

Introduction

In Switzerland, children enter Kindergarten at age five. However, not all children are mature enough and ready for school at this age. One of the parameters which determine a child's maturity, is its developmental stage in motor skills. In the preschool age the variability in motor skills between children is large. Thus, a reliable and valid test instrument is needed to assess the children's motor abilities at this age.

Aim: Here, we present the test-retest reliability of different motor tasks for children between three and five years.

Methods

Participants

Test-retest reliability was based on a sample of n = 20 normal children, 12 boys and 8 girls between 3 and 4.4 years of age (mean = 3.6, sd = 0.5). The children were tested twice within a period of two weeks by the same examiner. Each child was rated by the same examiner from videotapes.

Equipment

The Zurich Neuromotor Assessment (ZNA)^{1,2,3} was adapted and extended for children in the preschool years (i.e. between 3 and 5 years old). Originally, the ZNA was developed for children age 5 to 18 years and includes repetitive movements of fingers, hands and feet, alternative movements of hands and feet, sequential movements of the fingers, adaptive motor performance, static and dynamic balance tasks. The ZNA was partly simplified, some tasks were added, others omitted. Inserting coins in a box, threading bolts on a board, threading beads, towering stones, holding a pencil, walking on a bar, on a straight line, climbing stairs, running and sitting up and down were added, stress gaits were omitted. Quality scores ranged from zero (perfect) to 4 (not possible or refusal of task). We added the means and standard deviation of the results of the dominant side of all children on their first test.

Results

Correlation coefficients (significance level at p < 0.05, *) were performed between the data of the first and the second test session. They varied substantially between different motor tasks. The following findings can be reported:

- 1) All children performed goal oriented tasks.
- 2) Adaptive tasks showed in general a better correlation than pure motor tasks.
- 3) Pure motor tasks were not assessable in all children.
- 4) Qualitative measurements (on a 5 point scale) concerning locomotion were highly reliable.

Discussion

It is generally known that children between 3 and 5 years are difficult to examine. Depending on their motivational and maturational state they will perform a new task or not. This disentanglement of motivation and maturation is crucial. For tests of motor development it is necessary to have motivated children. Tasks in which subjects have to do something with objects are always performed. It is even possible to take time measurements. Tasks that are more difficult to perform (less goal oriented) are less suitable for tests in this age group, sometimes only half of the children participate. Tests that can only be performed by part of the children are not suitable for clinical practice. Therefore, adaptive tasks and locomotion tasks are predestined for children in this age group. Normative data of these tasks will be gathered in the nearest future.

Conclusions

For testing young children, it is most important to find tasks that they are willing to perform at this age. The motivation of the child determines whether one can do a test or not. Provided the tasks do involve objects and clear goals, children in this age group can be tested reliably.

Motor tasks (partly from the Zurich Neuromotor Assessment) ^{1,2,3}					
Pure motor tasks			mean	SD	
Repetitive movements	Finger	Timed performance (in s)	8.3	1.4	
	Hand	Timed performance (in s)	7.8	1.2	
	Foot	Timed performance (in s)	12.8	7.1	
Alternating movements	Hand (pro/supination in sitting)	Timed performance (in s)	14.2	5.0	
	Diadochokinesis	Quality measurements (0 - 2)	1.6	0.7	
	Foot	Timed performance (in s)	19.4	6.9	
Sequential movements	Finger	Quality measurements (0 - 4)	3.3	0.9	
Adaptive tasks					
Inserting coins in box		Timed performance (in s)	17.7	2.6	
Pegboard		Timed performance (in s)	41.2	9.5	
Threading bolts on board		Timed performance (in s)	40.6	16.5	
Threading beads on lace		Timed performance (in s)	80.3	30.1	
Stacking wooden columns		Amount of columns	4.1	1.4	
Pencil holding		Hand position (0 - 4)	2.1	0.8	
Dynamic balance	Side-to-side jumping	Quality measurements (0 - 4)	2.7	1.2	
	Hopping on one leg (count)	Quality measurements	6.7	4.7	
	Forward jumping	Quality measurements (0 - 4)	2.3	1.1	
Balance					
Static balance	Standing on one foot	Timed performance (in s)	5.4	3.9	
Locomotion	Different gaits	Walking on a straight line	Quality measurements (0 - 4)	2.0	1.2
		Walking on a bar (6.35 cm)	Quality measurements (0 - 4)	2.0	1.0
		Sitting up and down	Quality measurements (0 - 4)	1.4	1.0
		Running	Quality measurements (0 - 4)	1.6	1.1
		Climbing stairs	Quality measurements (0 - 4)	1.7	1.0



Pegboard



Threading bolts



Repetitive finger movements



Sequential finger movements

Correlation coefficients on motor tasks					
Pure motor tasks		Dominant side	Non-dominant side	Significance	
Repetitive movements	Finger	0.35 (n = 18)	0.32 (n = 18)		
	Hand	0.55 (n = 19)	0.55 (n = 19)	* *	
	Foot	0.40 (n = 18)	0.90 (n = 18)	* *	
Alternating movements	Hand (pro/supination in sitting)	0.05 (n = 16)	0.59 (n = 14)	* *	
	Diadochokinesis	0.57 (n = 19)	0.76 (n = 19)	* *	
	Foot	0.40 (n = 12)	0.84 (n = 10)	* *	
Sequential movements	Finger	0.75 (n = 20)	0.83 (n = 20)	* *	
Adaptive tasks					
Inserting coins in box		0.06 (n = 20)	0.58 (n = 20)	* *	
Pegboard		0.74 (n = 20)	0.83 (n = 20)	* *	
Threading bolts on board		0.84 (n = 16)	0.77 (n = 16)	* *	
Threading beads on lace		0.63 (n = 20)			
Stacking wooden columns		0.30 (n = 20)			
Pencil holding		0.61 (n = 20)		*	
Dynamic balance	Side-to-side jumping	0.83 (n = 20)		*	
	Hopping on one leg (count)	Not possible	Not possible		
	Forward jumping (0 - 4)	0.62 (n = 20)		*	
Balance					
Static balance	Standing on one foot	0.77 (n = 15)	0.55 (n = 17)	* *	
Locomotion	Different gaits	Walking on a straight line		*	
		Walking on a bar (6.35 cm)		*	
		Sitting up and down		*	
		Running	0.96 (n = 20)		*
		Climbing stairs	0.87 (n = 20)		*

Literature

- 1) Largo RH, Caffisch JA, Hug F, Muggli K, Molnar AA, Molinari L, Sheehy A, Gasser ST. Neuromotor development from 5 to 18 years. Part 1: timed performance. Dev Med Child Neurol. 2001 Jul; 43(7):436-43
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- 3) Rousson V, Gasser T, Caffisch J, Largo R. Reliability of the Zurich Neuromotor Assessment. The Clinical Neuropsychologist. 2008, 22: 60-72.