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ORIGINAL ARTICLE

Prevalence of developmental coordination disorder among Greek children with learning disabilities

Thomas Kourtessis*, Evgenia Thomaidou**, Anastasia Liveri-Kantere*, Maria Michalopoulou*, Katherine Kourtessis, & Efthimis Kioumourtzoglou*
* Democritus University of Thrace, ** Aristotle University of Thessaloniki

Abstract
The purpose of the present study was a preliminary investigation of the prevalence of probable developmental movement difficulties among children with learning disabilities within Greek school environment. Participants were 107 students from eight elementary schools in North-Western Greece. Fifty four of the participants had been recently diagnosed as children with learning disabilities. Fifty three classmates of the same age and sex but with no learning disabilities formed the control group. The Movement Assessment Battery for Children (Henderson & Sugden, 1992), which was used for motor assessment, includes three motor domains: manual dexterity, ball skills and balance. According to the results, 35 children (64.8%) of the experimental group exhibited severe movement problems while the respective number for the control group was eight (15.1%). Further statistical analysis revealed significant differences between the two groups regarding all motor domains as well as the total motor score. Within its limitations, the current study seems to be in agreement with the concurrent relative bibliography which states that, quite frequently, children with learning disabilities face motor coordination disorders as well. Despite the preliminary nature of the present study, it seems that motor assessment should be an integral part of the more general procedures of the assessment of learning disabilities.

Keywords: *Learning disabilities, movement difficulties, childhood, motor assessment*

Introduction

Children with Learning Disabilities (LD) are referred to those displaying a severe discrepancy between intellectual ability and performance on a standardized achievement test (Woodard & Surburg, 2001). They are usually diagnosed when individually administered standardized tests in mathematics, reading or written expression are well below that expected for their respective age, intelligence and schooling (American Psychiatric Association, 1994). Without any obvious pathology, children with LD may further 'exhibit significant movement difficulties that continue to cause problems throughout the school years' (Miyahara, 1994, p. 368). According to Woodward and Surburg (1997), some students with LD present subtle movement difficulties while others may only present minor motor awkwardness, such as poor balance and/or poor coordination. Learning Disabilities are often associated with and sometimes confused with Attention Deficit Hyperactivity Disorder (ADHD) behaviours and Developmental Coordination Disorders (DCD, Beyer, 1999). According to Jongmans, Smits-Engelsman & Schoemaker (2003), the above three conditions (LD, DCD and ADHD) frequently show comorbidity, which, until recently, has received little scientific attention. More specifically, LD may be associated with higher rates of DCD (American Psychiatric Association, 1994), while LD and ADHD may present a 50% ratio of comorbidity (Jongmans et al., 2003). [1]

*Correspondence: Thomas Kourtessis, Democritus University of Thrace, Department of Physical Education & Sport Science
University Campus, 69100 Komotini, Greece, E-mail: tkourtes@phyed.duth.gr

Developmental Coordination Disorder (DCD) is described by the Diagnostic and Statistical Manual-IV (DSM-IV, American Psychiatric Association, 1994) as a movement disorder characterized by a marked impairment in the development of motor coordination abilities that significantly interferes with performance of daily activities and/or academic achievement. The difficulties observed are not consistent with the child's intellectual abilities and are not caused by a pervasive developmental disorder or general medical conditions that could explain the coordination deficits (American Psychiatric Association, 1994). Furthermore, it is stated that manifestations of the disorder regarding young children may include clumsiness and delays in achieving developmental milestones such as walking, crawling, sitting, tying shoelaces, buttoning shirts, zipping pants. In the current study, the terms "probable DCD" and "movement difficulties" will be used interchangeably, since a) the assessment was based on the scores of only one diagnostic instrument and b) the second criterion described by DSM-IV (limitations in activities of daily living, American Psychiatric Association, 1994) was not measured.

Klazen (1972) reported a rather high percentage (42%) of children with learning disabilities facing motor difficulties. Later, Brying and Michelsson (1984) found that 18% of their sample of learning disabled children exhibited motor problems as well, while Sugden and Wann (1987) discovered that 29-33% of the assessed children with learning disabilities also presented problems in motor coordination. Through cluster analysis Miyahara (1994) found that, among 160 boys and girls with learning disabilities, more than 60% exhibited either motor problems or various difficulties in motor coordination. However the above results should be examined with caution since about 40% of the total sample was free of motor problems.

Specific learning disabilities (SLD) have been associated with coordination disorders in the past (Jongmans et al., 2003; O'Hare & Khalid, 2002). O'Hare and Khalid, (2002) for example stressed in their study that children with DCD had problems in writing (87%) and reading (70%), compared to children without motor difficulties (15% and 14% respectively). Moreover, Wimmer, Mayringer and Raberger (1999) stressed the fact that balance problems disappeared when children with dyslexia were excluded from their sample. Lower movement performance regarding balance and manual dexterity have also been reported by Jongmans and colleagues (2003) as well as by Ramus, Pidgeon and Frith (2003) who noted difficulties in locomotion as well as in "threading beads" in almost half of British children with dyslexia. They also concluded that the above difficulties may stem from attention deficits or developmental coordination disorders.

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Identification and assessment of learning disabilities in Greece is being performed by the public Centers of Diagnosis, Assessment and Support. However, the motor domain is being rather overlooked and under-assessed. Furthermore, there are no studies so far to investigate the existence of probable DCD in children with learning disabilities within Greek school environment. Therefore, the purpose of the present study was a preliminary effort to assess the probable movement difficulties of Greek elementary-school students with learning disabilities.

Methods

Participants

Participants were 107 students (*Mean age* = 113.02 months, *SD* = 16.95) from eight elementary public schools of two urban area of North and North-Western Greece. Fifty four of the participants (36 boys and 18 girls) had been recently diagnosed by the local Center of Diagnosis, Assessment and Support as children with learning disabilities, which were not caused by mental retardation, cerebral palsy or any other handicaps (*Mean age* = 113.04 months, *SD* = 17.15). The other 54 children (36 boys and 18 girls) of the same age and sex with the children of the experimental group but with no learning disabilities formed the control group. A girl from the control group did not complete the assessment and therefore the control group was formed by 53 children (*Mean age* = 113 months, *SD* = 16.92).

Measurements

The Movement Assessment Battery for Children (MABC, Henderson & Sugden, 1992), was used for the motor assessment of the children. The specific test is a battery especially designed to assess movement difficulties that determine, in a large degree, the child's social integration mainly in school (Henderson & Sugden, 1992). MABC is a norm referenced test which covers three major motor domains: (a) manual dexterity, (b) ball skills, and (c) static and dynamic balance. There are 32 tasks organized in four sets (eight tasks per set). Each band corresponds to one of the four Age Bands, which the test is designed for: Age Band 1 (ages 4-6), Age Band 2 (ages 7-8), Age Band 3 (ages 9-10), and Age Band 4 (ages 11-12). Task characteristics are the same for each Age Band.

The child's performance on each task (seconds, steps, catches, etc.) corresponds to a respective motor score from "0" (complete success) to "5" (fail-severe movement difficulty). The scores of all eight tasks are added at the end and their sum constitutes the child's motor score. Thus, a total motor score vary from "0" (for a child with no movement difficulties) to "40" (for a child with severe movement difficulties). This score denotes the child's motor ability compared to his/her age level (note that lower scores denote better performance). According to the norms (Henderson & Sugden, 1992) that are included in the test the differentiation criteria are the lowest 15th and 5th percentiles. If a child has a motor score that corresponds between the 15th and 6th percentiles, he or she exhibits moderate difficulties and is characterized as "at risk". If his or her motor score corresponds below the 5th percentile then the child has severe motor problems. Reliability and validity of the Movement ABC are good and are presented in details in the test's Manual (Henderson & Sugden, 1992). Regarding Greece, relative studies have shown acceptable reliability and validity results. Kasamakis (2005) has examined test-retest reliability in 82 Greek schoolchildren. Intraclass correlation coefficient between the two measures was quite adequate (.78). In another relative study, Ellinoudis, Kourtessis, Kiparissis, Kampas and Mavromatis (in press) explored the construct validity of MABC. The results from the factor analysis revealed a structure quite similar to that of the actual battery. The authors concluded that despite the fact that more relative research is necessary, it seems that MABC can be used safely in Greek school population (Ellinoudis et al., in press). The test is being used

widely in the international relative literature (Candell, Ahonen & Smyth, 1994; Chow & Henderson, 2003; Chow, Henderson & Barnett 2001; Dunford, Street, O' Connell, Kelly & Sibert, 2004; Geuze & Borger, 1993; Kourtessis, Tzetzis, Kioumourtzoglou & Mavromatis, 2001; Simons & Schwarz, 2001; Sugden & Chambers, 2003; Wright & Sugden, 1996).

Procedures

Motor assessment took place in especially prepared rooms in the schools. Each student was assessed individually. The tasks were applied with the order that is given in the Manual in order to retain its characteristics intact. Prior to the initial assessment the examiner had visited the schools several times and consequently became familiar to the children. Moreover, the (primary) researcher dedicated at least 15 minutes prior to each individual assessment, talking to the child and explaining what they were going to do.

Treatment of the data

Descriptive frequency analysis was used to obtain the actual percentages that corresponded below or above the criteria set by MABC's norms. Multivariate analysis of variance was performed to investigate probable differences between the two groups regarding the three motor domains of the test. "Manual dexterity", "ball skills" and "balance" served as dependend variables while "group" (LD/nonLD children) was the independent variable. Since the total MABC score is the sum of the domain scores, a separate one-way analysis of variance was performed to establish differences between children with and without LD. "Total MABC score" was the dependent variable while "group" was the independent one.

Results

In Figure 1, the distribution of children for both groups is presented based on their performance and the norms given by MABC. Thirty five children of the experimental group (64.8%), 25 boys and 10 girls presented performances corresponding to the lowest 5%, showing severe difficulties. Eight children (14.9%), four boys and four girls, were placed among the 6^{th} and 15^{th} percentile position showing that they were probably at "risk". Accordingly eight children form the control group (15.1%), five boys and three girls, exhibited severe motor difficulties (performing lower than the 5^{th} percentile position), while 11 children (20.7%), nine boys and two girls were "at risk".

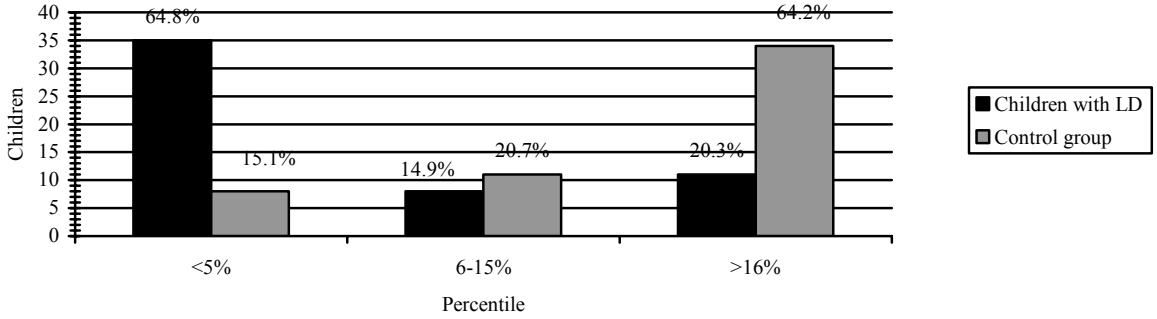

Figure 1. Distribution of children based on their performance and Norms given by MABC (<5% denotes severe coordination disorders, <15% denotes "at risk", >16% no movement difficulties)

Figure 2 presents a schematic comparison between the means in three motor domains of MABC and the general motor score of the groups. One-way multivariate analysis of variance showed significant differences regarding the motor domains (*Wilks'Lambda* =.714, $F_{(3,103)}$ = 13.734, $p < .001$, $n^2 = .287$). Further analysis showed important differences between the two groups in the areas of manual dexterity ($F_{(1,105)} = 29.910$, $p < .001$, $\eta^2 = .222$), of ball skills ($F_{(1,105)} = 10.774$, $p < .01$, $\eta^2 = .093$) and of balance ($F_{(1,105)} = 33.129$, $p < .001$, $\eta^2 = .240$), with the children of the control group to exhibit higher performances (see Figure 2). Finally, regarding total motor score, one-way analysis of variance revealed significant difference between the experimental and control group ($F_{(1,105)} = 40.72$, $p < .001$, $\eta^2 = .279$), with the control group to present significantly higher motor scores.

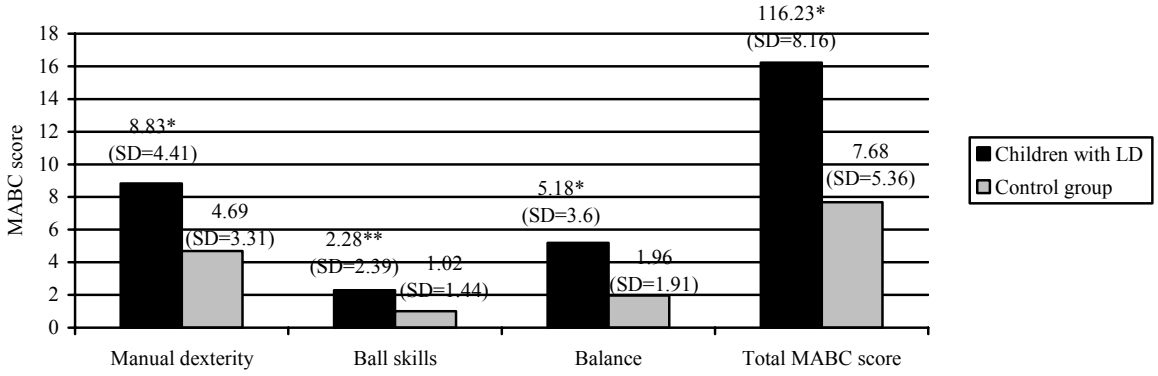

Figure 2. Comparison of the means of the three motor areas and the general motor score of the MABC between children with and without learning disabilities (higher performance shows more serious difficulties, *p<.001, **p<.01)

Discussion

The purpose of the present study was to assess the prevalence of probable DCD in a sample of Greek elementary-school students with learning disabilities (LD). The results revealed that approximately 65% of children with LD exhibited motor behavior that corresponded to the lowest level compared to their age.

The present findings are in agreement with the literature, where prevalence studies indicated that at least 50% of children with LD are identified with concomitant DCD (Jongmans et al., 2003; Kaplan, Wilson, Dewey & Crawford, 1998; Rintala, Pienimäki, Ahonen, Cantell & Kooistra, 1998; Sugden & Wann, 1987; Visser, 2003). Similar results have been found regarding many types of learning disabilities such as Specific Language Impairments, Reading Disorders, etc., suggesting that many cases may reflect a more generalized deficit, instead of a pure language, attention or coordination problem (Hill, 2001; Miyahara, 1994; Sergeand, Piek & Oosterlaan, 2006; Visser, 2003). Rintala and colleagues (1998) for example found that 71% of children with Developmental Language Disorders (DLD) manifested DCD as well. It should be noted that in the present study 35 out of the 54 children (64.8%) consisting the LD group exhibited definite coordination disorders. Dewey, Kaplan and Crawford (2002) have reported that learning disabilities, DCD and ADHD are prevalent in families of low educational level and socioeconomic status. The possibility that the current LD group was living with families with low socioeconomic status was not investigated in the present study. However, the correlation between socioeconomic family level and the co-existence of LD and DCD in children should be the goal of future research consideration. Another eight children of the experimental group (14.9%) of the present study were characterized as "at risk", exhibiting borderline motor performance. In relative studies (i.e. Kaplan et al., 1998; Smits-Engelsman et al., 2003), such borderline cases have been considered as DCD cases. If that was the case in the present study one can see that the prevalence of DCD among the Greek children with LD would be ejected from 65% to almost 80%. However, according to the instructions of the MABC the term "definite movement difficulties" refers only to the cases which correspond below the 5th percentile (Henderson & Sugden, 1992). Therefore, children "at risk" were not considered as probable DCD cases in the current study. On the other hand, borderline cases form definitely an "alarm" group which does not require immediate intervention, but it should be under close consideration and observation (Henderson & Sugden, 1992).

Concerning motor performance in the present study, children with LD performed significantly lower across all motor domains of the MABC, compared to the control group. The above finding is in agreement with studies supporting that children with learning disabilities exhibit delays in fine motor coordination, and poor static and dynamic balance (Cermak & Larkin, 2002; Cratty, 1996). Moreover, Jongmans and colleagues (2003) stressed that if concomitant learning disabilities are present in children with DCD, the severity of percetpuo-motor dysfunctions increases. In the study of Jongmans and colleagues(2003), children with a combination of DCD and LD performed very poorly on manual dexterity tasks as well as on dynamic balance. Regarding ball skills, one can see by observing Figure 2, that the scores of both groups were relatively low, denoting moderately poor performance (Henderson & Sugden, 1992). Concequently, the statistical significance as well as effect size were lower compared to those of manual dexterity and balance. Critchley and Critchley (1978) have stated that children with learning disabilities, such is dyslexia, often show high performance in tasks requiring the use of a ball. Since ball skills are included in many everyday activities of children, it seems that through everyday direct and indirect practice they are able to maintain at least a moderate level of performance. However, if the above finding is a circumstantial or a constant trend remains to be investigated.

An important implication that stems from the present findings is that a detailed and complete motor assessment may be incorporated to assess students with LD. So far, identification and assessment of children with LD in Greece is being performed by the public

Centers of Diagnosis, Assessment and Support for learning disabilities. However, the motor domain is being rather overlooked and under-assessed.

Finally, it should be stressed that a limitation of the current study was that access to the personal files of children with LD was not possible because of the very strict privacy policy. Thus, researchers were not able to combine specific learning disabilities to specific motor difficulties. To that extend, more detailed research is needed to shed more light in the issue of comorbidity within the spectrum of specific learning disabilities. Furthermore, no estimation of ADHD was obtained in the present study, regarding children with LD. Beyer (1999) has reported that 15 to 42% of children with LD may also exhibit ADHD. There is therefore a possibility some of the difficulties to be a result of probable ADHD and not DCD. Finally, the relatively high prevalence of movement difficulties among the control group prevents from final and definite conclusions. However, within the limitations that stem from its preliminary nature, the present study seem to underline the fact that severe movement difficulties among children with LD are a very common situation which calls for further relative research as well as for a more thorough approach regarding the management of the motor domain of children with LD.

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