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RESEARCH ARTICLE

GROSS MOTOR SKILLS OF PRIMARY SCHOOL CHILDREN WITH AND WITHOUT DYSLEXIA

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ABSTRACT

Background: Over the last few years, the notion that dyslexia is a learning disability, which initially appears as a difficulty in reading learning and later as unstable in spelled writing and as a lack of ability to manipulate written words in opposed to oral speech. The situation is essentially cognitive and usually genetic. It is not due to a mental deficiency, a lack of socio-cultural opportunity, emotional factors, or another brain building deficit. A large proportion of children with dyslexia are experiencing motor difficulties such as developmental coordination disorder. However, few studies have examined the qualitative gross motor skill performance of children with dyslexia. The development of gross motor skills through targeted physical education programs and instruction is of crucial importance for children's further motor as well as overall development both in school and in everyday life. Thus, further research into children's gross motor skills is considered necessary.

Object: The purpose of this study was to compare the motor skills of students with and without Dyslexia in children aged 9-12 years.

Methods: 120 children with and without Dyslexia 9-12 years of age from the fourth grade (Mage=9.28), fifth grade (Mage=10.32), and sixth grade (Mage=11.18) participated. The 'Test of Gross Motor Development' test [1] was used for the qualitative evaluation of gross motor skills.

Results: The results showed that in both skill categories children with dyslexia exhibited significantly lower motor performance than children without dyslexia, in each grade and in general. Also, dyslexic children in fourth and fifth grade had better performance than those in sixth grade.

Conclusion: Children with dyslexia have difficulty in the qualitative performance of gross motor skills. As this may affect their social development and academic performance, it is necessary to make appropriate adjustments to the design and implementation of Physical Education lesson.

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INTRODUCTION

Over the years, reflection in the scientific field about diagnosing and addressing learning difficulties experienced in childhood has become more and more intense. The most widely used definition of Learning Difficulties provided by the Joint Committee for Learning Disabilities is that "Learning Difficulties is a general term that refers to a heterogeneous group of disorders that are manifested by significant difficulties in the acquisition and use of listening, speaking, reading, writing, reasoning or mathematical skills. These disorders are inherent to the individual, are attributable to dysfunction of the central nervous system and may be present throughout life. Problems in behaviors of self-control, social perception, and social interaction may coexist with Learning Difficulties" (Ramus, 2013).

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One of the possible categorizations of these difficulties is proposed by the World Health Organization (2007) to the ICD - 10 Disorder Classification Tool, widely used diagnosis. In this, Learning Difficulties, which are not due to an acquired brain trauma or illness, fall into the broader category of developmental disorders called "Special Learning Difficulties" and are distinguished in disorders in reading, spelling, numerical skills, mixed form of disorders, other types of school-related disorders. Special learning difficulties are a much-discussed area in special education and this is evident from the plethora of definitions used by the scientific community (Klasen, 1972). Dyslexia, the most popular category of Special Learning Difficulties was defined by the International Society of Dyslexia in 2002 as follows: "Dyslexia is a neurological disorder, often inherited, which prevents the acquisition of language. It differs in severity from person to person and manifests itself with difficulties in the perception and expression of the language, especially in phonological processing, reading and writing, spelling and sometimes

arithmetic. Dyslexia is not the result of lack of motivation, sensory dysfunctions and inadequate educational and environmental opportunities, but may coexist with the above. Although dyslexia lasts throughout life, people with dyslexia often respond successfully to timely and appropriate intervention". However, the definitions that have been formulated from time to time and the studies that have been carried out have shown solid evidence in both dyslexia and specific learning difficulties: a. the ability-performance variance, b. the element of reading which is involved in all learning functions, and c. the "normal" general cognitive ability, separating the learning difficulties from the mental retardation (Ramus, 2013). Some features of dyslexia that are directly related to reading and writing such as the slow development of reading and writing, and the difficulty in acquiring these skills, the slow learning of letter matching and their sounds, the inability to distinguish visually similar letters , digits and words, the incorrect placement of letters in the word, or even the skipping of letters, the appearance of inversions and distortions of written symbols, the existence of mirror writing, the weakness in the sequential organization of information, problems in language processing and orientation problems make reading and writing procedures an insurmountable difficulty for a dyslexic child. In particular, not all children with dyslexia have all or the same characteristics in the same degree (Ramus, 2013). The difficulties they encounter relate to the cognitive, the learning, the psychosocial as well as to the motor domain. With regard to the cognitive field, these children experience difficulties in visual information processing, acoustic processing, verbal or numerical sequencing and automation. As the child grows up, it is likely to have difficulty in attending school, in terms of following and understanding the delivery of the lessons and participating in motor activities in the physical education lesson as well as in school breaks. In the area of learning, children with dyslexia face difficulties in reading and writing (Tziva-Kostala, 2011). Due to the difficulties in reading, they are unable to keep the information they receive from the text as they read to learn the content. This makes learning through reading particularly difficult, perhaps unfeasible (Fawcett,, 1992), and has a negative impact on the psychosocial field as well. In the writing, children with dyslexia have difficulty following spelling easier and faster to understand the new elements being imported, but also to recall what already exists. They miss, add or reverse letters and syllables. They do not use punctuation, and it is difficult for them to produce a written word that is properly organized and meaningful. They also write slowly and their graphic character is often unreadable (Fawcett, 1992) In particular, due to the repeated school failure experienced by students with dyslexia, they adopt the idea that they are mentally deficient in relation to their classmates and that any effort is in vain. This attitude leads to a reduction in self-esteem, motivation for learning and thus to resignation from the learning process (Ramus, 2013 and Fawcett, 1992). In the motor sector, due to the lack of automation and phonological awareness, children with dyslexia lag behind in motor skill performance. The hypothesis of the automation deficit predicts that there will be deficits not only in articulation but also in simple motor skills without linguistic elements such as passing beads while the phonological deficit hypothesizes that despite a possible lack of articulation, any deficit in passing the beads should be relatively mild and transient (Klasen, 1992). The classical case of Lashley (1951), that skillful movements are shared in neural mechanisms at exact time (Lenneberg, 1967), has incited a series of neuroanatomic studies showing that brain mechanisms for temporal organization of language processes overlap extensively with those for skillful manual action (Sugden, 1987). In the DSM-IV American Psychiatric Association,[4] Developmental Coordination Disorder (DCD) is described as a motor disorder characterized by a serious problem in developing the coordination of movements that significantly interferes with the performance of day-to-day activity or/and academic performance. Previous studies (e.g., Klazen, 1972) reported that a high proportion of Dyslexia children (42%) experience motor disorders. call the coexistence of cognitive and motor learning difficulties as "comorbidity". Brying and Michelsson as well as Sugden and Wann (Sugden, 1987) shared the same view. Similarly, subsequent surveys showed lower performance in balance and manipulative skills, as well as difficulties in locomotor skills (Ramus, 2003). Tziva-Kostala, Kourtessis et al. (Tziva-Kostala, 2011), reported that dyslexic children do not adequately perform ball skills. Kourtessis, Thomaidou et al. (Kourtessis, 2008), concluded that 65% of Dyslexia children exhibited motor behavior (ball skills, balance) corresponding to a lower level than their age; 50% of these children were identified by concurrent DCD. Accordingly, O'Hare and Khalid (O'Hare, 2002), stressed that children with DCD had problems in writing and reading compared to children without motor disorders. In general, the few studies that have been conducted on the subject, involve small samples of children with Dyslexia, in a wide range of ages of about 6 to 12 years, and include evaluation tools mainly for fine motor skills such as balance, and ball grip. Therefore, gross motor skills such as locomotor and manipulative have not been adequately investigated in children with Dyslexia. At the same time, gross motor skills have an important place in the school curriculum; their learning is essential as they form the basis for effective engagement in sports, gymnastics, dance, and leisure activities (http://www.fa3.gr/phys_educ_2/9diathematiko_dimotiko.htm) and contribute to the overall child development through well-structured movement activities (http://www.fa3.gr/phys_educ_2/9_diathematiko_dimotiko.htm). Also, children with better developed gross motor skills may find it easier to engage in more physical activity than those with less developed motor skills. Data from relevant studies showed however that teachers do not have the necessary attitudes, knowledge and skills to manage and improve the gross motor skills of dyslexic children (Lenneberg, 1967).

The purpose of this study was to compare the gross motor skills of children with and without dyslexia in upper elementary grades. The research questions of this study were:

- Would fourth, fifth and sixth grade children with and without Dyslexia differ significantly in qualitative performance of locomotor and manipulative skills?
- Would there be a significant difference in qualitative performance of locomotor and manipulative skills among children with dyslexia in different grades?
- Would there be a significant difference in qualitative performance of locomotor and manipulative skills among children without dyslexia in different grades?

MATERIALS AND METHODS

One hundred and twenty children, 9 to 12 years of age, from different regions of Greece participated. Of the 120 children, 53 were diagnosed with Dyslexia, by the Center for Differential Diagnosis and Support and 67 children without dyslexia; 50

were in the 4th grade, 39 in the 5th grade and 31 in the 6th grade. The research was approved by the Institute for Educational Policy and by the Ethics Committee of the Democritus Thrace. Information upon the study purpose and procedure was then communicated to all schools in Greece for the approval of the directors. Parents provided written consent about their children participation in the study. The protection of personal data was ensured with full anonymity of the students. Also, their right to withdraw from the research at any stage they wanted was secured. The Test of Gross Motors Development 2 [1], which includes twelve fundamental motor skills, was used to evaluate the quality of motor skills of students. It includes two categories: a) locomotor skills (run, gallop, hop, leap, horizontal jump, skip, slide) and b) object control skills (striking a stationary ball, stationary dribble, catch, kick, overhand throw, underhand roll).For each skill there are three (leap, skip, stationary dribble) up to four performance criteria (run, gallop, hop, horizontal jump, slide, striking a stationary ball, catch, kick, overhand throw, underhand roll). The maximum score for the locomotor skills category is 26 points and for the manipulative skills category 23 points. Each child performed two trials of each skill and the score for each criterion was 0 or 1. Two trained observers were recording the scores of each child. Grade 1was given when a criterion was observed in both attempts. The scores of the skills in each category were summed up, thus forming a total score for the category of locomotor skills and one for the category of manipulative skills. The assessment procedure of each child lasted about 15-20 minutes.

RESULTS

Table 1 shows means and standard deviations of all groups in both skill categories. Two Way Analysis of Variance showed that there was a statistically significant group X class interaction in locomotor skills, $F_{1,119}$= 12.17, p <.001. The following Pairwise comparative tests showed statistically significant differences between children with and without dyslexia in 4th grade (MD = 0.28, p <.001), 5th grade (MD = 0.26, p <.001), and 6th grade (MD = 0.59, p <.001). Students with dyslexia exhibited lower performance than their classmates, in all three grades. Also, statistically significant differences were found between students with dyslexia of 4th and 6thgrade (MD = 0.36, p <.001) and 5th and 6th grade (MD = 0.38, p <.001).Higher qualitative performance of locomotor skills was achieved by students with dyslexia in 4th and 5thgrades. In addition, a statistically significant difference in qualitative locomotor skill performance was found between 4th and 6th grade students without dyslexia (MD = 0.38, p<.001), in favor of the youngest. In the manipulative skills, the main effect of the factor "group" was statistically significant, $F_{1,119}$ = 89.68, p<.001. Students with and without dyslexia were significantly different (MD = 0.29, p <.001) in qualitative performance of manipulative skills, with the latter performing significantly better.

DISCUSSION

Dyslexia affects children in all areas, academic, social and motor (Kadesjo, 1999). The purpose of this research was to evaluate the gross motor skills of students with and without learning difficulties (Dyslexia) and to find possible differences in children 9-12 years of age. The sample of 120 students was roughly equally distributed in terms of gender, class and difficulty and quite representative, as it was conducted in various regions of Greece. The specific classes were chosen because the diagnosis of Dyslexia children is identified from the 2nd grade (8 years) and afterwards, in order to have their spelling skills developed. Children aged 9-12 (4th-6th grade), based on the elementary physical education curriculum, are expected to have developed motor, cognitive and collaborative skills, and to play games combining skills that are included in the evaluation tool used in the present study. Also, the basic skills in which children were evaluated are used daily in their play. Regarding the test used, few researchers used it to evaluate the motor skills of two different groups, as in the case of students with and without difficulty. It also combines locomotor skills (jogging, galloping, etc.) that require movement of the lower limbs, but also manipulative skills (dribbling, throwing, blowing ball etc.) that require movement of the upper limbs (Ulrich, 2013). The results showed that Dyslexia children's performance ranges well below the average of their classmates. Their difficulty in motor skills could be attributed to a neurological problem or a difficulty in balance. Lack of co-ordination (Fawcett, 1992), which is related to lack of concentration in the activity and memory (Fawcett, 1992) is also likely to play a significant role in their performance. Also, cerebellar dysfunction observed in dyslexic children impedes their motor performance (Kourtessis, 2008). Similarly, difficulties in qualitative performance of manipulative skills of children with dyslexia may be due to coordination difficulties, that are inconsistent with their age and the stage of development (Ramus, 2003). This affects them both academically and motorically (Kourtessis, 2008). Indeed, it has been reported that they usually present lower manipulative skills in some areas than their typically developing peers (Fawcett, 1999 and Snowling, 2000). Children are taught more manipulative skills but also use them more in the game and maybe even though they have differences they are not important for any age separately.

Further, the results showed that Dyslexic children of the 4th- and 5th grade children with dyslexia had better performance on locomotor skills than those of the 6th grade. According to earlier surveys, as the age of children increases the difficulties in movement and balance increase (Candell, 1994). It may also be due to the fact that appropriate teaching strategies were not applied to help these students learn basic motor skills, when they were enrolled in lower grades. The findings of the current research highlight the difficulty of children with dyslexia in coordinating their movements and confirm the international literature (Ulrich, 2013; http://www.fa3.gr/phys_educ_2/9_diathematiko_dimotiko.htm, 2006; Jongmans, 2003; Iversen, 2005; Henderson,, 1998), providing evidence that gross mobility is less developed than the one that fits their age, as they lag behind in locomotor skills and in the general movement of the lower limbs (Jongmans, 2003). In particular, children with dyslexia encounter particularly significant problems in manipulative skills, in balance skills (Missiuna, 2006 and Jongmans, 2003; Iversen, 2005) or in skills with high balance demands, such as locomotor skills. Thus, the difficulty faced by them leads to low scores, and as a result they are those that are selected last by their peers in group games, or even worse, it negatively affects their self-perception and their willingness to continue to try in the Physical Education course (Missiuna, 2006) However, targeted intervention programs can contribute to the improvement of motor performance of children with dyslexia (Dewey, 2002).

	4th Grade				5th Grade				6th Grade			
	With Dyslexia		Without Dyslexia		With Dyslexia		Without Dyslexia		With Dyslexia		Without Dyslexia	
Gross Motor Skills	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Locomotor Subtest												
Run	3.22	1.06	4	1.02	3.29	1.04	3.95	.21	1.05	.2	3.77	.94
Gallop	2.13	1.42	3.93	.37	2.94	.89	4	4	2.4	.2	3.72	.95
Hop	2.18	1.13	3	.13	2.35	.99	3	2	3	.2	2.83	.7
Leap	3.09	.97	4	.95	3	1.22	4	.95	2	1.02	3.61	1.14
Horizontal Jump	2.63	1.55	3.86	.44	2.41	1.22	4	.95	4	.95	3.77	.94
Skip	2	1.19	3	.1	2	.92	4	.95	3	.1	3.77	.94
Slide	3.18	1.43	3.96	.18	3.11	1.31	4	.95	3	.1	3.77	.94
Sum	18.45	5.88	25.75	.83	19.11	4.97	25.95	.21	16	4.75	24.33	6.14
Object Control Subtest												
Striking a Stationary Ball	2.4	1.4	3.89	.4	2.41	1.12	2	.92	2	1.5	2.94	1.21
Stationary Dribble	2.4	1.05	3	.8	2.11	1.26	3	1.27	3	1.26	2.94	1.21
Catch	3.31	1.17	4.11	.7	2.94	1.29	4.2	.8	4	.87	3.77	.94
Kick	2.54	1.81	3.87	.65	1.35	1.32	3.95	.21	4.31	.85	3.77	.94
Overhand Throw	2.77	1.6	3.93	.37	2.82	1.55	4	.95	2	.92	3.77	.94
Underhand Roll	2.22	1.65	3.48	.94	1.23	1.43	3.95	.21	4	.95	3.77	.94
Sum	15.68	6.22	22.13	1.99	12.88	4.91	20.9	.30	19	5.1	21	4.6

Conclusion

Dyslexia seems to be associated with low levels of gross motor development. Early diagnosis of motor skill performance and of motor coordination disorders offers more opportunities for recognition, intervention and treatment to both the disorder itself and the specific learning difficulties. Future studies could therefore examine the impact of school interventions on the performance of children with dyslexia and motor difficulties. The examination of the effects of physical education teachers' training programs on the adoption of appropriate teaching practices and the co-education of students with and without dyslexia and motor difficulties would also be of crucial importance.

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