«Original Article»

A comparison between prevalence and severity of postural abnormalities in children with developmental coordination disorder and healthy children

Gholam Ali Ghasemi[1], Vahid Seyed Azizi[2], Morteza Sadeghi[3*], Bashir Sohrabi[2]

1-Assistant Professor in Pathology and Corrective Movements, School of Physical Education and Sports Sciences, University of Isfahan, Isfahan, Iran.

2-M.Sc. in Pathology and Corrective Movements, School of Physical Education and Sports Sciences, University of Isfahan, Isfahan, Iran.

3-Ph.D. student in Pathology and Corrective Movements, School of Physical Education and Sports Sciences, University of Isfahan, Isfahan, Iran.

**Corresponding author:*
Morteza Sadeghi; Ph.D. Student in Pathology and Corrective Movements, School of Physical Education and Sports Sciences, University of Isfahan, Isfahan, Iran
Tel: +989171745485
Email: morteza67sadeghi@yahoo.com

Abstract

Background: Motor skills disorder in children with motor dysfunction is a common disorder in childhood. The aim of this study was to investigate the prevalence and severity of musculoskeletal disorders in children with developmental coordination disorder in comparison with healthy children.

Material and methods: Using developmental disorder coordination questionnaire (DCDQ'07), 59 male children with a developmental coordination disorder (length:134.71±6.91, weight: 31.66±6.66, age: 9.33±0.77) and 59 healthy male children were selected, and 13 physical anomalies were evaluated using flexible ruler, goniometer, mirror boxes, tape measure and chessboard. The data were analyzed using SPSS 16, independent *t*-test and Mann-Whitney U test with statistical significance at $p< 0.05$.

Results: Intensity prevalence of forward head, kyphosis and lordosis posture, crooked neck, shoulders down and tilted back abnormalities in male children with developmental coordination disorder was significantly higher than in the healthy group ($p<0.05$). However, there was no significant difference in prevalence of pelvic tilt, flat foot (foot pronation), pes cavus (foot supination), hallux valgus, hammertoe, knee valgus, and genu varum between the two groups ($p< 0.05$).

Conclusion: The results of our study revealed that the children with developmental coordination disorder need more attention and effective corrective action plans.

Keywords: Musculoskeletal disorders, Developmental coordination disorder, Developmental coordination disorder questionnaire

►*Please cite this paper as:*
Ghasemi GA, Seyed Azizi V, Sadeghi M , Sohrabi B. A comparison between prevalence and severity of postural abnormalities in children with developmental coordination disorder and healthy children. Jentashapir J Health Res 2014; 5(3):117-123

Received: 13.06.2013 **Accepted: 27.01.2014**

Introduction

Any deviation from the ideal body posture is unpleasant not only because of the irregular physical stature, but also for its negative impact on muscles efficacy and making one more susceptible to musculoskeletal disorders, nervous disorders, and pathological impairments of neuromuscular and musculoskeletal systems (1). In general, causes of skeletal abnormalities include congenital and genetic disorders, some diseases and injuries, inactivity, inappropriate postural patterns in standing, sitting, lifting and carrying heavy objects, body type, age and physical condition, lack of growth stimuli, mental states and cultural and educational problems (2). Lack of attention to organic weaknesses and structural defects that occurs during childhood and adolescence (the period of rapid growth) often leads to non-compensable disorders in the next stages of one's life that disrupts normal body functions and may even reduce longevity (3-4).

Developmental Coordination Disorder (DCD) occurs when a delay in the development of motor skills, or difficulty coordinating movements, results in a disability in daily activities. DCD is a scientific and academic term, which American Psychiatric Association has proposed in its revised literature of Diagnostic and Statistical Manual of Mental Disorders to describe this group of children (5-6). These children have no interest to participate in motor activities (7). Repeated failures of performing these actions will cause a child avoid participating in such activities (8). In addition, they might demonstrate intolerant, dissatisfaction and low self-esteem (9). Children with DCD do not have any problem in their nervous system, but their motor growth is less than their chronological or their real age (10). DCD is one of the motor disorders with about 5-6% prevalence in school-aged children (11). Most of the researches about DCD are related to spinal abnormalities in these children. For example, Seyedahmadi et al. (2011) showed that the spinal abnormalities have a high prevalence rate in these students, on the other hand these abnormalities lead to mobility limitations in them (12).

Teimouri et al. (2012) indicated the high prevalence of spinal abnormalities in children with DCD. Accordingly, only 36 to 40% of the students had a normal body posture and 60% of the boys and 33.63% of the girls had spinal abnormalities (13). Frederick et al. (2006) reported that these children had short steps length and more frequency during walking. Their trunks had high deviation during walking and they had low plantar flexion rate in toe-off (14) Larkin and Hur (1991) characterized the physical and motor with a flaw in head control, flexed arms in standing position, body stiffness during movement, sever hip flexion, obvious asymmetry, wider base of support and shorter steps (15).

The present study was conducted aiming to investigate the prevalence and severity of postural abnormalities in children with DCD and healthy children. It considers the risks and complications of physical abnormalities such as depression, lack of efficiency in daily activities (16), the high prevalence of physical abnormalities in school-age children (17), and possibility of severity of these abnormalities in DCD children due to existence of physical abnormalities. The primary aim of this study was to obtain general information on the prevalence of this disorder and to assess postural abnormalities in the children, and to compare them with healthy children. It is believed that postural abnormalities are directly associated with DCD. therefore, teachers and coaches should pay special attention to these children and utilize suitable corrective exercise programs for them.

Material and methods

In the present field study, comparative method is used. The participants consisted of 118 male school-age children with and without DCD living in Meshkinshahr city. We used available sampling method and the children were selected after obtaining parental consent form (59 male children per group). They were selected according to research field and we chose the appropriate test to use statistical analysis. A flexible ruler was used to measure kyphosis and lordosis. Seidi et al. (18) reported high validity and reliability (89% and 92%) for flexible ruler in measurement of lumbar lordosis. To measure the spine kyphosis, T1 and T12 vertebras were identified and marked. Then we put flexible ruler on the spine and by applying a gentle pressure, the form of vertebral column transferred on ruler, T1 and T12 vertebras were marked on it and then transferred on a piece of paper. To draw a spine curve, the same process was repeated by determining the L1 and L5 of lumbar vertebrae (13). In the next step, in order to obtain quantitative information, two points on the spine curve were connected and the length (L) of created line was measured using a ruler with 1 mm accuracy (L). The vertical distance from this line to the deepest point of the considering curve (arc) was measured (H).

Lordosis and kyphosis angles a defined as $\theta = 4arc\tan(2H/L)$ (19).

The measurement of forward head angle is carried out using a goniometer. In this method, participates are asked to remove their upper garments for the examiner to find the seventh cervical vertebra via touching (20). Then, while the participants were standing relaxed, they were asked to put their body weight equally between both legs and look straight. Examiner put the fixed arm of goniometer along the seventh cervical vertebra so it would be in parallel with the ground surface. The assistant registered the angle displayed by goniometer (21). A mirror box was used to assess foot position. The examiner observed and evaluated the image of person's foot in the plane mirror. In this position, the color of curve in the bottom of feet could be detected clearly during weight bearing, a proper standard for diagnosis. In order to evaluate the cervical tilt, back tilt, uneven shoulders, forward shoulder, pelvic tilt, and hallux valgus, we used chessboard fixed at a single location. About 45 cm behind the chessboard, using paint or chalk, was marked by a + sign. This point was perpendicular to the line of gravity of the board and it was where the participant's gravity line would be located. The distance of medial malleolus of participant feet from (+) was approximately about 4 cm and the examiner was about 3-4 meter away from the chessboard. While the examiner stood in front of the chessboard, the participants were asked to adjust their body with the gravity line of apparatus by the examiner command. At this point, the observations of various features was assessed and its accuracy improved by the New York test scores (22).

In order to diagnose the children with Developmental Coordination Disorder, we used parent-completed developmental coordination disorder questionnaire (DCDQ'07). Revised DCDQ'07 consists of 15 questions on the control of movement, gross motor, fine motor skills, and general coordination. This questionnaire is designed for children between 5 to 15 years old and is typically used to diagnose children with developmental coordination disorder.

In each question, parents compared the degrees of coordination in their children to other children of the same age and scored them in a 5-point rating scales. The time required to complete this questionnaire was 10 to 15 minutes (23). The questionnaire had an acceptable reliability and validity for applying to the Iranian children (10). Chronological age calculated by subtracting a child's

birth date from the test date was computed. The options per question were added together and considered as a total score. The total scores range for this 15-item questionnaire was to be 15 to 75.

Statistical analysis

Independent *t*-test and Mann-Whitney U test in SPSS 16 was used for data analysis. In addition, MS Excel software was used to draw charts and tables. In this study, statistical significance level was set at 0.05.

Results

Table 1 details the demographic characteristics of the participants, and Tables 2 and 3 illustrate the results of the independent *t*-test and Mann-Whitney U and the mean of numerical variables.

Table 1. Demographic information of participants

Variable group	Length (cm) MD ± SD	Weight (kg) MD ± SD	Age (year) MD ± SD
Children without DCD	134.7±6.9	31.66±6.6	9.3±.77
Children with DCD	135.9±5.3	32.38±7.9	9.7±1.25

Table 2. Independent t-test results for variables tested in the groups

		Kyphosis (degree)	Lordosis (degree)	Forward head (degree)	genu varum (cm)	valgus knee (cm)
Mean	Group with DCD	44.6	55.28	15.59	2.2	0.36
	Group without DCD	35.38	45.77	10.2	2.1	0.32
T value		5.3	4.13	5.38	0.46	1.4
Significance level (P)		0.00	0.05	0.02	0.7	0.6

Table 3. Mann-Whitney U test for variables tested in groups

		Torticaly neck (%)	Uneven shoulders (%)	Scoliosis (%)	Pelvic tilt (%)	Flat foot (%)	Pes cavus (%)	Hammer toe (%)	hallux valgus (%)	Total (%)
Group with DCD	Mean	24	40	18	3	4	8	22	27	18.25
Group without DCD		14	26	5	0	2	3	14	17	10.12
Z score		2.2	2.6	3.1	1.7	0.8	1.5	1.6	1.9	7.9
Significance level (P)		0.02	0.009	0.002	0.08	0.4	0.4	0.1	0.06	0.00

Discussion

Motor difficulties and impaired coordination have a major impression on a person's life (24). Generally, students are interested in playing with and joining peer groups who can perform common activities well and easily. Hence, the students with motor disorders will simply stay away from other kids (25). This inactivity can cause muscle weakness

and problems in the skeletal structure in students and leave negative effects on their personal and social life (12). One of the obvious deficits in school-aged children is DCD and motor dysfunction, which is a developmental disorder affecting motor abilities in normal children (10). Children with DCD are reluctant in doing activities that require physical and motor responses, causing them to show a low tolerance and self-esteem (9). Physical characteristics of children with DCD are usually diagnosed by relatives who have more close relationship (family member, a teacher, or a coach) with children. The result of all these abnormalities boils down to one thing, awkward movements of the child and problem in learning and performing new motor tasks (26). The aim of this study was to compare 13 physical anomalies in children with and without DCD.

Inactivity and psychological factors are main reasons of the physical abnormalities (2). The results of this study showed that lumbar lordosis, thorasic kyphosis and forward head were more severe in children with DCD. Seyedahmadi et al. (2011) also showed that the spinal abnormalities had a high prevalence rate in school-aged children and these abnormalities limited their movements. Larkin and Hur (1991) explained that these children were weak in head control (15). Low self-confidence and low sense of self-worth for a long-term could lead to fair posture in these children(27).

Other abnormalities in upper limb such as torticalis neck, uneven shoulders, and scoliosis in children with DCD were significantly higher than in healthy children. Some factors affecting high incidence of trunk and upper limb abnormalities in children with DCD include high trunk deviation during walking (12), poor coordination between body sides in unilateral activity (28), weak balance (29), and psychological factors such as low self-esteem (30).

In another study, Seyedahmadi et al. (2011) showed that the relation between spinal abnormalities and motor dysfunction was a bilateral relation (12). Despite the fact that these children have a different gait pattern compared to their peers, and suffer from balancing issues (14,32), there was no significant difference between the two groups in prevalence and intensity of physical abnormalities of the lower limb. This might have been due to a lower incidence of these abnormalities in all the patients as well as a small sample size, which made it difficult to achieve results that are more accurate. Normal organization of skeletal system (biomotor and biomechanical) facilitates fundamental activities of daily life (33). Any disorder and inability in skeletal muscles, bones, and joints make one feel uncomfortable and may cause depression and insufficiency in daily activities (16). According to Bernard's study (1996), 88% of the children in preschool up to fourth-grade have tilted vertebrae (34).

In this study, in 59 children with developmental coordination disorder, 308 physical deformities were observed in contrast with 177 physical abnormalities in 59 healthy children, which is a statistically significant difference. High physical abnormalities in children lead to poor posture in them. If these abnormalities are not prevented early, they can cause irreparable consequences (35). Early identification is highly important because with an incomplete development, the training of good corrective action plans can be more effective (17).

Acknowledgment

We gratefully acknowledge all the parents, children, colleagues, students, and service providers in the Department of Education in Meshkinshahr city who kindly supported our research.

References

1-Novak, CB, Mackinnon, SM. Repetitive use and static postures: a source of nerve compression and pain. Hand Ther 1997; 10(2):151-9.
2-Daneshmndi H, Alizadeh MH, gharekhanloo R. Corrective exercise.SAMT pub.2006.
3-Mummaneni P.V, Deutsch H, Mummaneni V.P. Cervicothoracic kyphosis. Am Neurosurg Clin 2006; 17(3):277-87.
4-Sinaki M , Brey R.H , Hughes C A , Larson D R, Kaufman K R. Balance disorder and increased risk of falls in osteoporosis and kyphosis: significance of kyphotic posture and muscle strength. Osteoporosis International 2004; 16(8):1004-10.
5-Sylvestre A, Nadeau L, Charron L, Lepage C. Social participation by children with developmental coordination disorder compared to their peers. Disability and Rehabilitation Journal 2013;35(21):1814-20.
6-American Psychiatric Association. (2000). Diagnostic and statistical manual of mental disorders (4th ed., text rev.). doi:10.1176/appi.books.9780890423349.
7-Kanioglou A, Tsorbatsoudis X, Barkoukis V. Socialization and behavioral problems of elementary school pupils with developmental coordination disorder. Perceptual and Motor Skills 2005; 101(1): 163-73.
8-Kanioglou A .Estimation Of Physical Abilities of Children with Developmental Coordination Disorder. Studies in Physical Culture And Tourism 2006;13(2): 25-32.
9-Missiuna C. Children with developmental coordination disorder: At home and in the classroom. Canada: CanChild, Center for Childhood Disability Research 2003.
10-Afsordeh R. Psychometric properties of the Persian version of the Developmental Coordination Disorder[MA dissertation], Isfahan; university of Isfahan 2011.
11-Kadesjo B, Gillberg C. Developmental coordination disorder in Swedish 7-year old children. Journal of American Academy for child and Adolescence Psychiatry 1999; 38(7): 820-28.
12-Seyedahmadi M, Taheri HR, Pejhan A, et al. [The relationship of spinal deformities with locomotion components of kepart test in elementary school students with dyspraxia] Persian. Q J Sabzevar Univ Med Sci 2011; 18(2):125-31.
13-Teimori S, Keavanloo F, Seyedahmadi M, Koushan M, Pejhan A. The effect of regular period of corrective exercises on spinal columns position in dyspraxia students. ZJRMS 2012; 14(1):1.
14-Deconinck FJ, De Clercq D, Savelsbergh GJ, Van Coster R, Oostra A, Dewitte G, Lenoir M. Differences in gait between children with and without developmental coordination disorder. Motor Control 2006;10(2):125-42.
15-Larkin D, Hoare D. Out of Step: Coordinating Kids' Movements. Nedlands, Western Australia: Active Life Foundation, 1991.
16-Karimazad A. Corrective exercise.Office of people force education and study .1st ed. 2008.
17-Brianezi,L, Cajazeiro D.Maifrino LBM. Prevalence of postural deviations in school of education and professional practice of physical education. J Morphol Sci 2011; 28(1): 35-6.
18-Seidi F, RajabiR, Ebrahimi TI, Tavani AR Moussavi SJ. The Iranian flexible ruler reliability and validity in lumbar lordosis measurement .World Journal of sport Sciences 2009; 2(2):95-9.
19-Rahmani nia F, Shamsi A, Niaraki R. The relationship between male weight categories of students with spinal abnormalities. Journal of research in sport science 2010; 4(1): 31-48.
20-Taheri H, Mahdavinejad R, Bagherian S,Omidali Z. Comparison of forward head in persons with chronic neck pain and healthypersons. Journal of research in sport science 2012; 7(2):162-7.
21-Yip CH, Chiu TT, Poon AT. The relationship between head posture and severity and disability of patients with neck pain. Man Ther 2008; 13(2): 148-54.
22-Rajabi R, samadi H.Labrotary corrective exercise guidance.Tehran: Tehran universitypress.2008.
23-Wilson BN, Susan G, Green D, Roberts G, Bonnie J. Psychometric Properties of the Revised Developmental Coordination Disorder Questionnaire. Physical & Occupational Therapy in Pediatrics 2009; 29(2): 182-202.
24-Emma JG, Murray TM, David RB. Vision in developmental disorders: Is there a dorsal stream deficit Brain Res Bull 2010; 31;82(3-4):147-60.
25-Haghbin Nazarpak M. Analytical Dyspraxia. Res on Except Child 2006; 18(4): 465-84.
26-Mandich A, Polatajko HJ. A cognitive perspective on intervention for children with developmental coordination disorder: the CO-OP experience. Human Movement Science 2001;20(1-2):183–210.
27-Esmaeelzadeh M, Salehi H, Namazizadeh M. Effect of selected rhythmic movements on static and dynamic balance in children with Developmental Coordination Disorder. Proceedings of 7th International Congress of physical education;Tehran 2008.
28-Geuze RH. Static balance and developmental coordination disorder. Human Movement Science 2003; 22(4-5): 527-48.

29-Dewey D. Wilson BN. Developmental coordination disorder: What is it? Physical and Occupational Therapy in Pediatrics 2001; 20(2-3): 5-27.
30-Cocks N, Barton B, Donelly M. Self-concept of boys with Developmental Coordination Disorder. Physical and Occupational Therapy in Pediatrics 2009; 29(1): 6-22.
31-Woodruff SJ, Bothwell C, Myers L. Gait pattern classification ofchildren with Developmental Coordination Disorder. Adapted Physical Activity Quarterly 2002; 19(3): 378-91.
32- Rosengren KS, Deconinck FJ, Diberardino LA 3rd, Polk JD, Spencer-Smith J, De Clercq D, Lenoir M. Differences in gait complexity and variability between children with and without developmental coordination disorder. Gait Posture 2009;29(2):225-9.
33-Barnett LA, Kooistra L, Henderson SE."Clumsiness" as syndrome and symptom. Human Movement Science 1998;17(4): 435-47.
34-Wall AE. Physically awkward children: A motor development perspective, in Theory and research in learning disabilities, 1982; Plenum Press: New York. 253-84.
35-Salek B.Validity and realibility of moror observation checklist for teachers in Iranian children [MA dissertation], Isfahan; university of Isfahan 2011.