

EFFECT OF VISUAL IMPAIRMENTS ON ACADEMIC PERFORMANCE

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Many teens underestimate their visual discomfort even though it can have an impact on their academic performance. The prevalence of visual impairments among 400 participants between the ages of 15 and 22 (average age 17.4) was studied and findings were compared to participants' academic standing.

INTRODUCTION

Vision is a complex phenomenon that to be effective requires all organic components involved to be intact. In the first few years of life, the eye develops to capture the best optical image possible, hinging on three components: the axial length of the eye, the refractive power of the cornea (transparent surface in front of the iris), and the refractive power of the crystalline lens (internal lens of the eye). Any imbalance between these three elements will cause a refractive disorder, or ametropia. Whether symptoms develop or not will depend on the type and scope of the refractive disorder (myopia, hyperopia or astigmatism). Corrections of ametropia aim merely to reestablish emmetropization and to reduce the symptoms of visual confusion or dysfunction [1-4]. The eyeball is contained in the eye socket, which also houses the six extraocular muscles. The extraocular muscles grant mobility to the eyeball and enable the fixation mechanism that contributes to normal binocular vision. A relationship exists between accommodation, the process by which the eye focuses on an object, and convergence, the process that merges the retinal images of the right and left eyes[4-10].

Vision-related symptoms can be caused by: inadequate optical correction, binocular vision anomalies, anomalies in accommodation, or the prolonged use of vision in conditions of stress and/or poor ergonomics [11].

BACKGROUND

Schools are finding it increasingly difficult to ensure the academic achievement of all students. And yet, the role of schools is to ensure that all students succeed and can reach the highest possible level of skill in their chosen track. Learning difficulties affect academic performance, can lead to academic failure, and are experienced by the student as a wound that affects their self-esteem, according them negative status in school and, as a result, society, whereas school is supposed to be a place for positive development and growth. This is all the more true for teens that are searching for their identity and place in society, and for those living in disadvantaged socio-economic conditions. Furthermore, with entry onto the job market coming at an increasingly later age, the key role that schools play in a teenager's life extends over an even longer period of time [12]. As such, any cause of learning difficulties delays the assimilation of knowledge, affects academic performance, decreases job opportunities, and creates social adjustment issues [13-16]. Furthermore, recent studies confirm that adequate management of refractive disorders could have a positive impact on quality of life [17-20] and could be economically beneficial in all regions of the world [21]. Management of visual impairments is a key public health issue [22-23].

In France, “despite the availability of individual screening from birth to age six for physical, cognitive, neurosensory and behavioral development and for integration in school, social and family life, no systematic monitoring between the ages of 6 and 18 exists” [24, p 163-164]. Any damage to full development of the visual system after the ages of 6 to 8 no longer being critical in nature [4], screening after that age is no longer mandatory, but advised. As studies become more intense, however, symptoms of visual problems may appear, since the demands on one's vision increase [25-26].

Since 2009, the Committee on Children with Disabilities, American Academy of Pediatrics, American Academy of Ophthalmology and American Association for Pediatric Ophthalmology and Strabismus have recognized that “vision problems can interfere with the learning process” [27, p. 837]. Prior research suggests that when visual impairments are present, an individual can become fatigued more quickly and/or have more difficulty focusing on a given task, and that any deficiency in reading, writing and spelling tasks has a negative impact on academic growth, the result being a handicap in one's chances for success. When a student's academic performance is poor, however, and particularly if the student does not complain of visual discomfort, attributing the student's difficulties to vision problems does

not come to mind. Moreover, despite the preponderance of research supporting the idea that visual function plays a significant role in academic performance, the exact nature of the relationship between untreated visual impairments and academic performance remains a controversial subject.

CONTROVERSY

The relationship between visual impairments and academic performance is a controversial subject, some research suggesting that vision does not affect reading skills [28-29] and that there are not enough indicators of academic performance in these studies [30-31]. In addition, experimental protocols (selection of tests, data collection and control population) vary too widely from one study to the next [30]. Furthermore, the vast majority of research focuses on children from birth to the age of sixteen [30-31].

PURPOSE

Given the preceding observations, the purpose of this research was to test the hypothesis according to which unscreened visual impairments might have an impact on the academic performance of young adults between the ages of 15 and 22. This study therefore primarily targets academic performance while taking into account factors recognized for their negative impact on academic performance. The first phase of the study focused on accurately assessing the presence of visual impairments among the target population. In the second phase, academic performance was appraised among two population groups: one group presenting untreated visual impairments and a second group presenting no such deficiencies. The third phase of the study looked at the academic performance of the two population groups referred for ophthalmological exams: the group that adopted corrective measures and the group that did not. The purpose of the study was therefore to determine, from the data collected, which individual characteristics or vision problems were most likely to have an impact on academic performance.

METHODOLOGY

From September 2012 to April 2013, 400 volunteers between the ages of 15 and 22, who had never before participated in a protocol of this type, responded to a visual symptoms questionnaire (VSQ) and subsequently received a vision exam (refraction and binocular vision) for detection of visual disturbances of which they may not have been spontaneously

aware. When persistent vision problems were detected, participants were invited to receive an ophthalmological examination and an orthoptic examination. The academic standing of these 400 young adults was then appraised. The subjects were then reviewed to determine if specific corrective lenses and/or orthoptic therapy had allowed for improvement in academic performance.

The validity of the vision-screening questionnaire (VSQ) was tested and verified against three models: the questionnaire as a whole, the questionnaire in its tercile form, and the questionnaire as split by hierarchical agglomerative clustering (HAC) into three sub-scores according to symptoms. The coherence and complementarity of the questionnaire's components were validated via two methods: KMO (Kaiser-Meyer-Olkin) and Cronbach's Alpha [32].

Next, and prior to planning a more complex study, any links between academic performance and the control variables collected were assessed via bivariate analysis. The data were then analyzed via methods arising from multidimensional and explanatory approaches conducted via STATA 12.1. The nature and effect of visual impairments on academic performance were then tested, as was, subsequently, the impact of corrective measures (eyeglasses and/or orthoptic therapy).

RESULTS

The results presented were drawn from analysis of the responses from the 400 participants aged 15 to 22, all matriculated at three high schools in the same sector of Paris. The data were collected between September 2012 and January 2014.

Among the participants, significant links between the presence of visual impairments and poor academic performance were found in the two types of analysis, bivariate and multivariate. Bivariate analysis showed a direct link between visual impairments and the quality of academic performance ($p < 0.01$). The methods arising from multidimensional and explanatory approaches resonated in terms of primary effect, were more complex, and, based on three models of the VSQ, showed the probability of visual impairments having an impact on academic performance (*see figure 1*). Analysis of the data furthermore showed that a lack of preventive measures (regular consultations) among the participants had a negative effect on academic performance ($p < 0.05$) and that the adoption of corrective measures had a positive

impact on academic achievement. Among participants, the probability of learning difficulties increased in the presence of refractive impairments and accommodation anomalies, and even further when binocular vision anomalies were present. Likewise, where participants did not have regular consultations (preventive screening measure for visual impairments), the probability of learning difficulties increased. Furthermore, the adoption of corrective measures improved visual comfort, and corrective lenses had a statistically positive impact on participants' academic performance (*see figure 1*).

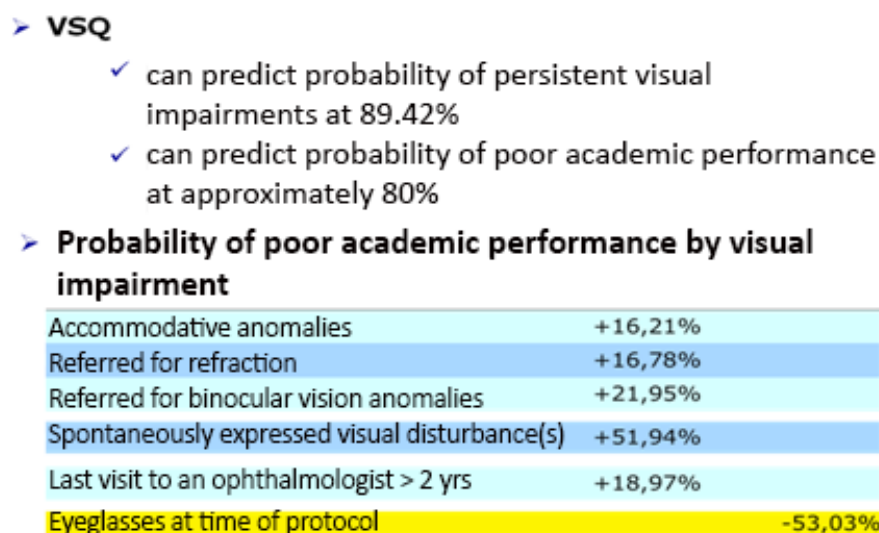


Figure 1 Visual impairments and vision-screening questionnaire vs. academic performance

Among the sample tested, however, the presence of persistent visual impairments (86.5% of participants) did not correlate to spontaneous expression of visual disturbances (24.3% of participants). In addition, a minority of participants were referred for refractive disorders (*see figure 2*); systematic research of binocular vision disorders should therefore be explored. Improvement in visual acuity is not sufficient to determine the need for optical correction [33, 35]. Ametropias, even slight, can be responsible for accommodative and binocular dysfunctions, and in such cases can be corrected [34-35]. Consequently, despite the participant selection bias (75.8% of participants with learning difficulties and 86.5% presenting persistent visual impairments), this original research, which in its statistical analysis included data on academic performance, the primary variable of the study, corroborates the results of prior research, i.e., that the presence of uncorrected visual impairments has a negative impact on academic performance [16, 31, 35-51] and that visual disturbances are generally minimized [52]. The young adults who participated in this study

neglected warning signs of visual impairments and minimized their visual disturbances despite these having effects on their academic performance (*see figure 3*).

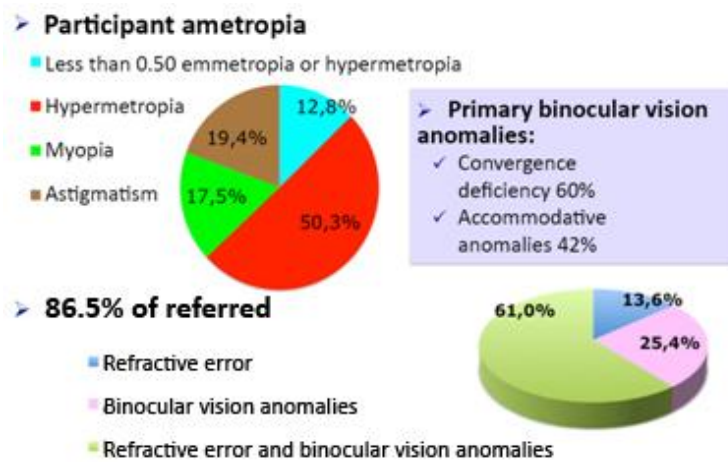


Figure 2 Visual impairments

➤ **Significant differences between adequate academic performance & weak academic performance**

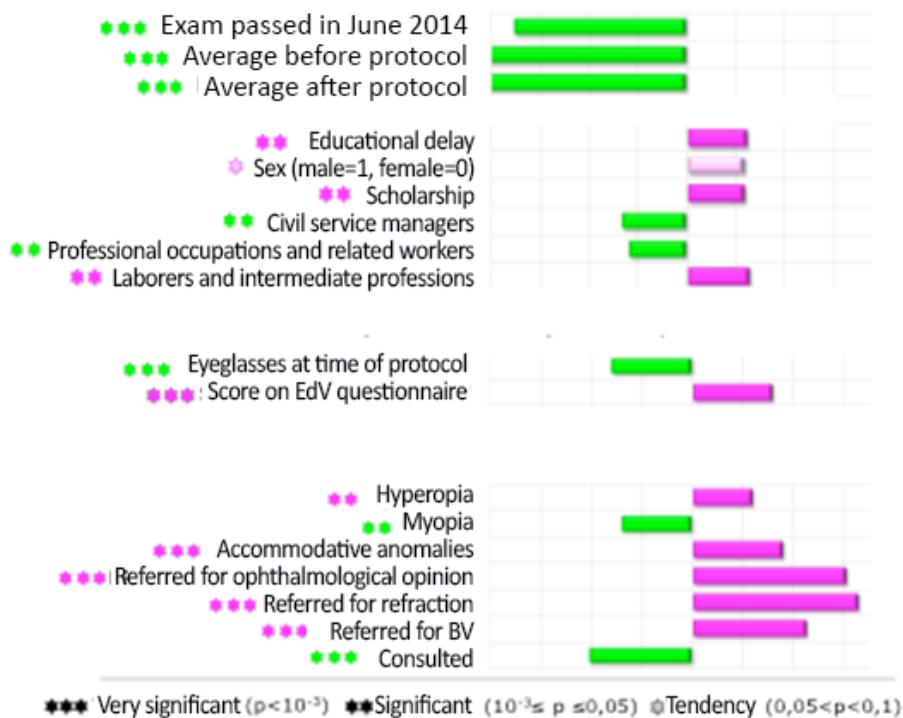


Figure 3 Significant differences between the two participant populations, those presenting learning difficulties (75.8%) and those not presenting learning difficulties (24.2%).

Better care management requires knowledge and that information be distributed to all [31, 36, 39, 53]. Reading and writing skills must be adjusted to the requirements of everyday life [54]. The vision of students must be clear, straightforward and comfortable for each of the tasks they will be asked to complete and to study in the best possible conditions [33, 55]. Diagnosis of a visual learning impairment should be comprehensive and multidisciplinary [40, 56] and performed in conjunction with parents to improve chances for improvement. Consequently, when academic performance is poor, an in-depth and systematic visual examination appears necessary [16, 31, 35, 38, 39, 41, 42, 44, 46, 47, 49- 51, 57- 59]. The use of an adjusted questionnaire could improve management of these impairments [60, 61].

There is consensus around the fact that poor academic performance is the consequence of multifactorial disturbances [62, 63], among which many factors surpass a purely academic framework [13-15, 62-100]. Once controlled for variables generally used to explain academic performance, then (age or educational delay, sex, education track, social sector, conditions in which homework is done, history of having consulted a speech pathologist, smoking or drug use), visual impairments do have an impact on academic performance, as does the absence of regular vision screening. Furthermore, the adoption of corrective measures improves visual comfort and has a statistically positive impact on participants' performance on end-of-year exams ($p < 0.01$).

CONCLUSION

The results of this study confirm the usefulness of in-depth and systematic oculo-visual exams (refraction, binocular vision and accommodative function) throughout one's schooling, as well as the positive impact of adopting corrective measures. Learning difficulties are multi-factorial; to best help students that are struggling, all factors should be taken into consideration. Furthermore, to assess the impact that visual impairments have on academic performance, it was necessary to use a questionnaire bringing together the symptoms related to visual impairments and to adapt the questions to a school-based population. The questionnaire proved to be a predicative tool of the quality of academic performance, the presence of visual impairments and the need for vision screening. Study of the VSQ continues, so that it can become a recommended monitoring tool that could be administered by all professionals in charge of children or teens.

Keywords: academic achievement, academic performance, academic results, learning problems, academic failure, vision anomalies, visual impairments, refraction, accommodation, binocular vision, vision screening.

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