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How are Gross Motor Functions, Manual Abilities, and Cognitive Functions related to the Quality of Life in Children with Cerebral Palsy?

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Abstract

Background: Cerebral palsy (CP) is the most common type of permanent movement and postural disorder in children leading to contractures, deformities, and activity limitations. Quality of life is considered as an outcome variable to evaluate the effectiveness of interventions for children with CP. In this study, we aimed to examine how the quality of life is related to gross motor functions, manual abilities, and cognitive functions in children with CP.

Methods: This research was a cross-sectional study on 200 children with CP aged 4-12 years selected through non-probability sampling. Quality of life, gross motor ability, hand function, and cognitive level were assessed using Cerebral Palsy Quality of Life Questionnaire (CPQOL), Gross Motor Function Classification System scale (GMFCS), Manual abilities Classification System Scales (MACS) and SPARCLE (Study of Participation of Children with Cerebral Palsy Living in Europe) scale.

Results: The results demonstrated that the CPQOL subscales was significantly correlated with the gross motor functioning (reference: GMFCS level one, $p < 0.05$), manual ability (reference: MACS level one, $p < 0.05$) and cognitive level in these children (reference: cognitive level >70, $p < 0.05$).

Conclusions: A poor performance child with CP has the potential to report poor QOL and it seems that a child with high level of performance has the potential to report better QOL. This needs more evidence for elaboration.

Key Words: Cerebral palsy, Child, Cognition, Cognitive level, Function, Gross motor, Manual ability, Quality of life.

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1- INTRODUCTION

Cerebral palsy (CP) is one of the most common movements and postural disorders in childhood that occurs because of a lesion in the developing brain (1). These children may experience a wide range of movement, postural, coordination, sensory, and cognitive disorders throughout their lives (2). Various treatments and rehabilitation interventions are performed to maximize the performance of these children (3, 4). Many efforts have been made to investigate the effect of these interventions on children with CP by employing appropriate outcome measures. In recent years, quality of life (QOL), as a manifestation of health and well-being, has been proposed as an outcome measure for evaluating the effectiveness of interventions (5). In the International Classification of Functioning (ICF), QOL has been proposed as the ultimate goal of interventions (6). QOL can also be considered as a predictor of a child's health status (7).

According to the definition of the World Health Organization, QOL is an individuals' understanding of his or her situation and circumstances in life, which is based on their culture, value system, goals, expectations, standards, and priorities. Therefore, QOL is completely individualized and subjective and is based on people's understanding of different aspects of their lives (8, 9). Although QOL has a multidimensional structure, many researchers agree that it is equal to persons' performance or is highly dependent on their performance (10). Studies showed impaired QOL in children with CP. This degree of impairment is associated with the level of independence in daily activities, mobility, clinical limitations, and social interactions (11). Shelley et al. (12) examined the relationship between the QOL of children with CP and their level of performance. In their study, the CPQOL questionnaire was used to evaluate the QOL of children with CP, and Gross Motor Functions Classification System (GMFCS) was used to evaluate their level of gross motor functioning. A significant relationship was found between the subscales of the QOL and gross motor functions. However, this association was more related to the physical subscale than the psychosocial subscales. The relationship between performance and QOL is not limited to walking performance and a positive relationship between physical activity and QOL has also been reported (11).

Park et al. (13) used path analysis to assess the relationship between strength, spasticity, gross motor function, and QOL on 62 children with spastic CP. There was a significant and direct relationship between spasticity, strength, and gross motor functioning, and between gross motor functioning and health-related QOL, as well as between strength and children's QOL. In another study, Kolman et al. (7) examined the predictors of health and QOL. They found that factors related to comfort, emotions, communication, and social interactions predicted QOL more than mobility and self-care. Maher et al. (14) also reported that physical activity significantly predicted the quality of physical and social life. However, in a systematic review of studies on the QOL of children and adolescents with CP in the middle- and low-income countries, it was reported that the physical subscale of QOL of children with CP was strongly correlated with motor functions (15). However, these children have a high QOL in the psychosocial subscale even if they have low performance (12).

Child performance may predict his/her QOL. Performance of children with CP including gross motor and manual functions and cognitive ability may predict the QOL of these children. Therefore, we aimed to investigate the relationship between the performance of children with

CP in terms of gross motor functions, manual abilities, and cognitive functions with their QOL.

2- Materials and Methods

In this cross-sectional study with non-probability sampling, 200 children with CP were enrolled from eight rehabilitation centers and three schools for children with special needs. We included children aged 4-12 years diagnosed with CP according to their medical records, whose parents were literate and agreed with their participation. Children with neurodegenerative diseases or psychiatric illness were excluded. Children were classified topographically and physiologically according to the Surveillance of Cerebral Palsy in Europe (SCPE) (16).

2-1. Tools and Measures

The data for this study were collected using the Persian version of the CPQOL-parent, a socio-demographic characteristics questionnaire (17), GMFCS (18), Manual Ability Classification System (MACS) (19), and the SPARCLE cognitive level estimation form (20).

The socio-demographic questionnaire includes 46 questions divided into four sections: questions related to the child, the parents, the child's caregiver, and the child's health status.

The CPQOL-parent version measures condition-specific QOL and is completed by the parents. This questionnaire has 66 items and is appropriate to assess the QOL of children with CP aged 4-12 years. The answer to each question is divided into a 9-point Likert scale, which the parent either selects or draws a line around (21, 22). CPQOL has seven subscales, including (1) social well-being and acceptance; (2) functioning; (3) participation and physical health; (4) emotional well-being; (5) pain and impact of disability; (6) access to services; and (7) family health. The Persian version of the CPQOL-parent version questionnaire was validated according to the protocol provided by the developers (17), and had acceptable reliability (ICC=0.47-0.84) and the subscales had appropriate internal consistencies (α=0.61-0.87) (17).

Gross motor functioning was assessed according to the GFMCS and based on spontaneous gross movements such as the child's head control, sitting, standing, and transferring (23). In this system, the gross motor functioning of children with CP is classified into five levels. In level one, children have the most, and in level five, children have the least independent motor functioning. This scale has acceptable validity and reliability (23, 24).

The MACS assesses children's manual ability based on how their hands are used to control objects in everyday life (25). This system is defined in five levels similar to the GFMCS. Children in level one have the highest manual ability, and children in Level five have the least control over the objects. MACS has been validated in Persian and has an acceptable level of validity and reliability (19).

Cognitive functioning in children with CP was estimated and classified into three levels including: >70, 70-50, <50. This classification was prepared and used by SPARCLE in Europe (20). Parents with children with CP are asked to answer four questions. Then, based on their responses, the children's cognitive level is identified.

2-2. Procedures

Following the recruitment of the participants, the aims and steps of completing the questionnaires were explained to them. Then, upon their willingness, written consent was obtained from the parents. In the next steps, the questionnaires of the study were completed according to the following order. First, CPQOL and socio-demographic questionnaires were completed consecutively by the parents.

Then, the children's GFMCS, MACS, and level of cognition were identified by an assessor (three occupational therapists) through interviewing the parents. On average, the whole process took about 60 minutes. This study was approved by the Ethical Committee of the University of Social Welfare and Rehabilitation Sciences (ID: 801/4/88/58).

2-3. Data analysis

Data were analyzed using SPSS software, version 19. Descriptive statistics were used to determine the characteristics of the participants. Linear regression was used to investigate the relationship between the subscales of CPQOL and children's functions, including gross motor function, manual ability, and cognitive function.

3- RESULTS

The mean ± SD age of the 200 children participating in this study was 7.7±2.40 years. The distribution of various levels of manual ability was almost close to each other in five levels according to MACS. Levels four and three had the highest percentage with 23% and 20%, respectively; and the other levels were 19% each. The distribution of gross motor functions according to the GFMCS was different from MACS. Levels four and two were the highest with 30.5%, and 24.5%, respectively. The lowest percentage was at level one with 11% (**Table 1**).

Table-1: Demographic characteristics of children with CP

Variable		Number	Percent
Sex:	Female	97	48.5
	Male	103	51.5
Cerebral Palsy Type:	Spastic (Unilateral)	36	18.0
	Spastic (Bilateral)	125	62.5
	Ataxic	10	5.0
	Dyskinetic	14	7.0
	Not Classified	15	7.5
Manual Ability Classification System (MACS):	Level 1	38	19.0
	Level 2	38	19.0
	Level 3	40	20.0
	Level 4	46	23.0
	Level 5	38	19.0
Gross Motor Function Classification System (GMFCS):	Level 1	22	11.0
	Level 2	49	24.5
	Level 3	31	15.5
	Level 4	61	30.5
	Level 5	37	18.5
Cognitive function:	>50	36	18.0
	50-70	46	23.0
	<70	118	59.0

Using linear regression, there were significant correlations between CPQOL subscales and gross motor functions including functioning, participation and physical health, access to services and family health subscales shown statistically. An inverse relationship was detected between severity of disability and QOL.

The results of linear regression revealed significant correlations between the

CPQOL subscales and the children's manual ability for social well-being, functioning, participation and physical health, emotional well-being and family health subscales. The relationship between CPQOL subscales and the children's cognitive level showed a statistically significant relationship with social well-being, functioning, participation and physical health, emotional well-being and family health. It was not significantly correlated with the other subscales (**Table 2**).

4- DISCUSSIONS

In this study, the relationship between CPQOL subscales and CP children's functions (gross motor function, manual ability, and cognitive level) were investigated. The study mainly dealt with the question of whether the children with a high level of function (i.e., gross motor, manual ability, and cognitive level) have a higher quality of life. The result revealed a statistically significant relationship between CPQOL subscales and gross motor functions, participation and physical health, access to services and family health subscales. Also, the relationship between the CPQOL subscales and the children's manual ability and children's cognitive level were statistically significant for the social well-being, functioning, participation and physical health, emotional well-being and family health subscales.

In previous studies, it has been concluded that despite the significant relationship between performance and physical subscales of QOL, there is no relationship between performance and psychosocial subscales of QOL or this relationship is weak (26, 27). It should be noted that the questionnaires, used in these studies, were more related to performance rather than well-being. Well-being is a broader term than performance and is a more appropriate term to describe health. Well-being includes the presence of positive emotions and moods, the absence of negative emotions, satisfaction with life, fulfillment, and positive functioning. In our study, we use CPQOL questionnaire that evaluates well-being along with functioning and participation. Shelley et al. (12), using CPQOL, investigated the CP children's QOL, and its relationship with gross motor functions. We sought the association between the results of this questionnaire not only with gross motor functions, but also with manual abilities and cognitive functions. We found that the relationship between QOL and gross motor functioning was significant and this relationship was also significant for the child's manual ability and cognitive level. This is a confirmation of previous studies, adding that not only gross motor performance but also the manual ability and cognitive level should be considered in regard to performance. In a study on children who were ambulated, Omura et al. (28) found a significant relationship between walking abilities and the physical subscale of CPQOL. They also reported that the physical subscales of QOL positively correlated with physical functioning, gait functioning, and the child's level of communication. However, this study was performed on children who were able to walk. In our study, level 4 and 5 of GMFCS showed inverse relationships with QOL in functioning, participation and access to services; and level 5 of MACS showed inverse relationships with QOL in social well-being and emotional well-being which are also seen in cognitive levels less than 50. Delicate motor functions, including speed and mastery of the upper limbs and visual-motor control, were named as the most important motor factors affecting the QOL of children with CP in a study by Chen et al. (29). In a study by Kolman et al. (7), inability to walk or understand the caregiver, being unhappy or sad, and not going to school were significant predictors of the poor QOL in children with CP.

Table 2. Linear regression analysis of the relationship between CPQOL subscales and the children's gross motor functioning, manual ability and cognitive functioning

Model	Gross Motor Function Classification System (GMFCS)				Manual Ability Classification System (MACS)				Cognitive functions			
	-	Beta	t	Sig.	-	Beta	t	Sig.	-	Beta	t	Sig.
Social well-being and acceptance	(Constant)	-	25.210	.000	(Constant)	-	34.131	0.000	(Constant)	-	61.594	0.000
	GMFCS2	0.085	0.784	.434	MACS2	0.036	0.417	0.677	50-70	-0.113	-1.618	0.107
	GMFCS3	-0.050	-0.504	.615	MACS3	0.040	0.465	0.642				
	GMFCS4	-0.070	-0.624	.533	MACS4	-0.051	-0.572	0.568	<50	-0.336	-4.827	0.000
	GMFCS5	-0.196	-1.901	.059	MACS5	-0.301	-3.487	0.001				
Functioning	(Constant)	-	23.096	.000	(Constant)	-	33.897	0.000	(Constant)	-	55.169	0.000
	GMFCS2	0.005	0.043	.966	MACS2	-0.232	-2.807	0.006	50-70	-0.213	-3.156	0.002
	GMFCS3	-0.040	-0.413	.680	MACS3	-0.231	-2.773	0.006				
	GMFCS4	-0.227	-2.070	.040	MACS4	-0.320	-3.781	0.000	<50	-0.397	-5.876	0.000
	GMFCS5	-0.333	-3.328	.001	MACS5	-0.530	-6.419	0.000				
Participation and physical health	(Constant)	-	22.531	.000	(Constant)	-	28.630	0.000	(Constant)	-	49.785	0.000
	GMFCS2	-0.009	-0.083	.934	MACS2	-0.081	-0.923	0.357	50-70	-0.090	-1.287	0.199
	GMFCS3	-0.109	-1.126	.262	MACS3	-0.107	-1.212	0.227				
	GMFCS4	-0.357	-3.256	.001	MACS4	-0.172	-1.904	0.058	<50	-0.315	-4.479	0.000
	GMFCS5	-0.234	-2.338	.020	MACS5	-0.314	-3.570	0.000				
Emotional well-being	(Constant)	-	21.392	.000	(Constant)	-	30.055	0.000	(Constant)	-	53.640	0.000

	GMFCS2	0.174	1.627	.105	MACS2	-0.092	-1.063	0.289	50-70	-0.161	-2.338	0.020
	GMFCS3	-0.047	-0.481	.631	MACS3	-0.074	-0.850	0.397				
	GMFCS4	-0.048	-0.430	.668	MACS4	-0.127	-1.422	0.157	<50	-0.365	-5.312	0.000
	GMFCS5	-0.178	-1.761	.080	MACS5	-0.357	-4.113	0.000				
Access to services	(Constant)	-	15.079	.000	(Constant)	-	17.846	0.000	(Constant)	-	29.142	0.000
	GMFCS2	-0.149	-1.376	.170	MACS2	-0.135	-1.497	0.136	50-70	0.032	.434	0.665
	GMFCS3	-0.266	-2.686	.008	MACS3	-0.155	-1.709	0.089				
	GMFCS4	-0.332	-2.952	.004	MACS4	-0.076	-0.818	0.415	<50	-0.123	-1.684	0.094
	GMFCS5	-0.218	-2.123	.035	MACS5	-0.157	-1.744	0.083				
Pain and impact of disability	(Constant)	-	8.472	.000	(Constant)	-	14.364	0.000	(Constant)	-	24.195	0.000
	GMFCS2	0.210	1.911	.058	MACS2	-0.001	-0.013	0.989	50-70	-0.046	-.636	0.526
	GMFCS3	0.271	2.702	.007	MACS3	-0.080	-0.873	0.384				
	GMFCS4	0.202	1.778	.077	MACS4	-0.104	-1.122	0.263	<50	0.111	1.521	0.130
	GMFCS5	0.182	1.749	.082	MACS5	0.011	0.121	0.904				
Family health	(Constant)	-	10.142	.000	(Constant)	-	11.796	0.000	(Constant)	-	21.224	0.000
	GMFCS2	-0.059	-0.536	.593	MACS2	-0.027	-0.301	0.763	50-70	-0.159	-2.188	0.030
	GMFCS3	-0.207	-2.074	.039	MACS3	-0.028	-0.309	0.758				
	GMFCS4	-0.189	-1.674	.096	MACS4	-0.024	-0.257	0.798	<50	-0.163	-2.240	0.026
	GMFCS5	-0.250	-2.429	.016	MACS5	-0.201	-2.240	0.026				

The results of the present study also demonstrated a significant relationship between the functioning aspects of CPQOL and children's manual ability. These results are in agreement with those of Shelly et al. (12) that showed a significant relationship between all CPQOL subscales (except "access to health services"). In their study, the relationship between the physical subscales of CPQOL was stronger than the psychosocial one. Teuscher et al. (2019) reported that manual ability and QOL were associated with health in a five-year follow-up study on children with CP. However, despite the significant relationship found between children's functions and the physical subscale of QOL, this relationship was not significant with other subscales (30). It may be concluded that a CP child with poor performance has the potential to report a poor QOL. This needs more evidence for elaboration.

5- LIMITATIONS OF THE STUDY

Due to the lack of a proper registry system in Iran for recording information on children with CP, access to these children through randomization was not possible. Therefore, this study applied the convenient sampling procedure.

One of the strengths of our study was our large sample size with appropriate distribution in various levels of gross motor functioning and manual ability.

6- ETHICS CONSIDERATIONS

This study was approved by the Ethical Committee of the University of Social Welfare and Rehabilitation Sciences (ID: 801/4/88/58). Informed written consent was obtained from the parents of children with CP.

COMPETING INTERESTS

None.

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