figure 3

Forest graph of relationship between alert values for non-myopic students and myopic factors

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- supplement.pdf