

Review articles

Relationship between dizziness and learning difficulties in schoolchildren: an integrative review

Eliza Mikaele Tavares da Silva¹

<https://orcid.org/0000-0002-9277-4657>

Alexandre Lucas de Araújo Barbosa¹

<https://orcid.org/0000-0003-1493-3429>

Erika Barioni Mantello¹

<https://orcid.org/0000-0003-3200-5474>

Cíntia Alves Salgado Azoni¹

<https://orcid.org/0000-0003-2175-9676>

Juliana Maria Gazzola¹

<https://orcid.org/0000-0002-9333-1831>

¹ Universidade Federal do Rio Grande do Norte – UFRN, Natal, Rio Grande do Norte, Brasil.

Research carried out in the Department of Phonoaudiology of the Federal University of Rio Grande do Norte-UFRN, Natal, Rio Grande do Norte, Brazil.

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ABSTRACT

Purpose: this study aims to verify the level of scientific evidence on the relationship between dizziness and academic achievement in childhood.

Methods: the study was performed using the following search terms: dizziness, vertigo, child, learning, spelling, learning skills, academic skills, reading, and their correspondents in Portuguese in the following databases: PubMed, Scielo, LILACS and PsycINFO. Observational studies that examined the relationship between dizziness and academic achievement in childhood, published between 2007 and 2017, were included. Articles that did not allow access to the full text, and studies based on samples with motor, hearing, and cognitive disorders were excluded.

Results: we initially found 315 articles and three met the established inclusion and exclusion criteria. These were scored according to the Newcastle-Ottawa Modified Scale with scores between 2 and 3 and as IIb according to the American Speech-Language Hearing Association levels of evidence and quality indicators.

Conclusion: the results of this integrative review showed a low level of scientific evidence on the relationship between dizziness and academic achievement in childhood. It is important to emphasize the importance of improving study design to better understand their relationship, to allow provision of the best preventive, assessment, and intervention methods.

Keywords: Postural Balance; Vertigo; Child Development; Dizziness; Learning Difficulties; Child

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Corresponding address:

Eliza Mikaele Tavares da Silva
Universidade Federal do Rio Grande do Norte, Centro de Ciências da Saúde
Departamento de Fonoaudiologia
Avenida Nilo Peçanha, 620, Petrópolis
CEP: 59012-300 - Natal, Rio Grande do Norte, Brasil
E-mail: elizamikaele@hotmail.com

INTRODUCTION

Body equilibrium refers to a sensory-motor function regulated by the central nervous system that integrates information from the vestibular, visual, and somato-sensory systems^{1,2}. This function is therefore responsible for providing postural stability during static or dynamic activities².

Thus, dizziness is understood as a dysfunction of body equilibrium caused by the divergence in the integration of sensory information that regulates postural control³. The prevalence of this complaint in children aged 0 to 18 years in Brazil is approximately 0.4% to 5.3%^{3,4}, and thus it can be assumed that up to 3.1 million may have the symptom in question. It is also worth noting that the prevalence may actually be higher since the population in general has difficulty describing vestibular complaints because these are subjective alterations³.

This change may result in several manifestations, such as physical and mental health insecurities, anxiety, difficulty in paying attention, memory loss, and fatigue⁴⁻⁷. In addition to these characteristics, it can cause challenges for the child to visually follow their teacher or colleagues, besides the difficulty of learning, which is characterized by deficits in the execution of reading and writing tasks in the classroom. This is due to inadequate integration between the vestibular system and oculomotor function^{1,2,8,9}.

Considering that learning requires a change in behavior resulting from past experience¹⁰, changes to this process, referred to as learning difficulties, are characterized by deficits in the execution of reading and writing tasks. This is caused by influences that have a pedagogical, family or individual origin¹¹, such as sensory alterations (e.g., visual, vestibular and auditory system), metabolic and motor disorders. Thus, otoneurological dysfunctions can cause great harm to school-aged children, as well as higher school absence rates, lower academic performance, and difficulties communicating, as well as disturbances of the psychological state¹².

Although the relationship between dizziness and learning difficulties is well established in textbooks^{13,14}, there are few studies that explain or examine their association. Oliveira and Capellini (2013)¹⁵ evaluated the motor performance of 40 schoolchildren, from 2nd to 4th grades in elementary education, aged 7 to 11 years, using the Motor Assessment Scale. The students were divided into four groups: GI: 10 students with developmental dyslexia, GII: 10 students with learning

disorders, GIII: 10 students with learning difficulties and GIV: 10 students with good academic performance. The study showed that students with dyslexia, and with learning difficulties and disorders performed less well in comparison to the control group in the balance tests. Franco and Panhoca (2008)¹⁶ studied vestibular symptoms in children with complaints of school difficulties. Eighty-eight children were evaluated through anamnesis, otorhinolaryngological, and audiological examinations. It was observed that children with school difficulties had a greater number of complaints of dizziness, vomiting, and nausea compared to children without school difficulties.

According to the Brazilian Institute of Geography and Statistics (IBGE)⁴, dropouts and dropout rates from elementary school between 2007 and 2010 ranged from 12.1% to 10.3% and 4.8% to 3.1%, respectively. Brazil has the third highest drop-out rate among the 100 countries with the highest Human Development Index (HDI), ranking below Bosnia and Herzegovina (26.8%) and Saint Kitts and Nevis in the Caribbean (26.5%). In Latin America, Brazil is only behind Guatemala (35.2%) and Nicaragua (51.6%) that have higher rates¹⁷.

Since otoneurological factors can affect the data cited above, creating tools that aid in the early identification or construction of an ideal model of care becomes of extreme importance for the reduction of these rates. However, among the researched literature, there are few studies that effectively analyze the relationship of otoneurological symptoms with school learning¹⁶⁻¹⁹.

It should be highlighted that it is not easy to obtain an accurate description of the symptoms from children or their caregivers, making it difficult to diagnose, thus the undervaluing of the complaint by the medical profession. However, it is imperative to recognize pediatric vestibular disorders early such that an etiological treatment to improve quality of life can be offered and prevent secondary alterations due to this disorder^{20,21}.

Given the information above, it is hypothesized that children with disorders of postural balance are more prone to having learning difficulties. Therefore, this study aimed at assessing the level of scientific evidence available on the relationship between dizziness and learning in children.

METHODS

The current study was an integrative review, carried out between June and September 2017,

using the following databases: PubMed, Scielo, LILACS, and PsycINFO. Articles that focused on the relationship between dizziness and learning in children were searched using the following combinations of descriptors in English and Portuguese: “*dizziness and learning and child*”; “*vertigo and learning and child*”; “*dizziness and learning*”; “*vertigo and learning*”; “*dizziness and reading*”; “*vertigo and reading*”; “*dizziness and reading and child*”; “*vertigo and reading and child*”; “*dizziness and spelling*”; “*vertigo and spelling*”; “*dizziness and spelling and child*”; “*vertigo and spelling and child*”; “*dizziness and learning skills*”; “*vertigo and learning skills*”; “*dizziness and learning skills and child*”; “*vertigo and learning skills and child*”; “*dizziness and academic skills*”; “*vertigo and academic skills*”; “*dizziness and academic skills and child*”; “*vertigo and academic skills and child*”; “*tontura e aprendizagem e crianças*”; “*tontura e aprendizagem*”; “*vertigem e aprendizagem e criança*”; “*vertigem e aprendizagem*”; “*tontura e leitura*”; “*tontura e leitura e criança*”; “*vertigem e leitura*”; and “*vertigem e leitura e criança*”.

Articles that met the following criteria were selected: observational studies that examined the relationship between dizziness and learning in children, published between 2007 and 2017, in English and/or Portuguese. Of these studies, the following were excluded: those that did not allow access to the full text and studies that included subjects with presented motor, auditory, or cognitive alterations, since these alterations are directly related to learning and balance disorders; and subjects with a close diagnosis of specific learning disorders (such as dyslexia, dysorthography, among others), because these disorders are related to neurobiological changes, and dizziness is associated with comorbidity and not cause of the difficulty.

The search for texts within the databases was performed independently by two researchers to minimize the loss of possible references. All references found among the databases were analyzed for relevance and later inclusion in the study.

Both evaluators selected studies based on titles and abstracts in order to verify which studies were related to the research theme. Articles that passed the initial assessment were fully read and analyzed for to verify they met the eligibility criteria.

In addition, articles were also analyzed and classified according to the levels of evidence used by the *American Speech-Language-Hearing Association* (ASHA) in 2004²², adapted from the *Scottish Intercollegiate Guideline* and the modified *Newcastle-Ottawa Scale (NOS)*²³. The levels of evidence used by ASHA are classified as follows: Ia - well-designed meta-analysis of multiple controlled and randomized studies; Ib - randomized and well-designed controlled study; IIa - well-designed non-randomized controlled study; IIb - well-designed quasi-experimental study; III - well-designed non-experimental study; and IV - expert committee report, consensus conference, clinical expert experience.

It should be noted that despite the diverging use of instruments/scales that analyze the methodological quality of observational articles included in studies such as these, the Newcastle-Ottawa Scale instrument (NOS) has been the most widely used to assess quality in the methodological study of case-control studies and cohort studies. However, cross-sectional studies are not included, which leads to the need to adapt the NOS.

Thus, the modified NOS, used in the study by Schuelter-Trevisol²³, was used in this study to analyze the included articles. The instrument included issues related to exposure and results. Each point that met the criteria established by the scale was given a point, resulting in scores ranging from zero (worst) to seven (best). The instruments were applied by two reviewers independently for each study included in the present study.

LITERATURE REVIEW

The initial search identified 315 articles. Of these, 122 were excluded based on multiple identifications by the different search terms, 18 based on overlap of results from different databases, and 163 because they did not mention the study topic in the title. Thus, 12 articles were selected for abstract analysis, seven of which were excluded because they did not meet the eligibility criteria or were not in agreement with the studied topic, and two articles were excluded after reading the full text. Final selection, through consensus, resulted in the inclusion of three articles that met the criteria established initially (Figure 1).

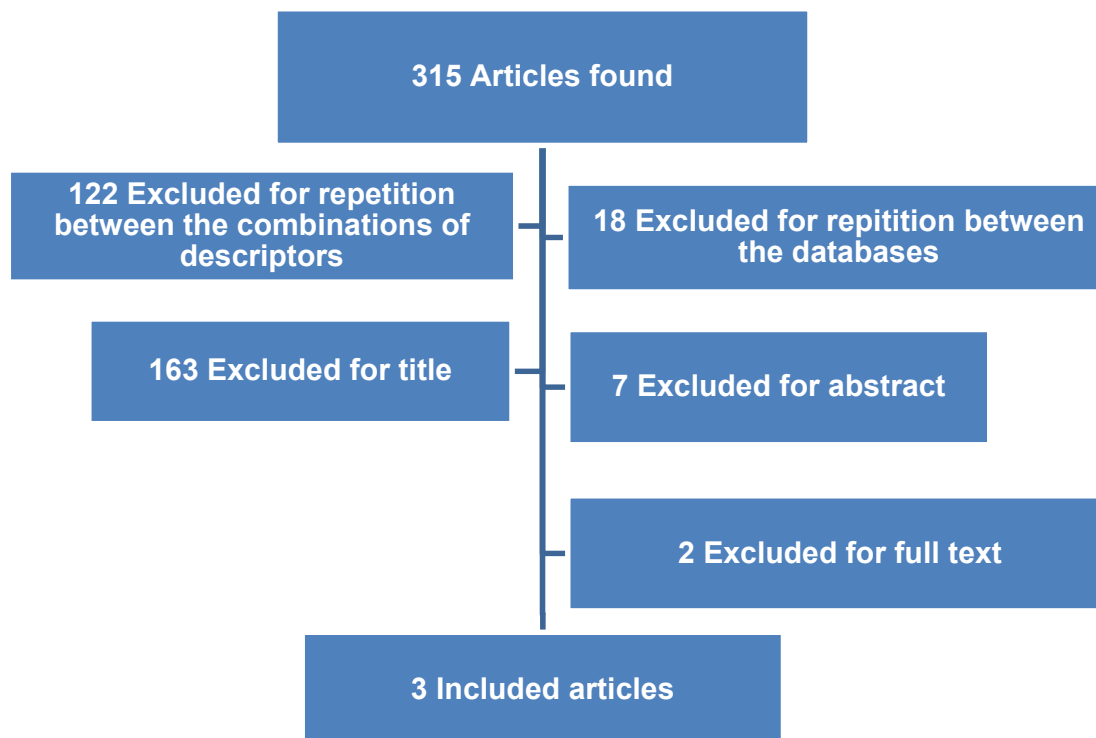


Figure 1. Flowchart for article selection

To aid in the visualization of the studies included in this review, some information was selected and summarized according to the following topics: author/year, sample, research design, instruments for group allocation, dizziness assessment tool, conclusion, and level of evidence (Table 1).

The three included articles in this study^{16,18,19} presented similar methodologies, probably because they had the same authors and similar samples, composed of schoolchildren between 7 and 12 years of age, enrolled in public schools in the city of Piracicaba/SP, in the years 2004/2005¹⁸ and 2004/2006^{16,19}. The sample was divided into two groups: schoolchildren with learning difficulties and schoolchildren without learning difficulties. From this, the presence of dizziness was verified through vestibular examination^{18,19} or anamnesis¹⁶.

The allocation of the children between the groups was made through self-reporting of learning difficulties. However, self-reporting may decrease the reliability of the allocation process, taking into account that the parents' perceptions of school performance may be influenced by a number of factors. However, self-reporting may decrease reliability in the process, taking into account that parents' perceptions of school performance may be influenced by a number

of factors, including school activities, organization of school material, and behavior in the classroom. The perception of dizziness may also be impaired, since the child most often does not understand the complaint and believes that the "sense of discomfort" is normal²⁴. In addition, the expressive capacity is still in a constructive process, which makes it difficult for parents to understand their symptoms and medical clinics. This feeling is often expressed through crying, hysterical crises, and tantrums^{25,26}. In this way, the evaluation process may have been influenced by several factors. The use of protocols, exams, or tests that complement the perception of the individuals would bring greater reliability to the allocation of groups and robustness to the results of the study, considering that the objective of the studies was to study vestibular function or vestibular symptoms in children facing difficulties in school.

The articles cited above do not state clearly whether the evaluators were blinded or if a sample calculation was performed. This implies that the samples made up of 50 and 88 children from the same city were done so for convenience, and thus diminishes the representativeness and external validity of the studies. However, the procedures and materials used in the study were

Table 1. Structured description of characteristics for evaluation of articles

Author/ Year	Sample	Study Design	Instrument for group allocation	Evaluation tool for dizziness	Results	Conclusion	Level of evidence
Franco, Panhoca (2007)	50 students	Cross-sectional clinical study	Interview	Vestibular examination	The most common general complaint found in the population was dizziness (36.0%) and the symptom in the school setting was headache (50.0%). Of children with learning complaints, 68.4% had vestibular alterations of irritative peripheral origin, both unilateral and bilateral.	Vestibular alterations presented a statistically significant relationship with complaints of school difficulties in children.	3, IIB
Franco, Panhoca (2008)	88 students	Not described	Interview	Interview (self-assessment)	Of the children evaluated, 49% mentioned having difficulties in school, with a predominance of complaints in reading (56.8%) and copying (43.2%). Vertigo (22.7%) was the most common otoneurological complaint (22.7%) in the general population and the most prevalent symptoms in school settings were anxiety (95.5%) and headache.	There was a statistically significant relationship between the complaint of dizziness and difficulties in reading and copying.	2, IIB
Franco, Panhoca (2008)	88 students	Cross-sectional clinical study	Interview	Vectonyst-agmography	Of the sample, 49% reported school difficulties. Of these, 67.4% presented with vestibular alterations of irritative peripheral origin.	There was a statistically significant relationship between school difficulties and performance in the tests of the precision parameter and caloric test.	2, IIB

described in detail, allowing the clinical reproducibility of the study.

The discussion of the relevance of the vestibular system for learning has been presented by several authors²⁵⁻²⁷, considering its influence in the process of language acquisition and learning, since it aids in the control of body position, ocular movements, and spatial perception. Thus, it is convenient to perform vestibular examinations in schoolchildren who present with indications of otoneurological dysfunctions.

The most common otoneurological dysfunctions in children and adolescents with dizziness are vestibular migraine and benign paroxysmal positional vertigo (BPPV). However, these symptoms are often masked or undervalued by possible progressive self-compensation^{3,28,29}. In addition, a study by Li et al. (2016)²⁹ showed that the number of diagnoses that may lead to vestibular dysfunction in childhood has increased, including cytomegalovirus, late prematurity, and concussion, and many of these cases do not seek specialized evaluation.

It should be highlighted that all articles reviewed, presented, and included in this study showed a statistically significant relationship in children with dizziness complaints and school difficulties. However, these were classified with the level of evidence between 3

and 2 according to the modified NOS scale. The study designs of the articles found were considered to be IIB – well designed quasi-experimental studies according to the levels of evidence employed by ASHA in 2004.

Although the relationship between dizziness and learning difficulties is clear in textbooks^{13,14} and in the articles cited in this study, research in this area is still scarce, with studies using fragile methodologies and a level of evidence that makes it impossible to establish a relationship between dizziness and learning in children. Thus, it is necessary to carry out studies with more robust methodologies that provide a scientific basis for this relationship and, therefore, build sufficient evidence for clinical guidelines and public policies that can support students with neurotological pathologies.

Knowing that vestibular dysfunction can have a serious impact on the development, performance, and well-being of children, we highlight the need to diagnose the cases described here and to refer them, when there is a medical indication, to early VR, since the literature³⁰ shows the effectiveness of the treatment in minimizing vestibular deficiencies, enabling the modification of the child's behavior in relation to body balance, and even obtaining vestibular reassessment results within the normal range after intervention.

CONCLUSION

This integrative review showed that in the Scielo, PubMed, LILACS, and PsycINFO databases, there was a low level of scientific evidence regarding the relationship between dizziness and learning in children.

Future studies are required to clarify and verify the established relationship between dizziness and learning processes, including cognitive, psychological, and scholastic factors. It is also important to focus on well-defined methodologies in order to have an understanding of this relationship, which, in all likelihood, should lead to better preventive, evaluative, and interventional design. However, the interdisciplinary action of professionals in the area of health and education, with the purpose that the referral and intervention occur early is necessary in order to decrease damage and improve the prognosis of the schoolchild.

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