DOI 10.2478/afepuc-2018-0009

DIFFERENCES IN SELECTED COORDINATON ABILITIES BETWEEN PUPILS WITH COMMUNICATION ABILITY DISORDER AND ABLE-BODIED PUPILS

Stanislav Kraček[1], Dagmar Nemček[1], Petra Kurková[2], Wioletta Lubkowska[3], Šimon Tomáš[1]

[1]*Faculty of Physical Education and Sports, Comenius University in Bratislava, Slovakia*
[2]*Faculty of Education, Palacký University Olomouc, Czech Republic*
[3]*Faculty of Physical Education and Health Promotion, University of Szczecin, Poland*

Summary: The aim of the study was to analyse and compare the level of selected coordination abilities of pupils with communication ability disorder (CAD) and able-bodied pupils in the same age category. Two groups of participants were recruited for the study: (1) pupils attending special elementary school for children with CAD (n = 17; 5 girls and 12 boys in mean age 11.2 ± 0.7 years), (2) and able-bodied pupils (n = 20; 12 girls and 8 boys in mean age 11.4 ± 0.5 years) without gender differentiation. 5 standardised tests measuring coordination abilities were used as a primary research method (Šimonek 2015): low jump test, spatial orientation ability test, circles through running test, one leg stand test, catching ball test. Group differences were analysed with Mann–Whitney U-test for independent samples. The level of significance was $\alpha < 0.05$. We found significantly higher level of spatial orientation ability and static balance displayed by able-bodied pupils comparing pupils with CAD. The level of lower limb kinaesthetic discrimination ability, rhythmic ability, frequency and reaction time in pupils with CAD are comparable to the level of able-bodied pupils. We recommend that children with CAD should participate in regular physical activities and sports after compulsory education together with able-bodied children to improve their fine and gross motor ability, coordination abilities as well as overall physical fitness.

Key words: communication ability disorder, able-bodied pupils, coordination abilities, physical education classes.

Introduction

The level of language skills and mastering the mother tongue is closely related to school performance of pupils (Bendíková 2012). The deficiencies in the usage of the language are shown not only in the external form of the spoken language, but also in the understanding, in the usage of written form of the language, i.e. in writing and reading, and thus in the whole learning process. Difficulties with language, speech and communication which are diagnosed in pre-school age often persist at the beginning of compulsory school attendance for 60 – 80 % of pupils (Zezulková & Kaleja 2015). Pupils with disturbed communication ability can (but need not be) included in the special education. The extent and severity of special educational needs are assessed by special educational or psychological examination by school counselling centre, which justifies the need of special education (Zezulková 2009; Bendíková & Jančoková 2013). Majority of pupils with disturbed communication ability does not qualify for special education (they are not pupils with severe communication ability disorder). However, problems with language, speech and communication of mild and moderate degree can have a negative influence on school performance and on overall development of the child. The teachers, therefore, more likely meet pupils with prolonged physiological problems, on the other hand the presence of pupils with severe communication ability disorder (CAD) is less frequent (Zezulková 2011; Zezulková 2013).

There is a high correlation between the level of motor skills development and the communication abilities development (Lechta 2002). Except of language and speech disorders which are characteristic for disturbed communication ability, children with a specific learning disorders, children with specifically disturbed speech development and children with dyslalia may also have problems with fine and gross motor ability development, graphomotor problems and problems in the coordination of several movements in a row (Vrbova et al. 2012). Based on their practical experience, the authors Kolář et al. (2011) found out, that children with dyspraxia have problems with the balance, mental and muscular relaxation disorders, selective motor disorder, problems with postural adaptation, rhythm disorders, problems of movement's fluency and speed and problem to estimate the movement (Gerlichová & Králová 2014; Bendíková 2011, 2017). Holma & Tamminen (1998) found, that the level of gross motor ability is in 70 % lower in children with CAD compared to able-bodied children in the same age. The results of their research indicate, that only the minimum number of children with CAD achieved the average level of motor abilities compared to the standard. They also found, that the children with CAD significantly improved their motor abilities in four of the five motor tests after specialized motor program application. Snowling (2000) reported, that 60 % children with dyslexia often have problems with coordination abilities development and other motor abilities development. Deelstra (2006) found evidence that children with dyslexia have significant deficit in tests measuring the coordination skills such as foot tapping test and movement repetitive test. Roškotová (2010) confirmed that regularity of the stretching exercises, strengthening exercises and subsequent muscle relaxation will improve fine and gross motor ability of the pupils who have been diagnosed with dyspraxia, dysgraphia and dysorthographia. After individual exercise program application (exercises on trampolines, with over-balls, therapy masters and fit-balls), the children with CAD improved their motor abilities in five of the six tests (Roškotová, 2010). Newmayer et al. (2007) demonstrated a correlation between regular participation in physical activity and speech abilities improvement in the group of 32 children aged 2-5 years who were diagnosed with CAD. Visscher et al. (2007) also confirmed that developmental language and speech disorders are often affected by the level of physical performance.

Considering the previous research findings, the aim of the study was to analyse and compare the level of selected coordination abilities of pupils with communication ability disorder and able-bodied pupils in the same age category without gender differentiation.

Methods

Participants

The research sample comprised 37 pupils attending 5th and 6th grades of two elementary schools in Bratislava (Slovakia). The special elementary boarding school for children with communication ability disorder located at Vlastenecké námestie Street was presented by 17 pupils (5 girls and 12 boys in mean age 11.2 ± 0.7 years) and the regular elementary school of Alexander Dubček at Majerníková Street was presented by 20 able-bodied pupils (12 girls and 8 boys in mean age 11.4 ± 0.5 years) (Table 1). Pupils of both elementary schools attended physical education classes twice a week in 45 minutes duration. None of the pupil took part at extra sport activity after compulsory education.

Table 1
The basic characteristics of research samples

SAMPLES	N	AGE/YEARS	HEIGHT/CM	WEIGHT/KG	BMI
Pupils with CAD	17	11.2 ± 0.7	153.1 ± 9.0	49.0 ± 15.2	21.0 ± 5.3
Able-bodied pupils	20	11.4 ± 0.5	156.7 ± 7.7	46.6 ± 9.0	18.8 ± 2.5

Pupils were informed of the purpose of the research and the procedure for testing the coordination abilities was realised in the presence of their physical education teacher and the researcher. Consent of the legal representatives of the pupils at special elementary school for children with CAD regarding the pupils' participation in the study was obtained well in advance.

Data collection

Five standardized tests measuring coordination abilities were used as a primary research method: low jump test, spatial orientation ability test, circles through running test, one leg stand test, catching ball test (Šimonek 2015).

- ***Low jump test*** to assess lower limb kinaesthetic discrimination ability. Pupils jumped with the legs together from a plinth to a ground for maximum distance twice. After marking 75 % of the maximum performance they were instructed to land with their heels on the marking. The test was performed three times and the distance of each heel from the marking was measured in centimetres for each trial. Distance values were collapsed across heels and trials to obtain one mean value (Hirtz et al. 1985).
- ***Spatial orientation ability test*** to assess spatial orientation ability, reaction time, agility and lower limb explosive power. Six 2-kg-heavy numbered balls were placed on the ground in the semi-circle shape (Figure 1). Pupils were placed behind the zero-ball faced back to the balls. On the teachers' sound signal (by announcing the number of the ball) pupils turned as fast as possible to the ball whose number the teacher has called and touched the particular ball always with the same hand and returned as quickly as possible back to ball number 0 and also touched it with the same hand. While pupils were returning to the zero ball the teacher announced another number. The test ended after the third number was announced, by touching the zero ball. The

test was performed two times and a better attempt was evaluated with an accuracy of 0.01 seconds.

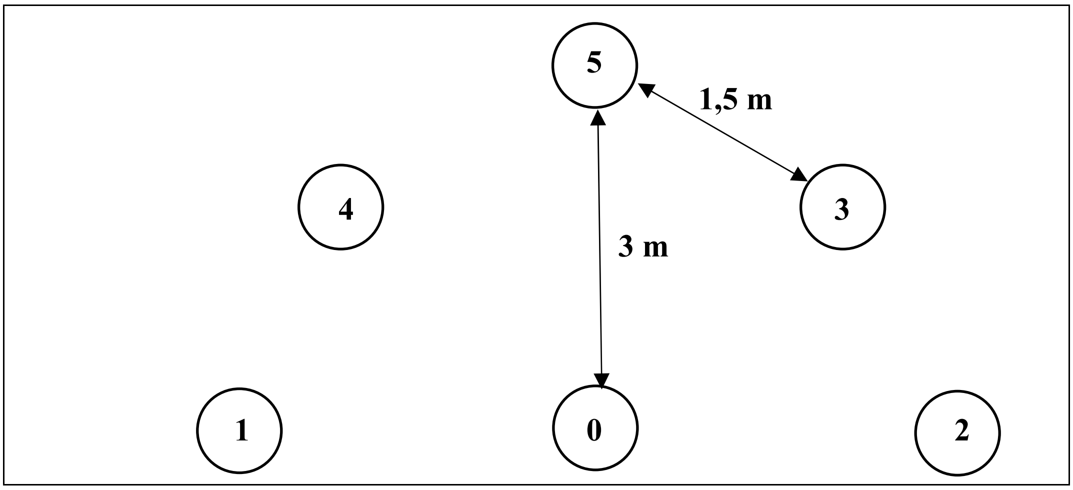

Figure 1

Schema of the spatial orientation ability test performance

- ***Circles through running test*** to assess rhythmic ability, lower limb kinaesthetic discrimination ability and frequency. Two 30 meters long running tracks were marked on the ground (Figure 2). Pupils started to run 15 meters there, then around the cone and 15 meters back as fast as possible (the first track). After 1-minute rest, pupils ran 15 m through the circles, then around the cone and 15 meters back without the circles as fast as possible (the second track). The test was performed only ones and time of the first track and time of the second track was recorded. Difference between the first and second run was evaluated with an accuracy of 0.1 seconds.

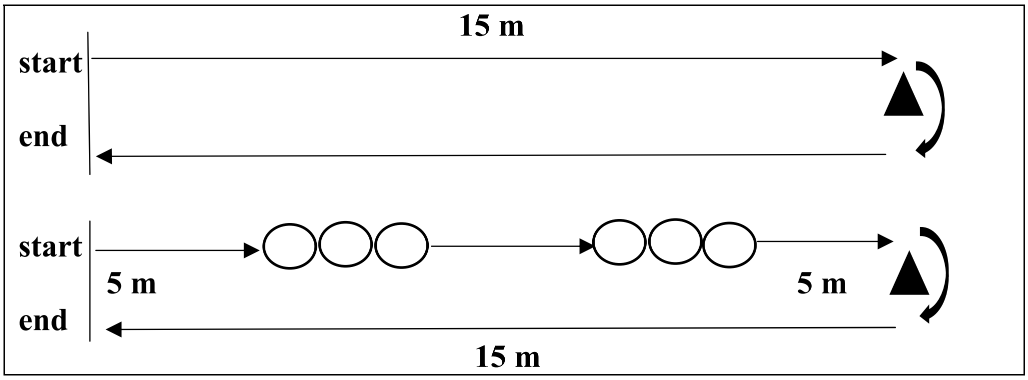

Figure 2

Schema of the circles through running test performance

- ***One leg stand test (eyes closed)*** to assess static balance. Pupils started to balance on two feet, hands on hip. One leg was lifted so that the toes of the lifted leg touched the inside of the knee of the planted leg, pupils closed their eyes (Figure 3). Pupils balanced on a dominate foot for as long as possible or until the foot toughing the knee moved away, or if they moved away from standing spot, or if they moved hands away from hip, or if they opened their eyes. The score was recorded in seconds and the test was performed two times. Better performance was evaluated.

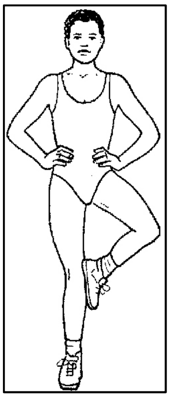

Figure 3
One leg stand test

- ***Catching ball test*** to assess the reaction time. Test was performed in pairs standing face-to face. The teacher held tennis balls in each extended hand to the shoulder width. The pupils stood faced to teacher and waited for unexpected ball release. Immediately when the ball was released by the teacher the pupils tried to catch the ball before the ball falls. The launch of the ball was irregular, and the left and right hands were not shuffled. They had 10 attempts and number of successful attempts was evaluated.

Data analysis

The statistical analyses were carried out with IBM SPSS version 23.0 for Windows. The data were examined for normal distribution and homogeneity of variance. Group differences were analysed with Mann–Whitney U-test for independent samples. The level of significance was $\alpha < 0.05$. The detection of dependence between two groups of variables was expressed by usage the coefficient "r" (Pett, 1997).

Results

Differences in low jump test performance between pupils with CAD and able-bodied pupils were not significant (U = 112.5; Z = 1.75; p = 0.079; r = 0.33) (Figure 4). We found out, that distance mean value presented better level of lower limb kinaesthetic discrimination ability in the group of able-bodied pupils (4.53 ± 2.38 cm) comparing pupils with CAD (6.96 ± 4.26 cm).

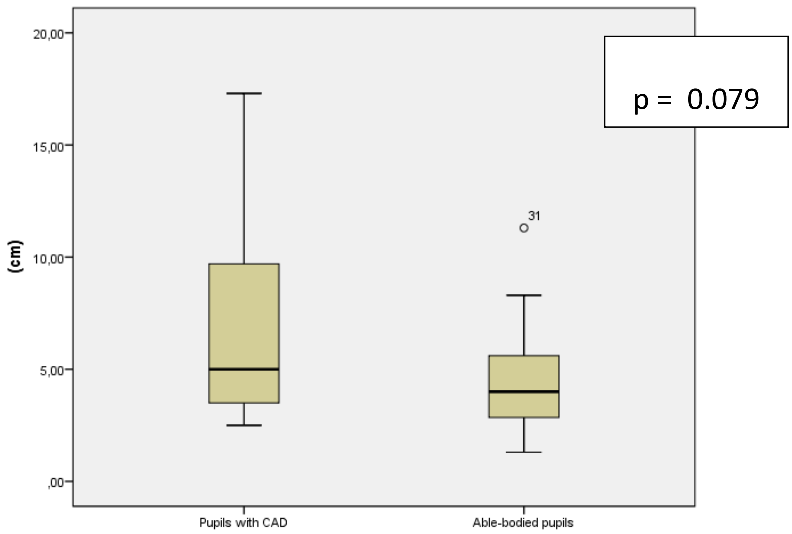

Figure 4
Low jump test performance comparison

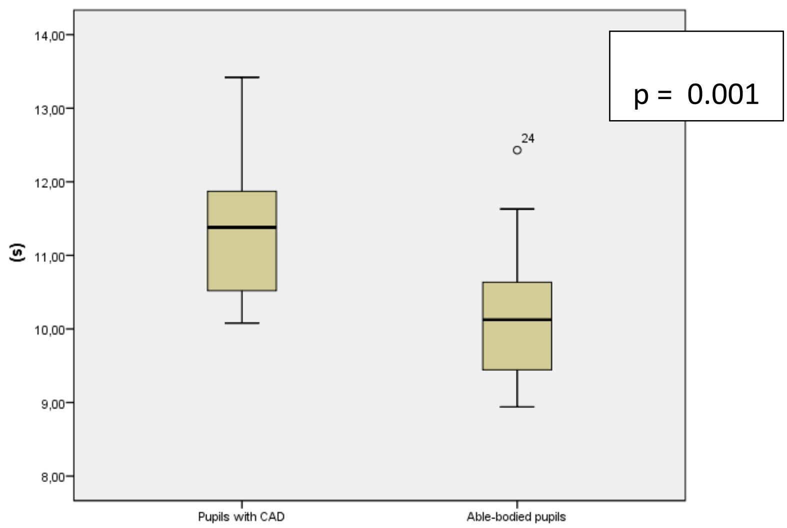

Figure 5
Spatial orientation ability test performance comparison

Analysing the level of spatial orientation ability, we found significant differences in achieved performance between pupils with CAD and able-bodied pupils (U = 64.0; Z = 3.23; p = 0.001; r = 0.52). Significantly higher level of spatial orientation ability was displayed by able-bodied pupils comparing their mates with CAD (Figure 5). Mean value confirm better results in the group of able-bodied pupils (10.14 ± 0.93 s) who performed particular test in shorter time comparing pupils with CAD (11.39 ± 1.12 s).

Performances in rhythmic ability, lower limb kinaesthetic discrimination ability and frequency did not show significant differences between able-bodied pupils and pupils with CAD (U = 156.5; Z = 0.412; p = 0.681; r = 0.10) (Figure 6), as well as mean values declared very similar performances between evaluated groups of pupils (able-bodied pupils 1.4 ± 1.9 s. vs pupils with CAD 1.5 ± 0.5 s.).

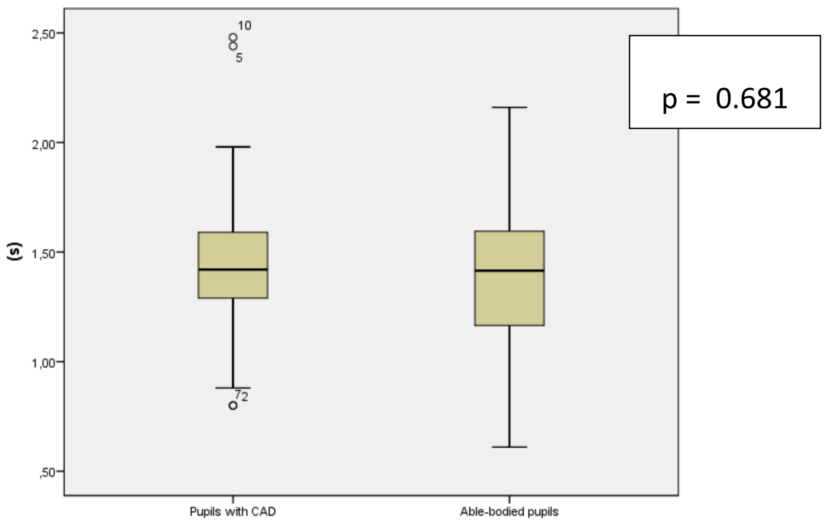

Figure 6
Circles through running test performance comparison

Significant differences between able-bodied pupils and pupils with CAD were presented in static balance performance (U = 87.0; Z = 2.53; p = 0.011; r = 0.23) where significantly higher level of static balance was achieved by able-bodied pupils comparing their mates with CAD (Figure 7). Mean values of achieved static balance ability also show very big differences between evaluated groups of pupils, when able-bodied pupils could keep the static position in mean of 17.3 ± 12.19 seconds comparing pupils with CAD who kept the static position on one leg with eyes closed only 9.05 ± 7.26 seconds.

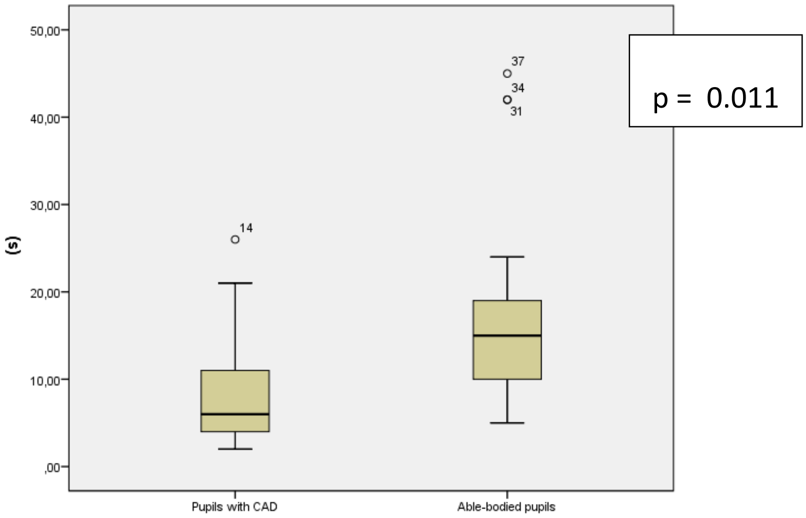

Figure 7

One leg stand test performance comparison

A comparison of the reaction time level using the catching ball test didn't reveal significant differences between able-bodied pupils and pupils with CAD (U = 154.0; Z = 0.494; p = 0.621; r = 0.10) (Figure 8). A mean value also displayed very similar results in successfully caught balls between able-bodied pupils (4.45 ± 2.08 number of successful attempts) and pupils with CAD (4.05 ± 1.78 number of successful attempts).

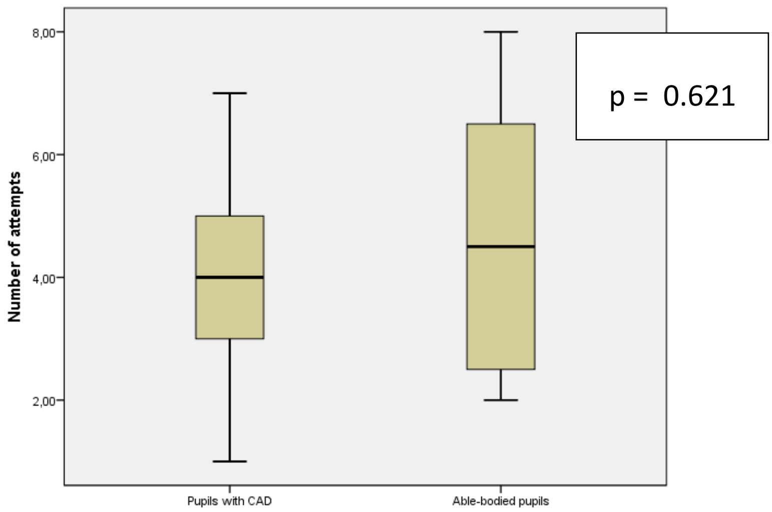

Figure 8

Catching ball test performance comparison

Discussion

The aim of our research was to analyse and compare the level of coordination abilities of pupils with communication ability disorder and able-bodied pupils in the same age category. The level of coordination abilities was assessed by five standardized tests. Concretely we measured the level of lower limb kinaesthetic discrimination ability, spatial orientation ability, rhythmic ability, static balance and reaction time. We found significant differences in two from five assessed abilities, concretely significantly higher level of spatial orientation ability and of static balance was displayed by able-bodied pupils comparing their mates with CAD. We did not confirm significant differences in assessment of lower limb kinaesthetic discrimination ability, rhythmic ability neither of reaction time between evaluated groups of pupils in age category 11 years.

The positive improvement of coordination abilities in the age category of 10-11-year-old children and even younger (6 – 8 year-old children) is successful (Nemček & Chybová 2016). Matějček (1993) argues that the deficits associated with CAD are associated with deficits in movements' coordination, attention, spatial orientation, visual and motor memory. These deviations can be caused by combination of defects in visual perception and rhythm signals that occur in children with CAD (Klenková 2007). Also, Škodová & Jedlička (2007) affirm that in children with developmental dysphasia can occur memory impairments and concentrating disorders as well as coordination disorders and impairments in other motor functions. The authors Engelsman et al. (2001) investigated the level of coordination abilities in children with dysgraphia diagnosis at primary school in Netherlands. The sample comprised pupils of the 4th and 5th grade (n = 125). They found out, that children who have a problem with handwriting showing significantly lower performance in fine motor ability comparing children with good handwriting taking in consideration their chronological age (Engelsman et al. 2001). Müller (2004) revealed defects in fine motor ability and other coordination skills in children with CAD. Other research suggests that children with dyspraxia diagnosis in the age of 7 – 10 years do not have a stable pattern of coordination in catching the ball and have a longer initiatory phase of the movement than children without dyspraxia (Kosová 2015).

Following the Šimonek's (2015) scale of ball-catching (4 – 5 successful attempts form 10) we found out satisfactory level of reaction time in pupils with CAD as well as able-bodied pupils. The research done by Finlay & McFillips (2013) was also aimed to compare the level of selected coordination abilities between two groups of pupils aged 9 – 10 years. One group consisted of pupils with CAD (n = 35) and the control group included pupils without CAD (n = 35). The authors found a significantly lower level of static balance, reaction time provided by catching ball test and agility in pupils with CAD comparing pupils without CAD. The authors did not find significant differences in the level of selected coordination abilities between genders (Finlay & McFillips 2013). Comparing our results, we found significantly lower level also in static balance in group of pupils with CAD comparing able-bodied pupils, but reaction time provided by catching ball test did not showed significant differences between evaluated groups of pupils in our investigation. Our results revealed significantly lower level of spatial orientation ability in the group of pupils with CAD compering able-bodied pupils. Kosová (2015) also confirmed significantly lower level of static balance by usage the same test (one leg stand test-eyes closed) in the group of 9 – 10 year-old pupils with dyspraxia diagnosis comparing their school-mates without dyspraxia.

Another investigation (Getchel et al. 2007) compared the performance of children with and without dyslexia on different subtests of the Test of Gross Motor Development and Movement Assessment Battery for Children and assessed whether there were developmental changes in the scores of the dyslexic group. Participants included 26 dyslexic children (19 boys and 7 girls; 9.5 yr. old, SD = 1.7) and 23 ages and sex-matched typically developing (17 boys and 6 girls; 9.9 yr. old, SD = 1.3) children as a control group. Mann-Whitney U tests indicated that the dyslexic group performed significantly lower than the control group only on the Total Balance subtest of the Movement Assessment Battery for Children. Additionally, the young dyslexic group performed significantly better on the Total Balance subtest, compared to the older dyslexic group. The results of Getchell et al. (2007) further suggest that cerebellar dysfunction may account for differences in physical performance.

Limits of study

The results cannot be generalized, they only attest two schools within the given region. This study was limited due to the low number of participating schools, especially special schools for children with CAD, and the number of pupils, as well as due to the lack of knowledge of the level of current fitness and overall health condition of the pupils under this study. Due to number of pupils we did not provide the gender differentiation.

Conclusion

Based on our results we can conclude that the level of lower limb kinaesthetic discrimination ability, rhythmic ability, frequency and reaction time in pupils with CAD are comparable to the level of able-bodied pupils. The level of spatial orientation ability and static balance was significantly higher achieved by able-bodied pupils comparing pupils with CAD in our investigation. However, based on achieved results, some differences should be implemented in teaching physical and sport education process to improve the level of motor abilities in pupils with CAD that we could recommend:

- It is important to approximate as close as possible to pupils' individual needs.
- Do not burden children with a lot of instructions. Instructions must be formulated briefly and clearly.
- There is need of sufficient explanation of concrete exercise, there is also need to repeat the explanation several times, and demonstrate it.
- There is no need to insist to exercises be excellent performed, it is often enough for the pupil with CAD to get closer to the flawless performance of the exercise.
- There is also important to create pleasant atmosphere in the physical education lessons and calm tempo of the teacher's speech usage.
- As a motivation tool, it is essential to use praise, compliment and small reward. In the assessment, it is necessary to emphasize the pupil's efforts and to follow the improvement compared to the previous period.

The overall view of the difficulty of teaching physical and sports education for children at a special school for children with CAD is comparable to a regular school. Therefor we further recommend that children with CAD should participate in regular physical activities and sports after compulsory education together with able-bodied children to improve their fine and gross motor ability, coordination abilities as well as overall physical fitness.

Acknowledgement

The scientific paper was supported by grant projects VEGA No. 1/0726/17 with the topic *"Sports motivational profile for different groups of population and the influence of various sport activity to improve the subjective dimension of quality of life"*

References

1. BENDÍKOVÁ, E., 2011. *Oporný a pohybový systém, jeho funkcia, diagnostika a prevencia porúch.* [Skeleto-muscular system, its functioning, diagnosis and prevention]. Banská Bystrica: Univerzita Mateja Bela. ISBN 978-80-557-0124-0.
2. BENDÍKOVÁ, E., 2012. *Kapitoly z didaktiky školskej telesnej a športovej výchovy*. . [Chapters of didactics of school physical and sport education]. Banská Bystrica : Univerzita Mateja Bela, Fakulta humanitných vied. ISBN 978-80-554-0487-5.
3. BENDÍKOVÁ, E., 2017. *Theory of health, movement and lifestyle of human beings.* Debrecen: University of Debrecen. ISBN 978-963-473-219-8.
4. BENDÍKOVÁ, E. & JANČOKOVÁ, Ľ., 2013. *Biorytmy, oslabenia a poruchy zdravia : kapitoly zo zdravotnej telesnej výchovy.* [Biorhythms, disabilities and health impairments: chapters of adapted physical education]. Banská Bystrica : Vydavateľstvo Univerzity Mateja Bela – Belianum. ISBN 978-80-557-0577-4.
5. DEELSTRA, H., 2006. *Early Language and Motor Development of Dyslexic Children*. 2006. Master Thesis. Utrecht University.
6. ENGELSMAN, B.C.M., A.S. NIEMEIJER & G.P. van GALEN, 2001. Fine motor deficiencies in children diagnosed as DCD based on poor graphomotor ability. In: *Human Movement Science Journal*, **20**(1-2), pp. 161-182.
7. FINLAY, J. & M. McFILLIPS, 2013. Comorbid motor deficits in a clinical sample of children with specific language impairment. In: *Research in Developmental Disabilities*, **34**(9), pp. 2533-2542.
8. GERLICHOVÁ, M. & E. KRÁLOVÁ, 2014. Design of music therapy programme for children with cerebral palsy. In*: Zdravotnícke listy*, **2**(1), pp. 25-32.
9. GETCHELL, N., P. PABREJA, K. NEELD & V. CARRIO, 2007. Comparing Children with and without Dyslexia on the Movement Assessment Battery for Children and the Test of Gross Motor Development. In: *Perceptual and Motor Skills*, **105**(1), pp. 207-214.
10. HIRTZ, P. et al., 1985. *Koordinative Fähigkeiten im Schulsport*. Berlin. Volks und Wissen Volkseigener Verlag.
11. HOLMA, P. & K. TAMMINEN, 1998. *The gross motor skills in children with communication disorders before and after the training program*. Master Thesis. University of Jyväskylä.

12. KLENKOVÁ, J., 1997. *Kapitoly z logopedie I*. [Chapters of logopaedics I.]. Brno: Paido. ISBN 80-85931-41.
13. KOLÁŘ, P., J. SMRŽOVA & A. KOBESOVA, 2011. Developmental Coordination Disorder – Developmental Dyspraxia. In: *Česká a Slovenská Neurologie a Neurochirurgie*, **74/107**(5), pp. 533-538.
14. KOSOVÁ, B., 2015. *Centrální koordinační porucha*. [Central coordination disorder]. Master Thesis. FTVS UK v Praze.
15. LECHTA, V., 2002. Symptomatické poruchy řeči u dětí. [Symptomatic speech disorders in children]. Praha: Portál. ISBN 80-7178-572-5
16. MATĚJČEK, Z., 1993. *Dyslexie – Specifické poruchy čtení*. [Dyslexia – Specific reading disorders]. Jinočany: H&H. ISBN 80-85467-56-9.
17. MÜLLER, O., 2004. *Dítě se speciálni vzdělávacími potřebami v běžné škole*. [A child in special educational need in regular school]. Olomouc: Univerzita Palackého. ISBN 80-244-0231-9.
18. NEMČEK, J. & V. CHYBOVÁ, 2016. Účinok štvortýždňového tréningového programu na zmeny úrovne vybraných prejavov koordinačných schopností tenistov vo veku 6 až 8 rokov. [Effect of four-week trainning program on level changes of selected coordination abilities effort in 6-8-year-old tennis players]. In: *Kondičný tréning v roku 2016*. Banská Bystrica : Slovenská asociácia kondičných trénerov a Univerzita Mateja Bela, pp. 104-113.
19. NEWMEYER, A.J., S. GRETHER, C. GRASHA, J. WHITE, R. AKERS et al., 2007. Fine motor function and oral-motor imitation skills in preschool- age children with speech-sound disorders. In: *Clinical Pediatrics*, **46**(7), pp. 604-611.
20. PETT, M.A., 1997. *Nonparametric statistics for health care research: statistics for small samples and unusual distributions*. Thousand Oaks, CA: Sage.
21. ROŠKOTOVÁ, I., 2010. *Dyspraxie a jej reedukace v mladším školským veku*. [Dyspraxia and its re-education in early school age]. Praha. Master Thesis. FTVS UK.
22. ŠIMONEK, J., 2015. *Testy pohybových schopností*. [Testing battery of motor abilities]. Nitra: Dominant Nitra.
23. ŠKODOVÁ, E. & I. JEDLIČKA, 2007. *Klinická logopedie.* [Clinical Logopaedic]. Praha: Portál. ISBN 978 80-7367–340-6.
24. SNOWLING, M. J., 2000. *Dyslexia*. Oxford: Blackwell Publishers.

25. VISSCHER, R., et al., 2007. *Motor profile of children with developmental speech and language disorders*. In: *Pediatrics*, **102**(1), pp. 158-163.
26. VRBOVÁ, R, J. BROZDOVÁ, B. HOUSAROVÁ, J. JEHLIČKOVÁ, L. PETRÁŠOVÁ & S. VAŇKOVÁ, 2012. *Metodika práce asistenta logopeda se žákem s narušenou komunikační schopností*. [Work methodology of logopaedics assistant with pupil with communication ability disorder]. Olomouc: Univerzita Palackého. ISBN 978-80-244-3312-7.
27. ZEZULKOVÁ, E. & M. KALEJA, 2015. Current question on logopaedic interventions in education of children and pupils with communication ability disorder. In: *Journal of Teaching and Education*, **4**(3), pp. 27-36.
28. ZEZULKOVÁ, E., 2009. *Žák s narušenou komunikační schopností v procesu edukace.* [The pupil with disturbed communication ability in the process of education]. Ostrava: Ostravská Univerzita.
29. ZEZULKOVÁ, E., 2011. *Jazyková a komunikativní kompetence dětí s mentálním postižením.* [Language and communication competence in children with mental disability]. Ostrava: Ostravská Univerzita.
30. ZEZULKOVÁ, E., 2013. *Rozvoj komunikační kompetence žáků s lehkým mentálním postižením.* [Development of communication competence in pupils with moderate mental retardation]. Ostrava: Ostravská Univerzita.