Investigation of Difference Between the Three Representatives of the Functional Status According to Upper Limb Functions and Participation in Children with Congenital Hemiplegic Cerebral Palsy

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Abstract

Background: Although there are many valid and reliable functional motor and communication functions classification tools to describe disabled children's functional status in clinical or research environments; however, the actual difference among their levels based on actual performance remains to be determined.

Aim: This study aimed to explore whether the three functional status representatives differentiate according to actual performance in everyday life in children with congenital hemiplegic cerebral palsy (CP).

Method: High to moderate functional motor and communication performance levels as described by Manual Ability Classification System (MACS), Gross Motor Function Classification System, and Communication Function Classification System (CFCS) were investigated in the context of the scaled scores of upper limb functions and participation in different life situations on ABILHAND-Kids and Child and Adolescent Scale of Participation (CASP) questionnaires. The data were collected from 98 children with congenital hemiplegic CP from different rehabilitation centers (mean age 9,3 years [SD 3.0 years], [%95 CI:8.7-9.9]; 42 females, 56 males); 28,6% classified to level I, 29,6 % to level II, and 41,8 % to level III in MACS.

Results: The study findings demonstrated that scaled scores of the upper limb functions and participation in different life situations clearly increased with the greater MACS, GMFCS, and CFCS level, except for CFCS levels closest to each other.

Conclusion: MACS and GMFCS was strongest predictor of a child's actual performance in daily life.

1. Introduction

Congenital hemiplegic cerebral palsy (CP) constitutes one-third of all typologies of CP (1 in 1300 live birth)[1], predominantly characterized by one upper and lower extremity affected[2]. Assessment of the children with hemiplegic CP is essential in identifying the existing problems associated with upper limb functions[3] and participation in different life situations ('involvement in a life situation')[4]. Moreover, in either research or clinical settings, it is also beneficial to quick yet robust document the clinical characteristics of the disabled children[3]. Following that, classification systems were developed as practical tools to concisely provide knowledge to researchers or clinicians as a snapshot of functional status of children with hemiplegic CP[5]. Consequently, classification systems might help both health professionals improve their communications with families/caregivers in clinical environments, and researchers constitute homogenous groups in research settings[6].

The Manual Ability Classification System (MACS), Gross Motor Function Classification System (GMFCS) and Communication Function Classification System (CFCS) are the most prevalent functional classification systems to report the functional motor and communication skills of children with CP into five-level, where level I represents the best and level V represents the worst performance in daily life[7; 8]. The Manual Ability Classification System was established to classify hand functions of children with CP based on the perceived hand use in daily living or structured settings[7; 9]. Although the MACS is commonly used to specify functional hand use both in clinical and in research settings [7; 10], there is still uncertainty related to the role of the affected hand when manipulating an object, e.g., uncertainty in the extent of involvement of the affected side while executing a meaningful activity. The Gross Motor Function Classification System was designed to discriminate the disabled children concerning gross motor functions[11]. Hence, using GMFCS and MACS together provides a broad range of information about functional motor profile, including gross and fine motor function, at a particular time point in children with CP[3], as well as enhances communication between families and health professionals. The CFCS instrument aims to grade communication performance concerning communication effectiveness with familiar or unfamiliar partners in daily life [12].

Consequently, the GMFCS, MACS, and CFCS are the evidence-based classification systems to describe both functional motor and communication levels of children with CP by sketching their functional motor and communication abilities in daily life[13]. A previous study has reported that these three classification systems complement each other to depict the child's capacity associated with upper limb functions, mobility, and communication performance [14] onto the World Health Organization's (WHO) international classification of functioning, disability, and health[15]. A potential inter-relationship among GMFCS, MACS, and CFCS was determined to strong or moderate in 222 children with CP aged 2-7 years. Besides, in the same study, it was found out that the GMFCS had a high correlation with MACS, however, less with CFCS [16]. Similarly, a relatively more recent study by Compagnone [14] reported a strong correlation between these three functional classification systems.

One aspect of the validation of the classification systems is their correspondence to the external references by using outcome measures [9]. Therefore, it is crucial to explore what means each of the classification system levels in the context of real-life utilizing the most appropriate outcome measures. In other words, validating the classification systems within the functional performance in daily life and understanding each level's potential difference in terms of an external reference is essential for clinicians, health professionals and caregivers/families. Following that, some studies have investigated a potential inter-relationship between these three prevailing functional classification systems in perspective of upper limb function, demonstrating a meaningful correlation among classification systems in question and functional performance in daily living [6; 9; 17]. However, while their unique resultants, these studies included participants of different typologies of CP at all MACS and GMFCS levels, which strengthens better understanding of the differences or similarities between high to moderate levels (I-III) of classification systems. Furthermore, it would be crucial to differentiate between high to moderate levels of classification systems in the context of upper limb function and participation to enhance communication between families and health professionals in the clinic settings and as well as to construct homogenous groups in the research settings. Actual discrimination between classification systems' levels based on the actual performance in basic daily living activities and involvement in different life situations is required to practically delineate the functional status of children with hemiplegic CP because effectively measuring the functional status of this population is vital in monitoring their functional status in short periods[18].

Based upon the premises mentioned above, the purpose of this study was to further investigate (1) actual differences between high to moderate levels of the prevailing functional classification systems in respect of upper limb functions and participation in different life situations and (2) an inter-relationship between MACS, GMFCS, and CFCS. We hypothesized that there would be a potential difference between the high to moderate levels of the classification systems based on functional performance in real world on children with hemiplegic CP

2. Material And Methods

2.1. Participant

Participants in this cross-sectional study were the children with hemiplegic CP between the ages of 7-14 years and were at the MACS, CFCS, and GMFCS levels I-III. Human Research Ethics Committee at the XXXX University approved the study protocols numbered 79236777-050.01.04. A convenience sample size of the 98 children diagnosed with congenital hemiplegia (56 males, 46 females) born in XXXX city was set from different rehabilitation centers. Informed consent was obtained and signed by the parents/guardian of the children. Participants’ functional motor and communication levels were evaluated by an experienced rehabilitation therapist who is expert in this field. Children with lower levels (IV-V) of functional motor and communication skills or diagnosed with acquired brain injury were excluded from the study.

2.3. Classification Tools of Functional Motor and Communications Performance

The participants' functional status in the study was documented using the GMFCS (inter-rater reliability; interclass correlation coefficient [ICC]= 0,93)[19], MACS (inter-rater reliability; ICC=0.89–0.98)[20], and CFCS (inter-rater reliability ICC= 0.66)[12] based on both clinical observation and the reporting of child's physiotherapist or families. These three instruments are universally accepted to describe the functional performance as a snapshot of functional motor and communication skills[3; 14] on a five-level scale from the score I to score V (lower level indicates the best capacity). Although some studies have attempted to explore the possible correlation between these instruments [12; 13; 17], the distinction among the classification systems’ levels, especially between high levels based on the activity and participation in natural settings, remains to be determined.

2.4. Outcome Measures of Upper Limb Functions and Participation

The ABILHAND-Kids was developed as a Rasch-based measure to report perceived manual ability of children with CP aged 6 to 15 years by their caregiver/parents [21]. The ABILHAND-Kids questionnaire consists of 21 items that are the best representative of specific daily activities requiring one or both hand use [22]. The potential advantage of this questionnaire is its usefulness in clinical and research settings, as it can be quickly completed[21]. The total score can be calculated based on converting the raw score into a logit measure on the website of http://rssandbox.iescagilly.be[23] . Finally, ABILHAND-Kids has excellent test-retest reliability (ICC=0.98) in evaluating upper limb functions of XXX children with CP[24]

The Child and Adolescent Scale of Participation (CASP) was used to documenting the extent of child's involvement in different life situations, including participation in home, school, and community activities[25]. The CASP includes 20 ordinal-scaled items as to home participation (6 items), 2) community participation (4 items), 3) school participation (5 items), and 4) home and community living activities (5 items). Its assessment items are suitable for school-aged children (5 years or older) and coincide with many activities in different life situations. Psychometric properties of the CASP, such as test-retest reliability, were demonstrated to good in Turkish children with CP (ICC=0.95) [26]

2.5. Statistical Analysis

Statistical analyses were performed using the SPSS software version 24. The variables were investigated using visual (histogram, probability plots) and analytical methods (Kolmogorov-Smirnov) to determine whether or not they are normally distributed. While investigating the associations between non-normally distributed and/or ordinal variables, the correlation coefficients and their significance were calculated using Spearman Test. Inter-relationship among MACS, GMFCS and CFCS was interpreted according to Spearman's correlation coefficient strength: $r<0.2$ very weak relationship; 0.2-0.4 weak relationship; 0.4-0.6 moderate relationship; 0.6-0.8 strong relationship; $r>0.8$ very strong relationship [27]. Categorical data were presented with percentage or frequency as appropriate, while continuous data were given as mean ± standard deviation. One-way ANOVA and Tukey's Test were performed to explore possible differences in mean upper limb functions and participation in different life situations scaled scores in three representatives of functional status on MACS, GMFCS, and CFCS. A univariate linear regression model was conducted to investigate separately the extent to which variables affected upper limb functions and participation in different life situations. Then, multiple linear regression analysis was performed to explore how functional motor and communication skills together contribute scaled scores of upper limb functions and participation in different life situations. To do so, level III of each classification system was accepted as reference category (0). Standard error bars were used to demonstrate mean scores with %95 confidence interval (CI) on assessment tools by each classification system level. An overall p-value of less than 0.05 was considered to show a statistically significant result.

3. Results

All study participants' demographic characteristics and prognostic variables, and mean ages of participants classified into different GMFCS, MACS, and CFCS levels were shown in Table I. Children at each of the three levels of the classification systems demonstrated similarity in the age ($p>0,05$). Among the 98 enrolled children, 57 (% 58,2) were in good functioning levels in MACS (level I-II), whereas 41 (% 41,8) were in moderate functioning level (MACS level III). On average, % 55,1 could walk independently in all environments (GMFCS I), % 38.1 could walk with some limitations (GMFCS II), and only % 6.1 required a hand-held device for mobility. Considering that the MACS is a classification system of disabled children's hand function in five levels (a lower value describes higher manual ability), most of the children in this study had effective hand use (MACS I-II). For communication skills, the predominant levels were level I (% 56.1) and level II (% 29.6) respectively, while fewer participants had a moderate score (level III; %14.3). That is, most of the study participants could independently and effectively communicate with people in most environments. Finally, except for hearing impairment, vision, speech, and cognition impairment was reported in 9 (% 9.2), 11 (%11,2), and 12 (% 12,2) of study participants, respectively.

The distribution of children at different MACS levels within GMFCS levels was demonstrated in Table II. As indicated, most children in MACS level I (89,3%) were qualified with GMFCS I; on the other hand, a very few percent (10,7%; 3 children) presented GMFCS II. Of children in MACS II, 55,2% had the best mobility level on GMFCS (level I); whereas 44,8% relatively had a lower mobility level on GMFCS (level II). Finally, children with MACS III demonstrated greater variability in mobility level on GMFCS than those with MACS I and II, with a majority part representing GMFCS II (53,7%).

Table III demonstrates comparison of participants' upper limb functions and participation in different life situations scaled scores on ABILHAND-Kids and CASP questionnaires according to MACS levels. Analysis of one-way ANOVA showed that the upper limb functions and participation in different life situations outcomes exhibited variability in participants at each of the three MACS levels (p= 0,000). In other words, children's s both upper limb functions and participation scaled scores on ABILHAND-Kids and CASP questionnaires were found clearly to increase with higher functioning levels of MACS (Post-Hoc: a>b>c). Moreover, Figures 1 and 4 illustrated the range of scaled scores of upper limb functions and participation in different life situations by MACS levels. According to Figure 1, children in MACS I demonstrated greater variability as to upper limb functions than children in MACS II and III.

Children in level I, II, and III at GMFCS differed greatly for upper limb functions and participation in different life situations outcomes (p=0,000) (Table IV). Furthermore, results of pairwise post-hoc tests suggested that participants in a higher functioning GMFCS level had more remarkable outcomes in both upper limb functions and participation in different life situations than those with a lower GMFCS level (Post-Hoc: a>b>c). That is, the higher GMFCS levels were found to be associated with greater mean scores on both the ABILHAND-kids and CASP-subtests. Children in GMFCS I presented greater variability for upper limb function (ABILHAND-Kids) than those in GMFCS II and III. In contrast, children in GMFCS III demonstrated greater variability in scaled scores on CASP-community participation subdomains than those in GMFCS I and II (Figures 2 and 5)

Table V shows upper limb functions and participation in different life situation outcomes by communication skills on CFCS. Results of one-way ANOVA displayed statistical meaningful differences among three levels related to both manual ability and participation in different life situation outcomes (p=0,000). However, isolated comparisons (pairwise post-hoc tests with Tukey) revealed a statistically significant difference only between high and moderate levels (CFCS I-III), whereas it was not found out statistically meaningful differences between level I and II, and between level II and III (Post-Hoc: a>c, a=b, b=c). In other words, the mean upper limb functions and participation scaled scores obtained by children qualified with one of three levels of CFCS differed significantly only between those qualified with levels I and III. In contrast, a significant difference could not be found between children classified into levels closer to each other for upper limb functions and participation in different life situations. Furthermore, as demonstrated in Figures 3 and 6, children qualified with CFCS III displayed greater variability in scaled scores on both upper limb functions and participation in different life situations than those characterized as CFCS I and II.

As demonstrated in Table VI, MACS levels were found to be moderately correlated with GMFCS levels (r=0,491, p=0,000), whereas, weakly correlated with the CFCS levels (r=0.247, p=0,014). Finally, a moderate relationship was observed between GMFCS and CFCS levels (r=0,574, p=000).

Table VII demonstrate the findings of regression models. For the upper limb functions, MACS, GMFCS, and CFCS explained % 65, % 23, and % 8 of variance, respectively. Also, it was found out that the MACS was the strongest predictor of participation in home, school, and home and community, explaining % 62, % 56, and % 48 of variance. On the other hand, the MACS and GMFCS contribute equally to the scaled score of community participation, with a % 48 variance. As a result, the manual ability level as defined by MACS is the strongest predictor of upper limb functions and participation in home and school environments compared to both gross motor and communication performance on GMFCS and CFCS (R^2 of MACS > R^2 of GMFCS and CFCS). At the same time, GMFCS is an identical predictor to MACS for participation in community environment where mobility would be more needed.

4. Discussion

This current study demonstrated significant differences among each of three levels of functional motor skills, as measured by the MACS and GMFCS, for upper limb functions and participation in different life situations, as measured by ABILHAND-kids and CASP-subtests in children with hemiplegic CP. For CFCS, a statistically meaningful difference was found only between high and moderate levels as to the same parameters mentioned above. On the other hand, no significant difference was described between communication performance levels closer to each other. In other words, upper limb functions and participation scaled scores clearly differed between each pair of MACS and GMFCS levels, while it was found out difference only between high and moderate levels of CFCS concerning same outcomes. Furthermore, this study has demonstrated weak to moderate inter-relationships among high to moderate functional ability representatives, as measured by the first three levels of MACS, GMFCS, and CFCS. Finally, our study results demonstrated that MACS was the strongest predictor factor of manual performance in daily life and participation in different life situations.

The gross motor, manual ability, and communication function classification systems objectively describe children and adolescents' functional profile through five levels to ensure a practical communication between health professionals and families [13; 28]. In brief, the GMFCS delineates motor disability or current motor function[19]; the MACS describes the manual ability of children with CP to manage daily activities;[29] and the CFCS measures communication performance regardless of the underlying functional or structural impairment [12], i.e., each level of these classification systems is expected to characterize children capacity concerning functional motor and communication skills with the most appropriate level [14; 28]. Although some previous studies have reported a strong relationship between these classification systems mentioned above [13; 16; 28], the difference among their levels was explored only by Öhrvall et al.'s study [6], indicating a strong correlation among MACS and GMFCS levels, and self-care and mobility capability. Similarly, our study showed significant differences between each pair of three representatives of functional motor (MACS and GMFCS) for executive functions and participation in different life situations. Together with, our study is different from the Öhrvall et al.'s study for some aspects, by investigating a possible difference among three representatives of functional status as to upper limb functions (ability to manage daily activities) and participation in the different life situations. Then, our study was conducted on a more homogeneous group (involving only children with hemiplegic CP), whereas the study in question enrolled participants with different typology of CP. On the same time, our study findings demonstrated that there was a meaningful difference only between high and moderate communication performance levels relating to upper limb functions and involvement in different life situations. In contrast, there was no significant difference between the CFCS levels closest to each other based on functional performance in the real world. But nevertheless, these results displayed that high communication performance is necessary for greater participation in different life situations and upper limb functions. As a result, our study's findings indicated that upper limb functions and participation scaled scores increase with greater GMFCS, MACS, and CFCS levels, except for CFCS levels closer to each other.

Our study findings suggested that manual ability level was the strongest predictor of manual performance in daily life and participation in home and school environments. Furthermore, manual ability and mobility level were analogous to explain variance in scaled scores of participations in the community environment, and as well as GMFCS was found a second important predictor factor for other outcomes. Consequently, MACS and GMFCS tools were complementary in predicting upper limb functions and the extent of participation in different life situations. Therefore, functional motor classification system tools (MACS and GMFCS) can be used as a concise and precise language by health professions, families, and researchers to describe a child's actual performance in daily life. In other words, both GMFCS and MACS can be used to predict the extent of participation in different life situations and performance in daily activities. These implications are in line with a previously published study' s results, reporting a strong relationship between MACS and ABILHAND-Kids [9]. As reported previously, the actual performance of children with CP is intimately related to gross and fine motor functions [14; 30]. Besides, gross motor functions [31], communication performance [32], and ability to manage daily activities [9] are essence for executional autonomy in participation in different life situations

Unlike some studies demonstrating a strong or moderate correlation between classification instruments of gross motor function, communication performance, and manual ability [13; 14; 16; 17], we found out a weak to moderate among functional motor and communication classification systems' levels. This variability may arise from difference in enrolled population. Eventually, the evident difference among three levels of MACS and GMFCS reported in this current study suggest that an appropriate functional motor level might predict disabled children's actual performance in daily life.

Although the homogeneous sample size was a strong aspect of our study, this may also have led to a limitation for the current study. Because our study participants' functional profiles changed between level I and Level III on the MACS, GMFCS, and CFCS, our raw data could include participants with lower functional status (level IV-V). Thus, further study is needed to investigate difference among all levels of classification systems for upper limb functions and participation in different life situations.

5. Conclusion

In conclusion, this study is novel in investigating possible differences among three representatives of functional status associated with upper limb functions and participation in different life situations by using ABILHAND-Kids and the CASP questionnaires as an external reference. Our study findings revealed significant differences among each of the three levels of MACS and GMFCS for manual performance and involvement in different life situations. However, for the communication performance instrument, although it was demonstrated a significant difference between high and moderate levels (I-III), levels closer to each other (I-II or II-III) have not differed in actual performance in daily life. Furthermore, MACS was found as the strongest predictor of manual performance in daily life and participation in home and school environments. In conclusion, we assert that upper limb functions and participation in different life situations are more sensitive to levels of functional motor classification instruments than levels of communication performance instrument.

Declarations

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Tables

Table I: Demographic Characteristics and Descriptive Information of the Participants

		(n=98) X ± SD, %95 CI		Age (y) X ± SD, %95 CI			
Age (y)		9,3 ± 3,0 [%95 CI:8.7-9.9]					
CASP	Home Participation	74,6 ± 17,3 [%95 CI:71.13-78.06]					
	Community Participation	71,0 ± 18,1 [%95 CI:67.37-74.62]					
	School Participation	68,9 ± 18,1 [%95 CI: 65.27-72.52]					
	Home and Community Living Activities	59,4 ± 18,5 [%95 CI:55.69-63.1					
ABILHAND-Kids (Logits)		2,2 ± 1,4 [%95 CI:1.91-2.48]					
		n	**(%)**				
Gender	Male	56	57,1				
	Female	42	42,9				
Affected Side	Right	49	50,0				
	Left	49	50,0				
Cognitive impairment	Yes	12	12,2				
	No	86	87,8				
Hearing impairment	Yes	0	0,0				
	No	98	100,0				
Speech impairment	Yes	11	11,2				
	No	87	88,8				
Visual impairment	Yes	9	9,2				
	No	89	90,8				
				X	**SD**	**%95CI**	**p**
MACS	I	28	28,6	8,9	3,1	7.6-10.1	0,634
	II	29	29,6	9,7	2,9	8.5-10.8	
	III	41	41,8	9,2	3,2	8.1-10.2	
GMFCS	I	54	55,1	9,1	3,0	8.28-9.9	0,382
	II	38	38,8	9,7	3,1	8.6-10.7	
	III	6	6,1	8,2	3,1	4.9-11.4	
CFCS	I	55	56,1	9,0	3,0	8.1-9.8	0,454
	II	29	29,6	9,3	2,9	8.1-10.4	
	III	14	14,3	10,1	3,4	8.1-12.0	

X; mean, SD; Standard Deviation; CASP; Child and Adolescent Scale of Participation; MACS, Manual Ability Classification System; GMFCS, Gross Motor Function Classification System; CFCS, Communication Function Classification system

Table II: Distribution of Children in Different MACS Levels Within GMFCS Levels

		GMFCS					
		I		II		III	
		n	%	n	%	n	%
MACS	I	25	89,3%	3	10,7%	0	0,0%
	II	16	55,2%	13	44,8%	0	0,0%
	III	13	31,7%	22	53,7%	6	14,6%

MACS, Manual Ability Classification System; GMFCS, Gross Motor Function Classification System; n, no of participants

Table III: Performance of children on ABILHAND-kids and CASP by MACS Levels

		MACS									
		I[a] (n=28)			II[b] (n=29)			III[c] (n=41)			P
		X	**SD**	**%95 CI**	**X**	**SD**	**%95 CI**	**X**	**SD**	**%95 CI**	
CASP	Home Participation	92,7	10,0	88.8-96.5	77,6	9,5	73.9-81.2	60,0	12,0	56.2-63.7	0,000
	Community Participation	87,9	13,6	82.6-93.1	72,6	11,1	68.3-76.8	58,2	14,7	53.5-62.8	0,000
	School Participation	87,3	13,2	82.1-92.4	71,2	8,9	67.8-74.5	54,8	13,2	50.6-58.9	0,000
	Home and Community Living Activities	75,9	14,5	70.2-81.5	63,4	13,3	58.3-68.4	45,2	12,5	41.2-49.1	0,000
ABILHAND-Kids (logits)		3,9	1,1	3.4-4.3	2,2	0,5	2.0-2.3	1,2	0,8	0.9-1.4	0,000

CASP, Child and Adolescent Scale of Participation; MACS, Manual Ability Classification System ; X; Mean, SS; Standard Deviation; Post-Hoc: a>b>c; n, no of participants

Table IV: Performance of children on ABILHAND-kids and CASP by GMFCS Levels

		GMFCS									P
		I[a] (n=54)			II[b] (n=38)			III[c] (n=6)			
		X	**SD**	**%95 CI**	**X**	**SD**	**%95 CI**	**X**	**SD**	**%95 CI**	
CASP	Home Participation	82,6	15,7	78.3-86.8	67,6	12,2	63.5-71.6	45,8	7,5	37.9-53.6	0,000
	Community Participation	81,1	14,4	77.1-85.0	61,5	12,2	57.4-65.5	39,6	9,4	29.7-49.4	0,000
	School Participation	78,2	15,6	73.9-82.4	60,9	11,6	57.0-64.7	35,8	7,4	28.0-43.5	0,000
	Home and Community Living Activities	67,9	17,6	63.0-72.7	51,6	12,5	47.4-55.7	31,7	6,1	25.2-38.1	0,000
ABILHAND-Kids (logits)		2,8	1,5	2.3-3.2	1,8	0,8	1.5-2.0	0,3	0,2	0.0-0.5	0,000

CASP, Child and Adolescent Scale of Participation; GMFCS, Gross Motor Function Classification System X; Mean, SS; Standard Deviation, Post-Hoc: a>b>c; n, no of participants.

Table V. Performance of children on ABILHAND-kids and CASP by CFCS Levels

		CFCS									P
		I[a] (n=55)			II[b] (n=29)			III[c] (n=14)			
		X	**SD**	**%95 CI**	**X**	**SD**	**%95 CI**	**X**	**SD**	**%95 CI**	
CASP	Home Participation	80,7	16,0	76.3-85.0	72,1	13,9	66.8-77.3	55,6	14,5	47.2-63.9	0,000
	Community Participation	79,4	14,6	75.4-83.3	65,6	15,2	59.8-71.3	49,0	13,6	41.14-56.8	0,000
	School Participation	76,1	15,8	71.8-80.3	65,5	15,4	59.6-71.3	47,9	13,4	40.1-55.6	0,000
	Home and Community Living Activities	65,8	18,2	60.8-70.7	56,4	14,6	50.8-61.9	40,4	11,8	33.5-47.2	0,000
ABILHAND-Kids (logits)		2,5	1,5	2.0-2.9	2,2	1,1	1.7-2.6	1,2	0,9	0.6-1.7	0,007

CASP, Child and Adolescent Scale of Participation; CFCS, Communication Function Classification system; X, Mean, SS; Standard Deviation; Post-Hoc: a>c, a=b, b=c; X, mean; SD, Standard Deviation; n, no of participant

Table VI: Inter-relationships between functional motor and communication systems

		MACS	GMFCS
GMFCS	r	0,491	
	p	0,000	
CFCS	r	0,247	0,574
	p	0,014	0,000

MACS, Manual Ability Classification System; GMFCS, Gross Motor Function Classification System; CFCS, Communication Function Classification system; r, Spearman Correlation Coefficient; p, significance

Table VII: Univariate and Multivariate Regression Analyses on Executive functions, Participation in Different Life situation, MACS, GMFC, and CFCS

Univariate Analysis									Multivariate analysis	
ABILHAND-Kids		R	R^2	df	F	t	p-value	B	Adjusted R^2	p-value
	MACS	0.8	0.65	1	179.505	13.398	0.000	1.363	0.65	0.000
	GMFCS	0.48	0.23	1	28.998	5.385	0.000	1.105		
	CFCS	0.29	0.08	1	9.186	3.031	0.003	0.56		
CASP-Home	MACS	0.78	0.62	1	158.113	12.574	0.000	16.425	0.71	0.000
	GMFCS	0.59	0.34	1	51.375	7.168	0.000	16.693		
	CFCS	0.49	0.24	1	30.258	5.501	0.000	11.611		
CASP-Community	MACS	0.68	0.46	1	83.048	9.113	0.000	14.827	0.68	0.000
	GMFCS	0.68	0.46	1	83.64	9.145	0.000	20.171		
	CFCS	0.6	0.36	1	54.035	7.351s	0.000	14.883		
CASP- School Participation	MACS	0.74	0.56	1	122.846	11.084	0.000	16.292	0.84	0.000
	GMFCS	0.65	0.42	1	70.619	8.404	0.000	19.223		
	CFCS	0.53	0.28	1	38.786	6.228	0.000	13.288		
CASP- Home and Community Living Activities	MACS	0.69	0.48	1	90.725	9.525	0.000	15.505	0.58	0.000
	GMFCS	0.57	0.32	1	46.319	6.806	0.000	17.231		
	CFCS	0.47	0.22	1	27.437	5.238	0.000	11.946		

MACS, Manual Ability Classification System; GMFCS, Gross Motor Function Classification System; CFCS, Communication Function Classification system; R, Correlation Coefficient; R^2, Explained Variance (%)

Figures

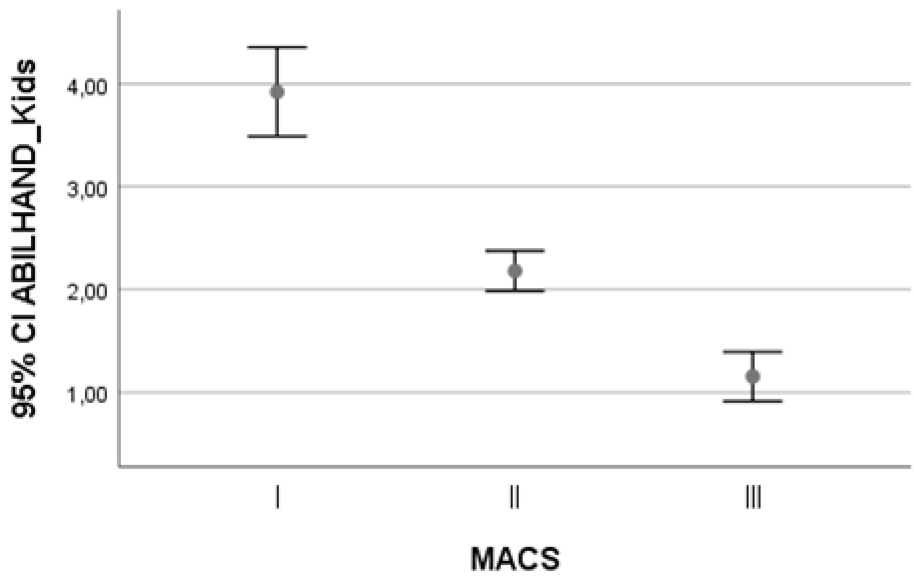

Figure 1

Mean Scores on ABILHAND-Kids with %95 Confidence Interval for each MACS level

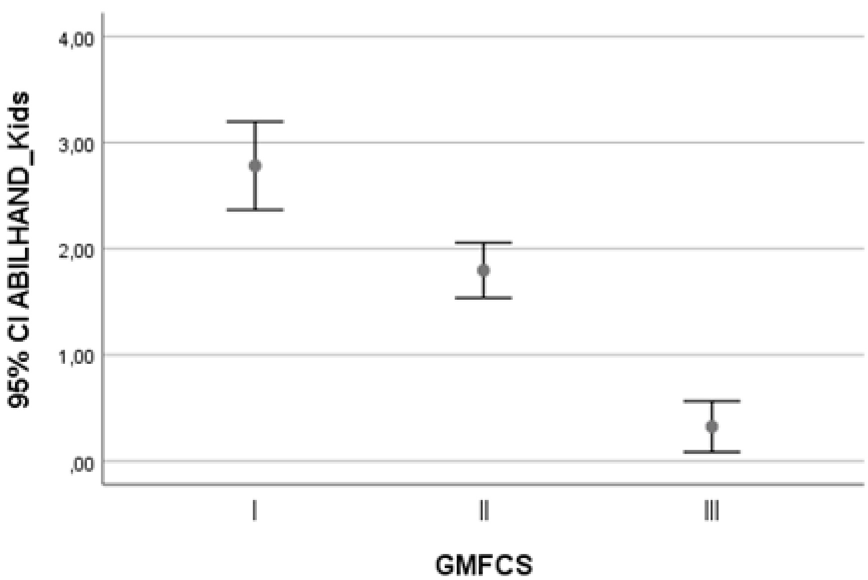

Figure 2

Mean Scores on ABILHAND-Kids with %95 Confidence Interval for each GMFCS level

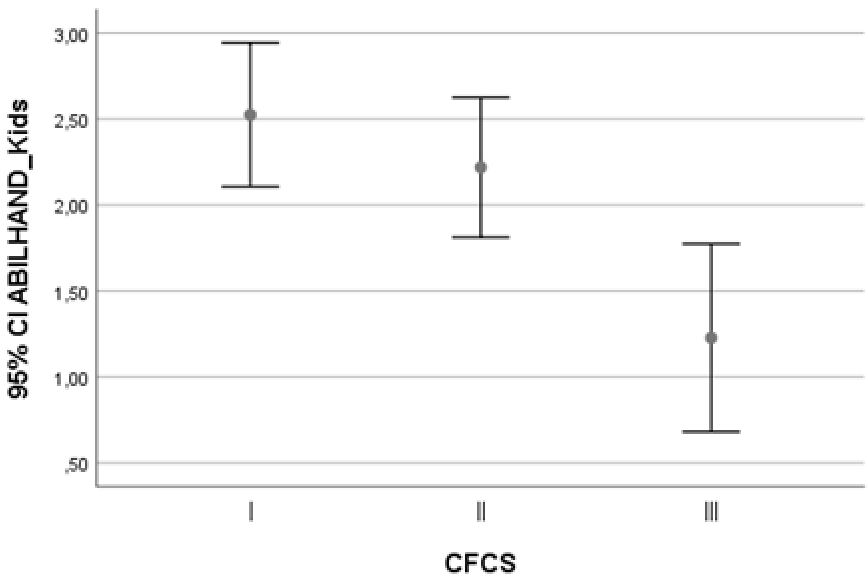

Figure 3

Mean Scores on ABILHAND-Kids with %95 Confidence Interval for each CFCS level

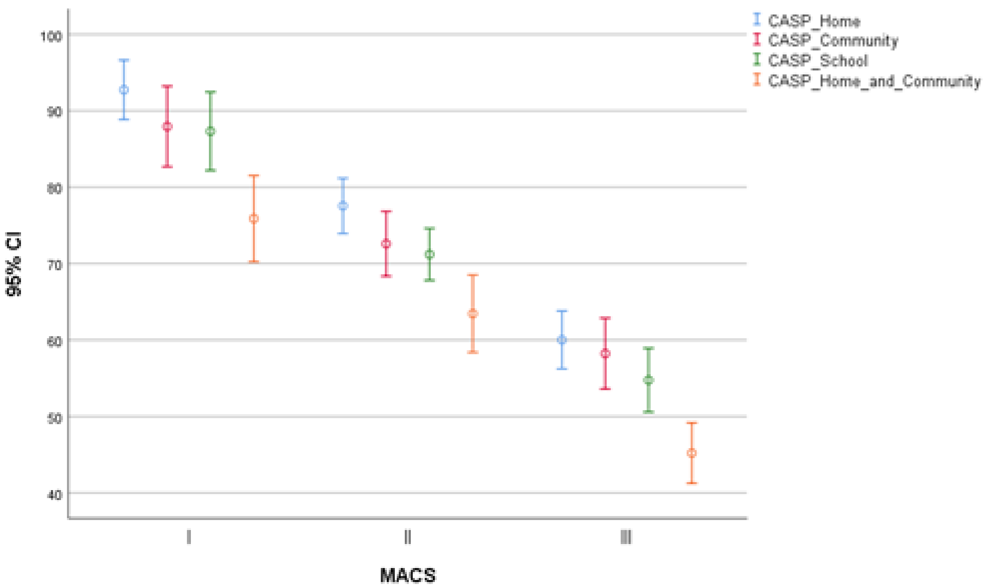

Figure 4

Mean Scores on CASP subdomains with %95 Confidence Interval for each MACS level

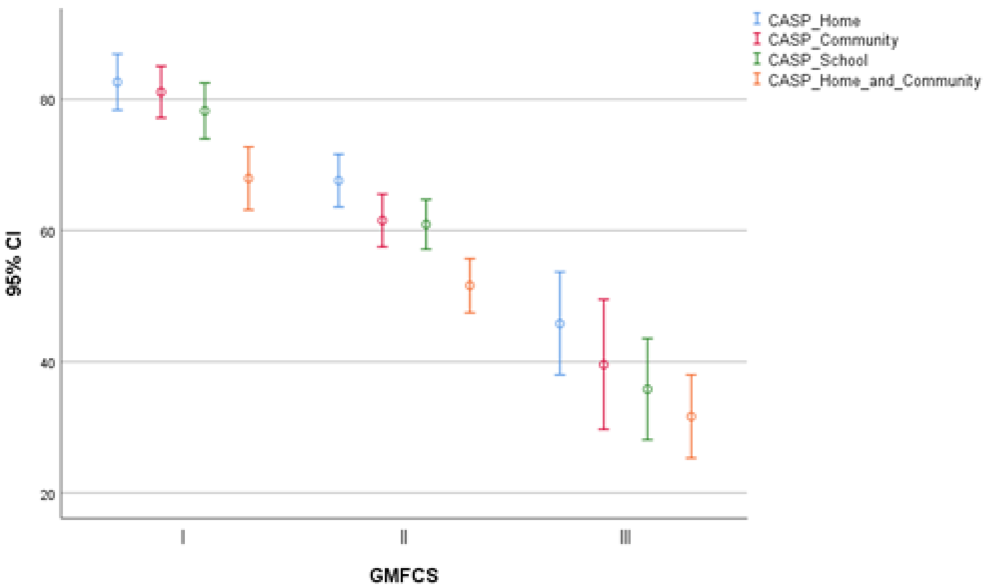

Figure 5

Mean Scores on CASP subdomains with %95 Confidence Interval for each GMFCS level

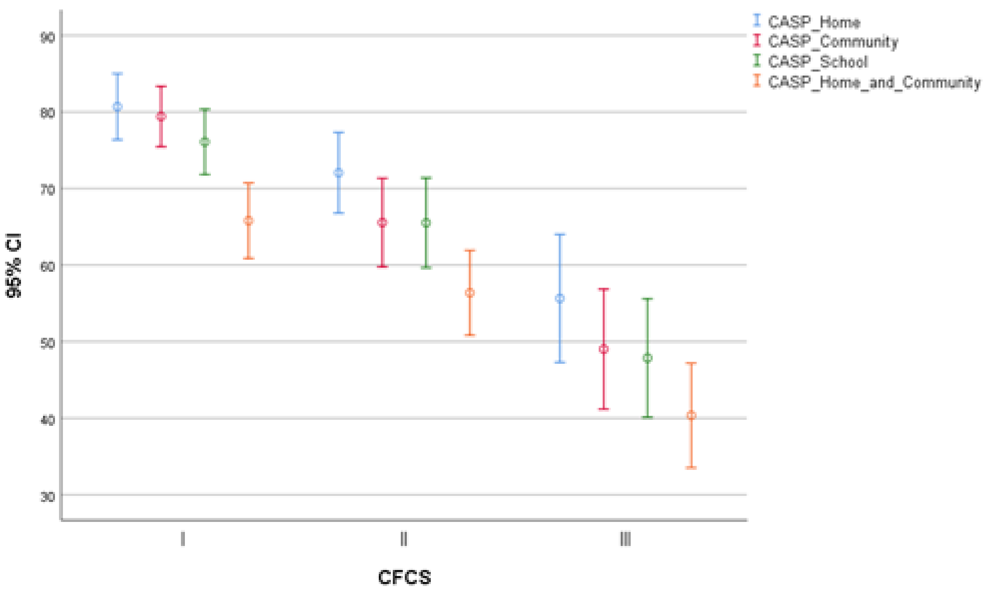

Figure 6

Mean Scores on CASP subdomains with %95 Confidence Interval for each CFCS level