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Research Article

Good Start Program for children's health: population identification of visual acuity loss

Programa Bom Começo para a saúde da criança: identificação populacional de perda da acuidade visual

Programa Buen Comienzo para la salud infantil: identificación de la población de la pérdida de agudeza visual

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Abstract

Introduction: Universal visual health screenings of schoolchildren are of great importance from a public health point of view, enabling early intervention in cases identified with visual deficiency, coinciding with the period in which intensive school work begins. **Objective:** To present population epidemiological data on visual acuity deficiency among participating third-grade students. **Methods:** Descriptive cross-sectional study, with population sampling. The students who participated were in the third grade at municipal elementary schools (n=422; 8 to 12 years old; M=8.6±0.6 years; 52% girls) in Nova Lima, Minas Gerais, Brazil. Keystone Vision stereoscopic equipment was used to assess visual acuity for distance and near, with monocular and binocular testing, with non-compressive occlusion of one eye. **Results:** According to the criteria of the Brazilian Ministry of Health and the ICD-10, 31% of the participants had visual loss for distance and 37% for near, in one or both eyes. According to the ICD-11, 13% of the participants had impaired visual acuity for distance and 17% for near. Of these participants, 9% were referred for ophthalmological evaluation. **Conclusions:** A high prevalence of visual health alterations was identified in the participants, which reinforces the importance, from the public health point of view, of universal screening of the visual health of schoolchildren. These descriptive epidemiological data can help health and education professionals in decision-making.

Keywords: Visual acuity; Health promotion; Eye health; School health services; Vision tests.

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Resumo

Introdução: As triagens universais da saúde visual de escolares detêm grande relevância do ponto de vista da saúde pública, possibilitando uma intervenção precoce dos casos identificados com deficiência visual que coincide com o período em que o trabalho intensivo de escolarização se inicia. **Objetivo:** Apresentar dados epidemiológicos populacionais de perdas da acuidade visual de participantes do terceiro ano do Ensino Fundamental. **Métodos:** Estudo transversal descritivo, com amostragem populacional. Participaram alunos do terceiro ano do Ensino Fundamental (n=422; 8 a 12 anos de idade; M=8,6 anos±0,6; 52% meninas) de todas as escolas municipais de Nova Lima (MG). Utilizou-se o equipamento estereoscópico Keystone Vision para avaliar a acuidade visual para longe e perto, com apresentação binocular e monocular, com oclusão não compressiva de um olho. **Resultados:** De acordo com os critérios do Ministério da Saúde e da 10ª Revisão da Classificação Estatística Internacional das Doenças e Problemas relacionados à Saúde (CID-10), 31% dos participantes apresentaram perda visual para longe e 37% para perto, em um ou ambos os olhos. Já de acordo com a CID-11, 13% dos participantes apresentaram deficiência na acuidade visual para longe e 17% para perto. Foram encaminhados 9% dos participantes para avaliação oftalmológica. **Conclusões:** Identificou-se prevalência alta de alterações da saúde visual nos participantes, o que reforça a importância, do ponto de vista da saúde pública, de triagens universais da saúde visual de escolares. Os dados epidemiológicos descritivos gerados podem auxiliar gestores da saúde e educação em tomadas de decisão.

Palavras-chave: Acuidade visual; Promoção da saúde; Saúde ocular; Serviços de saúde escolar; Testes visuais.

Resumen

Introducción: Los exámenes universales de salud visual de los escolares son de gran importancia desde el punto de vista de la salud pública, permitiendo una intervención temprana en los casos identificados con deficiencia visual, coincidiendo con el período en el que se inicia el trabajo escolar intensivo. **Objetivo:** presentar datos epidemiológicos de la población sobre la pérdida de agudeza visual entre los participantes del tercer año de la escuela primaria. **Métodos:** Estudio transversal descriptivo con muestreo poblacional. Participaron estudiantes del tercer año de la Enseñanza Fundamental (n=422; 8 a 12 años; M=8,6 años±0,6; 52% niñas) de todas las Escuelas Municipales de Nova Lima, Minas Gerais, Brasil. Se utilizó el equipo estereoscópico Keystone Vision para evaluar la agudeza visual de lejos y de cerca, con presentación monocular y binocular, con oclusión no compresiva de un ojo. **Resultados:** Según los criterios del Ministerio de Salud y la CIE-10, el 31% de los participantes presentó pérdida visual para lejos y el 37% para cerca, en uno o ambos ojos. Según la CIE-11, el 13% de los participantes presentaba alteración de la agudeza visual de lejos y el 17% de cerca. Fueron derivados para evaluación oftalmológica 9% de los participantes. **Conclusiones:** Se identificó una alta prevalencia de alteraciones de la salud visual en los participantes, lo que refuerza la importancia, desde el punto de vista de la salud pública, del tamizaje universal de la salud visual de los escolares. Los datos epidemiológicos descriptivos generados pueden ayudar a los gestores de salud y educación en la toma de decisiones.

Palabras-clave: Agudeza visual; Promoción de la salud; Salud ocular; Servicios de salud escolar; Pruebas de visión.

INTRODUCTION

Ophthalmological assessment in childhood and attention to eye problems must begin early, as there is a high prevalence of pathologies linked to vision.[1-5] The school, an institution that can bring together a large number of children, allows for a planned massive screening action for the promotion of collective health.[6]

The visual acuity test is the most used in ophthalmology, as visual loss can be corrected with refractive glasses in most cases. Visual acuity is the eye's ability to recognize two very close points. In other words, it is the degree of ability of the eye to discriminate spatial details, which is important for determining the shape and contour of objects.

In 1987, after a study on the detection of visual loss, it was recommended that ophthalmological examination be mandatory, or at least screening carried out by education professionals, for all children entering school.[7] School screening programs allow to tackle different public health problems in children, guide families to refer the student for early diagnosis and treatment, and dialogue with the areas of health and education. The longer the delay in identifying students' difficulties, the fewer are the chances of recovery and correction of the problem, as childhood is a sensitive period for the development of cognitive skills and school learning.[8]

However, many Brazilian children do not have their visual health adequately assessed because of socioeconomic and cultural factors, which make difficult the access to ophthalmological care through the Unified Health System (SUS) or private consultations. Often, government visual screening programs are the only chance for schoolchildren to have their vision assessed.[9] One of the obstacles to carrying out and maintaining ophthalmological examinations in school-age children, which is subject to SUS underfunding, is the high number of children who have never had an ophthalmological consultation.[1,2] Furthermore, the limitation of resources for visual health educational programs results in little knowledge among teachers about the symptoms and behavior of students with loss of visual acuity.[3,10]

Being aware of these limitations, the *Bom Começo* Program or Good Start Program was created to monitor the health and learning of children in schools, through a partnership between the *Universidade Federal de Minas Gerais* and the *Hospital de Olhos de Minas Gerais*.[11,12] With an epidemiological vision, the Bom Começo Program has strategic management planning focused on the prevention and early identification of sensory and learning difficulties and their overcoming. The Program seeks to establish, in a collaborative manner, a relationship between the family, the school, and public and private managers in favor of the well-being of the school community to face the vulnerabilities that compromise the health and learning of children and adolescents.

To achieve its objectives in a broad and effective way, the Bom Começo Program is divided into four stages: 1. training health and education professionals to recognize visual difficulties; 2. universal visual and hearing health screening; 3. screening of learning difficulties related to vision and intervention in reading; and 4. monitoring and monitoring the health of all children until (and even after) they leave school. The present study presents population epidemiological data on the prevalence of loss of visual acuity in third-grade students at municipal elementary schools in Nova Lima, Minas Gerais, collected in the second stage of the Bom Começo Program, in 2013.

METHODS

This prevalence study had a cross-sectional design, with population and representative sampling. Data collection from the prospective study, of intersectoral collaboration between Health and Education, carried out from September to November 2013, was analyzed.

The research was conducted with the approval of the Nova Lima Municipal Department of Education and the directors of the schools involved. All participants presented a consent form duly signed by their parents or legal guardians and by the children themselves. The study was approved by the Research Ethics Committee of the Federal University of Minas Gerais, under Certificate of Presentation for Ethical Approval (CAAE) No. 49765115.0.0000.5149. The research considered the ethical aspects pertaining to research involving human beings, in accordance with Resolution No. 466/12 of the National Health Council and the principles contained in the Declaration of Helsinki of the World Medical Association.[13]

Participants

All third-year elementary school classes from all 16 municipal public schools in Nova Lima, in the metropolitan region of Belo Horizonte, Minas Gerais, were invited to participate in the Good Start Program. Data from 422 participants (32% of the target population; 142% of the estimated sample; from eight to 12 years of age; M=8.6±0.6 years; 51.7% female) were included in the study.

Among the students in the target population who were invited to participate in the study, 524 (40%) presented the signed informed consent form (inclusion criteria). However, 102 students did not participate in the screening because: a. not having gone to school on the day of the assessment or b. not understanding the instructions during screening. Based on the sample size calculation, with a 95% confidence level, 5% margin of error and target population of 1,303 students enrolled in the municipality in 2013, a minimum of 297 participants was estimated for the sampled population (estimated sample).

In 2010, the municipality of Nova Lima had a Human Development Index (HDI) of 0.813, classified as very high according to the United Nations Development Program (UNDP). In 2013, the Basic Education Development Index (IDEB) for the initial years of municipal elementary education was 6.4 (national average=5.3; MG=5.9), according to the Educational Census of the National Institute of Educational Studies and Research (INEP).

Instrument

The Keystone Vision equipment (Mast Concepts Inc., USA), Universal Screener Model #1156, was used to assess visual acuity. It is an electromechanical, analog and standardized device, composed of slides with visual stimuli to evaluate distance and near visual acuity (monocular and binocular).[14] The evaluation of distance visual acuity is equivalent to the real distance of six meters or 20 feet. The assessment of near visual acuity is equivalent to 40 cm or 16 inches. The Keystone Screener is one of the most recommended stereoscopic instruments (presentation of one image for each eye) for screening programs in schools in the USA.[15] In addition to ensuring a fixed distance between the eye and the stimulus, the equipment assesses color vision, stereopsis, phoria and peripheral visual field.

According to the criteria of the Brazilian Ministry of Health[16] for regular referral to an ophthalmologist, participants were considered to have visual loss with: a. visual acuity less than or equal to 0.7 in either eye; and/or b. difference of two lines or more between the visual acuity of the eyes. These criteria are in line with the 10th Revision of the International Statistical Classification of Diseases and Related Health Problems (ICD-10),[17] of the World Health Organization (WHO) of the United Nations.

Additionally, the 11th Revision of the WHO ICD (ICD-11) was used,[18] which classifies the visual acuity presented as: category 0 — absence of visual impairment (≤0.5 or 20/40); category 1 — mild visual impairment (≤0.3 or 20/70); category 2 — moderate visual impairment (≤0.1 or 20/200); category 3 — severe visual impairment (≤0.05 or 20/400); categories 4 to 6 — blindness (≤0.02 or 20/1200 to no perception of light).

Procedures

Universal visual health screening of all participants was assessed by a health care professional. Each assessment lasted an average of 10 to 15 minutes, being carried out in school classrooms, with the least possible number of dispersive stimuli. Patients who previously wore glasses were examined with optical correction (acuity presented). First, the students positioned themselves to view the slide displays, looking into the Keystone View equipment with their foreheads pressed against the edge of the display. In monocular examinations, the stereoscopic equipment allowed both eyes to remain open, that is, non-compressive occlusion of one eye at a time was performed.

Data analysis

All data obtained were tabulated in an Excel spreadsheet and statistically evaluated using the IBM Statistical Package for the Social Sciences — SPSS (version 21.0, Chicago, IL). Descriptive analyses were carried out with mean, standard deviation and calculation of the prevalence of changes given in percentage. To calculate the difference in means, visual acuity values were converted to logMAR. Differences in categorical data were analyzed using the χ^2 test and comparisons of means using analysis of variance (ANOVA). Cohen's d determined the clinical significance of differences between means, with the effect size interpreted using criteria of 0.2 for a small effect, 0.5 for a medium effect, and 0.8 for a large effect.[19] The level of significance was established at $p<0.05$.

RESULTS

Universal visual health screening made it possible to identify schoolchildren with loss of monocular or binocular visual acuity for distance or near (Table 1). Participants with changes in visual acuity screening and who had never received ophthalmological care (n=37; 8.8%) were referred for additional exams. As recommended by the *Olhar Brasil* (Brazil See) Project of the Ministry of Health and the Ministry of Education,[16] participants received free glasses with refractive prescription.

Table 1. Frequency and percentage of participants (*n*=422) classified as having normal vision or visual loss in the universal visual health screening.

Distance	Eyes	Criterion	Normal vision n (%)	Visual loss n (%)
Distance	Monocular	ICD-10	290 (69)	132 (31)
		ICD-11	367 (87)	55 (13)
	Binocular	ICD-10	345 (82)	77 (18)
		ICD-11	388 (92)	34 (8)
Near	Monocular	ICD-10	264 (63)	158 (37)
		ICD-11	350 (83)	72 (17)
	Binocular	ICD-10	341 (81)	81 (19)
		ICD-11	388 (92)	34 (8)

Source: research data. Programa Bom Começo, Nova Lima, Minas Gerais, 2013.

There was no statistical difference in visual acuity between the right and left eyes, for distance or near. No statistical difference in visual loss was identified between the sexes, either in average visual acuity or in the proportion of results with visual loss (criterion ≤0.7 or ≤0.5), in monocular or binocular vision, for distance or near.

Criteria from the Ministry of Health and the 10th Revision of the International Statistical Classification of Diseases and Health-Related Problems for loss of visual acuity

According to the criteria of the Ministry of Health[16] and ICD-10,[17] in the assessment of monocular distance visual acuity, 69% of participants had normal vision and 31% had visual loss in one or both eyes

(18% 20/40; 5% 20/50; 4% 20/70; and 5% no-line). In the assessment of monocular near visual acuity, 63% of participants had normal vision and 37% had visual loss in one or both eyes (20% 20/40; 6% 20/50; 5% 20/70; and 6% no-line).

In the assessment of binocular distance visual acuity, 82% had normal vision and 18% visual loss (10% 20/40; 3% 20/50; 3% 20/70; and 2% no-line). In the assessment of binocular near visual acuity, 81% had normal vision and 19% visual loss (11% 20/40; 3% 20/50; 2% 20/70; and 3% no-line). According to the criteria of the Ministry of Health16 and ICD-10,17 in the assessment of monocular distance visual acuity, 69% of participants had normal vision and 31% had visual loss in one or both eyes (18% 20/40; 5% 20/50; 4% 20/70; and 5% no-line). In the assessment of monocular near visual acuity, 63% of participants had normal vision and 37% had visual loss in one or both eyes (20% 20/40; 6% 20/50; 5% 20/70; and 6% no-line).

In the assessment of binocular distance visual acuity, 82% had normal vision and 18% visual loss (10% 20/40; 3% 20/50; 3% 20/70; and 2% no-line). In the assessment of binocular near visual acuity, 81% had normal vision and 19% visual loss (11% 20/40; 3% 20/50; 2% 20/70; and 3% no-line).

Criteria from the 11th Revision of the International Statistical Classification of Diseases and Related Health Problems for visual acuity deficiency

According to the new ICD-11[18] criteria for monocular distance visual acuity, 87% of participants had no visual impairment and 13% had visual impairment (9% mild impairment, 4% moderate impairment, and none of the participants had blindness). In the assessment of monocular near visual acuity, 83% of participants had normal vision and 17% had visual impairment (11% mild impairment, 6% moderate impairment, and none of the participants had blindness). In both the assessment of binocular visual acuity for distance and near vision, 92% had normal vision and 8% had visual loss.

DISCUSSION

The present study aimed to present population epidemiological data on visual acuity loss in participants in the third year of elementary school, collected in the second stage of the Good Start Program. Universal visual acuity screening revealed a high prevalence of visual loss in schoolchildren.

According to the Ministry of Health criteria[16] for regular referral to an ophthalmologist, which is the most used in prevalence studies and which is in line with ICD-10, 31% of participants had visual loss for distance and 37% for near. According to ICD-11, 13% had distance visual impairment (9% mild impairment, 4% moderate impairment and none of the participants had blindness) and 17% near vision.

At the end of the screening, 8.8% of participants were referred to an ophthalmologist with the aim of more accurately verifying the cause and degree of visual loss, as well as having prescription glasses made. The remaining participants who were not referred were already using prescription glasses or were already being monitored by an ophthalmologist.

Different factors may explain the high prevalence of loss of visual acuity found in the present sample. Prevalence studies have presented different methodological criteria, which makes it difficult to compare results. As demonstrated, it is important that the criteria for classifying visual acuity loss be explicit. When comparing the ICD-10 results with the new ICD-11 results, with a less demanding cutoff, fewer participants presented loss of visual acuity (31 vs. 13%).

Regarding distance, Dutch ophthalmologist Herman Snellen stipulated, in 1862, that the optotype table and the participant should maintain a standard of 20 feet between them, which is equivalent to six meters. This distance was considered in the stereoscopic instrument used in the present study and in three comparison studies.[20-22] However, eight studies positioned the Snellen table at 5 meters,[1-3,23-27] a shorter distance than that recommended by the Ministry of Health.[16] This discrepancy of one meter less can facilitate reading and underestimate the prevalence of loss of visual acuity.

Another fundamental factor to consider is the cutoff criteria for loss of visual acuity. Most studies used the Ministry of Health or ICD-10 criteria, which stipulate values equal to or less than 0.7 (≤20/29) for visual loss. Differently, four studies used values lower than 0.7 (<20/29) as criteria,[21,22,27,28] which reduces the prevalence percentage. However, for the classification of visual acuity presented, the ICD-11 stipulates values equal to or less than 0.5 (≤20/40) as criteria. These analyses according to ICD-11 must be considered with caution, as the translation into Portuguese, coordinated by the Ministry of Health, is not yet available.

Monocular visual acuity showed greater visual loss than binocular vision, both for distance (31 vs. 18%) and near (37 vs. 19%), which may demonstrate that participants compensated for the loss of one eye with binocular fusion. The present study did not identify a statistical difference in visual acuity between the sexes, being in line with two others,[20,26] but different from those that found a higher prevalence in males[3,27,29] or in females. [1,9,21-23,25]

In Minas Gerais, the literature found a prevalence of 10% loss of visual acuity in Belo Horizonte,[20] 13% in Alfenas,[3] 15% in Itaúna[1] and 21% in Patos de Minas.[2] Screenings in other Brazilian states identified the prevalence of visual loss of 6% in Amazonas,[23] 6% in Espírito Santo,[21] 7% in Paraná,[30] 17% in Mato Grosso,[31] 13% in Rio Grande do Sul,[9,24]13% in São Paulo[4,25] and 14% in Santa Catarina.[22,27]

This range of 6 to 21% prevalence of visual acuity loss in Brazilian samples is consistent with different international assessments of school-age children.[32-38] For example, a 5% loss of visual acuity was found in Iraq,[32] 6% in the USA,[33] 6 to 10% in Ethiopia,[34,35] 10% in Indonesia,[36] 11% in China[37] and 29% in Egypt.[38]

A limitation that stands out is the delay of almost a decade in reporting the results of this research, whose data collection was carried out in 2013, due to the change in the composition of the research team and the need for a more detailed analysis of the data collected. Furthermore, despite the sample size of the present research being large (*n*=422 participants), another perceived limitation was the difficulty of effectively screening all possible third-grade children (object population), since 779 enrolled students did not submit the duly signed informed consent form and another 102 students did not attend school on the day of the assessment or did not understand the instructions. These difficulties reinforce the importance of permanent screening programs, preferably repeated annually, so that no child is effectively left behind.

As a limitation of the instrument, the prevalence results presented probably contain a proportion of false-positive results, since the Keystone View is a rapid and scalable initial screening device, but not a diagnostic device. In other words, universal screening favors the sensitivity index, so that the maximum number of true positives (*i.e.*, participants with visual loss) are selected, despite increasing the number of false-positives (*i.e.*, participants with normal vision). It is recommended, for future research, that all screened participants with visual loss be retested after 15 minutes. This retest after 15 minutes was not carried out, as at the time it was not included in the Keystone View application protocol in the Good Start Program.

CONCLUSION

Universal visual health screenings for schoolchildren, such as those carried out by the Good Start Program, are of great relevance from a public health point of view. The evaluation of students in the third year of elementary school proved to be ideal, enabling early intervention in cases identified with visual loss, coinciding with the period in which intensive school work begins.[29] It is concluded that there is a high prevalence of visual acuity loss in participating third-graders in the city of Nova Lima, Minas Gerais, with 13% of participants presenting loss of visual acuity for distance and 17% for near, with 9% referred for ophthalmological evaluation.

Since the treatment of visual loss is a public health problem, the data generated can assist health and education managers in decision-making, such as referral for complementary examinations and planning public policies. The originality of this publication is to support health care professionals in comparing results according to two cut-off criteria. Furthermore, the difference between the terminologies used should be noted, with the Ministry of Health and ICD-10 using the term “loss of visual acuity” and the new ICD-11 using the term “visual impairment”.

The Bom Começo Program, focused on promoting health as a whole, allowed the early identification and monitoring of students with sensory and learning changes, with continuous attention to contribute to effective learning. In addition to improving the health of society, the Bom Começo Program produced some benefits for the university, such as the opportunity to test technologies and products developed in laboratories on a large scale, access to market needs and financial support for research.[28]

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CONFLICT OF INTERESTS

Nothing to declare.

AUTHORS’ CONTRIBUTIONS

RQG: Conceptualization, Data curation, Obtaining Funding acquisition, Project administration, Writing – original draft. DAV: Conceptualization, Data curation, Formal analysis, Validation, Writing – original draft. FCS: Conceptualization, Investigation, Software, Validation, Writing – review & editing. JAC: Conceptualization, Investigation, Software, Validation, Writing – review & editing. JRG: Supervision, Validation, Writing – review & editing. MRG: Conceptualization, Data curation, Investigation, Project administration, Supervision, Writing – review & editing.

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