

Children's bedroom illumination while reading at night

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Conflict of interest declaration

Abel Szeps and Rafael Iribarren are consultants of NOVAR.

Abstract

Objective: This study aims to describe children's patterns of reading at night.

Methods: A questionnaire was developed as a google survey with 10 brief questions sent by email to a sample of 35,000 adult subjects who had attended two ophthalmic medical centers in Argentina. Questions included information on age, gender, whether the child had myopia or not, if the child read before going to bed, if there were one or two lights on while reading, and the type of house the child lived in (simple house, house with garden and high rise building).

Results: The sample consisted of 588 school aged children (mean age =10.9 ± 2.6 years; 51.7% males). The prevalence of "self-reported myopia", "no spectacle use (emmetropes)" and "spectacle use other than myopia" was 21.0%, 62.9% and 16.1% respectively. A large percentage of the children read at night in bed before sleeping (81.6%). In 31.7% of cases children read with lights off with only the light of the device, in 26.4% read with one light on, and in 18.0% of the cases read with two

lights on (23.8% answered that their children did not go to bed reading). Older age was the only variable associated with an increased odds of self-reported myopia (odds ratio: 1.16; 95% CIs 1.04, 1.29; $p=0.006$).

Conclusion: We found that most children go to bed reading at night in mesopic conditions under low illumination. This could be a risk factor for myopia development. Thus, further studies are necessary to explore this hypothesis.

Keywords: myopia, reading, illumination, ophthalmopediatrics, risk factors

Iluminación del dormitorio de los niños mientras leen por la noche

Resumen

Objetivo: Describir los patrones de lectura nocturna de los niños.

Métodos: Se elaboró un cuestionario mediante la herramienta del Formulario de Google con 10 preguntas breves, enviado por correo electrónico a una muestra de 35.000 sujetos adultos que habían acudido a dos centros médicos oftalmológicos de Argentina. Las preguntas incluían información sobre la edad, el sexo, si el niño tenía miopía o no, si el niño leía antes de acostarse, si había una o dos luces encendidas mientras leía y el tipo de casa en la que vivía el niño (casa sencilla, casa con jardín y edificio alto).

Resultados: La muestra consistió en 588 niños en edad escolar (edad media = $10,9 \pm 2,6$ años; 51,7% varones). La prevalencia de "miopía autodeclarada", "no uso de gafas (emétopes)" y "uso de gafas distinto de la miopía" fue del 21,0%, 62,9% y 16,1% respectivamente. Un gran porcentaje de los niños leía por la noche en la cama antes de dormir (81,6%). En el 31,7% de los casos los niños leían con las luces apagadas con sólo la luz del aparato; en el 26,4% leían con una luz encendida, y en el 18,0% de los casos leían con dos luces encendidas (el 23,8% contestó que sus hijos no se acostaban leyendo). La edad avanzada fue la única variable asociada a una mayor probabilidad de miopía autodeclarada (odds ratio: 1,16; IC 95%: 1,04; 1,29; $p=0,006$).

Conclusiones: Encontramos que la mayoría de los niños se acuesta a leer por la noche en condiciones

mesópicas bajo baja iluminación. Esto podría ser un factor de riesgo para el desarrollo de la miopía. Por lo tanto, son necesarios más estudios para explorar esta hipótesis.

Palabras clave: miopía, lectura, iluminación, oftalmopediatría, factores de riesgo.

Iluminação do quarto infantil durante a leitura à noite

Resumo

Objetivo: Descrever os padrões de leitura noturna das crianças.

Métodos: Foi desenvolvido um questionário utilizando a ferramenta Google Form com 10 perguntas curtas, enviado por e-mail a uma amostra de 35.000 sujeitos adultos que frequentaram dois centros médicos oftalmológicos na Argentina. As perguntas incluíam informações sobre idade, sexo, se a criança era míope ou não, se a criança lia antes de dormir, se uma ou duas luzes estavam acesas durante a leitura e o tipo de casa em que a criança morava (casa simples, casa com jardim e prédio alto).

Resultados: A amostra foi composta por 588 crianças em idade escolar (média de idade = $10,9 \pm 2,6$ anos; 51,7% do sexo masculino). A prevalência de "miopia autorreferida", "não uso de óculos (emétopes)" e "uso de óculos que não seja miopia" foi de 21,0%, 62,9% e 16,1%, respectivamente. Uma grande percentagem de crianças lê à noite, na cama, antes de dormir (81,6%). Em 31,7% dos casos, as crianças lêem com as luzes apagadas apenas com a luz do aparelho; Em 26,4% liam com uma luz acesa e em 18,0% dos casos liam com duas luzes acesas (23,8% responderam que os filhos não iam para a cama lendo). A idade avançada foi a única variável associada a maior probabilidade de miopia autorreferida (odds ratio: 1,16; IC 95%: 1,04; 1,29; $p=0,006$).

Conclusões: Descobrimos que a maioria das crianças vai para a cama para ler à noite em condições mesópicas e com pouca iluminação. Este poderia ser um fator de risco para o desenvolvimento de miopia. Portanto, mais estudos são necessários para explorar esta hipótese.

Palavras-chave: miopia, leitura, iluminação, oftalmologia pediátrica, fatores de risco.

Introduction

Myopia stands one of the more prevalent causes of visual disability in the emerging adult population aged 50 and over, with a peak prevalence at midlife, 25 years before age related macular degeneration which climbs after the age of 75¹. The main accepted risk factors for myopia are family history of myopia, early age of onset, heavy reading habits along with high academic achievement and environmental light exposure². Going to bed late was also associated with myopia progression in one study³.

Outdoor exposure to bright light helps preventing myopia onset⁴⁻⁶. Many studies have followed the discovery in 2005 that mean refractive error was related to outdoor exposure in the Sydney Myopia Study⁷. But indoor light intensity has also been shown to affect emmetropization in kindergarten children before they begin reading⁸. A study in China has shown that increasing illumination from 200 to 500 lux in classrooms decreases myopia progression in children⁹. Cohen in 2010 found that chicks growing in low light of 50 lux (near the upper limit for mesopic vision) develop myopia in 3 months' time with no spectacle or form deprivation intervention¹⁰.

Special defocus spectacles have recently shown choroidal thickening while reading with room lights on¹¹. This choroidal thickening is in line with an effect on decreasing eye growth and arresting myopia progression. Further experiments testing choroidal thickening with lights off, under mesopic conditions, showed that choroidal response was abolished¹². Those results may suggest that reading at night with lights off may prevent the eye to recognize the STOP grow signal which has less sensitivity under low illumination¹². Thus it seems important to further research on which are children's habits at night, especially reading with low illumination. As reading at night in dim lights could be a risk factor for myopia, this study aims to describe children's patterns of reading at night, and characteristics of the room illumination.

Materials and methods

A questionnaire was developed as a google forms survey with 10 brief questions sent by email to a sample of 35,000 adult subjects who had attended in the past years two ophthalmic medical centers, Drs. Iribarren Eye Consultants (downtown of Buenos Aires City) and Quilmes Ophthalmological Center (outer Buenos Aires), for different ocular complaints. The emails were gathered as part of demographic data at first visit of every adult subject attending the medical centers involved in the study. In both polyvalent centers, adults and their children are attended systematically. Every child that is attended at the two institutions has a complete ocular and visual examination including cycloplegic refraction. Myopia is a well-known disease in our 97% literate population which has a 15% to 30% prevalence in adults in this country.

The questionnaire included a brief explanation of the anonymous status and suggested answering the survey in case the adult subject had children between ages 7 and 15 years. The lower limit was seven years because children begin to read at those ages in Argentina. In this 97% literate population, when a child is diagnosed with myopia the parents are given verbal information that "the child has myopia", thus making possible to ask the population whether the child had myopia or not.

The questionnaire was delivered only once for each patient during the month of March 2024, and data were gathered in an excel table. A parent could answer the survey as many times as children he or she had. This can be then considered an unselected sample of data of schoolchildren from general ophthalmological attention centers. The survey did not collect other demographic data except age and gender. The Ethics Committee of the Argentine Council of Ophthalmology was consulted for this type of study stating that for studies based on population surveys with no intervention and anonymity the ethical approval was waived.

Questions included information on whether the child had myopia or not, if the child read

before going to bed and how much time the task involved, if there were one or two lights on while reading, how many days per week was this done, if the child preferred books or cellphones and the type of house the child lived in (simple house, house with garden and high rise building). The complete survey can be seen in the Appendix I (translated from the original in Spanish). Answer options included multiple choice or free text.

The google docs form was exported to an excel table. Text data were converted to code numbers. The statistical analysis was performed with SPSS (version 15). Numeric variables such as age were expressed as means, medians and standard deviation (SD). Age was converted by using the mean value to binary with a cut point at 12 years. Discrete variables were expressed as percentages. The reading habits of the group referring to have myopia was compared with the reading habits of the group which did not use spectacles at all (probably emmetropes or low hyperopes). Logistic regression analysis was performed for myopia —non-myopia versus myopia as the binary dependent variable and all the other independent variables were included in the model controlling for age and gender—. A *p* value < 0.05 was considered significant.

Results

The sample consisted of 588 school aged children. The mean age was 10.9 ± 2.6 years and 51.7% were males. The prevalence of “self-reported myopia”, “no spectacle use (emmetropes)” and “spectacle use other than myopia” was 21.0%, 16.1% and 62.9% respectively. A large percentage of the children read at night in bed before sleeping (81.6%). In 31.7% of cases children read with lights off with only the light of the device, in 26.4% read with one light on, and in 18.0% of the cases read with two lights on (23.8% answered that their children did not go to bed reading). Of the 364 subjects that answered the question of how long did their children stay in the room reading, 42.6% said that it was less than 30 minutes. However, 27.7% said that this habit lasted for two hours or more. Out of the 429 that answered

the question of frequency of this habit in week-days, 47.3% said that this happened all days. Cellphones or tablets were preferred in 53.4% of cases compared to 31.1% for books and the rest of the children alternated between both books and cellphones. Of the 100 children who read at night for two hours or more, 77.0% preferred cellphones or tablets, while only 8.0% preferred books and the rest alternated both ($p < 0.001$); these figures were reversed when those who read up to 30 minutes or less (data not shown). High rise buildings were the home of 20.0% of subjects, while houses with gardens were of 45.4% of the cases, and the rest were houses without gardens.

For the binary logistic regression analysis only two groups were considered: myopes versus emmetropes. Older age was the only variable associated with an increased odds of self-reported myopia (odds ratio: 1.16; 95% CIs 1.04, 1.29; $p = 0.006$).

Discussion

This study shows that reading with low lights is a usual habit of the new generation of children. To our knowledge this habit has not been explored in myopia research trials. Recent research on myopia shows that illumination is crucial on how the retina perceives the balance between ON and OFF contrast¹³⁻¹⁴. And this mechanism could in turn affect emmetropization, as it seems that under low lights in mesopic conditions the retina does not perceive accurately the ON contrast that stops the eye from growing¹⁵⁻¹⁶. Interestingly, a previous study used objective measurements of light and found that myopic children were less time in the dark during the last hours of the day and suggested that not being in the dark could be a risk for myopia¹⁷. However, myopic children spent more time than the emmetropic peers under mesopic conditions¹⁷, perhaps showing that myopic children go to bed reading while emmetropic children turn-off their lights and not read.

It has been shown that bright light prevents myopia progression when applied in the last hours of the day but not in the morning or at midday¹⁸, and that myopic defocus is most effec-

tive in the afternoon than in the morning¹⁹. It is probable that what children do in the last two hours before sleep could be related to myopia onset and progression. That is probably because the retino choroidal signal for ocular growth may be present during the whole day, but as the eye grows more during the night²⁰, the signal sent in the last hours of the day may be more important for ocular growth than that from the morning. Thus, our group will continue to explore this hypothesis. It would also be interesting to explore the spectral composition of lights used by children at home, although it is known that by law all illumination in our country has changed to led several years ago.

There are several limitations of this short report. The questionnaire was not validated, and it is subject to recall-bias. In addition, myopia was self-reported. The study recruited a convenience sample that is not necessarily population based. Nevertheless, the gender distribution coincides with the 50.8% prevalence of males in the 7-14 years in the general population of Argentina according to the last census²¹. The rates of self-reported myopia prevalence around 20% of the sample also shows a similar distribution as previous populations studies in the country²²⁻²⁴.

Conclusions

We found that most children go to bed reading at night, and that perhaps 50% of them do it in mesopic conditions under low illumination. This habit could be a non-explored risk factor for myopia. Thus, further studies are necessary to explore the hypothesis that this habit could be a risk factor for myopia development.

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Appendix

Do children go to sleep reading?

This is an anonymous survey to find out if your school-aged children 7-15 years old go to sleep reading. Please complete the voluntary survey once for each of your children. Your data will be treated anonymously as at no time will the form ask for the names of your children. Thank you very much for your cooperation. These are just a few short questions for each child in your care.

1. **How old is your child (between the ages of 7 and 15)?**
2. **What is the gender of your son/daughter?**
 - BOY
 - GIRL
3. **Does your child wear glasses for nearsightedness?**
 - Yes, wears glasses for nearsightedness
 - No, does not wear glasses
 - Wears glasses, but does not have myopia.
4. **At what age did your child get his/her first pair of glasses?**

5. **Does your child go to sleep at night with books, tablets or mobile phone?**
 YES
 NO
6. **If your child stays up at night reading, does he do it with the light on in the room, or with the light off?**
 Goes to bed to read with only the light of a bedside table on
 Reads with the central light of the room on and the bedside table also
 Read in the dark with the light of a tablet or mobile phone
 Does not stay up at night Reading
7. **If your child goes to sleep reading, how long does it take before he/she falls asleep (if not reading at night, leave blank)?**
8. **If your child goes to bed reading, how many times a week does he/she read? If he/she does not read at night, leave blank**
 Once or twice a week
 Four or five days a week
 Every day of the week
9. **What is your child's preference (if he/she does not read at night, leave blank)?**
 Paper books
 Mobile phone or tablet
 Alternates both
10. **Finally, how is your house?**
 House with terrace
 House with a garden
 High rise building