

## APPLICABILITY OF THE DEVELOPMENTAL COORDINATION DISORDER QUESTIONNAIRE FOR CHILDREN IN SERBIA

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*The aim was to evaluate the applicability of the Developmental Coordination Disorder Questionnaire (DCDQ) adapted for use on the population of children in Serbia. The sample consisted of 901 children (age range 60-168 months) who did not have problems with coordination and the clinical sample of 58 children (age range 60-108 months). The parents assessed their child's coordination rating it on a 5-point Likert scale. Internal consistency of the instrument was 0.94, item-correlations were as high as over 0.70, test-retest reliability was good ( $r=0.97$ ,  $p=0.00$ ). The results revealed a significant positive correlation between the total questionnaire score and age ( $r=0.28$ ,  $p=0.00$ ). Factor analysis confirmed three-factor structure. The questionnaire had good sensitivity (98%) and specificity (78%). The DCDQ applied on Serbian children has a potential to be a reliable and valid instrument for screening children with coordination problems.*

**Key words:** *developmental coordination disorder, assessment, clumsiness, cross-cultural adaptation*

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## INTRODUCTION

Results obtained from numerous studies have confirmed that developmental coordination disorder (DCD) is a neurodevelopmental condition which persists from childhood to adulthood (Blank, Smits-Engelsman, Polatajko, & Wilson, 2012; Kirby, Sugden, & Purcell, 2014). Incidence rates of DCD that have been reported in different studies range from 1.7% and 5%-6% to 19% in school-age children (American Psychiatric Association, 2013; Lingam, Hunt, Golding, Jongmans, & Emond, 2009; Tsiotra et al., 2006).

Children with DCD show difficulties in performing motor activities, which is associated with a lack of motor coordination and which interferes with their academic achievement or activities of daily living. Motor coordination disorders are unrelated to general medical conditions such as cerebral palsy or intellectual disability (American Psychiatric Association, 2013).

The main observed features in DCD are clumsiness (American Psychiatric Association, 2013) and slowness (Farmer, Echenne, & Bentourkia, 2016), but several other manifestations have been described as well, such as problems in performing different motor tasks, passivity and poor coordination, lack of fine motor skills, and difficulties in daily activities (Cairney & Veldhuizen, 2013; Magalhães, Cardoso, & Missiuna, 2011; Missiuna et al., 2014). Failure to perform motor tasks may lead to development of emotional and social difficulties (Cummins, Piek, & Dyck, 2005). It is not unusual that there are more than one additional disorders present, such as attention deficit, language deficit, or overlapping motor problems (Goulardins et al., 2015; King-Dowling, Missiuna, Rodriguez, Greenway, & Cairney, 2015). This impairment affects a child's academic performance and daily activities, and has an impact on an individual's growth and development (Hands, Licari, & Piek, 2015).

The criteria for establishing a diagnosis of DCD have been changing over time; however, the new criteria for DCD were published in The Diagnostic Statistical Manual of Mental Disorders (5<sup>th</sup> ed; DSM-5; American Psychiatric Association, 2013). In order to obtain a diagnosis of DCD, a child has to meet four diagnostic criteria. Smits-Engelsman (2015) summarized the use of DSM criteria and proposed a flowchart for the diagnosis of DCD, as well as terminology for DCD. The diagnosis requires the use of a norm-referenced motor test and the recommended cut-off scores of 15<sup>th</sup> percentile on a standardized test (Smits-Engelsman, Schoemaker, Delabastita, Hoskens, & Geuze, 2015). However, an evaluation with these instruments is time-consuming, requires a special testing environment, trained staff, and furthermore, the tests are frequently unavailable due to their costs.

In order to detect children with DCD as early as possible and prevent possible future difficulties, it is strongly recommended that standardized questionnaires should be used as screening instruments which would be completed by parents or teachers, and thus provide additional information about motor function of a child. One of these specific screening instruments that assess coordination of movements in children is the parent-reported Developmental Coordination Disorder Questionnaire (DCDQ) (Wilson, 2007), developed to identify subtle motor problems in children aged 5-15 years. This questionnaire has been translated and cross-culturally adapted in several countries (<http://www.DCDQ.ca/cross-cultural-adaptations/es.html>). The DCDQ proved to be a useful instrument for screening and monitoring change in children.

However, a thorough review of literature data showed that no research in Serbia had previously addressed psychometric properties of this questionnaire. We believed that a cross-cultural adaptation of the DCDQ for the population of children in Serbia would enable easier recognition of children at risk for movement problems and in this way contribute to early intervention and prevention of further difficulties.

Therefore, the aim of this study was to evaluate applicability of this parents completed questionnaire and to investigate psychometric properties of the Serbian version of DCDQ.

## METHOD

### Participants

The sample consisted of a total of 959 children; out of whom 901 children had no problems with motor coordination, aged 5.0 – 14 years (age range in months 60-168; Mean=6 years 2 months; (SD 27.34)) and gender balanced (440 (48.9%) boys and 461 (51.1%) girls). There was no statistically significant difference between boys and girls in terms of age ( $\chi^2=99.78$ ;  $p=0.65$ ). Control subjects were randomly recruited from public kindergartens and schools. The inclusion criteria were absence of any developmental disorders or other medical conditions that could have affected motor performance. The sample was formed of children from different regions in Serbia but greater part was from Vojvodina. We included children from urban and rural area.

The clinical group included 58 children aged 5-10 years (age range in months 60-108; Mean=7 years 8 months (SD 14.30) who were gender balanced (33 (56.9 %) boys and 25 (43.1%) girls). There was no statistically significant difference between boys and girls with regard to age ( $\chi^2=37.95$   $p=0.15$ ). Children were randomly recruited from rehabilitation centers and private therapy practices. All children had been diagnosed with impaired motor function as a result of manifested clumsiness, but without clinically relevant additional disorders, such as a specific neurological disease, cerebral palsy or intellectual disabilities. According to Smits-Engelsman and associates (2015) recommendations and proposed terminology for studies including DCD populations, we described this group of

children as 'a probable DCD' (p-DCD), due to the fulfillment of some but not all of the DSM-5 criteria.

Sample distribution according to the age groups and the mean scores on the DCDQ is given in Table 1.

Two weeks after the initial assessment, 62 parents from the normative group and 36 parents from the clinical group were asked to complete the DCDQ again for testing the reliability of the questionnaire.

## Instrument

The Developmental Coordination Disorder Questionnaire (DCDQ) (Wilson, 2007) is used to get information from parents about their child's motor performance. Parents assess their child's coordination in comparison with other children of the same age and rate it on a 5-point Likert scale. The DCDQ consists of 15 items grouped into three areas: control during movement, fine motor skills/handwriting, and general coordination. Total score ranges from 15 to 85, with the cut-off scores provided to support "indication of DCD", "suspect DCD", or "probably not DCD". The DCDQ presented here is considered to have good psychometric properties. As reported in an earlier study (Wilson et al., 2009) Cronbach's alpha was 0.89; corrected item-total correlations ranged from 0.42 to 0.67; concurrent validity of the DCDQ revealed moderate but significant correlations (range of correlations of 0.40 to 0.60) with other standardized tests of motor skills. It was also found that the agreement between them was very high when identifying children who were non-DCD, but low when identifying those with DCD (Crawford, Wilson, & Dewey, 2001). The three factors structure is found in the DCDQ. Overall sensitivity is 84.6% and specificity is 70.8% when using age related cutoff scores (Wilson et al., 2009). These psychometrics results are evident and similar in many other cross cultural DCDQ adaptations (<http://www.DCDQ.ca/cross-cultural-adaptations/es.html>).

The questionnaire was translated in accordance with the guidelines provided by Beaton et al. (Beaton, Bombardier, Guillemin, & Ferraz, 2000). The questionnaire was translated twice into Serbian by two independent professionals who have different professional backgrounds and profiles (one translator has knowledge of the concepts assessed by the instrument and the other is not related to the health area). The questionnaire was adapted culturally to maintain content validity. Some adaptations were straightforward (converting feet to meters, finding equivalent phrase for the idiom “bull in a china shop”), while others proved to be more challenging. In some cases the whole phrases were replaced by single words (“hits an approaching ball”), and in one case a phrase was omitted in the translation into the target language (“appears to slouch”), as it was believed the particular item in the questionnaire was made clearer by omitting the description. The word “printing” proved somewhat challenging, as the Serbian language has a number of translations of that word that reveal nuances in meaning. The pre-final version in Serbian was done by two translators, a proofreader and an observer, who reviewed both versions and reached an agreement about it. The pre-final version in Serbian was then back translated by two English language professionals, blinded to the original version, after which translators and an observer produced a common translation in English. This version was approved by the author of the DCDQ (B. Wilson).

The final stage was a pilot research – a probe testing on a sample of 50 parents, and the questionnaire showed good characteristics and also served for minor language improvements made according to parents’ suggestions.

This resulted in the final version of the Serbian adaptation of DCDQ (DCDQ-SR).

## Procedure

The study was approved by the Ethics Committee of the Faculty of Medicine of the University of Novi Sad (Decision No. 01-1709/1). School administrators were informed about the aim and course of this study. Parents or legal guardians were given oral and written information about the purpose of the study, and only those who gave a written consent for their child were enrolled in the study. They had an opportunity to fill in the questionnaire at place of their convenience, i.e., at home, school or institution, and they returned it to the teacher or nurse.

## Statistical analysis

The obtained data were analyzed with IBM, SPSS, version 24. Descriptive statistics was used to describe the sample.

Internal consistency of the DCDQ was estimated using Cronbach's alpha, inter-item and item-total correlations. In the interpretation of results, Cronbach' alpha was considered acceptable if above 0.7 and good if above 0.8 (Bruton, Conway, & Holgate, 2000).

Construct validity was examined by exploratory factor analysis with varimax rotation.

The effects of gender and age and their interaction on DCDQ were tested using linear regression. Discriminative validity was tested with t-test for independent samples. Sensitivity and specificity were assessed using the area under receiver operating characteristic (ROC) curve.

Test-retest reliability was tested using Pearson's correlation coefficient. Correlation up to 0.29 was considered low, up to 0.49 moderate and above 0.50 high (Cohen, 1988).

## RESULTS

The number of subjects with regard to age and mean questionnaire scores are presented in Table 1.

*Table 1 – Sample distribution according to age groups and mean DCDQ scores*

Non-DCD			p-DCD		
Number of participants	Age in months Mean(SD)	Score on DCDQ Mean(SD) (Range)	Number of participants	Age in months Mean(SD)	Score on DCDQ Mean(SD) (Range)
185	64.75 (3.71)	62.43 (9.01) 15-75	24	64.25 (3.56)	30.96 (6.84) 22-47
104	76.62 (3.15)	64.4 (8.02) 36-75	17	77.53 (3.06)	31.71 (9.41) 19-58
132	88.06 (3.27)	64.43 (10.37) 21-75	7	89.29 (2.75)	40.86 (6.93) 30-52
153	101.51 (3.24)	66.59 (8.01) 16-75	8	100.38 (3.06)	34.13 (10.98) 19-49
118	112.76 (3.59)	66.24 (8.41) 15-75	2	108.00 (0.00)	41.00 (5.65) 37-45
91	125.48 (3.49)	67.53 (8.37) 20-75			
47	135.09 (3.18)	67.0 (8.07) 44-75			
33	149.42 (3.80)	69.09 (8.47) 37-75			
38	161.00 (4.04)	69.21 (7.04) 43-75			

Internal consistency of the instrument (Cronbach's alpha coefficient) was 0.94 for the whole sample. In order to assess reliability of items, we calculated the item-total correlation. All correlations were acceptable and very high (above 0.60), except for the items 14 and 15 (0.58 and 0.59, respectively) (Table 2). Inter-item correlation was also satisfactory, and ranged from 0.38 to 0.78.



*Table 2 – Item-total correlation*

Item	Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
Throws ball	0.78	0.69	0.94
Catches ball	0.74	0.67	0.94
Hits ball	0.71	0.60	0.94
Jumps over	0.74	0.67	0.94
Runs and stops	0.75	0.67	0.94
Plan activity	0.76	0.64	0.94
Writing fast	0.75	0.70	0.9
Writing legibly	0.70	0.68	0.94
Effort and pressure	0.63	0.50	0.94
Cuts	0.72	0.59	0.94
Like time spots	0.74	0.63	0.94
Learning new skills	0.75	0.61	0.94
Quick/competent	0.73	0.56	0.94
Bull in china	0.58	0.54	0.94
Fatigues easily	0.59	0.54	0.94

The test-retest reliability was investigated on a sample of 98 subjects using Pearson's correlation coefficient. There was a strong positive correlation between the first and the repeated test ( $r=0.97$ ,  $p=0.00$ ). Kappa measure of agreement was 0.36,  $p=0.00$  indicating that the questionnaire had a good test-retest reliability.

Exploratory factor analysis was employed in order to determine the structure of the questionnaire. In order to verify that the research sample was appropriate and suitable for factorization, the following analyses were performed. Kaiser-Meyer-Olkin test of the adequacy of the sample for the factor analysis was 0.94, which was highly satisfactory. Bartlett's sphericity test was also satisfactory (10506.40,  $p=0.00$ ). After the suitability of the sample was determined, further analysis was carried out. Exploratory factor analysis showed the existence of three factors. The first factor accounted for the highest percentage of explained variance (35.26%), while the other two factors explained lower percentages of variance (22.73% and 13.77%, respectively). Table 3 presents contribution of the items to each of the three factors after varimax rotation.

*Table 3 – Contribution of items to rotated factors*

Item	Factor		
	1	2	3
Throws ball	<b>0.79</b>	0.29	0.18
Catches ball	0.77	0.26	0.16
Hits ball	<b>0.70</b>	0.30	0.17
Jumps over	<b>0.80</b>	0.22	0.18
Runs and stops	<b>0.73</b>	0.31	0.22
Plan activity	<b>0.68</b>	0.41	0.19
Writing fast	0.39	<b>0.78</b>	0.16
Writing legibly	0.29	<b>0.84</b>	0.14
Effort and pressure	0.22	<b>0.76</b>	0.23
Cuts	0.42	<b>0.70</b>	0.15
Like time spots	<b>0.73</b>	0.26	<b>0.26</b>
Learning new skills	0.68	0.29	<b>0.32</b>
Quick/competent	<b>0.54</b>	0.42	<b>0.33</b>
Bull in china	0.27	0.19	<b>0.84</b>
Fatigues easily	0.27	0.20	<b>0.85</b>

The results showed that the assumed structure of the questionnaire was confirmed. The first factor (control during movement) was described by the first six items, the second factor (fine motor skills) was described by the following four items, and the third factor (general coordination) was described by the remaining items of the questionnaire.

Discriminant validity was tested by t-test. Of the total number of non-DCD children, 34 (5.70%) had an indication of DCD, whereas 44 (75.9%) of p-DCD children had an indication of the DCD diagnosis.

In order to determine the sensitivity and specificity of the questionnaire, we applied the ROC analysis, which yielded the sensitivity of 98% and specificity of 78%, which is consistent with the recommended standards for a satisfactory diagnostic test.

In order to balance the sample, we formed a sub-sample of non-DCD children (n=594) matched for age and gender with p-DCD children (n=58). This sub-sample is used for comparison across the two groups. In addition, we were interested in differences in the total scores between controls and p-DCD children. Children from the non-DCD group achieved significantly higher overall scores M=64.47 (SD 8.98)

in comparison with p-DCD children  $M=33.16$  ( $SD\ 8.74$ ), with a statistically significant difference ( $t=25.39$   $p=0.00$ ). These results confirmed good discriminant validity of the instrument.

The association of gender and age with the DCDQ score was tested by linear regression (Table 4). The girls had higher scores on the questionnaire  $M=65.38$  ( $SD\ 9.15$ ) compared to boys  $M=63.65$  ( $SD\ 9.18$ ) but the difference was not significant. There was a significant positive correlation between the total score and age ( $r=0.22$ ,  $p=0.00$ ) and not a significant correlation between gender and the total score.

*Table 4 – The association between gender and age and DCDQ score*

Area	R	F	p	Variable	B	Beta	t	p
Total coordination	0.22	17.50	0.00	gender	1.82	0.07	1.89	0.06
				age	0.17	0.21	5.53	0.00

## DISCUSSION

The aim of our study was to construct a cross-cultural adaptation of the Developmental Coordination Disorder Questionnaire for the Serbian-speaking region, and thereby enable its use in Serbia as well as in neighboring countries due to the same language and cultural background.

Translation of the original questionnaire was done in accordance with the translation recommendations, taking into account the linguistic and cultural differences. Overall, we strived to strike a balance between preserving the original content, finding precise semantic and grammatical equivalents and making the questionnaire easily understandable to the general population in the target language.

Our results showed an extremely high reliability (0.94) for the whole questionnaire, which is consistent with the results of previous studies on reliability of this questionnaire (Girish, Raja, & Kamath, 2016; Hua et al., 2015; Nowak, 2016; Wilson et al., 2009) where the Cronbach alpha is higher than 0.80.

We found a high item-total correlation for the whole questionnaire, except for items 14 and 15, which deserve special attention. Item 14, the phrase “bull in a china shop”, refers to the assessment of overall coordination of the child. It is possible that parents did not understand this idiom correctly, and that instead of overall coordination, they assessed the child’s precision and carefulness in some specific situations e.g. only when the child is in narrow or fragile place. Item 15 refers to muscle tone and stability of the child. The lower item-total correlation found for this item may be explained by the increasingly prevalent sedentary lifestyle, or by parents accustomed to children mainly spending their free time sitting in front of a computer or TV, without physical activity, so that they did not perceive the child’s stability and posture as problematic.

The good test-retest reliability and low variability demonstrated on repeated testing after two weeks in our study, proved the instrument to be reliable even over time. In earlier studies (Martini, St-Pierre, & Wilson, 2011; Tseng et al., 2010) test-retest reliability were 0.90 to 0.97 which is confirmed in our study.

Exploratory factor analysis showed the existence of three factors. The three-factor solution, although with a different item distribution, is consistent with previous research (Girish et al., 2016). The first factor describes the first six items, the second factor describes the next four items, and the third factor describes the remaining items in the questionnaire. However, we noticed a difference in the distribution of the following three items of the first factor: Item 11 “Your child is interested in and likes to participate in sports games or activities which require good motor skills.”; item 12 „Your child easily learns new motor tasks (e.g. swimming, rollerblading) and does not require more practice or time than other children to achieve the same level of skill“; and item 13 “Your child is fast and skillful in tidying up, putting on shoes, tying shoelaces, dressing, etc.”- which in our sample had a greater contribution to explaining the first factor (0.73; 0.68 and 0.54, respectively), i.e., the factor dealing with control during movement.

The three factors singled out in our study may be explained by cultural differences related to parents' perception of the expected child's interest and involvement in sports activities, and considering that no research was done in our region that used DCDQ as a measuring instrument, we are not able to compare our results with relevant results obtained in a social and cultural environment similar to ours.

Analysis shows that 5.70% of the total number of non-DCD children had an indication of DCD. Literature shows inconsistent data about estimation of DCD because prevalence is directly related to the manner in which assessment is conducted and the establishment of cut-off points. It is estimated that 6% of the world population is affected by DCD thus our result that 5.7% of the controls would have an indication of DCD is expected.

The sensitivity of the DCDQ, on our sample, was satisfactory, as well as the specificity and are in agreement with other observations (Wilson et al., 2009) or even higher. In addition, the observed significant and positive correlation between the total score and age suggests that it is important to consider age when using DCDQ cut-offs.

Finally, our results are in agreement with other studies (Capone et al., 2007; Caravale, Baldi, Gasparini, & Wilson, 2014; Prado, Magalhães, & Wilson, 2009) confirming that the DCDQ-SR may be a useful screening tool in early recognition of children suspected for motor coordination problems.

## **Study limitations**

Clinical sample (p-DCD) fulfills some but not all of the DSM-5 criteria. Although whole sample size was relatively large, the small clinical sample limited statistical analysis. The sample should be formed from different regions in Serbia not mainly from Vojvodina. Matched comparison in all age groups would have been beneficial, but we did not have all age groups in the clinical sample.

## Conclusion

The DCDQ-SR applied to children in Serbia has the potential to be a reliable and valid instrument for screening children with coordination problems. However, it is necessary to carry out further research to test the concurrent validity of the instrument as well as the possibility of its application with younger children.

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## PRIMENJIVOST UPITNIKA ZA PROCENU RAZVOJNOG POREMEĆAJA KOORDINACIJE KOD DECE U SRBIJI

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### Sažetak

Cilj ovog rada je da se ispita mogućnost primene Upitnika za procenu razvojnog poremećaja koordinacije (Developmental Coordination Disorder Questionnaire – DCDQ) kod dece u Srbiji. Ukupan broj ispitanika (N=959) podeljen je u dve grupe, prvu je činilo 901 dete (uzrast u mesecima 60-168) koja nisu ispoljavala probleme koordinacije, a drugu 58 dece koja su činila klinički uzorak (uzrast u mesecima 60-108). Roditelji su koordinaciju kod svog deteta ocenjivali na petostepenoj Likertovoj skali. Interna konzistentnost instrumenta iznosila je 0,94, a jtem korelacija 0,70, a test-retest pouzdanost ( $r=0,97$ ,  $p=0,00$ ). Rezultati pokazuju da postoji značajna pozitivna korelacija između ukupnog skora na Upitniku i uzrasta deteta ( $r=0,28$ ,  $p=0,00$ ). Faktorskom analizom dobijena je trofaktorska struktura Upitnika, koji ima dobru senzitivnost (98%) i specifičnost (78%). Na osnovu navedenih podataka može se zaključiti da je Upitnik za procenu razvojnog poremećaja koordinacije, pouzdan i validan skrining instrument i primenjiv na populaciji dece u Srbiji.

**Ključne reči:** razvojni poremećaj koordinacije procena, nespretnost, kros-kulturalna adaptacija

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