**Supplementary Material**

The association between menarche and myopia and its interaction with related risk behaviors among Chinese school-aged girls: a nationwide cross-sectional study

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**The validation trial of the definition of myopia in Chinese National Survey on Students’ Constitue and Health (CNSSCH)**

In 2012, our collaborators in Anhui Medical University conducted a validation trial to test the accuracy of the definition of myopia that have been used in CNSSCN since 1985. The trial was approved by the ethics committee of Anhui Medical University (grant No. 2013001). This trial was a subproject of the ‘Students Major Disease Prevention and Control Technology and Its Development and Application’ (1147 project, Grant No.201202010), funded by the research special fund for public welfare industry of health of the Ministry of Health of China. The principal investigator of the 1147 project is Prof. Jun Ma, one of our co-authors and the head of the Institute of Child and Adolescent Health, Peking University.

Briefly, students at grade 1-8 were recruited from 18 primary and secondary schools in Shenyang by a multi-stage cluster sampling procedure. All selected students and their parents signed the consent form. Students with strabismus, amblyopia or other significant eye diseases were excluded. Finally, a total of 1620 students (50.0% female) with signed consent form were included in the trial. For all participants (both eyes), the myopic status was measured by both the method described in our manuscript and cycloplegic (by eyedrops) refraction. The gold standard of myopia was defined as spherical equivalent cycloplegic refractive error ≤-0.50 D for at least one eye. The main results of the validation trial are displayed in **Supplementary Table S1.** More details of the trial could be found in Pei’s masters’ thesis (in Chinese but with English Abstract)1.

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| **Supplementary Table S1**. The validation of the definition of myopia in CNSSCH compared to gold standard |
| 　 | 　 | Myopia\* | 　 | Non-myopia\* | 　 | Validation |
| 　 | N | Positive | Negative | 　 | Positive | Negative | 　 | Sensitivity (95%CI), % | Specificity(95%CI), % | PPV (95%CI), % | NPV (95%CI), % |
| Grade 1-3 (aged 7~9) | 616 | 93 | 19 | 　 | 67 | 437 | 　 | 83.0(76.0-90.0) | 86.7(83.7-89.7) | 58.1(50.5-65.8) | 95.8(94.0-97.7) |
| Grade 4-5 (aged 10~11) | 438 | 207 | 21 | 　 | 46 | 164 | 　 | 90.8(87.0-94.5) | 78.1(72.5-83.7) | 81.8(77.1-86.6) | 88.6(84.1-93.2) |
| Grade 7-8 (aged 12~13) | 566 | 382 | 20 | 　 | 31 | 133 | 　 | 95.0(92.9-97.2) | 81.1(75.1-87.1) | 92.5(90.0-95.0) | 86.9(81.6-92.3) |
| Overall | 1620 | 682 | 60 | 　 | 144 | 734 | 　 | 91.9(90.0-93.9) | 83.6(81.2-86.0) | 82.6(80.0-85.2) | 92.4(90.6-94.3) |
| Note:\*defined by gold standard; PPV=Positive predictive value; NPV=Negative predictive value; CI, confidence interval. CNSSCH, Chinese National Survey on Students’ Constitute and Health |

**Supplementary Table S2**. The univariate Spearman correlation coefficients matrix of variables included in analysis

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | menarche status | age by day | urban rural location | sleep duration | homework time |
| age by day | 0.72  | 　 | 　 | 　 | 　 |
| urban-rural location | -0.03  | 0.01  |  |  |  |
| sleep duration | -0.39  | -0.49  | 0.06  |  |  |
| homework time  | 0.31  | 0.39  | -0.09  | -0.28  |  |
| weekend outdoor activity frequency | -0.06  | -0.06  | 0.06  | 0.07  | -0.12  |

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| **Supplementary Table S3.** The diagnose of multi-collinearity in several models  |
|  | df | Model 2 |  | Model 3 |  | Pre-menarche model |  | Post-menarche model |
| GVIF | GVIF^1/2df |  | GVIF | GVIF^1/2df |  | GVIF | GVIF^1/2df |  | GVIF | GVIF^1/2df |
| menarche status | 1 | 2.1 | 1.5 | 　 | 2.1 | 1.4 | 　 | 　 | 　 | 　 | 　 | 　 |
| age by day | 1 | 2.1 | 1.5 |  | 2.5 | 1.6 |  | 1.1 | 1.1 |  | 1.3 | 1.1 |
| urban rural location | 1 |  |  |  | 1.0 | 1.0 |  | 1.0 | 1.0 |  | 1.0 | 1.0 |
| sleep duration | 5 |  |  |  | 1.4 | 1.1 |  | 1.1 | 1.0 |  | 1.2 | 1.0 |
| homework time  | 4 |  |  |  | 1.3 | 1.0 |  | 1.1 | 1.0 |  | 1.1 | 1.0 |
| weekend outdoor activity frequency | 3 |  |  |  | 1.0 | 1.0 |  | 1.0 | 1.0 |  | 1.0 | 1.0 |
| survey year | 1 |  |  |  | 1.0 | 1.0 |  | 1.0 | 1.0 |  | 1.0 | 1.0 |
| GVIF: generalized VIF (variance inflation factor), GVIF^1/2df is derived to make GVIF values with different df comparable. For continuous variables, GVIF is equal to VIF, VIF>10 indicates a multi-collinearity may be a problem, in some studies the threshold 4 or 5 may also be used2. For category variables, GVIF^1/2Df＞101/2(or 51/2,41/2) indicates the multi-collinearity may be a concern3. Even applying the strictest threshold, the multi-collinearity in different models in present study are not a concern. Model 2~model 3 are shown in table 2 in the manuscript. Pre-menarche model and post-menarche model is shown in table 4 in the paper. |

**References**

**1.** Pei Chenlu. Studies of vision care related behavior and methods for myopia screening in Chinese elementary and secondary students.MS thesis. Anhui Medical University, 2014.(in Chinese, with English abstract)

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**2.** O Brien RM. A Caution Regarding Rules of Thumb for Variance Inflation Factors. *Qual Quant.* 2007;41(5):673-690.

**3.** Hendrickx J, Pelzer B, Grotenhuis MT, Lammers J. Collinearity involving ordered and unordered categorical variables. *RC33 conference in Amsterdam*; 2004.