Applicability of Standardized Physical Fitness Tests in Children with Different Types of Disabilities

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Abstract

Adapted fitness tests and tests for children without disabilities are used for evaluating the effects of physical training programs of children with disabilities. This study investigated the applicability of those frequently-used tests for children with different types of disability. A total of 282 children ages between 5 and 14 years with Cerebral Palsy, Spina Bifida, Brachlial Plexus Injury, Spinal Cord Injuries, Amputations, Neuromuscular Diseases, Traumatic Brain Injury, Orthopedic Deformity, Intellectual Disability, Down Syndrome were participated in the study. Gross Motor Function Measure, Modified Ashworth Scale, Posture Analysis, Berg Balance Scale, Sitting Balance, 9 Holed Peg, Sit and Reach, Pro-agility, Anticipation Time, Curl-up, Modified Curl-up, Lateral step-up, Hand grip, Medicine Ball Throw, Pull up and 6 Minute Walk tests were used for evaluation. The major result of this study is that the differences in physical fitness levels, functionality and severity of sequelae rule out using several tests commonly even if the type of disability is the same.

Keywords: *assessment, evaluation, disability, adapted*

Introduction

Evaluating the effects of physical education programs with objective tests are necessary for monitoring the results, providing substantial information for families, creating cooperation with the physical therapy specialist and setting long-term goals (Tripp & Zhu, 2005). Testing perception, talent and movement skills for directing the children with disabilities to sports and consequently screening their physical and psychological conditions will enhance the success of rehabilitation.

Tests applicable on healthy peers are frequently used for the evaluation of children with disabilities. In addition, spesific tests designed particularly for the people with disabilities are also used (Russell *et al.*, 1989; Bae, Waters & Zurakowski, 2008; Brashear *et al.*, 2002). However, using the tests for healthy children on those with disabilities may lead to significant problems of application, programming and evaluation/monitoring (Baumgartner & Horvat, 1988). These problems were partially minimized through modification of the tests (Menear, Sims &Phillips, 2007); nonetheless different types of disabilities were considered in the same group, and the heterogeneity of the group as the participants' mental and physical characteristics had not been taken into account (Baumgartner & Horvat, 1988; Menear, Sims & Phillips, 2007). There are a limited number of studies which report the applicability of those tests on children with different types of disability (Winnick & Short, 2014).

Physical fitness tests for disabilities were preliminarily used by Johnson and Londeree (1976) for mental disabilities. Test of Gross Motor Development-3 (TGMD-3) (Winnick, 2010, Wiar & Darrah, 2001), Brockport Physical Fitness Test (BPFT) (Winnick & Short, 2014) and Brunininks Oseretsky Test of Motor Proficiency (BOTMP) (Wiar & Darrah, 2001) are frequently used test bateries to evaluate the effects of exercise programs in people with disabilities. TGMD-3 intends to evaluate gross motor skills (locomotor and object control) of younger children who are healthy or need special education (Winnick, 2010). BOTMP enables measuring both gross and fine motor skills. It can also be used for children with learning disabilities in addition to healthy peers and it is applicable for older children (Wiar & Darrah, 2001). Brockport Physical Fitness Test (BPFT), adapted from a test battery applicable for healthy children, enables distinctive evaluation of children with different types of disability. BPFT comprises 27 items which evaluate aerobic functioning, body composition and musculoskeletal functioning. It is designed for young people between 10 and 17 years of age with mental disabilities and mild physical disabilities. BPFT is recommended for young people with spinal cord injuries, cerebral palsy, blindness and congenital anomalies or amputations. These types of disabilities were elaborately examined and the tests were reported to be applicable for also other types of disabilities (Winnick & Short, 2014).

People with physical disabilities who have limited mobility, low concentration skills, cannot spend their energies economically and have poor coordination must be monitored with easily applicable functional tests. Monitoring children with objective tests helps to identify the physical capacities of children with disabilities and to design individual exercise programs for them. This evaluation also acceleratesthe development of motor skills, helps to direct them to

proper sports programs and ensures the continuity of exercising. This study investigated the applicability of standardized tests for healthy children and adapted fitness tests for the people with different types of disabilities.

Methods

Participants

A total of 282 children with disabilities ages between 5 and 14 years were participated in the study. Children with;Cerebral Palsy, Spina Bifida, Brachlial Plexus Injury, Spinal Cord Injuries, Amputations, Neuromuscular Diseases, Traumatic Brain Injury, Orthopedic Deformity, Intellectual Disability, Down Syndrome were included. As a prerequisite for admission to the program, the individuals with disabilities were asked to obtain a disability report issued by a healthcare organization.

Materials and Procedure

The initial evaluation was performed by the physician and the physiotherapist. Children who has ability to follow verbal instructions, have not a severe physical disability (severe spasticity/contracture, loss of balance while sitting) which prevents sports participation were admitted. Children who had a seizure in the last six months were not admitted. The participants were divided into groups according to the types of their disabilities (Table 1). Demographic features of the admitted 151 boys and 131 girls according to the types of their disabilities are shown in Table 2.

Children who found eligible after the inspections, were attended to functional tests which evaluate strength, balance, flexibility, agility and coordination. These tests were applied by sports scientists. The tests were applied in the beginning and repeated after 3 months.For adjudging the applicability of the tests, children's status of completion of the tests were examined. Any tests which could not be completed during the initial inspection but were achieved after 3 months were considered applicable. The reasons of failure to perform the tests (physical limitation or mental/psychological maladaptation) were recorded.

The study was conducted according to the Helsinki Declaration, and approved by the local ethics committee. The objective and procedures of the study were explained verbally and by text to each participant. The document for informed consent was signed by the parents of the participants prior to study.

Tests applied to children with different types of disability:

9-Holed Peg Test

This test assesses the fine motor skills (Smith and Hong, 2000). It was implemented on both hands separately to assess the affected and non-affected extremities of the children with disabilities.

Sit and Reach Test

This test evaluates the flexibility of the lumbar extensor and leg flexor muscles (Winnick, 1999). It was applied in two different ways: Two-legs and one-leg (right and left separately).

Pro-Agility Test

This test assesses the agility. In this test, 3 cones with 5 meters distance in-between are placed along a track of 10 meters. The participant stands against the cone in the middle; he/she first touches the cone on the left and then the cone on the right, and finally, returns to the cone in the middle quickly and the completion time is recorded (Faigenbaum *et al.* 2006).

Table 1: The Distribution of the Participants According to the Types of Disabilities

Disability Types	Applied Children		Admitted Children		Nonadmitted Children	
	n	%	n	%	n	%
General	462	100	282	61	180	39
Cerebral Palsy	248	53,7	162	65	86	35
Intellectual Disability	64	13,9	29	45	35	55
Spina Bifida	30	6,5	22	73	8	27
Down Syndrome	23	5	11	48	12	52
Neuromuscular Diseases	21	4,5	15	71	6	29
Brachial Plexus Injury	15	3,2	14	93	1	7
Orthopedic Deformity	9	1,9	8	89	1	11
Traumatic Brain Injury	9	1,9	7	78	2	22
Pervasive Developmental Disorder	9	1,9	3	33	6	67
Epilepsy	6	1,3			6	100
Idiopathic Scoliosis	5	1	5	100		
Metabolic Diseases	4	0,9			4	100
Achondroplasia	2	0,4	2	100		
Visually Impaired	2	0,4	1	50	1	50
Spinal Cord Injury	2	0,4	1	50	1	50
Hearing Impaired	1	0,2	1	100		
Chronic Illness	1	0,2	1	100		
Others	11	2,4			11	100

Table 2: Demographic Features of the Admitted Children According to the Types of Disabilities

Disability Types	Admitted Children	Gender		Age		Height		Weight	
	n	Boy	Girl	M	SD	M	SD	M	SD
General	282	151	131	8,4	3,4	122,7	18,3	25,9	10,1
Cerebral Palsy	162	91	71	8,4	3,3	123,0	18,8	25,3	9,9
Intellectual Disability	29	14	15	8,8	4,6	127,3	15,0	27,6	10,2
Spina Bifida	22	9	13	6,7	2,1	112,7	14,3	23,9	8,8
Down Syndrome	11	10	1	7,8	2,5	117,1	14,3	25,1	11,7
Neuromuscular Diseases	15	8	7	8,0	3,0	114,6	20,2	23,4	11,0
Brachial Plexus Injury	14	8	6	7,6	2,4	122,3	18,8	28,6	8,1
Orthopedic Deformity	8	3	5	9,1	2,6	130,8	13,5	32,5	15,2

Traumatic Brain Injury	7	2	5	11,9	4,3	138,7	16,7	32,6	8,2
Pervasive Developmental Disorder	3	2	1	6,3	1,5	122,0	8,9	21,7	5,5
Idiopathic Scoliosis	5	1	4	9,8	3,8	126,6	23,0	26,2	7,4
Achondroplasia	2		2	13		110		25,0	1,4
Visually Impaired	1	1		16		149		48	
Spinal Cord Injury	1		1	9					
Hearing Impaired	1	1		16		157		52	
Chronic Illness	1	1		6		105		17,7	

Anticipation Time Test

This test assesses the hand-eye coordination and was applied with the Bassin Anticipation Timer (Lafayette Instrument Co., Model 50575) (Ramella, 1984).

6-Minute Walk Test

This test assesses endurance. Walking distance, in 6 minute with controlled sprints was recorded, and used for sub-maximum endurance evaluation (Crapo *et al.*, 2002).

Gross Motor Function Measure-88

Gross Motor Function Measure-88 (GMFM-88) evaluates the gross motor functions of children with cerebral palsy (Russell *et al.*, 1994).

Modified Ashworth Scale

Modified Ashworth Scale (MAS) evaluates spasticity (Bohannon &Smith, 1987).

Posture Analysis

Posture alignment changes were assessed using the New York Posture Rating Chart. The participant is assessed in posterior and lateral directions while standing and looking at a constant point marked at his/her eye level (Hennessey &Watson,1993).

Strength Tests

Curl-Up Test

This test evaluates abdominal muscle endurance and strength. The participants were asked to do curl-ups until they were exhausted, and the time-number data of curls were recorded (Short & Winnick, 2005). Modified curl-up test (curl up while holding hands) was used in children who failed to curl up without supports.

Lateral Step-Up Test

This test assesses functional strength and endurance of the lower extremity. The number of steps that a participant goes up and down in 30 s. was recorded (Blundell, Shepherd, Dean, Adams & Cahill, 2003).

Hand Grip Test

This test assesses hand grip strength. JAMAR Hydraulic-digital hand dynamometer which measures forces higher than 5 kg was used for children without upper extremity disability. It was not possible to use the standard hand grip devices to assess children with upper extremity weaknesses. A dynamometer which can measure very low changes of forces and which can easily be placed in the palm was required. A special dynamometer (precise up to 1 millibar) (Figure 1) was developed by Dr. Yaşar Tatar specifically for this program, calibrated and used.

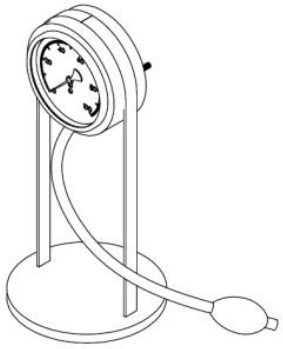

Figure 1: Hand grip strength measuring device

Medicine Ball Throw Test

This test evaluates upper extremity muscle strength. The child was asked to throw a ball with a weight of 2 kg over his/her shoulder 3 times, and the furthest distance was recorded (Michael, McManus & Masters, 2005). The participants were seated during this test as the test intended to measure the upper extremity strength.

Pull-Up Test

This test evaluates isometric strength and endurance of the upper extremity muscles. Exhaustion time of children was recorded while the children lie on their back, pull up the bar and hold at 2,5 to 5 cm distance to their chin (Short & Winnick, 2005).

Balance Tests

Berg Balance Test

This test evaluates the functional balance. Berg Balance Scale consists of 14 items. It evaluates various parameters such as sitting, standing and one-leg standing (Gan, Tung, Tang & Wang, 2008).

Sitting Balance

Seated Postural Control Measure evaluates sitting balance. Pelvis, trunk and head positions were assessed in anterior and lateral directions (Fife *et al.*, 1991).

Static Balance Test

This test assesses static posture control. The centre of pressure parameters while standing on one and/or two legs was examined (Uzun, 2013). The data obtained with the balance platform (Tekscan- Matscan, Boston, USA) and are also used for foot plantar pressure analysis of children with disabilities.

*****There may be differences in the number of evaluated individuals and participants of the program as some of the children included in the program could not participate in the measurements taken on different test days.

Data Analysis

Datas were reported as mean ± standard deviation (SD). Percent success rates of children with different types of disability were used for analysis.

Results

More than 50% of children with cerebral palsy completed all tests except the curl-up test (Table 3). Over 70% of the children with intellectual disability completed sit and reach, pro-agility, medicine ball throw, pull up and posture analysis tests. The ratio of completing other tests was in the range of 41-57% (Table 4). More than 50% of children with spina bifida completed the pro-agility, 6 min walk, static balance, lateral step up and posture analysis tests which require ambulation as well as all other tests than the curl-up test (Table 5). Over 67% of children with brachial plexus injury completed all evaluation tests (Table 6). Less than 50% of the children with Down-syndrome completed the tests except the medicine ball throw test and pro-agility test (Table 7).Less than 50% of children with a neuromuscular disease completed the pro-agility, 6 min walk, posture analysis, curl-up, lateral step-up test, hand grip, sitting balance and static balance tests (Table 8).More than 70% of children with traumatic brain injury completed all tests except the left hand 9-holed peg test (Table 9). Children with orthopedic problems (other than amputation, mostly various lower extremity problems) could understand and successfully complete all tests (Table 10).

*The statistical analysis of groups with idiopathic scoliosis, achondroplasia, chronic illness, visually impaired, hearing impaired, spinal cord injury and pervasive developmental disorder could not be reflected due to the low number of participants in these groups.

Table 3. Applicability of Physical Fitness Tests in Children with Cerebral Palsy

	Application	Completion		Failure		Reason of Failure			
						Physical Limitation		Mental/Psychological Maladaptation	
	n	n	%	n	%	n	%	n	%
Right-9Holed Peg Test	148	95	64	53	36	32	60	21	40
Left-9 Holed Peg Test	148	105	71	43	29	24	56	19	44
Sit and Reach Test	157	129	82	28	18	18	64	10	36
Pro-Agility Test	150	93	62	57	38	41	72	16	28
Anticipation Test	139	100	72	39	28	5	13	34	87
6 min Walk Test	160	97	61	63	39	43	68	20	32
GMFM	130	103	79	27	21			27	100
MAS	141	126	89	15	11	2	13	13	87
Postur Analyse	151	103	68	48	32	31	65	17	35
Curl Up Test	157	65	41	92	59	76	83	16	17
Modified Curl Up Test	92	84	91	8	9			8	100
Right-Lateral Step Up Test	160	108	68	52	32	38	73	14	27
Left-Lateral Step Up Test	160	108	68	52	32	38	73	14	27
Right-Hand Grip Test	135	89	66	46	34	15	33	31	67
Left-Hand Grip Test	135	88	65	47	35	15	32	32	68
Medicine Ball Throw Test	150	127	85	23	15	11	48	12	52
Pull Up Test	151	134	89	17	11	4	24	13	76
Berg Balance Test	146	121	83	25	17	10	40	15	60
Sitting Balance	126	90	71	36	29	14	39	22	61
Static Balance Test	139	74	53	65	47	45	69	20	31

Table 4: Applicability of Physical Fitness Tests in Children with Intellectual Disability (ID)

	Application	Completion		Failure		Reason of Failure			
						Physical Limitation		Mental/Psychological Maladaptation	
	n	n	%	n	%	n	%	N	%
Right-9 Holed Peg Test	28	15	54	13	46			13	100
Left-9 Holed Peg Test	28	15	54	13	46			13	100
Sit and Reach Test	28	20	71	8	29			8	100
Pro-Agility Test	28	22	79	6	21			6	100
Anticipation Test	27	11	41	16	59			16	100
6 min Walk Test	28	15	54	13	46			13	100
Postur Analyse	29	22	76	7	24			7	100
Curl Up Test	28	14	50	14	50	6	43	8	57
Modified Curl Up Test	14	8	57	6	43			6	100
Right-Lateral Step Up Test	28	16	57	12	43			12	100
Left-Lateral Step Up Test	28	16	57	12	43			12	100
Right-Hand Grip Test	28	15	54	13	46			13	100
Left-Hand Grip Test	28	15	54	13	46			13	100
Medicine Ball Throw Test	28	22	79	6	21			6	100
Pull Up Test	28	20	71	8	29			8	100
Berg Balance Test	29	14	48	15	52			15	100
Sitting Balance	24	10	42	14	58			14	100
Static Balance Test	28	16	57	12	43			12	100

Table 5: Applicability of Physical Fitness Tests in Children with Spina Bifida (SB)

	Application	Completion		Failure		Reason of Failure			
						Physical Limitation		Mental/Psychological Maladaptation	
	n	n	%	n	%	n	%	n	%
Right-9 Holed Peg Test	22	19	86	3	14			3	100
Left-9 Holed Peg Test	22	19	86	3	14			3	100
Sit and Reach Test	22	16	73	6	27	3	50	3	50
Pro-Agility Test	22	10	45	12	55	9	75	3	25
Anticipation Test	22	18	82	4	18			4	100
6 min Walk Test	22	10	45	12	55	9	75	3	25
Postur Analyse	21	9	43	12	57	9	75	3	25
Curl Up Test	22	4	18	18	82	15	83	3	17
Modified Curl Up Test	18	15	83	3	17	1	33	2	67
Right-Lateral Step Up Test	22	10	45	12	55	9	75	3	25
Left-Lateral Step Up Test	22	10	45	12	55	9	75	3	25
Right-Hand Grip Test	22	18	82	4	18			4	100
Left-Hand Grip Test	22	18	82	4	18			4	100
Medicine Ball Throw Test	22	17	77	5	23	3	60	2	40
Pull Up Test	22	19	86	3	14			3	100
Berg Balance Test	20	13	65	7	35	4	57	3	43
Sitting Balance	20	12	60	8	40	6	75	2	25
Static Balance Test	22	11	50	11	50	9	82	2	18

Table 6: Applicability of Physical Fitness Tests in Children with Brachial Plexus Injury (BPI)

	Reason of Failure

	Application	Completion		Failure		Physical Limitation		Mental/Psychological Maladaptation	
	n	n	%	n	%	n	%	n	%
Right-9 Holed Peg Test	11	10	91	1	9	1	100		
Left-9 Holed Peg Test	11	10	91	1	9			1	100
Sit and Reach Test	12	12	100						
Pro-Agility Test	11	11	100						
Anticipation Test	12	10	83	2	17			2	100
6 min Walk Test	11	10	91	1	9			1	100
Postur Analyse	14	14	100						
Curl Up Test	11	8	73	3	27	3	100		
Modified Curl Up Test	3	3	100						
Right-Lateral Step Up Test	12	12	100						
Left-Lateral Step Up Test	12	12	100						
Right-Hand Grip Test	10	8	80	2	20	2	100		
Left-Hand Grip Test	10	9	90	1	10			1	100
Medicine Ball Throw Test	12	12	100						
Pull Up Test	12	11	92	1	8	1	100		
Berg Balance Test	10	8	80	2	20			2	100
Sitting Balance	6	4	67	2	33			2	100
Static Balance Test	9	7	78	2	22			2	100

Table 7: Applicability of Physical Fitness Tests in Children with Down Syndrome (DS)

	Application	Completion		Failure		Reason of Failure			
						Physical Limitation		Mental/Psychological Maladaptation	
	n	n	%	n	%	n	%	n	%
Right-9 Holed Peg Test	11	4	36	7	64			7	100
Left-9 Holed Peg Test	11	4	36	7	64			7	100
Sit and Reach Test	11	5	45	6	55			6	100
Pro-Agility Test	11	6	55	5	45			5	100
Anticipation Test	11	3	27	8	73			8	100
6 min Walk Test	11	3	27	8	73			8	100
Postur Analyse	11	4	36	7	64			7	100
Curl Up Test	11	3	27	8	73			8	100
Modified Curl Up Test	8	2	25	6	75			6	100
Right-Lateral Step Up Test	11	3	27	8	73			8	100
Left-Lateral Step Up Test	11	3	27	8	73			8	100
Right-Hand Grip Test	11	2	18	9	82			9	100
Left-Hand Grip Test	11	2	18	9	82			9	100
Medicine Ball Throw Test	11	7	64	4	36			4	100
Pull Up Test	11	4	36	7	64			7	100
Berg Balance Test	11	1	9	10	91			10	100
Sitting Balance	10	2	20	8	80			8	100
Static Balance Test	11	1	9	10	91			10	100

Table 8: Applicability of Physical Fitness Tests in Children with Neuromuscular Diseases (ND)

	Application	Completion		Failure		Reason of Failure			
						Physical Limitation		Mental/Psychological Maladaptation	
	n	n	%	n	%	n	%	n	%
Right-9 Holed Peg Test	14	11	79	3	21	2	67	1	33
Left-9 Holed Peg Test	14	10	71	4	29	2	50	2	50
Sit and Reach Test	14	13	93	1	7	1	100		
Pro-Agility Test	14	6	43	8	57	6	75	2	25
Anticipation Test	13	7	54	6	46	2	33	4	67
6 min Walk Test	14	4	29	10	71	7	70	3	30
Postur Analyse	14	6	43	8	57	5	63	3	37
Curl Up Test	14	2	14	12	86	11	92	1	8
Modified Curl Up Test	12	8	67	4	33	3	75	1	25
Right-Lateral Step Up Test	14	5	36	9	64	7	78	2	22
Left-Lateral Step Up Test	14	5	36	9	64	7	78	2	22
Right-Hand Grip Test	13	5	38	8	62	4	50	4	50
Left-Hand Grip Test	13	5	38	8	62	4	50	4	50
Medicine Ball Throw Test	14	12	86	2	14	1	50	1	50
Pull Up Test	14	11	79	3	21	2	67	1	33
Berg Balance Test	13	11	85	2	15	1	50	1	50
Sitting Balance	11	4	36	7	64	3	43	4	57
Static Balance Test	14	4	29	10	71	7	70	3	30

Table 9: Applicability of Physical Fitness Tests in Children with Traumatic Brain Injury (TBI)

	Application	Completion		Failure		Reason of Failure			
						Physical Limitation		Mental/Psychological Maladaptation	
	n	n	%	n	%	n	%	n	%
Right-9 Holed Peg Test	7	7	100						
Left-9 Holed Peg Test	7	3	43	4	57	4	100		
Sit and Reach Test	7	7	100						
Pro-Agility Test	7	7	100						
Anticipation Test	7	7	100						
6 min Walk Test	7	7	100						
Postur Analyse	6	6	100						
Curl Up Test	7	5	71	2	29	2	100		
Modified Curl Up Test	2	2	100						
Right-Lateral Step Up Test	7	7	100						
Left-Lateral Step Up Test	7	7	100						
Right-Hand Grip Test	7	5	71	2	29	2	100		
Left-Hand Grip Test	7	7	100						
Medicine Ball Throw Test	7	6	86	1	14	1	100		
Pull Up Test	7	7	100						
Berg Balance Test	7	7	100						
Sitting Balance	5	5	100						
Static Balance Test	6	6	100						

Table 10: Applicability of Physical Fitness Tests in Children with Orthopedic Deformity (OD)

	Application	Completion		Failure		Reason of Failure			
						Physical Limitation		Mental/Psychological Maladaptation	
	n	n	%	n	%	n	%	n	%
Right-9 Holed Peg Test	8	8	100						
Left-9 Holed Peg Test	8	8	100						
Sit and Reach Test	8	8	100						
Pro-Agility Test	8	8	100						
Anticipation Test	7	7	100						
6 min Walk Test	8	8	100						
Postur Analyse	6	6	100						
Curl Up Test	8	8	100						
Modified Curl Up Test									
Right-Lateral Step Up Test	8	8	100						
Left-Lateral Step Up Test	8	8	100						
Right-Hand Grip Test	8	8	100						
Left-Hand Grip Test	8	8	100						
Medicine Ball Throw Test	8	8	100						
Pull Up Test	8	8	100						
Berg Balance Test	8	8	100						
Sitting Balance	7	7	100						
Static Balance Test	6	6	100						

Discussion

This study was produced from a European Union Project which was planned for social integration of children with disability. In this project evaluating the effects of the training program with objective tests was one of the primary goals. In this study the applicability of frequently used physical fitness tests was investigated. Similar average ages of children with different types of disability eliminated the effects of the age in evaluation. Sex ratio among the general population of the program was 54/46% for male/female. The balanced distribution of sex facilitated generalization of the tests.

Assessing the results with regard to inclusion criterias most of the participants who have not admittedto the study were children with CP's and ID's. This was due to the inclusion criterias (ability to follow verbal instructions, not having any severe physical inability which prevents sports participation). Taking into consideration the emphasis of Baumgartner and Horvat, (1988) the sports scientists in this study were informed and trained on the application of tests in different types of disabilities at the beginning of the study. Multidisciplinary assessments were carried out with physicians, physiotherapists and sports scientists for valid and reliable testing of children with disabilities. Furthermore, sufficient explanations, repetitions and time were given to solve the problems related to not having participated in physical fitness tests before, and not comprehending the tests due to mental incompetence.

It was found that children with CP accounted for the highest percent in participation to this study which children with physical disabilities were included. It may be related to the higher

prevalence of CP in general population. CP incidence in Turkey was reported at around 2-4.4/1000, compared to 2/1000 of the world (Serdaroğlu, Cansu, Özkan, & Tezcan, 2006; Yılmaz Yalçınkaya *et al.*, 2014). CP was reported as the cause of 67% of severe physical disability in childhood (Cans *et al.*, 2004). The high number of CP applications to the study is compatible with those data. A great number of the children with CP, who applied to the study were not included in the program due to not satisfying the main criteria (severe spasticity/contracture, loss of balance while sitting).

In children with CP, the tests were applied with high rates of success. The low percentage of ability to complete the curl-up test is due to the weakness in abdominal muscle strength rather than mental/psychological maladaptation. The high completion ratio of the modified curl-up test also supports our opinion. GMFM-88 could be completed in all participants with CP other than those children with mental/psychological maladaptation. The applicability of this test, which evaluates functional limitations of children during activities of daily living, is important for programming and monitoring physical education for all children. Adaptation problems were observed with only 13 children (maladaptation-crying) during the application of MAS. It was considered to be due to the reactions of children as they associate the application of the test with rehabilitation implementations/exercise. Static balance test of children with CP could not be carried out mostly due to physical limitations. The failure in this test may also be the reason of the failure in pro-agility, 6 min walk, posture analysis and Berg balance tests which may be associated with it. The reason of unaplicabilityof 9-holed peg test in CP is mostly physical incompetence, while the reason of unaplicability in hand grip test is mental/psychological maladaptation. We believe that the difference in the reason of failure between the two tests, which evaluate hand functions, is caused by the impact of time restriction on the application of the test.

In children with ID and DS, only those who could follow verbal instructions and had mild physical disabilities were accepted. In children with both types of disabilities, following Baumgartner and Horvat (1998)'s recommendations, sufficient time and repetitions were given appropriate for the child's specific needs to ensure that the child understands the tests and attunes to the trainer. Despite these precautions, the problems of comprehending the instructions of the tests and participants' adaptation to the tests lowered the success rates of the tests. Meanwhile, the applicability of the tests in the ID group was higher compared to the DS group. Menear *et al.* also reported the difference between ID and DS and suggested modifications for the tests (Menear *et al.*, 2007). Children with ID could complete all tests at a high ratio, except berg balance test and sitting balance test as they required the ability to follow different instructions, and the anticipation time test which is relatively difficult to understand. Nevertheless, it was noted that the completion ratio of the modified curl-up test was not high for children with ID, mainly due to the problem in understanding the test could not be overcome. Failure to complete the curl-up test even after modification was also observed during the evaluation of children with DS. We believe, in accordance with the opinion of Baumgartner and Horvat (1988) that age is another factor for failure to apply a number of tests in these groups. The high success rate of children in both groups in the tests such as pro-agility test and medicine ball throw test indicate

the necessity of adapting the tests from daily life. Furthermore, making modifications such as placing an attractive object towards the point for the child to reach, in order to increase the child's motivation to complete the sit and reach test will increase the applicability of the tests (Menear et al., 2007). The different testing profiles of children with ID and DS in the present study suggest that the method of evaluating children with ID and DS in the same category, which was preferred for Brockport Test Battery (Short & Winnick, 2005) should be reconsidered.

In the developed countries, the SB incidence is 0.1% (Olney & Mulinare, 2002), whereas the rate in Turkey was reported as 0.15-0.4% (Güvenc *et al.*, 1993; Tuncbilek, Boduroğlu & Alikaşifoğlu, 1999). In Gaziantep (Turkey), where the study was conducted, the excessive number of SB despite high consumption of food containing vitamin B (wheat products) indicates the effectiveness of other factors in SB formation. It was noted that children with SB had a low rates of completing the tests that require locomotion such as walking and agility tests and balance/posture, while they completed the tests requires the use of upper extremity at high rates. This suggests that the failure of children with SB to complete the tests was caused by lower extremity/core muscle weakness rather than mental/psychological problems. Application of curl-up without supports was limited while curl-up with supports was completed successfully. Deciding which of those tests would be used by judging the level of injury will be beneficial. It indicates that even if they have the same type of disability, severity of damage and the differences in functional limitations are required to be considered during the selection of tests.

Children with BPI completed all tests in higher rates including upper extremity tests at the involved sides. The fact that the completion rates dropped under 90% in certain tests was related to maladaptation caused by children's ages.

Children with NMD were generally successful in the tests that require the use of upper extremity, but their rates of completing pro-agility test, 6 min walk test, posture analysis, lateral step up test and static balance tests, which required standing for a certain period of time were low. The failure to complete sitting balance, curl up and modified curl up tests is thought to be caused by trunk/core muscle weakness of children. It indicates that the exposure level of the body parts should also be considered together with the type of disability when selecting tests.

Children with TBI and OD generally understood and successfully completed the tests. It was noted that children with OD did not have any physical limitation or mental/psychological maladaptation which might effect completion rates of the applied tests.

Considering the percentages of applicability of the tests within the general assessment;

Peg board test could be completed by all groups except ID and DS with a high percentage. Mental/psychological maladaptations in these groups reduced the applicability of this test. Furthermore, ID group could complete the tests with a higher percentage than DS group. TBI group had a lower success rate in left hand peg board test which was affected. Children with hemiplegic CP could complete the test with high rates despite the problems caused by their physical limitations.

Sit and reach test could be completed by all groups except DS with a high percentage. Variationin the applicability was also found for this test between ID and DS groups. Completion

of the test despite the high number of lower extremity affected children participating in the program, indicates the importance of body and upper extremity support to conduct this test.

The agility test was successfully completed with a high percentage particularly by OD, BPI and ID groups. The problems which effects locomotion of SB and NMD groups reduced the applicability of this test for these groups. Children with DS could complete the test at a very low percentage although they did not have any physical disabilities.

Children with TBI, OD, CP, SB and BPI could complete the reaction time test with a high percentage. Completion percentages of both ID and DS groups were low, while ID group had a higher completion percentage than DS.

Children with TBI, OD and BPI could complete the Six Minute Walk Test with a high percentage. Children with NMD did not have the required physical capability to complete the test. The applicability of the test was also low for SB and CP groups due to the limitations of lower extremity motor functions. Although the ideas suggesting that reducing the time and distance or conducting the test with healthy peers could increase the completion rate (Menear, Sims, & Phillips, 2007) were taken into account, DS and ID groups had a low percentage of completing the tests.

For posture analysis, children are required to stand at a predetermined position for a period of time. This test cannot be used for children who cannot stand up. Successful completion rates of the tests was low due to the problem of standing stil without changing position in ID and DS groups.

Curl-up test could be completed with a high percentage by OD, TBI and BPI groups. Physical limitations of SB and NMD groups reduced the completion percentage of the test, while the test had higher success rates when it was applied with supports (modified curl up test). ID group had higher completion percentages than DS group.

Lateral step up test was found applicable for TBI, OD and BPI groups. CP, SB and NMD groups failed to complete the test due to the physical limitations, while ID and DS groups failed due to mental or psychological maladaptation.

Children with BPI had a low rate of success completing the hand grip test particularly with their involved extremity. Children with DS also failed the hand grip test. NMD group had a low percentage of completing the test due to both physical and mental/psychological maladaptations.

Medicine ball throw test could be completed by all groups with a high percentage. It is because the test could easily be understood or it was similar to the activities of daily life. Children with BPI also had a high completion percentage of the test with support from the healthy side of their bodies.

Pull up test could be applied successfully in all groups except DS.

It was found that Berg balance test could be completed at very low rates in the DS group, and it could be completed under 50% by the ID group. It is believed that the problems in understanding the test had a negative impact on applicability rates.

In the sitting balance test, in addition to ID and DS groups, the completion rate of the test was also found low for the NMD group.

The static balance test, which requires standing 30 s. on the force platform was completed with a very low percentage by DS and NMD groups while OD, TBI and BPI groups could completed it with a high percentage. It was completed by around at a rate 50% of the other groups.

This study differs from other studies as it includes the examination of several functional tests on different types of disability. Individual reporting or tests specific for a certain group of disability (modified Ashworth scale etc.) are frequently used in this kind of studies. Although this method is functional for monitoring changes in the same type of disability, tests which can commonly be used for collective evaluation of different types of disability are needed.

In conclusion, there may not be any test-evaluation systems which can be applied for all types of disabilities, even after being modified. Even having the same disability type does not allow using several/all tests commonly. The differences in physical fitness levels, functionality and severity of sequelae rule out using several tests commonly even if the type of disability is the same. Modifications will be required in the application of the tests according to the physical limitations of the affected extremities. "Psychological adaptation problems" experienced during the application of the tests and the "mental incompetence" in understanding and completing the test should be considered in different categories. It should be remembered that tests will be considered applicable if the deficiencies in understanding the test can be corrected with repeated practice.

Recommendations

For physical fitness test applications in children with disabilities, attention should be paid to:

- Obtain a medical evaluation report which includes the movements and functions that should be avoided,
- Obtain a consent form from the children's parents before starting the tests,
- Train the instructors on the applicability of tests for different types of disability,
- Make necessary arrangements to ensure children's safety during the tests,
- Consider that the time required for each child to understand, practice and apply the test may be different,
- Remember that being tested with a group increases motivation of certain children while it may have a negative impact on others,
- Consider that physical and mental problems specific for the disability may require certain modifications in the application of the tests,
- Choose the tests for the evaluation of children with disabilities according to the children's physical performance levels and modify the tests when necessary,
- Know that individual needs of each child may also require special modifications for each test,
- Avoid changing the purpose of the test as a result of the modifications,
- Conduct preliminary and final tests in similar conditions,
- Note the results of the tests on straightforward forms,
- Evaluate the test results with a multidisciplinary approach,

- Generate short, straightforward reports for families and other professionals involved in the child's education and rehabilitation,
- Use follow-up forms to transfer the development of the child to the daily life, and receive help from the family in this regard.
- Conduct the evaluation using the test criteria of Education for All Handicapped Children (Trip & Zhu, 2005).

Compliance with Ethical Standards

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Ethical Approval

All procedures performed in the study were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

Informed Consent

Informed consent form was obtained from all participants' parents.

Conflict of Interest

The author declares that he has no conflict of interest.

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