Article • Vision Screening of Elementary Students with Learning Disabilities in Greece

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ABSTRACT

Purpose: This study aims to evaluate and document the visual performance of elementary students identified with learning disabilities in Greece.

Methods: Students in elementary school who were previously diagnosed and on record with the school district as having a learning disability participated in this research. Optometric tests were performed according to standard protocols to evaluate visual acuity, near point of convergence, oculomotor function, stereopsis, fusion, accommodation flexibility, and vergence facility.

Results: None of the 82 students classified with learning difficulties passed all of the optometric tests. Eight (9.7%) students failed VA, 29 (35.3%) failed NPC, 55 (67.1%) failed accommodative facility, 44 (53.6%) failed vergence facility, 15 (18.3%) failed stereo acuity, 11 (13.4%) failed fusion, and 56 (68.3%) failed the Maples oculomotor test. The majority of students failed more than 2 tests (89.1 %).

Conclusion: Greek students with learning disabilities were found to have poor performance in functional vision testing, with 100% of subjects failing at least one visual function test. An analytical evaluation of vision before or at the same time as the evaluation for learning disabilities is crucial. If interventions are offered to every child with learning disabilities in order to overcome visual restrictions, remediation of the identified visual deficiencies may improve school performance.

Keywords: Learning disabilities, visual dysfunctions, visual skills

Introduction

This research came about from a 2018 article published in the Editor's Newspaper in Greece.[1] In this article, three well-known psychologists and psychiatrists commented that learning disabilities in the country affect almost 30% of children. This number is higher than the comparable percentage of incidence all over the world. For example, according to University College London, the percentage of students with learning disabilities is less than 10% in the United Kingdom.[2]

Having read this statement, the first question that emerged was regarding the criteria for labeling a child as learning disabled. The diagnostic procedure for learning disability in Greece requires an evaluation from a committee, which includes representation from several specialties. This committee consists of a psychologist, a physiologist, an occupational therapist, a special education teacher, and a speech therapist. The notable omission is a visual evaluation by an optometrist.[3]

Pediatric Vision Testing for Children with Learning Disabilities in Greece

In Greece, children are only referred for optometric or opthalmologic examination in cases where there is a severe ocular problem. Parents are primarily sent to an ophthalmologist for an eye examination. The examination includes ocular health, ocular integrity, and refractive error. However, visual

function, including the accuracy and efficiency of oculomotor pursuit and saccadic eye movements, dynamic acuity, accommodation skill, eye alignment, vergence coordination, and visual perception are typically not included in primary vision care. As optometrists, we are well aware of the need for efficient visual skills, included those listed, in order for effective learning to take place. This study aimed to evaluate and document the visual performance of elementary students identified with learning disabilities in Greece.

Methods

Optometric Assessments

All of the children who participated in this research were students in 4th or 6th grades who were previously diagnosed with learning disabilities. Subjects included 29 (35.4%) boys in the 4th grade, 20 (24.4%) girls in the 4th grade, 12 (14.6%) boys in the 6th grade, and 21 (25.6%) girls in the 6th grade. Students in 4th and 6th grade were enrolled in the study because they should have passed at least 2 eye exams prior to functional vision screening. The vision assessment evaluated visual acuity (VA), near point of convergence (NPC), accommodative amplitude and facility, vergence facility, stereopsis, pursuit and saccadic oculomotor function, and first- and second-degree fusion. Our protocol abided by the tenets of the Declaration of Helsinki and followed published test administration protocols.

Visual Acuity

A Snellen optotype chart consisting of numbers was viewed at a testing distance of 6m, under correct lighting standards. The examination was completed with habitual lens correction (with glasses or without glasses if not worn). VA was recorded as the line in which more than 50% of the numbers were identified. Each eye was tested separately, and then binocular visual acuity was also recorded. VA was expected to be equal to or better than 20/25 to pass this assessment. A difference between the two eyes should also not be greater than one line.[4]

Near Point of Convergence

The student was instructed to maintain gaze as a Wolff wand was brought toward their nose. The fusion break was recorded as the distance at which one of the two eyes no longer followed the target. The recovery point measurement was achieved by moving the target away from the subject's face and locating the point at which eye cooperation returned. The test was repeated several times in order to draw an average performance and a stable response. The published acceptable breakpoint values are between 5 and 8 cm, with recovery between 8 and 11 cm.[5,6] The acceptable breakpoint for this study was set to under 8 cm and the acceptable recovery under 11 cm.[7]

Accommodative Facility

Accommodative facility assesses the ability to acquire a clear and distinct image quickly. In this research, we tested the individual's ability to change focus between +/-2.00 D flipper lenses.

The child sat on a chair at a slanted desk with a 20-degree tilt and a viewing distance of 40 cm. Accommodative rock cards with words were used as targets. As the student cleared the print and accurately read the words on the testing card, the examiner changed the position of the flipper lens. A full cycle was considered as viewing through both +2.00 and -2.00. When the time reached 1 minute, the assistant stopped the procedure, and the number of cycles was recorded. First binocular accommodative facility (BAF) was executed, and then monocular accommodative facility (MAF) testing was completed. Passing criteria were set at 5 cpm binocular and 7 cpm monocular.[8-11] Suppression check in the form of a Worth 4-dot was performed prior to binocular testing.

Vergence Facility

The flexibility of moving the eyes between convergence and divergence posture was tested with a prism flipper consisting of 3^{Δ} BI /12^{Δ} BO with targets at 40cm. The child sat on a chair at a slanted desk tilted 20 degrees. Accommodative rock cards with words were used as targets and were viewed through one side of the 3^{Δ} BI /12^{Δ} BO prism flipper. When the student recognized one word correctly without double vision, the flipper was changed to the opposite side. A full cycle was completed by changing the flipper to view through both 3^{Δ} BI and 12^{Δ} BO prism. When the time reached one minute, the assistant stopped the procedure, and the number of cycles was recorded. The minimum requirements for normal facility between convergence and divergence were set at 15 cpm.[6]

Stereopsis

A Random Dot 3 stereo test was administered using polarized glasses at 40 cm in photopic conditions. Shapes should be recognized in response to various stereoscopic objects starting at a disparity of 600 arc sec and ranging down to 12.5 arc sec. The maximum stereoscopic acuity of the examinee was recorded.[6]

Pursuit and Saccade Oculomotor Function

The purpose of the oculomotor test is to evaluate the quality and accuracy of pursuit eye movements and saccadic eye movements. The Maples oculomotor test was used to evaluate the performance of students' ocular motility.[12]

Oculomotor testing was conducted by an examiner holding a Wolff wand at a distance of 40 cm from the examinee and assessing the accuracy and ability according to the testing protocol. Behind and next to the examiner, a second observer objectively evaluated body and head movements. The examinee was instructed to "follow the target as if your eyes were connected to it with an invisible rope." The examiner performed two counterclockwise circles 20 cm in diameter and then two clockwise circles of the same diameter to assess pursuit oculomotor function. Saccadic oculomotor testing was completed with two Wolff wands, with the student alternating gaze between the two.

Evaluation of performance was made following the published test instructions and included scoring four areas: ability, accuracy, amount of head movement, and amount of body movement.

Worth 4-Dot Fusion

According to Worth, there are three stages of binocular processing: simultaneous perception (1st degree), flat fusion (2nd degree), and stereopsis (3rd degree).[13] In order to achieve three-dimensional perception, a child needs to have the ability to fuse information from each eye into one spatial perception.[14]

Sensory fusion was tested with a Worth 4-dot at viewing distances of 40 cm and 3 m. The student wore red/green glasses and was asked how many lights they saw and which colors they were. A normal test response is four dots, with two green, one red, and one a brown/orange color. In case that the response was 2 or 3 dots, suppression was recorded. When the response is 5 or more, diplopia is present.[4]

Table 1. Pass/Fail Criteria

Visual Acuity (VA)	Monocular (withing 1 line) ≥20/25 Binocular ≥20/25
Near Point of Convergence (NPC)	>8cm (break) >11cm (recovery)
Accommodative Facility	<5 cpm (monocular) <3 cpm (binocular)
Vergence Facility	≤12 cpm
Stereo Acuity	≥50 sec

Pass/Fail Test Criteria

In order to evaluate the performance of each individual, criteria were set to determine the pass/fail performance on each functional vision test. Tables 1 and 2 show the minimum accepted values for passing each assessment.

Maples oculomotor test norms for children in 4th and 6th grade are shown in Table 2.[12]

Results

The total number of examined students was 82. All of the included students had a prior diagnosis of a learning disability (Figure 1). Of the study participants, 8 students (10%) had a combined diagnosis of dyslexia and attention deficit hyperactivity disorder (ADHD). Dyslexia as a single diagnosis was present in 34 students (41%). Attention deficit disorder (ADD) or ADHD was found in 35 students (43%). Language processing disorder was identified in 3 participants (3%), dysgraphia in 1 student (2%), and dyscalculia in 1 student (2%). Although ADD/ADHD is a neuro-developmental deficit and not an official learning disability, children in this category had received an academic designation of learning disability and were included.

Students were evaluated on seven optometric tests. Figure 2 shows the overall student performance. Eight (9.7%) students failed VA, 29 (35.3%) failed NPC, 55 (67.1%) failed accommodative facility, 44 (53.6%) failed vergence facility, 15 (18.3%) failed stereo acuity, 11 (13.4%) failed fusion, and 56 (68.3%) failed the Maples oculomotor test. The majority of failures were in ocular motility, accommodative facility, and vergence flexibility testing.

Table 2. Maples Oculomotor Test Norms for Children in 4th and 6th Grade.[12]

	Pursuit Eye Movement				Saccadic Eye Movement			
STUDENT	ABILITY	ACCURACY	HEAD MOV.	BODY MOV.	ABILITY	ACCURACY	HEAD MOV.	BODY MOV.
4th Grade Boys	5	4	4	4	5	3	3	4
4th Grade Girls	5	4	4	5	5	3	3	4
6th Grade Boys	5	4	4	4	5	3	3	4
6th Grade Girls	5	4	4	5	5	3	4	5

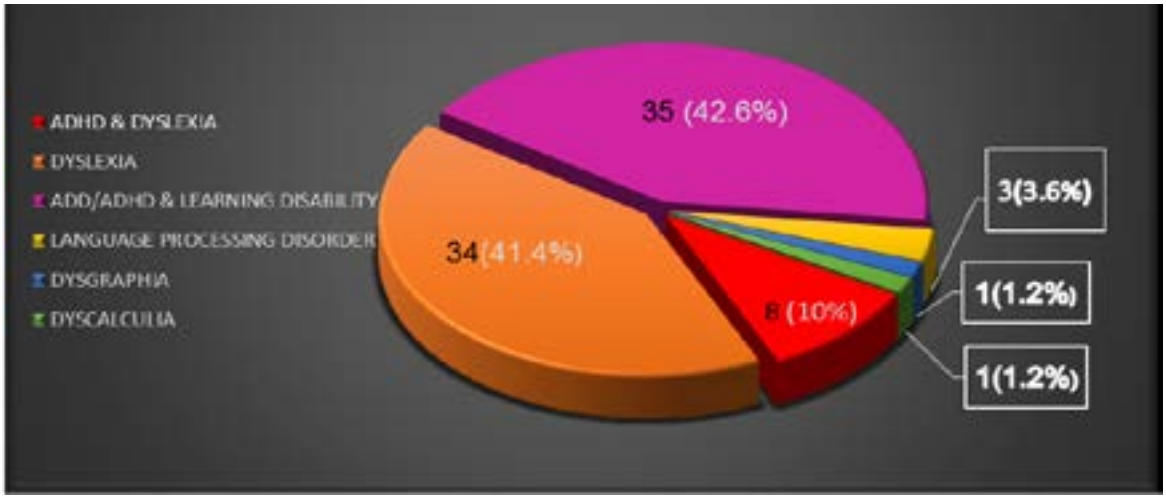

Figure 1. Chart showing the categorization of learning disabilities of participating students

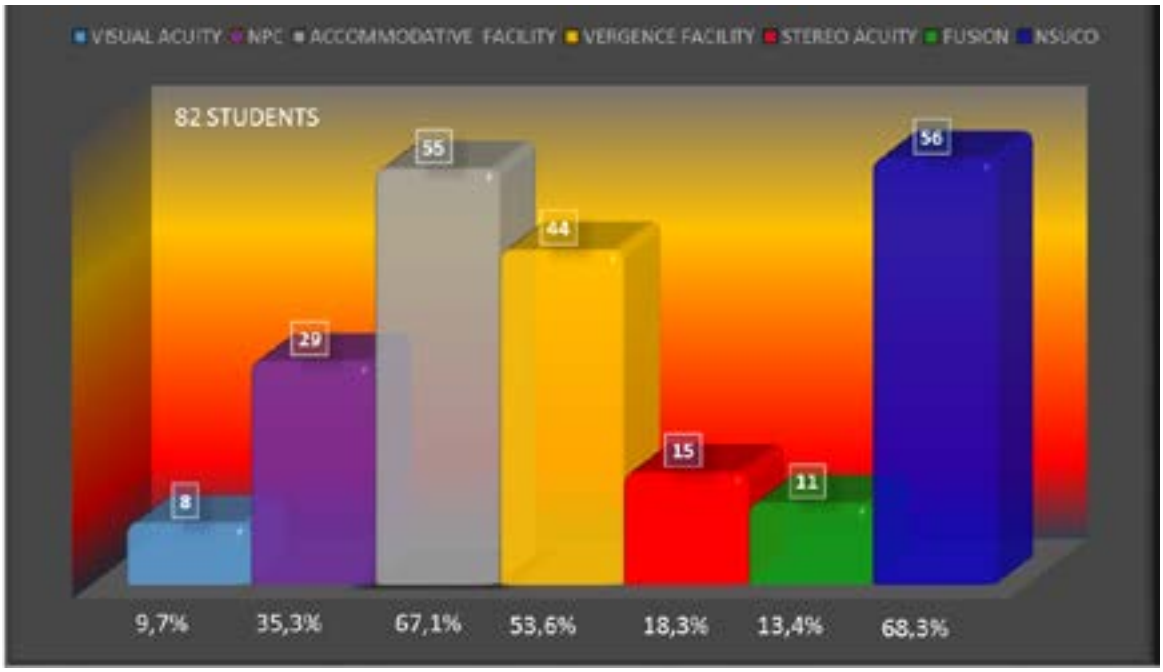

Figure 2. Graph of the number of students with diagnosed learning disabilities who failed each optometric test

Table 3 represents the distribution of the number of failed tests exhibited by this group of students. None of the students with learning disabilities passed all of the optometric tests.

Discussion

Testing this clinical population showed that all participants failed at least one vision test. This demonstrates that children diagnosed with learning disabilities exhibit visual restrictions. This population also showed multiple deficits in visual development. Vision assessment showed that 73 students (89.1%) failed more than 1 test. Multiple areas of visual dysfunction were found in 60 students (73.3%), who failed 3 or more optometric tests. The main areas of difficulty were identified to be ocular motility, accommodative flexibility, and vergence flexibility.

Table 3. Number of Tests Failed by Students with Learning Disabilities

Number of tests failed	Number of students	Percentage
0 tests	0	0
1 test	9	10.9
2 tests	13	15.8
3 tests	20	24.4
4 tests	22	26.9
5 tests	15	18.3
6 tests	3	3.7
	82	100

It is important to note that of the children diagnosed with ADHD and dyslexia (35) or ADHD and learning disabilities (8), three 3 (6.9%) failed VA, 16 (37.2%) failed NPC, 25 (58.1%) failed accommodative facility, 24 (55.8%) failed vergence facility, 8 (18.6%) failed stereo acuity, 6 (13.9%) failed fusion, and 29 (67.4%) failed the Maples oculomotor test.

Test results in this study are similar to those in a study published by Samrat Sarkar[15] that showed that symptoms of ADHD and non-strabismic binocular vision problems are similar. There is a need to specify the foundation of those symptoms.

In this study, only 8 students (9.8%) had uncorrected refractive errors. This evidence demonstrates that clarity of eyesight is not the reason that students with learning disabilities show visual restrictions. Visual refractive integrity is important, but it is not the only factor in efficient visual performance. A child's development and learning ability requires visual efficiency and accuracy. When there are functional vision problems, children exhibit restrictions to their performance, have reduced attention span, and perform with a slower processing speed of information. Several prior studies show that visual performance is closely connected with learning difficulties.[16-18] If interventions are offered to every child with learning disabilities to overcome visual restrictions, remediation of the identified visual deficiencies may improve school performance.[18]

Educational committees in Greece evaluate the learning ability of students based on a specialist's diagnosis. Currently, the evaluation covers only the psychological profile, body coordination, writing skills, social behavior, and oral fluency. A visual function examination is not included. This study indicates that an optometric visual evaluation should be considered necessary. Optometric vision care and vision therapy, if needed, should be the starting point for the rehabilitation of those children.

Conclusion

An analytical evaluation of vision before or at the same time as the evaluation by the committee for learning disabilities is vital. If interventions are offered to every child with learning disabilities to overcome visual restrictions, remediation of the identified visual deficiencies may improve school performance. This help may include lenses, prisms, tints, and optometric vision therapy. Identifying and addressing vision deficiencies appropriately should be part of the educational plan for students with learning disabilities.

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