Myopia, genetics, and ambient lighting at night in a UK sample

J A Guggenheim, C Hill, T-F Yam

Background: It has been reported that exposure to artificial lighting at night during the first 2 years of life was very strongly associated with subsequent myopia development. Methods: The strength of this association was tested in a UK sample for the first time. The study population comprised 122 university students.

Results: Myopia occurred with approximately equal frequency in those who slept with and without light exposure at night. In contrast, two largely genetic factors, parental myopia and race, were both significantly associated with myopia development, as has been found previously.

Conclusion: This study provides further support for the view that night-time light exposure during infancy is not a major risk factor for myopia development in most population groups. In a subset of this cohort for which spectacle prescriptions were available for both parents (49 trios), the heritability of ocular refraction was estimated to be 0.31.

Methods

Subjects aged between 18–40 inclusive were recruited from the Cardiff University student population, via advertisements describing the study. Criteria for exclusion were a history of keratoconus, connective tissue disease, cataract, or refractive surgery. Subjects underwent cycloplegic autorefraction on the right eye. Their parents were sent a questionnaire inquiring whether the subject had slept in darkness, with a night light, or with the room light on, before the age of 2 years, using the questions of Quinn et al.1 Parents were asked about their own use of spectacles or contact lenses using the “indirect method” questions of Walline and co-workers,14 and where possible, the spectacle prescription of each parent was obtained from their optometrist (when these were worn). In cases where the prescription was not available, the classification of parents as myopic or non-myopic was determined from their questionnaire responses as described by Walline et al.14 Myopia was defined as a mean spherical equivalent of ≤–0.50 D, as described by Quinn et al. All data were analysed for right eyes only, as ocular refraction is known to be highly correlated between fellow eyes of the same subject.

In all, 122 subjects participated in the study (mean age 21.6 years, range 19–36 years, 71% female, 66% white, 34% Asian). No subject had to be excluded. Parental refractive status (myopic versus non-myopic) could be determined from questionnaires for both parents of 81 subjects and for at least one parent of a further 29 subjects. Refractive details were obtained for both parents of 49 subjects and for at least one parent of a further 31 subjects. Ethical approval for this project was obtained from the local research ethics committee and all subjects and their parents provided informed consent. Fisher’s exact test and the $\chi^2$ test were used for the statistical evaluation of $2 \times 2$ and $3 \times 2$ contingency tables, respectively. Heritability was calculated from the regression of offspring values for mean sphere on “mid-parent” values.

Results

In this UK sample there was no significant association between night-time light exposure and myopia (Table 1A; $\chi^2$, $p=0.21$). This remained the case when subjects in the “night

<table>
<thead>
<tr>
<th>Table 1</th>
<th>Number of subjects with myopia as a function of night-time light exposure during first 2 years of life</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Darkness</td>
</tr>
<tr>
<td>Subject not myopic</td>
<td>22</td>
</tr>
<tr>
<td>Subject myopic</td>
<td>51</td>
</tr>
<tr>
<td>B</td>
<td>Darkness at night</td>
</tr>
<tr>
<td>Subject not myopic</td>
<td>22</td>
</tr>
<tr>
<td>Subject myopic</td>
<td>51</td>
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In (B) the data from the night light and room light groups are pooled. Note that while not statistically significant, myopia was more common in subjects who slept in darkness during infancy.
detect an effect of similar magnitude. The correlation coefficient was available for only one parent (open symbols; n=31). Spearman
val 0.14 to 0.50) for the 49 families for which data were available for both parents.

DISCUSSION
In this UK sample there was no evidence of an association between night lights and myopia. A similar conclusion was drawn from studies in the United States by Gwiazda et al. However, in subjects from Singapore and China, Saw and co-workers did find a weak association between night lights and myopia that almost reached statistical significance, and in a very recent study, Loman et al found a significant association between myopia and the number of hours of complete darkness to which young adults were currently exposed at night.

The population studied here had a higher prevalence of myopia (64%) and a lower prevalence of hyperopia than the general population (see distribution of offspring mean spheres in Fig 1) suggesting a source of ascertainment bias. As has been noted previously, given that the subjects studied by Quinn et al were aged between 2–16 years, they showed a similar high prevalence of myopia (with 30% of subjects myopic). Although a myopia prevalence of 64% is typical of university students, our study was also likely to have been affected by an ascertainment bias, with more myopes choosing to participate than non-myopes. Such selection and response biases have the potential to either inflate or mask the effect being investigated. By selecting subjects attending a university paediatric ophthalmology clinic, the population studied by Quinn et al is likely to have suffered from a different source of selection bias, but possibly a similar response bias.

In contrast with the lack of an effect from night lights, this study once again confirms the higher prevalence of myopia in Asians compared to Europeans, and the influence of parental myopia in determining the refractive errors of their children. However, the heritability estimate obtained here (0.31) is much lower than that obtained in two careful twin studies that were carried out recently, both of which used considerably more subjects than were included in the present investigation (n=506 and 114 twin pairs, respectively). We speculate that several factors might have contributed to this difference. Firstly, our heritability has wide confidence intervals and thus could be a considerable underestimate (and while the linear regression residuals for the calculation do not show a significant deviation from normality, the sample is too small to provide a robust test of this). Secondly, our subjects had a more varied ethnicity, and a higher proportion of high myopes, compared to those examined in the two twin studies. Thirdly, our heritability estimate is subject to a source of bias, since emmetropic parents would be less likely to wear spectacles, and thus would have been excluded from our analysis. Finally, because twin studies make the assumption that “common environment” effects are independent of zygosity, they tend to overestimate heritability in comparison with population studies.

In conclusion, our results suggest that night-time light exposure played a lesser part than genetic factors in the myopia development of this UK student population.

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