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Myopia and night lighting. Investigations on children with negative family history

Krótkowzroczność a oświetlenie nocą. Badania dzieci z ujemnym wywiadem rodzinnym

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Streszczenie: Cel pracy: celem badań było sprawdzenie na dużej populacji polskich dzieci, czy przebywanie dzieci w wieku do 2 lat w pomieszczeniach oświetlonych prowadzi do częstszego występowania krótkowzroczności. W celu wykluczenia wpływu czynników genetycznych przebadano dzieci z ujemnym wywiadem rodzinnym w kierunku krótkowzroczności.

Materiał i metody: przebadano 3905 uczniów z ujemnym wywiadem rodzinnym w kierunku krótkowzroczności (1800 chłopców i 2105 dziewcząt w wieku 6–18 lat, średni wiek 12,2 roku, SD = 3,3). Wykonywano skiaskopię po cykloplegii 1% tropicamidem. Krótkowzroczność rozpoznawano wtedy, gdy ekwiwalent sferyczny < -0,50 D. Rodzice badanych uczniów wypełniali ankietę na temat wywiadu rodzinnego w kierunku krótkowzroczności oraz ekspozycji dziecka w wieku do 2 lat na światło emitowane przez lampy żarowe lub fluorescencyjne. Analizę danych przeprowadzono testem χ^2 Pearsona. Przyjęto poziom istotności $p < 0,05$.

Wyniki: u dzieci, które do 2. roku życia spały w pomieszczeniach oświetlonych, nie stwierdzono częstszego występowania krótkowzroczności w wieku szkolnym ($p > 0,05$). Nie zaobserwowano różnic w działaniu światła emitowanego przez lampy żarowe lub fluorescencyjne na częstość występowania krótkowzroczności ($p > 0,05$).

Wnioski: krótkowzroczność występująca w populacji polskich dzieci z ujemnym wywiadem rodzinnym w kierunku krótkowzroczności nie jest związana z przebywaniem dzieci w wieku do 2 lat w pomieszczeniach oświetlonych. We wcześniejszych pracach przedstawialiśmy badania przeprowadzane na innych populacjach i ich wyniki odmienne niż w badaniach opisywanych w tej publikacji, stąd wniosek, że prawdopodobnie wczesna ekspozycja na światło oraz wywiad rodzinny/genetyka oddziałują na siebie i wpływają na występowanie krótkowzroczności.

Słowa kluczowe: krótkowzroczność, oświetlenie nocą, lampy żarowe, lampy fluorescencyjne.

Summary: **Purpose:** The aim of our study was to investigate if ambient lighting at night before the age of 2 years is associated with the occurrence of myopia in a large population of Polish children. To eliminate the influence of genetic factors, only children with a negative family history of myopia were included.

Material and methods: A total of 3905 students, all of whom had a negative family history of myopia were examined (1800 boys and 2105 girls, aged 6–18 years, mean age 12.2, S.D. 3.3 years). The examination included retinoscopy under cycloplegia with 1% tropicamide. Myopia in the subjects was defined as a spherical equivalent of at least -0.50 dioptres. The parents of all students examined completed a questionnaire on the child's family history of myopia as well as the child's exposure to light emitted by incandescent or fluorescent lamps before the age of two years. Data analysis was performed using chi-squared Pearson test; p-values of <0.05 were considered statistically significant.

Results: Sleeping until the age of two with a room light is not associated with the presence of myopia during school years ($p > 0.05$). No differences in the use of light emitted by incandescent or fluorescent lamps on the prevalence of myopia was found ($p > 0.05$).

Conclusions: Myopia is not associated with night light use before age of 2 years in a population of Polish children with a negative family history of myopia. Because both, the restricted population and results differ from our previous positive associations, perhaps early light exposure and family history/genetics interact in influencing the occurrence of myopia.

Key words: myopia, night lighting, incandescent lamps, fluorescent lamps.

Introduction

In 1999, Quinn (1) had indicated that myopia occurs frequently among children whose parents reported that they slept in lighted rooms before the age of 2 years. These investigations had been carried out on 479 children ranging from 2 to 16 years of age and have generated considerable interest around the world.

In the years following that study a few works have come out concerning the described association. Re-examination

of this study by Gwiazda (2) and Mutti (3) in the USA, Guggenheim (4) in the UK, and Saw (5,6) in Singapore failed to confirm more frequent occurrence of myopia among persons who slept in lighted rooms during their childhood.

Chapell (7) have found no significant differences in incidence of myopia in children 0–2 years old who had slept in darkness, with a night light, room light, or hall light. Adults who were reported by their parents to have slept with a night light

on from 0–2 years of age were significantly more likely to be myopic than those who were reported to have slept from 0–2 years of age in any other lighting condition.

Czepita (8) after having examined 3377 students in the age between 6–19 years, observed that sleeping until the age of two with a room light turned on is associated with the occurrence of myopia. Czepita (9,10) also found that light emitted by fluorescent lamps is associated with the occurrence of astigmatism.

Some authors have suggested that the observed association between night lighting and myopia may be related to some extent to genetic factors (2-6).

Therefore, in our studies we decided to exclude all children with a positive family history of myopia in order to investigate if ambient lighting at night before the age of 2 years is associated with the occurrence of myopia in a large population of Polish children.

Material and methods

A total of 3905 schoolchildren were examined (1800 boys and 2105 girls, in the age 6–18 years, mean age 12.2, S.D. 3.3 years). The children examined, students of elementary and secondary schools, were Polish and resided in and around Szczecin, Poland. The students examined were Caucasian and there were no children of mixed ethnicity.

Participation was voluntary. Before beginning the examinations, the doctors met with the children, their parents or legal

guardians and teachers. It was explained what the examinations were about. The children, parents or legal guardians and teachers had an opportunity to discuss the study with the experimenters prior to giving consent. Informed consent was obtained in each case from children, parents or legal guardians and school principals. The studies were approved by the Bioethics Committee of the Pomeranian Medical Academy. The research protocol adhered to the provisions of the Declaration of Helsinki for research involving human subjects.

The examination included retinoscopy under cycloplegia. Cycloplegia was induced with two drops of 1% tropicamide administered 5 min apart. Thirty minutes after the last drop, pupil dilation and the presence of light reflex was evaluated as later retinoscopy was performed. Retinoscopy was performed in a dark room and all schoolchildren were examined by the same doctor (AM).

All refractive error readings were reported as a spherical equivalent (SE) (sphere power plus half negative cylinder power). Myopia was defined as a spherical equivalent (SE) (sphere power plus half negative cylinder power) of at least -0.50 dioptres (D). Mean refractive error of myopes was -1.1, S.D. 0.9. Children with medium and high hyperopia were not excluded from the studies. Distribution of refractive errors was not normal. Median = 0.000. Range = 16.50.

To eliminate the influence of genetic factors, only children with a negative family history of myopia have been examined.

Myopia/ Krótkowzroczność	No light/ Bez światła n (%)	Night lamp/ Lampa nocna n (%)	Television/ Telewizja n (%)	Room light Światło pokojowe n (%)	Total Razem n (%)
Absent/ Nieobecna	2659 (86.87)	589 (87.39)	117 (87.97)	30 (81.08)	3395 (86.94)
Present/ Obecna	402 (13.13)	85 (12.61)	16 (12.03)	7 (18.92)	510 (13.06)
Total/ Razem	3061 (100.00)	674 (100.00)	133 (100.00)	37 (100.00)	3905 (100.00)

Tab. I. Myopia and kind of night lighting.

Tab. I. Krótkowzroczność a rodzaj oświetlenia nocą.

Type of room/ Rodzaj pomieszczenia	Myopia/ Krótkowzroczność	Incandescent lamps/ Lampy żarowe n (%)	Fluorescent lamps/ Lampy fluorescencyjne n (%)	Total/ Razem n (%)
Living room/ Pokój dzienny	Absent/ Nieobecna	2725 (86.81)	26 (0.83)	2751 (87.64)
	Present/ Obecna	385 (12.27)	3 (0.10)	388 (12.36)
Child's room/ Pokój dziecięcy	Absent/ Nieobecna	2718 (86.62)	33 (1.05)	2751 (87.67)
	Present/ Obecna	383 (12.17)	5 (0.16)	387 (12.33)
Parent's bedroom/ Sypialnia rodziców	Absent/ Nieobecna	2723 (86.83)	26 (0.83)	2749 (87.66)
	Present/ Obecna	380 (12.12)	7 (0.22)	387 (12.34)
Kitchen/ Kuchnia	Absent/ Nieobecna	2563 (81.65)	188 (5.99)	2751 (87.64)
	Present/ Obecna	353 (11.25)	35 (1.12)	388 (12.36)
Bathroom/ Łazienka	Absent/ Nieobecna	2656 (84.64)	95 (3.03)	2751 (87.67)
	Present/ Obecna	377 (12.01)	10 (0.32)	387 (12.33)

Tab. II. Myopia and room lighting.

Tab. II. Krótkowzroczność a rodzaj oświetlenia nocą.

The parents of all students examined completed a questionnaire on the child's family eye history as well as the child's exposure to night lighting before the age of two. In the questionnaire the parents were asked: who in the child's family suffered from what kind of eye diseases, who in the child's family used to wear what kind of glasses, under which lighting conditions did the child sleep at night until the age of 2 years, which type of lighting (incandescent or fluorescent) was usually used in the living room, child's room, parent's bedroom, kitchen, bathroom until the age of 2 years? When nobody in the first and second degree relatives had myopia, then it was accepted that family history for myopia is negative. The questions in the questionnaire were of closed answers category.

Data analysis was performed using chi-squared Pearson test; p-values of <0.05 were considered statistically significant.

Results

In the performed investigations we have found that sleeping until the age of two with a room light turned on does not associate with the presence of myopia during school years ($p > 0.05$). Also, it was observed that sleeping until the age of two with a night lamp, television or room light turned on does not lead to development of myopia ($p > 0.05$) (Tab. I).

We also found no differences in the use of light emitted by incandescent or fluorescent lamps. In all examined rooms the prevalence of myopia was similar ($p > 0.05$) (Tab. II).

Discussion

In our study performed on a large population of Polish children with a negative family history of myopia we found that myopia is not associated with night light before age 2. Moreover, we found no association between sleeping in a room until the age of two with light emitted by incandescent or fluorescent lamps and myopia.

In experimental investigations it was observed that rearing chicks in continuous light produces a shallow anterior chamber, enlarges the eyeball, decreases the thickness of the cornea, sclera, retina, and choroidea, as well as induces extensive anatomical changes in the retina (11,12). It was shown by Boelen and Cottrill (13) that rearing chicks under 12: 12 h light: dim conditions suppressed the amplitude of diurnal cycling of dopaminergic activity. Those results were later confirmed by Liu (12). Studies on higher primates yielded different results. Smith (14) observed that in infant monkeys constant light exposure does not promote the constellation of ocular changes (in particular corneal flattening, a decrease in anterior chamber depth, and an increase in vitreous chamber depth), that has been observed in light-reared chickens. Besides that, he has determined that ambient lighting at night does not appear to overtly compromise the functional integrity of the vision-dependent mechanisms that regulate emmetropization in higher primates (15). Probably, in children night lighting may suppress dopaminergic activity with subsequently reduced release of dopamine and stimulation of eye growth. That is why it seems likely that disturbances in the daily light/dark cycle during the period of time when refraction is developing may disrupt emmetropization and lead to myopia.

Loman (16) described a greater progression of myopia among 23–44 years old law school students subjected to a longer exposition of light at night. A similar study carried out in Finnish conscripts by Vannas (17) disclosed that although myopia could not be associated with the month of birth, there was a general trend towards a higher prevalence of myopia among conscripts living north of the Arctic Circle. Those finding suggests that ambient lighting may produce refractive effects in children older than two years. The critical period for an influence of the light/dark cycle on refractive development, if it exists at all, is not of a duration measured in months.

Recently, Mandel (18) after examining Israeli conscripts found that moderate and severe myopia is associated with birth during summer months. Similar results were achieved by Mc-Mohan (19), who after examining adults from the United Kingdom determined that high myopia is associated with birth during summer or autumn rather than in winter months. The exact associating mechanism is not known but might be related to exposure to natural light during the early perinatal period.

Because both the restricted population and results differ from our previous positive associations (8,10), perhaps early light exposure and family history/genetics interact in influencing the occurrence of myopia. This may be the reason why sometimes this association appears and sometimes not.

Conclusions

Myopia is not associated with night light use before age of 2 in a population of Polish children with a negative family history of myopia. Because both the restricted population and results differ from our previous positive associations, perhaps early light exposure and family history/genetics interact in influencing the occurrence of myopia.

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