Development and Standardization of a Test of Motor Proficiency in Children with Intellectual Disabilities in India

Ritu Kalgotra[1*], Jaspal Singh Warwal[1]
1. University of Jammu, India

ABSTRACT

Purpose: *To develop a scale for the assessment of gross and fine motor skills of the children with mild and moderate intellectual disabilities so that their skills could be assessed and accordingly interventions in physical activities could be specifically designed for them.*

Method: *Thirty-eight items for the Test of Motor Proficiency scale was developed after initial try out, pilot study and final try-out by the researchers. Fifty children with mild intellectual disabilities (n = 26), and moderate intellectual disabilities (n = 24) aged between 6 to 17 years fulfilling inclusion and exclusion criteria were selected from special schools in Jammu district, J&K (India).The Test of Motor Proficiency was administered on the selected sample.*

Results: *Internal consistency as calculated through Cronbach's Alpha was .906, indicating very good reliability. There was a highly significant correlation between the two independent assessments in inter-rater reliability r (48) = .95, p< .05 and also within the domains of motor proficiency, Visual-Motor control r (48) =.72, p< .05, Upper limb speed and dexterity r (48) = .98, p< .05 , Running speed and agility r (48) =.99, p< .05, Bilateral coordination r (48) =.96, p< .05, Strength r (48) =.98, p<.05, upper limb coordination r (48) =.62, p< .05. Concurrent validity of Test of Motor Proficiency was established against BASIC- MR; the correlation of BASIC-MR (M = 151.92, SD = 18.08, N = 50) and Test of Motor Proficiency (M = 49.22, SD = 12.23, N = 50) was highly significant r (48) = .76, p< .05. The construct validity assessed through test retest was r (48) =.97, p< .05.*

Implications: *The Scale can be used in the assessment of gross and fine motor skills of children with mild and moderate intellectual disabilities for clinical and research purposes.*

Keywords: *Motor proficiency, Dexterity, Agility, Bilateral coordination, Visual-Motor, Intellectual disability.*

* **Corresponding Author:** Ritu Kalgotra. Email: ritusatya7@rediffmail.com

INTRODUCTION

Intellectual disability is a disorder with onset during the developmental period that includes both intellectual and adaptive functioning deficits in conceptual, social, and practical domains (DSM-American Psychiatric Association (2013)). Individuals with intellectual disabilities are physically less active than the general community (Temple and Walkley 2003; Emerson 2005; Stanish, Temple and Frey 2006) due to their low level of motor abilities (Horvat and Franklin, 2001; Seagraves et al, 2004). Insufficient physical activity further limits the person's autonomy in activities of daily living (Piek, Dawson, Smith and Gasson, 2008) which negatively affects their health (Carbo-Carrete, Guardia-Olmos and Gine 2016). The sedentary lifestyle results in lower balance performance, overall motor functioning (Giagazoglou et al, 2012; Horvat, Ramsey, Amestoy and Croce, 2003; Lin et al, 2010; Yildirim, Erbahceci, Ergun, Pitetti and Beets, 2010), and motor impairments among inactive individuals with intellectual disabilities (Carmeli, Bar-Yossef, Ariav, Levy and Liebermann, 2008). Motor deficits are commonly reported in persons with intellectual disabilities since this condition can affect cognitive and motor functions (Cleaver, Hunter and Ouellette-Kuntz, 2009; Hartman, Houwen, Scherder and Visscher, 2010; Vuijk, Hartman, Scherder and Visscher, 2010). With adequate levels of motor skills training, children with intellectual disabilities can participate and enjoy different physical activities. But adequate testing of the motor skills of these children is a prerequisite before designing any intervention in physical activities to develop their motor skills. Without regular motor testing, the objective to attain physical strength or fitness cannot be achieved (Horvat and Franklin, 2001; Pitetti et al, 2001; Pitetti and Yarmer, 2002). The commonly used scales in different studies are the Bruininks–Oseretsky Test of Motor Proficiency (BOTMP) (Bruininks and Bruininks, 2005), Movement Assessment Battery for Children (M-ABC) (Henderson, Sugden and Barnett, 2007). These scales are costly, time-consuming (Bruininks and Bruininks, 2005), difficult and create a rigid evaluation environment which is difficult for the children with intellectual disabilities. Currently, there is no tool for the assessment of fine and gross motor skills that is standardized on Indian children. Therefore, there was a need to develop a scale that is ecologically valid, sensitive to the child's level of comfort, less time-consuming, cost-effective and easy to administer and score by staff in Indian special school settings.

AIMS

1. To develop a scale to assess fine and gross motor skills in children with intellectual disabilities.
2. To investigate the reliability and validity of the scale.

METHOD

Design

This research studies the psychometric properties of the Test of Motor Proficiency using the observation method.

Selection and Description of Participants

A total of 50 children with mild (n = 26) and moderate intellectual disabilities (n= 24) participated in this study from special schools in Jammu district J&K (India), with age ranging from 6 to 17 years. The permission from heads of the institutions was granted to conduct research. After explaining the study procedure in detail, consent forms were signed by the legal guardians. Children were selected after fulfilling both inclusion and exclusion criteria.

Inclusion criteria

1. Children of both sexes, aged between 6 to 17 years.
2. Children with mild and moderate intellectual disabilities as identified by an IQ test.

Exclusion criteria

1. Children with severe and profound intellectual disabilities as categorized by I.Q test.
2. Children on anti-depressant or sedative medication.
3. Children showing destructive behaviour or severe behaviour disorders as judged by the care staff.
4. Children with cerebral palsy, multiple disabilities, physical disabilities.

Procedure

Children with intellectual disabilities diagnosed as per the International Classification of Diseases-10 (WHO, 1992) criteria were selected for the study. Seguin Form Board Intelligence test was administered individually to determine their I.Q. The test assessed visual discrimination, matching, speed, accuracy, eye-hand coordination and visual-motor skills. For standardization of the scale, 26 children with mild intellectual disabilities and 24 children with moderate intellectual disabilities categorized on the basis of I.Q test scores were selected for the study. The age of children with mild intellectual disabilities ranges from 6.33 to 17.00 (M=13.21, SD=3.13) and I.Q ranges from 50.65 to 64.58 (M=57.53, SD =4.10). The age of children with moderate intellectual disabilities ranges from 7.58 to 16.66 (M =11.73, SD =2.57) and I.Q ranges from 35.30 to 46.17 (M = 41.74, SD =3.24). 56% of the sample belonged to rural areas whereas 44% stayed in urban areas.

Ethical considerations

Ethical approval was obtained from the head of to the Department, Department of Education, University of Jammu to conduct the research. Identity and personal information of the participants were kept confidential during reporting of the study. Information form and consent forms were developed in concise and accessible language. The study procedure was explained in detail to the legal guardians who then signed the consent forms. Participants were allowed to voluntarily withdraw from the trial without giving any reason.

Development of the Test of Motor Proficiency

A 69 item scale was initially developed after an exhaustive review of available information on fine and motor skills of children with intellectual disabilities. Different scales such as Development Coordination Disorder Questionnaire (DCDQ; Wilson et al, 2009), Bruininks-Oseretsky Test of Motor Proficiency (BOT-2; Bruininks and Bruininks, 2005), Movement Assessment Battery (MAB; Henderson, Sugden and Barnett, 2007), Behavioural Assessment Scale For Indian Children-MR (BASIC-MR; Peshawaria and Venkatesan, 1992) were reviewed. Children with intellectual disabilities were directly observed for their capability to perform motor skills under different domains in special schools, and the comments from caretakers, teachers, and professionals working with these children were assessed. All the items were written clearly for easy measurement

after specific observation and recording to avoid any confusion. The children were assessed for their motor skills on the domains of visual-motor control, upper limb speed and dexterity, running speed and agility, balance, bilateral coordination, strength and upper limb coordination. Visual-motor control and upper limb speed and dexterity were grouped as fine motor skills whereas running speed and agility, balance, bilateral coordination, strength and upper limb coordination were grouped as gross motor skills. The items within each domain of fine and gross motor skills were placed in increasing order of difficulty so that maximum number of children with intellectual disabilities would be able to perform the items at the lower end than at the upper end of the scale and complete the test. A glossary was prepared to give clear instructions on the administration of the items wherever the items were clearly explained. A material kit and scoring sheet were prepared to go with the scale. Direct observation technique was used to determine the actual performance of each child. The scale was administered by the researchers with the help of the teacher/caretaker. The materials required for performing the skill was kept ready before starting the assessment. The point score was written on the scoring sheet. Gross and fine motor skills were measured and assigned numerical scores (point score) for each item on the child's performance on the scale.

Initial try-out of the Test of Motor Proficiency consisting of 69 items was carried out on seven children; three children with mild intellectual disabilities and four children with moderate intellectual disabilities, aged between 6 and 17 years. The results of the scores obtained by these children indicated the practical feasibility of using the Test of Motor Proficiency. Expert opinion and suggestions were sought from professionals working in the field of intellectual disability. They were asked to rate all the items on a point rating scale. By pooling the expert comments, certain items rated as least relevant were eliminated which led to 52 items in all the domains. Content-wise changes in the Test of Motor Proficiency, done after the initial try-out are

> Sentence structure: "Climbs down the stairs" changed to "climbs down the stairs using alternate feet";"Throws ball into a basket "changed to "throws ball into a basket with both hands";"Throws ball in any direction" changed to "Bouncing a ball and catching it with both hands".
>
> Change of items: "Puts small objects into the container" changed to "Placing pennies in a box with preferred hand".

Sequence arrangement: Sequencing of items 3, 4 and 5 in Visual-Motor control domain was done. Activities were arranged from simple to complex: such as copying of triangle, copying of a circle and then copying of cuboid.

A pilot study of the 52 item scale was carried out on the children with mild intellectual disabilities (n = 13) and children with moderate intellectual disabilities (n = 07). Few items which were non- functional, or difficult to perform were deleted reducing the scale to 40 items.

Final try out of the 40- items of Test of Motor Proficiency was administered on the sample of 50 children with intellectual disabilities (children with mild intellectual disabilities (n = 26) and children with moderate intellectual disabilities (n = 24). Data obtained with the Test of Motor Proficiency was statistically analyzed through Statistical Package for Social Sciences version 16.0 for Windows (SPSS Inc., 2007). Two items with zero variance were removed from the scale during reliability analysis (Cronbach's Alpha) reducing the scale to 38-items. The overall mean baseline scores for gross and fine motor skills and their domain wise distribution of scores is given in Table 1.

Table 1: Domain-wise distribution of scores of Test of Motor Proficiency

	Domains	No. of test items	Min	Max.	Sum	Mean	Std. Deviation
1.	**Fine motor skills**						
A.	Visual-Motor control	06	3.00	7.00	236.00	4.72	1.26
B.	Upper limb speed and dexterity	05	6.00	21.00	560.00	11.20	3.57
2.	**Gross motor skills**						
C.	Running speed and agility	01	1.00	5.00	157.00	3.14	1.03
D.	Balance	05	3.00	14.00	423.00	8.46	2.66
E.	Bilateral coordination	04	.00	13.00	142.00	2.84	1.83
F.	Strength	02	2.00	9.00	270.00	5.40	1.48
G.	Upper limb coordination	15	9.00	24.00	718.00	14.36	3.06
	Overall	38	29.00	80.00	2506.00	50.12	11.63

Every item in both gross and fine motor skill is specific and not generalized. The scoring for each item is different because there are variations in performing each item under different domains (Table 2). There is no uniform schema for scoring individual items. The points for scoring individual items vary from 0-4 to 0-8 within as well as across the domains.

Table 2: Scoring of items in the different domains of Test of Motor Proficiency

Domains	Items	Scoring of different items									
A.	1.	PS RS	> 6 0	6 1	2-5 2	1 3	0 4				
	2.	PS RS	> 6 0	6 1	2-5 2	1 3	0 4				
	3 to 5.	PS RS	TD 0	PP 1	VP 2	C 3	I 4				
	6.	PS RS	> 10 0	10 1	8-9 2	3-7 3	0-2 4				
B.	7.	PS RS	0-5 0	6-10 1	11-13 2	14-15 3	16-17 4	18-19 5	20-21 6		
	8.	PS RS	0-1 0	2-3 1	4 2	5 3	6 4	7 5	8 6	9 7	> 9 8
	9.	PS RS	0 0	1-3 1	4-6 2	7-9 3	10-12 4	13-16 5	17-20 6	21-24 7	25-35 8
	10.	PS RS	0 0	1-10 1	11-15 2	16-20 3	21-25 4	26-30 5	31-35 6	36-40 7	> 41 8
	11.	PS RS	0 0	1-10 1	11-15 2	16-20 3	21-25 4	26-30 5	31-35 6	36-40 7	> 41 8
C.	12.	PS RS	> 19 1	18 2	17 3	16 4	15 5	14 6	13 7	< 12 8	
D.	13 & 14.	PS RS	0 1	1-3 2	4-5 3	6-8 4	9-10 5				
	15.	PS RS	0 1	1-3 2	4-5 3	6-8 4					
	16.	PS RS	TD 0	PP 1	VP 2	C 3	I 4				
	17.	PS RS	0 1	1-3 2	4-5 3	6-8 4	9-10 5				
E.	18.	PS RS	0 0	1 1	2 2	3 3	4 4	>4 5			
	19 to 21.	PS RS	TD 0	PP 1	VP 2	C 3	I 4				

F	22.	PS RS	0 0	1-4 1	5-8 2	9-12 3	13-16 4				
	23.	PS RS	0 0	1-2 1	3-4 2	5-6 3	7-8 4	9-10 5	11-12 6	13-14 7	15-16 8
G	24 to 28.	PS RS	0 0	1-2 1	3-4 2	5 3					
	29 to 38.	PS RS	TD 0	PP 1	VP 2	C 3	I 4				

PS= Point Score, RS=Raw Score, TD= Totally Dependent, PP= Physical Prompting, VP=Verbal Prompting, C= Clueing, I= Independent

During the administration of the scale, the raw scores were recorded and converted into point scores. These point scores are converted to standard scores which are then interpreted qualitatively as per norms shown in Table 3.

Table 3: Z Scores and qualitative norms for interpretation of different domains of the Test of Motor Proficiency.

	Domains	Raw scores	Z-scores	Qualitative norms
A.	Visual-Motor control	20-25	+0.951 to +1.630	Very high
		15-19	+.271 to +.815	High
		10-14	-.407 to +.135	Average
		5-9	-1.086 to -.0543	Low
		0-4	-1.222 to below	Very low
B.	Upper limb speed and dexterity	31-38	+1.034to 1.664	Very high
		23-30	+.314 to +.994	High
		15-22	-.404 to +.224	Average
		7-14	-1.124 to -.494	Low
		0-6	-1.2to be1ow	Very low
C.	Running speed and agility	7-8	+1.020 to+ 1.428	Very high
		6	+.612	High
		4-5	- .204 to + .204	Average
		2-3	-1.020 to -.612	Low
		1	-1.428	Very low

D.	Balance	19-23	+1.032 to+1.621	Very high
		15-18	0.442 to +.884	High
		10-14	-.294 to +.294	Average
		5-9	-1.032 to -.442	Low
		0-4	-1.179 to below	Very low
E.	Bilateral coordination	15-17	+1.188 to +1.584	Very high
		11-14	+.396 to +.990	High
		7-10	-.396 to +.198	Average
		4-6	-.990 to -.594	Low
		0-3	-1.188	Very low
F.	Strength	11-12	+1.248 to+1.525	Very high
		9-10	+.693 to+ .970	High
		6-8	-.138 to +.416	Average
		3-5	-.970 to -.416	Low
		0-2	-1.240 to below	Very low
G.	Upper limb coordination	45-55	+1.061 to +1.685	Very high
		34-44	+.374to +.998	High
		23-33	-.312 to + .312	Average
		12-22	-.998 to -.374	Low
		0-11	-1.061 to below	Very low
	Overall	141-177	+1.014 to +1.717	Very high
		106-140	+0.331 to +0.995	High
		71-105	-0.351 to +0.312	Average
		36-70	-1.034 to -0.370	Low
		0-35	-1.053 to below	Very low

RESULTS

Descriptive statistics, Pearson correlation coefficient and reliability analysis (Cronbach's Alpha) were used to analyze the data.

Reliability: The measures of reliability were calculated by Cronbach's Alpha, a measure of internal consistency for the sample (N=50) and 38 items was .906 (Cronbach's Alpha Based on Standardized Items =.903) indicating very good reliability. Items 19 and 20 were removed from scale due to zero variance during the calculation of reliability. Item-total Statistics of Test of Motor Proficiency are given in Table 4.

Table 4: Item-Total Statistics of Test of Motor Proficiency

Item no.	Items	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Cronbach's Alpha if Item Deleted
A.	**Visual-Motor control**			
1	Draw a line through a straight path with a preferred hand	46.86	144.69	.90
2	Drawing a line through a curved path with preferred hand	47.58	148.12	.90
3	Copying a triangle with preferred hand	48.90	141.80	.90
4	Copying a circle with preferred hand	48.94	144.71	.90
5	Copying cuboids with preferred hand	49.16	147.36	.90
6	Cutting out a circle with preferred hand	49.16	148.58	.90
B.	**Upper limb speed and dexterity**			
7	Placing pennies in a box with preferred hand	46.52	135.39	.89
8	Stringing beads with preferred hand	46.84	137.28	.90
9	Drawing vertical lines with preferred hand	47.04	131.99	.89
10	Making dots in the circle with preferred hand	47.32	133.93	.89
11	Making dots with preferred hand	47.18	134.19	.89
C.	**Running speed and agility**			
12	Running speed and agility	46.08	131.62	.89
D.	**Balance**			
13	Stand on the preferred leg on the floor	46.92	141.78	.90
14	Walking forward on walking line	47.08	137.87	.90
15	Walking forward heel- to- toe on walking line	47.42	137.31	.90
16	Hops on one foot (preferred foot)	48.60	142.85	.90
17	Climbs down the stairs using alternate feet	47.62	135.30	.90

E.	**Bilateral coordination**			
18	Alternately tapping feet while making circles with fingers	48.94	143.93	.90
19	Jumping up and clapping hands	48.70	139.92	.90
20	Jumping up and touching heels with hands	48.78	145.68	.90
21	Drawing lines and crosses simultaneously	48.52	135.72	.91
F.	**Strength**			
22	Standing broad jumps	46.26	138.11	.90
23	Sit-ups	46.78	135.84	.90
G.	**Upper limb coordination**			
24	Bouncing a ball and catching it with both hands	47.92	142.19	.90
25	Bouncing a ball and catching it with preferred hand	47.92	142.60	.90
26	Catching a tossed ball with both hands	48.46	150.78	.90
27	Catching a tossed ball with preferred hand	48.52	144.09	.90
28	Throwing a ball at a target with preferred hand	48.76	145.12	.90
29	Touching nose with index fingers-eyes closed	47.50	141.72	.90
30	Touching thumb to fingertips-eyes closed	47.64	143.29	.90
31	Pouring liquid from one glass to another without spilling	47.42	146.49	.90
32	Turns pages singly from the book	48.84	150.13	.90
33	Opens the door	48.56	150.78	.90
34	Folds paper and insert into an envelope	48.40	149.87	.90
35	Wipes blackboard clean using duster	48.30	149.07	.90
36	Throws ball into a basket with both hands	48.38	146.60	.90
37	Tears off a sheet	48.44	146.08	.90
38	Threads a medium sized needle	48.88	141.86	.90

Cronbach's Alpha if item is deleted as indicated in Table 4 ranges from .89 to .91 which proved very good internal consistency of the items.

Inter-rater reliability: The inter-rater reliability for the Test of Motor Proficiency was measured where rater 2 was trained by the researcher who was the caretaker/ teacher of the school. The scores for the two assessments were correlated (Table 5). Cronbach's Alpha for rater 1 was .906 and for rater 2 it was .850.

Table 5: Correlation in inter-rater reliability

Domains	Rater I&II	Mean (N=50)	SD	r
Visual-Motor control (fine motor)	Rater 1	4.72	1.26	.72*
	Rater 2	5.36	1.46	
Upper limb speed and dexterity	Rater 1	11.20	3.57	.98*
	Rater 2	11.20	3.57	
Running speed and agility	Rater 1	3.14	1.03	.98*
	Rater 2	3.10	1.09	
Balance	Rater 1	8.46	2.66	.99*
	Rater 2	8.46	2.65	
Bilateral coordination	Rater 1	1.94	2.08	.96*
	Rater 2	2.02	2.08	
Strength	Rater 1	5.40	1.48	.98*
	Rater 2	5.36	1.54	
Upper limb coordination	Rater 1	14.36	3.06	.62*
	Rater 2	16.54	4.50	
Overall	Rater 1	49.22	12.23	.95*
	Rater 2	51.94	12.66	

* $p < .05$

The results in Table 5 indicated a highly significant correlation between the two independent assessments in overall and in all the domains of motor proficiency. The overall correlation was $r(48)=.95$, $p<.05$, and within the domains of motor proficiency, Visual-Motor control $r(48)=.72$, $p<.05$, Upper limb speed and dexterity $r(48)=.98$, $p<.05$,Running speed and agility $r(48)=.99$, $p<.05$, Bilateral coordination $r(48)=.96$, $p<.05$, Strength $r(48)=.98$, $p<.05$, Upper limb coordination $r(48)=.62$, $p<.05$.

Validity: Concurrent validity of Test of Motor Proficiency was established against BASIC-MR Behavioural Assessment Scale For Indian Children With Mental Retardation, Part- A (Peshawaria and Venkateshan1992) for the motor domain (M= 151.92, SD = 18.08, N=50). The correlation of BASIC-MR (M = 151.92, SD = 18.08, N=50) and Test of Motor Proficiency (M= 49.22, SD=12.23, N=50) was highly significant r (48) =.76, p<.05.

Construct validity was measured for the differences between the mean scores at test and retest. Children were retested after a time interval of 4 months. Each child with mild and moderate intellectual disabilities was assessed individually. Scores (Mean and Std. Deviation) derived on test-retest were correlated. The reliability by Cronbach's Alpha was .906 for the test and for the retest it was .861.

Table 6: Test and retest scores of different domains of Test of Motor Proficiency (construct validity).

Domains		Mean (N=50)	SD	r
Visual-Motor control	Test	4.720	1.26	.79*
	Retest	5.160	1.39	
Upper limb speed and dexterity	Test	11.20	3.57	.99*
	Retest	11.26	3.59	
Running speed and agility	Test	3.14	1.03	.99*
	Retest	3.12	1.06	
Balance	Test	8.46	2.66	.99*
	Retest	8.44	2.68	
Bilateral coordination	Test	1.94	2.08	1.00*
	Retest	1.94	2.08	
Strength	Test	5.40	1.48	1.00*
	Retest	5.40	1.48	
Upper limb coordination	Test	14.36	3.06	.67*
	Retest	18.16	3.39	
Overall	Test	49.22	12.23	.97*
	Retest	53.48	11.36	

* p < .05

Table 6 shows a highly significant correlation between the test and retest items scores of different domains of motor proficiency: correlation for Visual-Motor control r (48) =.79, p<.05, Upper limb speed and dexterity r (48) =.99, p<.05, Running speed and agility r (48) =.99, p<.05, Balance r (48) =.99, p<.05, Bilateral coordination r (48) =1.00, p<.05, Strength r (48) =1.00, p<.05, Upper limb coordination r (48) =.67, p<.05. Overall correlation for all the domains was r (48) =.97, p<.05.

DISCUSSION

The aim to develop this scale coincided with the study of Carbo-Carrete, Guardia-Olmos and Gine (2016) that developed and psychometrically assessed an instrument examining the support needs and strategies regarding physical activity by using individuals with intellectual disability, service providers, and family members. The analysis revealed adequate reliability for the developed instrument, with α value between .70 and .80, and good construct validity for the versions of the scale from three information sources. Psychometric properties of a scale assessing motor skills were assessed by Wuang, Lin, Yueh-Hsien, Su and Chwen-Yng (2009) where they assessed the validity in individuals with intellectual disabilities through partial credit Rasch model to examine the measurement properties of the BOT-2 among 446 children and adolescents with intellectual disability aged 4 to18 years. Items in each composite of the revised BOT-2 showed a good fit to the Rasch model and demonstrated excellent reliability (range .90 to .97). Items from fine manual control and body coordination composites were mostly targeted at the lower levels of ability in these domains. Reliability and validity of the Movement Assessment Battery for Children-2 Checklist (MABC-2), which is similar to our study, was assessed by Schoemaker, Niemeijer, Flapper and Smits-Engelsman (2012). The internal consistency of the 30 items of the Checklist was determined to measure reliability. Discriminative validity was assessed by comparing the scores of children with and without movement difficulties. Construct validity was investigated using factor analysis. Concurrent validity was measured by calculating correlations between the Checklist, Test, and the DCDQ'07. The checklist scores for children with and without motor impairments significantly differed (p<.001) and the scores for the Checklist and DCDQ'07 were significantly correlated r(S) =-.38 and p<.001, and r(S) =-.36 and p<.001, respectively. Wilson, Crawford, Green, Roberts, Aylott and Kaplan (2009) assessed the Developmental Coordination Disorder Questionnaire on 287 children to identify motor problems in children of 8 to 14.6 years of age. 15 items with the

strongest psychometric properties were selected through internal consistency, factor loading, and qualitative/quantitative feedback from researchers, clinicians, and parents. Concurrent validity was supported through correlations between DCDQ scores and Movement Assessment Battery for Children (r = .55) and Test of Visual-Motor Integration (r = .42) scores. Results indicated internal consistency alpha .94 and construct validity was provided through differences in scores between children with and without DCD ($p < .001$).

It is concluded that the Test of Motor Proficiency (38 item scale) has high reliability and validity, and could be used in the assessment of gross and fine motor skills of children with mild and moderate intellectual disabilities for clinical and research purposes.

Limitations and suggestions

1. The scale has been developed primarily for children with mild and moderate intellectual disabilities aged 6 to 17 years and therefore, it is best suited for this group; but with few modifications, this scale can be adapted for children with severe and profound intellectual disabilities.
2. The reliability and validity analysis of the scale was done on a small sample size.
3. Time to administer the test is 45 minutes; with further simplification, the time period could be reduced for clinical purposes.
4. Face validity and cross-cultural validity will need to be established.
5. Reliability and validity of the scale could be tested on adults with intellectual disabilities.

Implications

Gross and fine motor skills of children with mild and moderate intellectual disabilities could be assessed through this scale, and accordingly individualized interventions could be designed to improve their motor skills in special schools. The scale could also be useful in the assessment of intervention programmes intended to improve motor skills of children in institutional settings by researchers, non-government and government organizations. The availability of this scale will be a small step towards more research on children with intellectual disabilities as there is need for evidence-based research in this area.

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