Assessment of Balance and Environmental Adaptation in Children with Spastic Cerebral Palsy

Dina Mohamed Abd El Fadil, Msc. Pediatrics, Al- Azhar University
Prof.Ahmed Mohamed El Kahky, Professor of Physiotherapy, Faculty of Postgraduate Childhood Studies Ain Shams University
Prof.Samia Samy Aziz, Professor of Public and Child Mental health, Faculty of Postgraduate Childhood Studies Ain Shams University
Dr.Sherif Ahmed Samy Kandeel, Assistant Professor of Rheumatology and Rehabilitation, Director of Childhood Disabilities Center, Al- Azhar University

Abstract

Background: Cerebral palsy (CP) describes a group of disorders of posture and movement that occur as a result of a non- progressive disturbance in the infant brain. Balance is an important element of children with spastic CP which describe the ability of the child to safely and independently function in a variety of environments. Environmental adaptation and social participation of children CP is influenced by both their functional skills and environmental factors.

Aim: To assess balance and quality of life in children with spastic CP.

Methodology: Fifty six spastic cerebral palsy children from both sexes aged (4- 12) years participated in this study. All participants were subjected to full clinical examination, neurological examination, functional motor skills by GMFMCS and GMFM- 66, balance assessment by PBS and SCALE and assess the effect of level of motor impairments and quality of life in children with spastic CP.

Results: there was statistically significant correlation between GMFM- 66 and PBS (P value= 0.01, r= 0.89). Also statistically significant correlation between GMFM- 66 and SCALE (P value= 0.01, r= 0.65). There was statistically significant correlation between GMFM- 66 and QOL (P value=0.0 1, r= 0.534). That SCALE and PBS tools as regard GMFM- 66 could distinguish between different functional balance and different levels motor impairments in children with CP. Quality of life (QOL) of children with spastic cerebral palsy were affected by level of motor impairments and more effective tool in children with CP above seven years old.

Conclusion: PBS and SCALE are valid tools to assess balance in children with spastic CP. Environmental adaptation and social participation of children CP is influenced by both their functional skills and affect quality of life.

Recommendation: Further researches are also required to evaluate balance and environmental adaptation of children with spastic CP

Keywords: Cerebral Palsy, Balance, Quality Of Life and Environmental Adaptation.

تقييم التوازن والتكيف البيئى فى الأطفال الذين يعانون من الشلل الدماغى التشنجى

مقدمه: الشلل الدماغى هو مجموعه من الاضطرابات التى تصيب الجهاز العصبى نتيجه اصابه المخ مما يؤدى الى قصور فى وظائف الدماغ التوازن عند الاطفال يعتبر تكامل عده انظمه حيويه والتى تؤدى الى القدره على بلوغ هدف الوقوف والحفاظ على هذه المهاره وتقليل الاعتماديه ان التكيف البيئى والبيئه المحيطه بالاطفال مرضى الشلل الدماغى تختلف من طفل للاخر وتؤثر ايضا على مدى مشاركتهم فى المجتمع مشاركه فعاله، وعلى الرغم بصفه عامه قدراتهم اذا اتيحت لهم الفرصه واتم ازاله المعوقات فانهم يستطيعون المشاركه فى المجتمع بشكل مرضي.

المنهجيه: الهدف تقييم التوازن وجوده الحياه فى الاطفال الذين يعانون من الشلل الدماغى التشنجى ولقد اجريت هذه الدراسه على ستة وخمسين طفل من الاطفال المترددين على كل من عيادات مركز ذوى الاحتياجات الخاصه كليه الدراسات العليا جامعه عين شمس وعيادات مركز معوقات الطفوله جامعه الازهر من كلا الجنسين. تم تطبيق الاختبارات التاليه لكل طفل على حده: نظام تصنيف الوظائف الحركيه/ مقياس المهارات الحركيه- ٦٦ مقياس التوازن الطفولي* مقياس التحكم الاختيارى للاطراف السفليه* مقياس جوده الحياه لمنظمه الصحه العالميه.

النتائج: وقد لوحظ وجود علاقه ارتباط ايجابى بين مقياس المهارات الحركيه- ٦٦ ومقياس التوازن الطفولى، كذلك علاقه ارتباط ايجابى بين مقياس المهارات الحركيه- ٦٦ ومقياس التحكم الاختيارى للاطراف السفليه، بالاضافه الى وجود ارتباط ايجابى بين مقياس المهارات الحركيه ومقياس جوده الحياه لمنظمه الصحه العالميه اسفرت نتائج البحث عن ان كلا من مقياس التوازن الطفولى ومقياس التحكم الاختيارى للاطراف السفليه يعتبروا وسائل فعاله لتقييم التوازن. كذلك ان التكيف البيئى والمشاركه المجتمعيه للاطفال ذوى الشلل الدماغى التشنجى تتأثر وتؤثر بمستوى المهارات الحركيه وجوده الحياه. الخلاصه مقياس التوازن الطفولى ومقياس التحكم الاختيارى للاطراف السفليه يعتبروا وسائل فعاله لتقييم التوازن فى الاطفال ذى الشلل الدماغى التشنجى كذلك التكيف البيئى للاطفال ذوى الشلل الدماغى التشنجى تتأثر بمستوى المهارات الحركيه وجوده الحياه.

الكلمات الافتتاحيه: الشلل الدماغى التصلبى للاطفال- التوازن- جوده نوعيه الحياه- التكيف البيئى.

Introduction:

Cerebral palsy (CP) describes a group of disorders of posture and movement that occur as a result of a non- progressive disturbance in the developing fetal or infant brain. (Robert et.al, 2010).

In Egypt, El- Tallawy et.al, (2011) reported a prevalence of 2.04 per 1000 live births among children in Al- Kharga District, New Valley. Another study conducted at Al- Quseir City, Red Sea Governorate in Egypt, reported a prevalence of CP in children of 3.06 per 1000 live births (El- Tallawy et.al, 2014).

The most common form of CP is spastic cerebral. Spastic type has been subcategorized as: spastic hemiplegia, spastic diplegia, spastic quadriplegia, among children with CP, It has been detected that 35% of spastic CP cases are hemiparetic, 28% are diparetic, and 37% are quadriparetic. In some studies, hemiparetic, diparetic, quadriparetic terminologies are replaced with the terms unilateral and bilateral Mockford and Caulton (2010).

Unfortunately, No treatment lead to a permanent cure and its management is only supportive. The management plan depends mainly on the specific type of CP and associated comorbidities. The type of treatment administered may vary throughout the child's life to reflect changes in condition and the patient's capabilities.

Balance deficits are one of the most common problems for spastic cerebral palsy. Children with cerebral palsy (CP) have limitations with postural control and anticipatory postural adjustments. Their capacity to sit, stand and walk independently are delayed which interfere with daily life activities. (Hartbourne et.al, 2010). Balance is defined as the ability to control the center of mass relative to the base of support. (Atkinson et.al, 2011).

As impairments in standing balance can be effectively treated through therapeutic exercise so assessment of postural control in standing is important for monitoring development, diagnosing impairments, planning treatment programs, and evaluating change in pediatric populations (Majlesi et.al, 2014).

Children with cerebral palsy (CP) have impairment of balance and high risk of falling, with 35% of patients reporting daily falls, and an additional 30% reporting monthly or weekly falls (Boyer and Patterson, 2018).

Environmental adaptation and environmental factors are the master on functioning and disability processes (Law et.al, 2013) Despite this children with a disability generally participate in less physical activity than their able- bodied peers and it is critical to identify interventions that create meaningful long- term change in child and family physical activity behaviours (Carlon et.al, 2013).

Several studies have shown that some environmental factors such as lack of physical and emotional support, inaccessibility of the physical environment, and negative attitudes affect participation of children with CP. This also found that the physical, social, and attitudinal environment influences participation of children with CP, understood as their involvement in diverse life areas. (Colver et.al, 2012).

Children with CP with a major motor impairment, presence of pain and intellectual disabilities obtain lower QOL (Arnaud et.al, 2008) and that these factors interfere with their participation in daily activities and the fulfillment of social roles. Therefore, high participation is associated with the availability of a better environment (Colver et.al, 2012) and that a supportive, accessible environment is a predictor of better QOL (Law et.al, 2014).

Aim Of The Study:

The present study was conducted to evaluate SCALE and PBS tools as regard GMFM- 66 to assess the balance in children with spastic CP and to assess how environmental adaptation can affect the quality of life also to assess the effect of level of motor impairments and quality of life QOL in children with spastic CP.

Methodology:

The study was done on children with cerebral palsy visiting the clinics of Faculty of Postgraduate Childhood Studies Ain Shams University and in the clinics of Childhood Disabilities Center Al- Azhar University from 1 st of January 2018 till 30th of June 2019.

Total number of examined patients was 850 children, 216 children fulfilled study criteria, parents of 56 children only accepted and gave written consent to be included in this study. In this descriptive analytical study, all subjects diagnosed with spastic cerebral palsy 33 female and 23 male with age 4- 12 years old were in one group subdivided according to age into 2 groups. First subgroup from 4years old to less than 7 years old and second subgroup from 7 years old to 12 years.

The inclusion criteria were children below 12 years old, they with motor function severity level of I- III, classified by gross motor function classification system (GMFCS), ability to follow verbal instructions for performing the examinations and ability to stand independently with or without the use of hand- held support for at least 60 seconds.

The exclusion criteria is children with Sensory impairments, Absence of understandable speech, skeletal surgery within the previous year. The gross motor function of the children participating in the study were evaluated with the use of the GMFM- 66 (Gross Motor Function Measure- 66) tool, Balance evaluated by pediatric balance scale (PBS) and by selective control assessment of lower extremity (SCALE). then WHOQOL BREF scale was administered on parents of all participating children (WHOQOL Group 1994).

Statistical analysis:

Data were analyzed using Statistical Program for Social Science (SPSS) version 12.

Ethical consideration:

According to the instruction of the research ethical scientific committee, Faculty of postgraduate childhood studies (IPGCS, 2014), with an informed written consent from parents.

Results:

The study was conducted on fifty six children with spastic cerebral

palsy aged (4- 12) 33 male with 58.9% and 23 female with 41.1%.

Table (1) Correlation between GMFM- 66 and PBS

		GMFM66	PBS
GMFM66	Correlation	1	0.893
	Sig. (2- tailed)		0.000
	N	56	56
PBS	Correlation	0.893	1
	Sig. (2- tailed)	0.000	
	N	56	56

Analysis of Correlation between GMFM- 66 and PBS showed statistically significant correlation between GMFM- 66 and PBS (P value= 0.001, r= 0.89), very strong association.

Table (2) Correlation Between GMFM- 66 And SCALE

		Gmfm- 66	SCALE
GMFM66	Correlation	1	0.651
	Sig. (2- tailed)		0.000
	N	56	56
SCALE	Correlation	0.651	1
	Sig. (2- tailed)	0.000	
	N	56	56

Analysis of Correlation between GMFM- 66 and SCALE showed statistically significant correlation between GMFM- 66 and SCALE (P value= 0.001 r= 0.651), strong association.

Table (3) Correlation Between GMFM- 66 And WHOQoL BREF

		GMFM66	QOL
Gmfm- 66	Correlation	1	0.534
	Sig. (2- tailed)		0.000
	N	56	56
QOL	Correlation	0.534	1
	Sig. (2- tailed)	0.000	
	N	56	56

Analysis of Correlation Between GMFM- 66 And WHOQoL BREF showed statistically significant correlation between GMFM- 66 and QOL (P value= 0.001, r= 0.534), strong association.

Table (4) Correlation Between PBS And SCALE

		SCALE	PBS
SCALE	Correlation	1	0.0491
	Sig. (2- tailed)		0.000
	N	56	56
PBS	Correlation	0.491	1
	Sig. (2- tailed)	0.000	
	N	56	56

Analysis of Correlation between PBS and SCALE showed statistically significant correlation between PBS and SCALE (P value= 0.001, r= 0.49), strong association.

Table (5) ANOVA test: analysis age groups differences according to WHOQoL BREF tool results

QOL	Sum Of Squares	df	Mean Square	F	Sig.
Between Groups	309.053	1	309.053	4.942	0.030
Within Groups	3377.072	54	62.538		
Total	3686.125	55			

Analysis of age groups differences according to WHOQOL BREF tool results showed significant difference between the two age groups (group from four to below seven years old and group from seven to twelve years old) P value< 0.01, F= 4.94, Thus the older the children the better WHOQOL BREF tool results.

Discussion:

Cerebral palsy was the most common cause of motor disability in childhood Sewell et.al (2014). Children with CP had many neurological deficits that interfere with motor function, care, comfort, or positioning These impairments included neuromuscular and musculoskeletal problems such as spasticity, muscle contractures, bone deformities, loss of selective motor control and weakness Mark (2011).

Postural control played a major role in contributing to motor disorders in children with CP. Postural stability was crucial for purposeful movement and functional activities. Poor postural control limited gross motor functions, ability to explore and interact with the environment, affecting the quality of life for children with CP.

Furthermore, problems with dynamic balance were common in children with cerebral palsy and included inappropriate muscle organization, abnormal intersensory integrative ability and late onset of muscle activation Damiano et.al (2013).

In present study there was statistically significant correlation between GMFM- 66 and PBS scores p value= 0.001 r= 0.651, strong association, that agreed with Sook Hee et.al (2012) showed PBS total score was strongly correlated GMFM- 66 scores, PBS could test balance function associated with walking and standing. PBS could be considered a simple and valid scale for examining functional balance in children with CP.

In the study there was statistically significant correlation between GMFM- 66 and QOL scores p value= 0.001, r= 0.534, strong association that agreed with Chulliyil et.al (2014) showed that School- aged cerebral palsy children who were more functionally dependent were found to have worse quality of life. Those children who were more functionally independent in their participation in play& school activities felt better about their physical, social, emotional, educational& environmental well-being.

In the present study there was statistically significant correlation between GMFM- 66 and SCALE scores p value= 0.001, r= 0.651, strong association, that agreed with Noble et.al (2018) reported that SCALE was significantly correlated with GMFM- 66 in a small group of individuals with bilateral spastic CP. The strong relationship observed for SCALE with GMFM compared to normalized muscle volume suggested that selective motor control was the dominant factor over muscle size and joint stiffness in determining an individual's gross motor function. Consequently, SCALE, as a measure of selective motor control strongly correlated with GMFCS and to gait abnormality. Balzer et.al (2016) demonstrated a significant difference between SCALE scores for children with GMFCS levels I and II, but were unable to show a significant difference between SCALE scores for GMFCS levels II and III.

In the present study there was statistically significant correlation between PBS and SCALE scores (P value= 0.001, r= 0.49), strong association, that agreed with Hyoungwon Lim (2015) reported SCALE items were significantly correlated with two PBS dimensions (standing

and postural change).

In the present study children included were diagnosed with spastic cerebral palsy and age group (4- 12) and quality of life was assessed using WHOQOL- BRIF that agreed with El- Weshahia et.al (2017) assessed QOL for children with spastic CP at age (4- 12) using CP- QOL questionnaire and also showed that assessment of QOL for children with CP was crucial for making an appropriate decision for providing health care for them.

Conclusion:

Pediatric balance scale (PBS) and selective control assessments of lower extremity (SCALE) tools are valid tools to assess the balance especially functional balance in children with spastic cerebral palsy.

Environmental adaptation and level of motor impairment can affect on quality of life of children with CP and their parents and social participation.

There is high association between gross motor function and Quality of Life for children with cerebral palsy and the older the children the better results of quality of life assessments scores.

Recommendations:

- Considering PBS and SCALE is assessment tools for balance for children with CP.
- Thus the present study is a step in quantitive evaluation of balance in children with cerebral palsy and also establishing that tools could be applied in clinical routine examinations of balance.
- Future research should also investigate other aspects of the child's life, as participation and services received and not received.
- It is important to consider all functional aspects of a child as well as to observe how associated health conditions contribute to influencing not only the child's life but the parents as well, to contribute to improving the quality of life of the child and family.

In addition, There are many different ways in which environments, activities, and routines can be adapted to make them more conducive for children to encourage participation and environmental adaptation.

References:

1. Arnaud, C., White- Koning, M., Michelsen, S. I., et.al (2008). Parent-reported quality of life of children with cerebral palsy in Europe. **Pediatrics**, 121(1), 54- 64.
2. Atkinson HL and Nixon- Cave K (2011). A tool for clinical reasoning and reflection using the international classification of functioning, disability and health (ICF) framework and patient management model. **Phys Ther**; 91: 416- 30.
3. Balzer J, Marsico P, Mitteregger E, Van der Linden ML, Mercer TH and Hedel HJ, (2016). Construct validity and reliability of the selective control assessment of the lower extremity in children with cerebral palsy, **Dev. Med. Child Neurol**. 58 167- 172.
4. Boyer E. R. and Patterson A. (2018), Gait pathology subtypes are not associated with self- reported fall frequency in children with cerebral palsy, **Gait Posture** 63 189- 194.
5. Carlon SL, Taylor NF, Dodd KJ, et.al (2013). Differences in habitual physical activity levels of young people with cerebral palsy and their typically developing peers: a systematic review. **Disabil Rehabil**; 35: 647- 655.
6. Chulliyil SC, Walter S, Russell D. et.al (2014): Correlation of functional independence and quality of life in school aged children with cerebral palsy. **International Journal of Contemporary Pediatrics**; 1(1): 32- 36.
7. Colver, A., Thyen, U., Arnaud, C. et.al (2012). Association between participation in life situations of children with cerebral palsy and their physical, social, and attitudinal environment. **Archives of Physical Medicine and Rehabilitation**, 93(12), 2154- 2164.
8. Damiano DL, Wingert JR, Stanley CJ, et.al (2013). Contribution of hip joint proprioception to static and dynamic balance in cerebral palsy. **J. Neuro Eng Rehabil**; 10: 57.
9. El- Tallawy HN, Farghaly WM, Shehata GA, et.al (2014). Cerebral palsy in Al- Quseir City, Egypt: prevalence, subtypes, and risk factors. Neuropsychiatr **Dis Treat**; 10:1267- 1272.
10. El- Tallawy HN, Farghaly WM, Shehata GA, Metwally NA, Rageh TA and Abo- Elfetoh N (2011). Epidemiology of cerebral palsy in El-Kharga District, New Valley (Egypt). **Brain Dev**; 33: 406 411.
11. El- Weshahia HM., Mohamed MK, Abd- Elghany H, Omarb T, and E. Azzawib (2017) Psychometric properties of a translated arabic version of cerebral palsy quality of life questionnaire: primary caregiver form. **Alexandria Journal of Pediatrics**, 30: 53- 60.
12. Hartbourne, R., Willett, S., Kyvelidou, A., Deffeyes, J., and Stergiou, N., (2010): A comparison of Interventions for Children with Cerebral Palsy to Improve Sitting Postural Control, **Physical Therapy**; 90(12), 1881- 1889.
13. Hyoungwon Lim (2015): Correlation between the selective control assessment of lower extremity and pediatric balance scale scores in children with spastic cerebral palsy **J. Phys. Ther. Sci.** 27: 3645- 3649.
14. Jonathan J. Noble, Martin Goug and, Adam P Shortland, (2018): Selective motor control and gross motor function in bilateral spastic cerebral palsy. **Dev. Medicine& Child Neurology** 42: 606- 618.
15. Law M, Anaby D, Teplicky R, Khetani **MA**, Coster W, and Bedell G (2013). Participation in home environment among children and young with and without disabilities. **Br J Occup Ther.**; 76(2): 58- 66.
16. Law, M., Hanna, S., Anaby, D., Kertoy, M., King, G.& Xu, L. (2014). Health- related quality of life of children with physical disabilities. **BMC Pediatrics**, 14, 26.
17. Majlesi M, Farahpour N, Azadian E and Amini M (2014). The effect of interventional proprioceptive training on static balance and gait in deaf children. **Res Dev Disabil**; 35: 3562- 7.
18. Mark, E., (2011): Treatment of neuromuscular and musculoskeletal problems in cerebral palsy, **Pediatr Rehabil**; 4(1): 5- 16.
19. Mockford M and Caulton JM (2010). The pathophysiological basis of weakness in children with cerebral palsy. **Pediatr Phys Ther**; 22: 222-

233.

20. Robert J., Steven E., Peter L. and Beth T. (2010): Probability of walking, wheeled mobility, and assisted mobility in children and adolescents with cerebral palsy, **Journal of development medicine& development;** 52(1): 66- 71.
21. Sewell MD, Eastwood DM and Wimalasundera N (2014). Managing common symptoms of cerebral palsy in children. **BMJ**; 349: g5474.
22. Sook Hee Yi, Ji Hye Hwang, Sang Jun Kim and Jeong- Yi Kwon, (2012) Validity of Pediatric Balance Scales in Children with Spastic Cerebral Palsy **Neuro- pediatrics**; 43: 307- 313.
23. World Health Organization, International Classification of Functioning, Disability, and Health (1994): **WHOQOL and WHOQoL- BREF Children& Youth Version**.