

# Myopia in schoolchildren in a rural community in the State of Mexico, Mexico

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**Purpose:** This study sought to determine the prevalence of myopia in schoolchildren of a rural population in Mexico.

**Methods:** A cross-sectional study was conducted in 317 children between 6 and 12 years old. A complete refractive examination was performed, including static retinoscopy without cycloplegic agents. All procedures were conducted according to the Declaration of Helsinki.

**Results:** In total, 9.7% (95% CI: 13.07–6.52) of the examined children were myopic (spherical equivalent  $\leq -0.50$  D), 4.4% (95% CI: 6.66–2.14) presented astigmatism (cylinder  $\leq -1.50$  D), and 5.4% (95% CI: 7.89–2.91) presented hyperopia (spherical equivalent  $\geq +0.50$  D).

**Conclusion:** Additional research is required to assess the prevalence of refractive errors in rural areas in Mexico, to analyze the associated risk factors, and to implement appropriate eye care plans for this population.

**Keywords:** myopia, refractive errors, hyperopia, astigmatism

## Introduction

The potential for a myopia epidemic has been described due to the increase in its prevalence in recent years.<sup>1–14</sup> Various factors affect the prevalence of myopia, including age,<sup>4,8–13</sup> ethnicity,<sup>14–17</sup> the criteria for defining myopia and genetic,<sup>18–20</sup> and environmental factors.<sup>5,6,17,21–23</sup> The main environmental factors analyzed thus far include near work,<sup>16,17,21,23–25</sup> outdoor activities,<sup>16,26–29</sup> and population type (rural or urban).<sup>30–33</sup>

The change in the prevalence of myopia in each geographical zone is as follows: Pakistan,<sup>7</sup> 36.5% in adults; Japan,<sup>8</sup> 41.8% in adults; India,<sup>5,9</sup> 28% and 34.6% in adults; Singapore,<sup>10</sup> 30.7% in adults; Poland,<sup>11</sup> 13.3% in children; Ireland,<sup>12</sup> 2.8% and 17.7% increased from 6 and 7 years to 12 and 13 years; Hong Kong,<sup>13</sup> 36.71% in children; and USA,<sup>14</sup> the prevalence of myopia increased from 1971–1972 to 1999–2004. There are a few studies about the prevalence of myopia in Latin America, for example, Los Angeles Latino Eye Study reported a prevalence of myopia (spherical equivalent [SE]  $\leq -1.00$  D) of 16.8% in the worse eye from adults aged 40 years and older;<sup>34</sup> in Brazil, the prevalence of myopia in indigenous people was reported to be 2.3% in the right eye (RE), 3.1% in the left eye (LE), and 1.6% bilateral.<sup>35</sup> In Mexico, the studies have assessed the prevalence of myopia only in urban areas.<sup>36–39</sup> Moreover, some of these studies cannot be compared due to the definitions of refractive errors used.<sup>36,37</sup> In 2003, Villarreal et al<sup>38</sup> studied 1,035 children between 12 and 13 years of age in Monterrey, Mexico, and reported a prevalence of myopia of 44% (SE  $\leq -0.50$  D), hyperopia of 6% (SE  $\geq +1.00$  D), and astigmatism of 9.5% (cylinder  $\leq -1.50$  D).

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In 2007, Rodríguez-Ábrego and Sotelo-Dueñas<sup>39</sup> studied 1,136 children between 6 and 15 years of age in the City of Nezahualcoyotl, State of Mexico, and reported a prevalence of myopia ( $SE \leq -0.50$  D) of 33%; nevertheless, in this study, the diagnosis of refractive state was determined without cycloplegic agents. The current study focused on improving the available information on the prevalence of myopia in rural areas.

## Methods

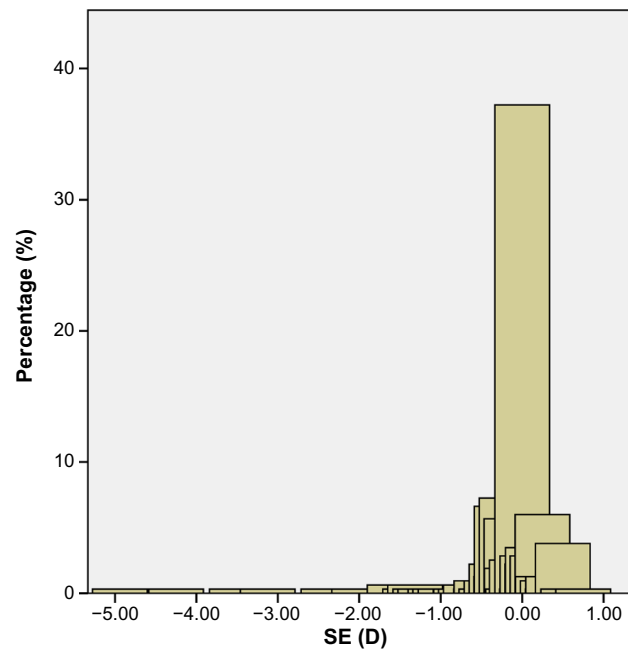
A cross-sectional study was conducted in the community of San Juan Teacalco, Temascalapa, State of Mexico, which has 2,970 inhabitants,<sup>40</sup> whose main economic activities are agriculture and animal husbandry. There are three schools (two elementary and one secondary), and one communitarian health center led by a physician and a nurse. Optometrical and ophthalmological examinations are not undertaken at this communitarian health center. A total of 317 out of 339 schoolchildren (22 kids were excluded because they did not attend the class at the day of our examination) between 6 and 12 years old (mean  $\pm$  standard deviation [SD] of  $8.66 \pm 1.90$  years) were examined at the elementary schools of Ignacio Zaragoza ( $n=175$ ) and General Francisco Villa ( $n=142$ ). Of these children, 44.8% were girls and 55.2% were boys. Three optometrists from Instituto Politecnico Nacional carried out refractive diagnosis in the following two stages:

- 1) Screening: a survey was conducted to collect the following data: visual acuity at 3 m with the Snellen chart, personal data, the use of glasses, family history of the use of glasses, and symptoms and examination of eye adnexa. Children who had any ocular pathology or those whose parents failed to sign an informed consent form were excluded.
- 2) Refractive diagnosis: refractive examination was performed using static retinoscopy without cycloplegic agents. The bichromatic and Jackson cross cylinder subjective tests were applied, too.

The study was approved by College of Professors of the Interdisciplinary Center for Health Science from Instituto Politecnico Nacional. All procedures were conducted according to the Declaration of Helsinki. Written informed consent was obtained from the parents of the children. Statistical analysis was performed using the statistical software SPSS 23 (IBM, SPSS, Statistics 23).

## Results

Figure 1 shows the distribution of the mean SE of both eyes.



**Figure 1** Distribution of the mean SE of both eyes.  
**Abbreviation:** SE, spherical equivalent.

The SE of the right eye (RE), with a mean  $\pm$  SD of  $-0.1183 \pm 0.567$  D, was compared with that of the left eye (LE), with a mean  $\pm$  SD of  $-0.1075 \pm 0.629$  D.

Myopia in at least one eye or bilaterally was the main refractive error, with a prevalence of 9.7% or 6.6%, respectively, as shown in Table 1.

In the entire sample, 7.9% reported a family history of some type of refractive error, and 5.4% wore glasses.

The risk factors for myopia were analyzed using Fisher's exact test and logistic regression analysis, as shown in Table 2. The control group comprised children who are not shortsighted. We found that the prevalence of myopia was higher in males (10.3%). In addition, 16.1% of the myopic patients reported a family history of wearing glasses, and 22.6% wore glasses themselves.

**Table 1** The prevalence of refractive errors

| Refractive error | Definition                                  | Percentage | 95% CI     |
|------------------|---|------------|------------|
| Myopia           | $SE \leq -0.50$ D in at least one eye       | 9.8        | 13.07–6.52 |
| Myopia           | $SE \leq -0.50$ D bilateral                 | 6.6        | 9.33–3.87  |
| Hyperopia        | $SE \geq +0.50$ D in at least one eye       | 5.4        | 7.89–2.91  |
| Astigmatism      | Cylinder $\leq -1.50$ D in at least one eye | 4.4        | 6.66–2.14  |
| Astigmatism      | Cylinder $\leq -1.50$ D bilateral           | 2.2        | 3.81–0.58  |

**Abbreviations:** CI, confidence interval; SE, spherical equivalent.

**Table 2** The risk factors for myopia

| Factors                                     | Cases | Controls | P-value | OR (95% CI)         |
|---|-------|----------|---------|---------------------|
| <b>Sex</b>                                  |       |          |         |                     |
| Female                                      | 13    | 129      | 0.850   | 1.138 (0.537–2.410) |
| Male  | 18    | 157      |         |                     |
| <b>Father, mother, or both wear glasses</b> |       |          |         |                     |
| Yes   | 5     | 20       | 0.083   | 2.558 (0.887–7.379) |
| No  | 26    | 266      |         |                     |
| <b>Use of glasses</b>                       |       |          |         |                     |
| Yes   | 7     | 10       | 0.00042 | 8.05 (2.811–23.052) |
| No  | 24    | 276      |         |                     |

**Abbreviations:** OR, odds ratio; CI, confidence interval.

## Discussion

In our study, the prevalence of myopia was 9.8%, which is lower than that reported in studies performed in urban areas by Villarreal et al (44%)<sup>38</sup> and Rodríguez-Ábrego and Sotelo-Dueñas (33%).<sup>39</sup> Furthermore, it is possible that the prevalence of myopia found in our study and Rodríguez-Ábrego and Sotelo-Dueñas's<sup>39</sup> study may be lower because of an overestimation due to the lack of cycloplegic agents for the determination of refractive errors.<sup>41–43</sup> However, our results are consistent with the studies performed in the People's Republic of China and India, where a lower prevalence of myopia in rural areas was found than that in urban areas.<sup>30–33</sup>

Among myopic patients, 22.6% wore glasses, which is a larger percentage than that previously reported by Villarreal et al (17%)<sup>38</sup> and Rodríguez-Ábrego and Sotelo-Dueñas (17.6%)<sup>39</sup> in urban areas. However, our results are consistent with the findings of Castanon et al,<sup>44</sup> in which a higher frequency in the use of eyeglasses was observed among younger children in rural areas (odds ratio [OR]=10.6; 95% confidence interval [CI]: 5.3–21.0). Additionally, a significant difference was found in this study ( $P=0.00042$  and OR =8.05; 95% CI: 2.81–23.05) for nonmyopic subjects.

In our study, 16.1% of the myopic subjects had a family history with this condition, which was slightly significantly different ( $P=0.083$  and OR =2.558; 95% CI: 0.887–7.379) compared to nonmyopic subjects. In contrast, Rodríguez-Ábrego and Sotelo-Dueñas<sup>39</sup> found significant differences ( $P=0.001$  and OR =1.62; 95% CI: 1.22–2.14), although this difference may have been due to sample size variation across studies and the area where the study was realized.

Villarreal et al<sup>38</sup> and Rodríguez-Ábrego and Sotelo-Dueñas<sup>39</sup> reported a significant difference in the prevalence of myopia according to sex, being women the most affected. In contrast, we observed a higher percentage of myopic males (10.3%) than females (9.15%), although this difference was not significant ( $P=0.850$ ).

The prevalence of hyperopia (5.4%) and astigmatism (4.4%) was also lower than what has been reported previously by Villarreal et al.<sup>38</sup> The low prevalence of hyperopia and astigmatism may have been due to the lack of use of cycloplegic agents for determining the refractive diagnosis.<sup>40–43</sup>

We are conscious about the induced inaccuracy in assessing the prevalence of refractive errors due to the fact that we did not use cycloplegic agents. However, we considered that the clinical diagnosis, and hence the prescription of eye-glasses, should be on the basis of a more realistic setting for our children, who exert a latent accommodation in ordinary situations, as reported elsewhere.<sup>43</sup>

## Conclusion

Although the prevalence of myopia and other refractive errors is low, it is important to conduct further research to assess the prevalence of refractive errors in rural areas, to analyze the associated risk factors, and to implement visual health plans, both informational and corrective, with the aim of improving the quality of vision in the rural population.

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## Author contributions

All authors contributed toward data analysis, drafting and critically revising the paper and agree to be accountable for all aspects of the work.

## Disclosure

The authors report no conflicts of interest in this work.

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