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.

Both genetic and environmental factors are implicated in the aetiology of myopia. Historically, near work activity—for example, reading, has been considered the most important environmental risk factor, although two comprehensive genetic studies have recently suggested that additive genetic factors are responsible for over 80% of the variation in refractive error in European populations, leaving only a minor component that could be due to environmental factors to which people are variably exposed. However, Quinn and co-workers have reported an association between night-time light exposure during the first 2 years of childhood and subsequent myopia development (in a US population group attending a university paediatric ophthalmology outpatient clinic) the magnitude of which was so strong that it would be expected to dominate genetic factors in the aetiology of myopia. Interestingly, the disruption of normal diurnal lighting rhythms is known to alter refractive development in chickens resulting in eyes with flatter corneas, shallower anterior chambers, and deeper vitreous chambers (with this latter effect possibly being an emmetropisation response to the anterior segment changes). However, these chick studies would predict that continuous light exposure would predispose to hyperopia rather than myopia, and Smith et al have recently found that in rhesus monkeys continuous light exposure does not induce the dramatic changes in refractive development seen in chicks. In addition, three studies (two in the United States, one in Singapore and China) have failed to replicate the findings of Quinn et al in human populations. We tested the strength of the association between night-time lighting and myopia development in a UK sample for the first time.

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. Parents were asked about their own use of spectacles or contact lenses using the “indirect method” questions of Walline and co-workers, 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. 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 χ2 test were used for the statistical evaluation of 2×2 and 3×2 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; χ2, p=0.21). This remained the case when subjects in the “night

Table 1 Number of subjects with myopia as a function of night-time light exposure during first 2 years of life

<table>
<thead>
<tr>
<th></th>
<th>Darkness Night light Room light</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subject not myopic</td>
<td>22</td>
</tr>
<tr>
<td>Subject myopic</td>
<td>51</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Darkness at night Light exposure at night</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subject not myopic</td>
<td>22</td>
</tr>
<tr>
<td>Subject myopic</td>
<td>51</td>
</tr>
</tbody>
</table>

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.

J A Guggenheim, C Hill, T-F Yam

Br J Ophthalmol 2003;87:580–582
Table 2 Number of subjects with myopia as a function of their sex (A) and ethnicity (B)

<table>
<thead>
<tr>
<th></th>
<th>Male</th>
<th>Female</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subject not myopic</td>
<td>13</td>
<td>31</td>
</tr>
<tr>
<td>Subject myopic</td>
<td>22</td>
<td>56</td>
</tr>
<tr>
<td>B</td>
<td></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>36</td>
<td>8</td>
</tr>
<tr>
<td>Asian</td>
<td>44</td>
<td>34</td>
</tr>
</tbody>
</table>

Table 3 Number of subjects with myopia as a function of parental myopia

<table>
<thead>
<tr>
<th></th>
<th>Neither parent myopic</th>
<th>Either parent myopic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subject not myopic</td>
<td>20</td>
<td>15</td>
</tr>
<tr>
<td>Subject myopic</td>
<td>17</td>
<td>39</td>
</tr>
</tbody>
</table>

Figure 1 Correlation in ocular refraction between parents and offspring. All data are from right eyes only. Mid-parent values are the average mean spherical equivalent for both parents (solid symbols; n=49), or the value for a single parent when a prescription was available for only one parent (open symbols; n=31). Spearman correlation coefficient r = 0.482 (n=80; p<0.0001). The broken line shows the linear regression (b=0.31) for the 49 families for which data were available for both parents.

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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