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The impact of computer use in myopia progression: A cohort study in Spain

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ABSTRACT

Objective. Many subjects, especially highly educated subjects, are increasingly exposed to computer use. This exposure might represent an explanation for the growing rates of myopia.

Methods. We assessed 17,217 Spanish university graduates from the SUN project, an open-recruitment cohort. Their mean age was 38.5 years (SD 12.1), and their mean time of exposure to computers was 14.3 h/week (SD 14.6). We estimated multivariable-adjusted odds ratios (OR) for the risk of myopia development and/or progression (≥0.5 diopters) according to baseline exposure to computer and to changes in exposure.

Results. The age and sex-adjusted OR comparing > *40 h/week of exposure* versus < 10 h/week was 1.34 (95% confidence interval (CI): 1.12–1.60). This association remained essentially unchanged after additional adjustments. Comparing participants who increased their exposure to computers, versus those with no change, the age and sex-adjusted OR was 1.49 (1.34–1.66). This result was unchanged after additional adjustments.

Conclusions. To our knowledge this is the first large longitudinal assessment in young adults, showing that exposure to computer use is associated with myopia development or progression in a cohort of Spanish university graduates. Further studies are needed to confirm these epidemiological findings.

Introduction

Refractive status is determined by the balance of the axial length of the eye and the optical power of the cornea and the lens (Saw et al., 1996; Morgan et al., 2012). Myopia is the most common refractive error among young adults (Konstantopoulos et al., 2008a) and in the past decades, its prevalence has increased (Morgan et al., 2012), with huge social, educational, and economic consequences (Morgan et al., 2012), including the high costs of optometric correction (Saw et al., 2000). Also some patients operated with refractive surgery are developing new refractive defects after the surgery (Sayegh, 2009). Therefore, there is a need to identify preventable risk factors for myopia.

Near work, such as close reading distance (<30 cm), may represent a preventable causal factor for myopia development and its progression, because of the excess of accommodation of the lens, and because of its possible influence on the growth of the axial diameter of the eye (Morgan et al., 2012), but despite the biological plausibility for this association, previous studies are not conclusive. Epidemiological studies conducted in the late 1970s concluded that near work accounted only for a negligible fraction of myopia cases (Konstantopoulos et al., 2008a; Saw et al., 2000; Mutti et al., 2002; Rah et al., 2001) or that there were doubts on the association between near work and myopia (Lu et al., 2009). The current available evidence does not resolve whether or not near work is a risk factor for myopia development.

In the last decades the exposure to display screen equipments (DSE) has increased, especially because of a massive occupational use of computers. It is conceivable that this almost universal and extensive exposure might represent a powerful risk factor for the development or progression of myopia and might have contributed to its rising prevalence.

The aim of our study was to investigate the association between exposure to DSE or computer use and the risk of myopia development and/or progression in an extensive cohort of Spanish university graduates.

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Subjects and methods

Study population

The SUN Project [Seguimiento Universidad de Navarra, University of Navarra Follow-up] is a prospective cohort study, formed by Spanish university graduates. The objectives, design and methods of the SUN study have been previously published (Seguí-Gómez et al., 2006; Martínez-González et al., 2002). Briefly, the cohort began in December 1999 and the recruitment of participants is permanently open (constantly including new participants). Information is gathered biennially by mailed questionnaires. Participants of all ages may be included in the SUN cohort, but they must have university studies. Thus, a better control of confounding by education-related variables is achieved, which makes the interpretation of results easier and adds validity to the high-quality information derived from their questionnaires.

Among participants recruited for the cohort who responded to the baseline questionnaire (Q0 or questionnaire at inclusion) before March 2008 (n = 19,581), 2306 were lost to follow-up (88.2% retention rate) and 58 did not answer to the question about changes in myopia, so we included 17,217 participants with 2-year follow-up information about myopia development and/or progression (Fig. 1). The median follow-up time between baseline and the reception of the 2-year follow-up assessment (Q2 or questionnaire for 2-year follow-up) was 2.33 years (mean = 2.55, SD: 0.88).

The Institutional Review Board of the University of Navarra approved the study and voluntary completion of the first questionnaire (Q0) was considered to imply informed consent.

Assessment of exposure to computers

Exposure to DSE was assessed by a questionnaire inquiring about the number of hours of exposure to computer use during a typical week day and during a typical weekend day. These questions had thirteen possible responses, ranging from 'never' to '9 or more hours/day'. We calculated the average time of exposure to computers per week at baseline multiplying the use in a workday by 5 and the use in a weekend day by 2, and adding them up.

Participants were classified into the following five categories according to their typical time of computer use: <10 h/week, 10 to <20 h/week, 20 to <30 h/week, 30 to <40 h/week and 40 or more hours per week. Questionnaires also inquired about changes in computer use.

We built a combined score of baseline exposure to computers during the whole week (in the same five categories) and changes in use during the follow-up period (categorized in 2 groups: participants who reduced or maintained constant their typical time of exposure, and those who increased their exposure). Therefore, we obtained 10 categories of cross-stratified exposure to baseline weekly use and changes in use. We considered the lowest category those participants with the lowest baseline use (<10 h/wk) who did not increase their time of using DSE as the reference category. We estimated adjusted ORs for the other nine categories.

Assessment of other variables

The baseline questionnaire also collected information on sociodemographic variables including marital status, anthropometric characteristics, such as body mass index (BMI), lifestyle and health related habits, including smoking, alcohol intake, sleeping behaviour, time of television watching leisure-time, physical activities or sports.

Assessment of the outcome

The follow-up questionnaires included the following question: *Have you been diagnosed by a medical doctor of new-onset myopia or a progression of 0.5 or more diopters in myopia, since the last questionnaire you filled in?*

Participants who responded affirmatively to this question on Q2 were considered as incident cases. When the participant left this question missing, we used his answer to this same question in the 4-year follow-up questionnaire (Questionnaire for 4-year follow-up, or Q4) (766 participants). If this question was also missing in the Q4 we used the participants' answers to a short questionnaire (a shorter version of the follow-up questionnaires only used when participants, after several reminders, do not answer to the full-length follow up questionnaires). In all questionnaires (Q2, Q4 and short questionnaire) the question was exactly the same.

Statistical analysis

We used logistic regression models to assess the relationship between myopia progression and time of exposure to computers, after adjusting for potential confounding. We estimated multivariable-adjusted odds ratios (ORs) and their 95% confidence intervals (CIs) for the risk of myopia development and/or progression (≥0.5 diopters) according to baseline exposure to DSE and to changes in exposure. We assessed two different exposures: 1) time of exposure at baseline during a typical week and 2) increased exposure from baseline to 2-year follow-up. We considered the category "<10 h/week" as the reference category for the first exposure; and "no change" as the reference category for the second exposure.

To assess the association for the joint exposure to baseline computer exposure and changes in exposure during follow-up, we made 10 categories and estimated 9 ORs using the lowest exposure (<10 h/week and reduced/maintained exposure) as the reference category.

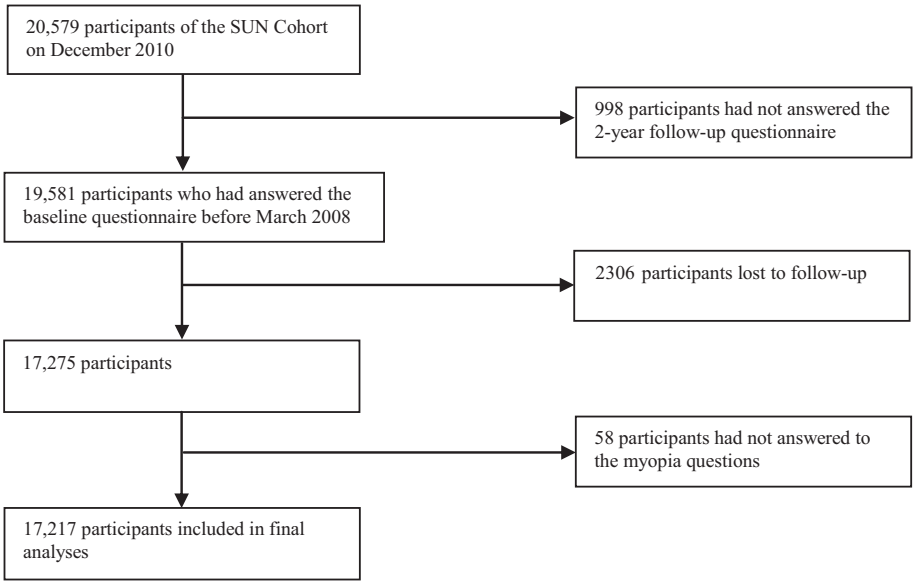

Fig. 1. Flowchart of study participants.