

# Visual acuity evaluation in children of the elementary school of Curitiba

## *Relação entre acuidade visual e condições de trabalho escolar em crianças de um colégio do ensino fundamental público de Curitiba*

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### ABSTRACT

**Purpose:** Verify the rate of non-detectable low visual acuity (VA) in a public school of Curitiba and evaluate the relation between vision reduced, learning and study condition. **Methods:** Snellen visual acuity testing was done to all students from first to third grades at a Municipal School of Curitiba. Classroom's length and light intensity were obtained as well as the size of blackboard and books' letters. Academic scores were obtained from all students with VA equal or less than 20/30OU. **Results:** Of all 242 students, 225 presented VA equal or better than 20/25, and 17 (7.03%) equal or worse than 20/30. One of those 17 students study on the last row of chairs and had a low school performance. The light intensity was within the rules of NBR – 5413. Besides that, the letter of blackboard corresponds to 20/200 in Snellen VA test, and the book's letters corresponds to J3 in Jaeger near VA test. **Conclusion:** The school presented good conditions and structure for schoolwork. However, learning and good condition of studying could be related. In addition to a screening of VA, schools must be mindful of the conditions necessary for good schoolwork.

**Keywords:** Visual acuity; Children; Schools; Learning; Educational measurement

### RESUMO

**Objetivo:** Observar o nível de acuidade visual (AV) de estudantes do ensino fundamental público de Curitiba, bem como avaliar a relação entre redução visual, aprendizado e as condições estruturais de estudo. **Métodos:** Medida da AV dos alunos de primeira a terceira série de uma escola pública de Curitiba pelo método de Snellen, medição do comprimento e intensidade luminosa das salas, além do tamanho das letras no quadro negro e dos livros didáticos. Obtenção do boletim escolar dos alunos com baixa visão. **Resultados:** Das 242 crianças examinadas, 225 (92,97%) apresentaram acuidade visual boa, ou seja, AV 20/20 ou 20/25 em ambos os olhos, e 17 (7,03%) apresentaram AV igual ou pior que 20/30. Desses 17, somente um sentava na última linha de carteiras, o qual era o único que apresentava notas abaixo da média; todos os outros 16 tiveram notas na média escolar. A iluminação das salas de aulas estavam todas dentro do preconizado pelo NBR-5413. O tamanho da letra usada pela professora no quadro negro corresponde a 20/200 da tabela de Snellen, e no livro ao que corresponde J3 da tabela de Jaeger. **Conclusão:** A escola fornece condições e estrutura adequadas para o aproveitamento pleno dos alunos. Pode-se relacionar aprendizado com boas condições de trabalho escolar. Sendo assim, além de uma triagem da AV, as escolas devem estar atentas as condições estruturais necessárias para um bom trabalho escolar.

**Descritores:** Acuidade visual; Crianças; Instituições acadêmicas; Aprendizagem; Avaliação educacional

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## INTRODUCTION

A census performed in 2000 by the Brazilian Institute of Geography and Statistics (IBGE) showed that about 16.5 million people had some type of visual disorder in Brazil — almost 10% of the population at the time. Of these, 20-30% were children<sup>(1)</sup>.

Based on data by the Ministry of Education, about 5.8 million children are currently enrolled in the first year of education in Brazilian public (state) schools. An estimated 10% of them need eye glasses, while 10% present other eye disorders<sup>(2)</sup>.

Around 80-85% of the learning process is known to depend on vision, and low visual acuity can affect several areas of child development related to skills mediated by vision<sup>(3)</sup>. Untreated visual impairment affects not only school performance, but also social behaviour. Furthermore, it can lead to work accidents, producing a significant socio-economic burden to the country.

Identifying learning difficulties in the school environment is not easy and often requires a multidisciplinary team. The incidence of learning deficits among children in various countries is around 10-16%. In the United States, 15% of children have school difficulties during elementary education, but in Brazil there are no studies reporting a precise figure<sup>(4)</sup>.

Several factors can affect learning, of which the most significant are sensory, intellectual and emotional disabilities. After the problem is identified, children are often sent to special learning programmes<sup>(5)</sup>.

When visual impairment affects learning, optical and non-optical methods should be used to improve visual function. Optical methods include ophthalmic treatment based on the specific needs of the person. However, non-optical methods can be implemented on a more general basis, improving conditions for all persons in an environment. In a classroom, factors to be considered include the font size of teaching materials, lighting conditions, and the distance from the desks to the blackboard and the teacher<sup>(6)</sup>.

Several papers deal with techniques to work with the residual visual function of visually-impaired people, thus significantly improving their quality of life even if the impairment is not corrected<sup>(7)</sup>. However, few studies approach the school work conditions of children with visual acuity deficits but without severe visual impairment.

This study was motivated by the fact that education is essential for a child's intellectual, social and cultural development; therefore, schools should provide adequate structures and conditions for pupils to achieve their full potential.

### **Objective**

To assess the visual acuity (VA) of elementary-school children in public schools of Curitiba and to examine the relationship between learning, visual impairment and the structural conditions offered by schools.

## METHODS

The study was conducted during a single school day among pupils in grades 1-3 of elementary education at Anita Merhy Gaertner School, which is part of the municipal education network of Curitiba. Pupils who did not attend class on the day of the study or who did not provide their parent's informed consent were not included in the study.

The study had been previously approved by the Research Ethics Committee of Positivo University under file number 152/2006, and parents or caretakers were asked to provide their free and informed consent. The school management also consented to the study.

The study was conducted under direct supervision by an ophthalmologist, which allowed researchers to measure visual acuity.

Visual acuity was measured separately in each eye using the Snellen chart in a large and well-lit room. Each child was positioned 6 metres away from the chart, and corrected visual acuity was measured in children who wore glasses. The researchers recorded the last line in the chart read without difficulty, i.e. the best VA for each eye.

In order to examine the relationship between learning, visual impairment, and the structural learning conditions offered by the school, only pupils with a VA worse than 20/30 in both eyes were assessed. The parents of these children were noticed and referred to a clinic of the Brazilian public health system for specialist assessment and adequate treatment when necessary. The school performance of pupils was assessed based on their grades, A, B, or C, where A indicates a performance above 80%, B indicates a performance above 60% (the minimum passing grade), and C indicates that the pupil did not achieve the minimum passing grade and a student evaluation board would decide whether he/she passed or failed the school year.

The position of each child relative to the blackboard and the teacher was assessed based on the row where they were seated.

Lighting conditions were assessed with an Instrutherm LD 300 light meter. Rooms with an average of 500 lux were considered appropriate as determined by NBR 5413 (a Brazilian standard establishing the minimum average lighting conditions in artificially-lit working areas), while those below 250 lux or above 750 lux were considered inappropriate<sup>(8)</sup>.

The size of a teacher's handwriting on the blackboard was considered appropriate when it reached the smallest angle of vision equal to or greater than that corresponding to 20/30 in the Snellen chart, or J3 in the Jaeger chart in the case of textbooks.

## RESULTS

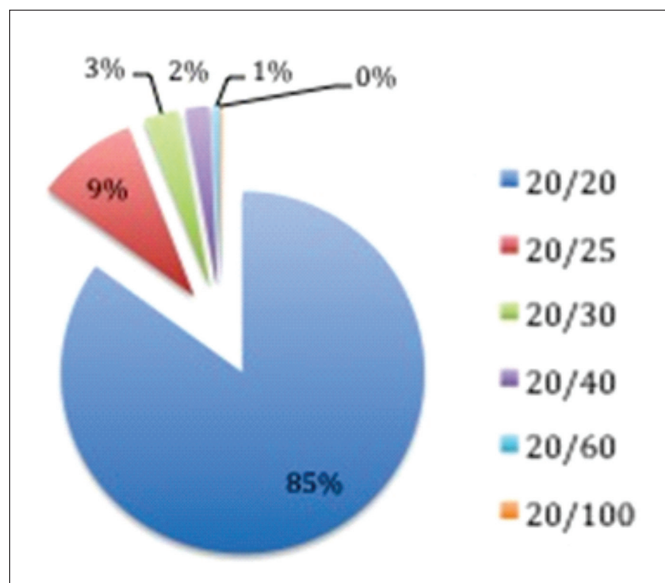
A total of 242 children were examined, with a mean age of  $8 \pm 1.20$  years. Of these, 134 (55.37%) were female and 108 (44.63%) were male. Seventy-nine pupils were in the first grade, 84 in the second grade, and 79 in the third grade of elementary education.

In total, 225 (92.97%) children had good visual acuity, i.e. 20/20 or 20/25 in both eyes. The number of children with a vision of 20/30 or worse was 17 (7.03%), and none of them used optical correction. Also, none of them had ever undergone ophthalmic evaluation.

Analysing both eyes separately, of the 484 eyes included in the study, 412 (85%) had a VA of 20/20, 44 had 20/25, 15 had 20/30, and 10 had 20/40. Only 2 eyes had a VA of 20/60, and one had 20/100. No pupils had a VA of 20/80 or 20/200 (Figure 1).

Among the 17 children with VA equal to or worse than 20/30, only one had not achieved the minimum passing grade.

As regards their position in the classroom, 7 children were seated on the first row, 4 on the second, 4 on the third, 1 on the fourth, and 1 on the fifth and last row. Only the pupil seated on the last row had a low mean grade (C), while all others had



**Figure 1.** Number of eyes (%) / VA

average (B) grades. None of them had a mean grade of A.

Six pupils were in first grade, 6 in second grade, and 5 in third grade, distributed over 21 classrooms.

All classrooms had only 5 rows of desks. The average distance from the desks to the blackboard was 1.5 metres in the first row, 3 metres in the second, 4 metres in the third, 5 metres in the fifth, and 6 metres in the fifth row.

Average room lighting was 402 lux, ranging from 304 to 500 lux.

Textbooks had a font size of 0.3 cm, corresponding to J3 in the Jaeger scale. The handwriting of teachers on the blackboard had an average size of 7 cm, corresponding to 20/200 on the Snellen chart.

## DISCUSSION

Vision is one of the most relevant factors for school learning. School faculty should bear that in mind and should, first and foremost, provide ophthalmic assessment to their pupils. Children with low visual acuity often perform poorly at school.

A study conducted at a school in Pouso Alegre/MG, Brazil, found that visually-impaired pupils had lower grades than those with normal vision, showing that low visual acuity can interfere with school performance<sup>(9)</sup>.

As well as screening their pupils' VA, schools should be aware of the structural conditions required for good school performance. Adequate lighting conditions, proper font size on the blackboard, the position of pupils in the classroom, and how to deal with pupils with visual deficits are important factors<sup>(6)</sup>.

In our study, only 7.03% of children had low visual acuity; by contrast, a study conducted in Londrina/PR in 2000 found a prevalence of 17.1%<sup>(10)</sup>. Another study conducted at schools in Porto Alegre/RS found a prevalence of 19%<sup>(11)</sup>. One hypothesis to explain such variation in prevalence is the fact that there is a health clinic integrated to the school assessed in our study which facilitates ophthalmic examination, as many of the pupils with a good VA in this school used optical correction.

In our study, VA was assessed using the Snellen chart, which

is widely used in the pre-diagnosis of visual acuity worldwide. The method is easy to apply and indicates whether a person needs to consult an ophthalmologist or not. In a campaign called "Olho no Olho" ("Eye to Eye"), conducted by the Brazilian Council of Ophthalmology and the Federal Government, children with VA worse than 20/30 were referred to an ophthalmologist<sup>(12)</sup>.

This campaign also included other assessments; for example, in a public school in Santana do Ipanema, Alagoas, it was found that 89% of children who had been prescribed glasses in a previous school ophthalmic evaluation continued to use optical correction. Also, the reasons why the remaining 11% were not wearing glasses were identified, which helped inform a subsequent similar project<sup>(13)</sup>.

Another study conducted in 2008 in a municipal school in Botucatu, São Paulo, found high rates of agreement between visual acuity testing using the Snellen chart and the photoscreener method. However, due to the high cost of the equipment and difficulties in finding the necessary inputs, Snellen's method is the best choice for detecting eye disorders in children who can inform their visual acuity<sup>(14)</sup>.

Assessing visual acuity in school children helps not only identify eye problems, but also instruct parents to seek eye care so that their children can fully develop their abilities and realise their potential.

Other studies have also reported on the relationship between school performance and visual impairment. In Cali, Colombia, a 60.5% prevalence of visual disorders was found among students who failed their school year, while the rate among successful students was only 12.1%<sup>(15)</sup>. Another study conducted in Juiz de Fora, Brazil, found a significant association between visual disorders and low school performance, showing that 89.5% of students with a VA within the normal range had good school performance, compared to only 75% of those with reduced VA<sup>(16)</sup>.

In our study, it cannot be said that there was a relationship between visual acuity and school performance, as only one child with poor vision had low grades. However, it should be noted that this child was also seated in the last row of desks.

For this reason, teachers should be alert to possible manifestations of visual impairment such as difficulties in locomotion, reading, copying, and drawing, as well as pupils reading school materials from a very short distance<sup>(17)</sup>. Identifying students with treatable visual impairment helps improve their quality of life and school performance<sup>(7)</sup>.

These studies are also important because they help diagnose congenital cataract and refer children to specialist examination. This issue was addressed in a retrospective study conducted at Piedade Hospital between 2006 and 2007, which found that the average time between the suspicion of congenital cataract by a paediatrician or layman and ophthalmic examination was 3 months. Therefore, screening protocols are critical to avoid this long waiting period and to promote the child's well-being<sup>(18)</sup>.

The results of our study showed that the school provides an adequate structure and conditions to its students, allowing them to achieve their full potential. The distance from the blackboard to the last row of desks did not exceed six metres (the distance used in the Snellen test), and the lighting conditions in the classrooms were within the limits recommended by the NBR 5413 standard<sup>(8)</sup>. As mentioned, only one student sitting in the last row had low average grades.

Lighting conditions were assessed using a light meter which

found light intensities between 304 and 500 lux, i.e., optimal values for a classroom<sup>(8)</sup>.

The handwriting of teachers on the blackboard measured 7 cm, which is equivalent to a 20/200 vision on the Snellen chart from the last row of desks. From the first row, it would be equivalent to a 5/200 vision. The training of teachers at this school was thus considered appropriate.

Also, school textbooks used a font size of 14, equivalent to J4 on the Jaeger chart.

When the learning conditions of school children with a slightly decreased VA are very good, certain difficulties and even symptoms can go unnoticed, such as tearing, continuous blinking, discomfort, or frowning<sup>(17)</sup>. Therefore, all school children should undergo yearly VA screening<sup>(12)</sup>.

## CONCLUSION

Only 7.03% of the children included in this study had a visual acuity equal to or worse than 20/30.

The school provides an adequate structure and conditions to its students, allowing them to achieve their full potential. The classrooms had adequate lighting conditions and length, and teaching materials had adequate font size.

Only one child had poor vision and poor school performance; this child was also seated in the last row of desks, thus suggesting a relationship between learning and good school work conditions.

Schools should screen their students' VA yearly and should be aware of the conditions required for proper learning.

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