COMMUNICATION ABILITIES OF JORDANIAN INDIVIDUALS WITH CEREBRAL PALSY ACCORDING TO TYPE, AGE, AND MENTAL ABILITIES

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ABSTRACT

Objectives: To identify the speech characteristics of various types of Jordanian cerebral palsied children and young adults, and to relate them to age, the associated dysarthria, and cognitive level.

Methods: The medical records of 248 cerebral palsied children and young adults seen at the Royal Rehabilitation Center, between 1990 and 2005, were reviewed and analyzed retrospectively. The type, oral motor abilities, Intelligence Quotient, and other disabilities were identified for each case. The speech and language assessment results were categorized into normal, moderate disability, or severe disability. Findings were analyzed with regression analysis and Pearson's correlation using SPSS 10.

Results: No statistically significant differences were found in the speech characteristics between the four main types of cerebral palsy. However, strong correlations were found between speech proficiency and both oral-motor abilities and Intelligence Quotient level, and, to a lesser degree, with the age group.

Conclusion: The results of this study showed that speech characteristics of Jordanian cerebral palsied cases are not different from those reported in the literature for other languages.

Key words: Cerebral palsy, Dysarthria, Jordanian, Mental abilities, Speech characteristics

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Introduction

The term cerebral palsy (CP) refers to a nonprogressive motor disorder that results from an insult to the central nervous system. It is of a chronic nature that results primarily in abnormal muscle tone, faulty coordination, or abnormal positioning. In addition, despite the fact that the insult occurs around the time of birth, complications and more manifestations continue to develop with development and growth. Also, other involvements may include intellectual, perceptual, auditory, feeding, speech and language, and emotional functioning.[1,2]

Published literature report an incidence of cerebral palsy between 1.5 and 3.0 per 1,000 live births.[3,4] Estimates provided by the Jordanian Cerebral Palsy Foundation (0.36%) are a little bit higher than the international incidences.

One of the most common sequelae of this childhood disability is speech disorders. This is mainly the result of dysarthria, which is associated with 31% to 88% of cerebral palsied cases.[5,6] A

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comprehensive definition of dysarthria was provided by Duffy[7] as "a collective name for a group of neurological disorders resulting from abnormalities in the strength, speed, range, steadiness, tone, or accuracy of movements required for the control of the respiratory, phonatory, resonatory, articulatory, and prosodic aspects of speech production. The responsible pathophysiologic disturbances are due to central or peripheral nervous system abnormalities and most often reflect weakness; spasticity; incoordination; involuntary movements; or excessive, reduced, or variable muscle tone".

The communication abilities of the CP patients are highly related to the severity and type of the CP as each has a different pathophysiology that might have different impact on speech musculature and coordination.[8,9] Concomitant disabilities, such as apraxia of speech, limited intellectual abilities, and hearing impairment, might aggravate the situation.[1] Apraxia of speech, which might accompany the dysarthria, is impairment in the planning or programming of commands needed for normal sequence and prosody of speech sounds.[7]

There are, generally, four classes of cerebral palsy (CP), spastic, athetoid, ataxic, and mixed.[8,10-12] Spastic CP, which is characterized by increased muscle tone and stretch reflexes, constitute three quarters of all forms of CP. In this form, dysarthria and dysphagia, and even mental retardation, are more common when the spasticity involve both sides of the body when compared to hemiplegia. Athetoid CP, which is characterized by abnormal posture and involuntary movements, also is commonly associated with dysarthria and dysphagia. Pure athetosis constitutes 5% of the total CP population, while dystonic athetosis presents 10% of the total CP population.[11] Ataxic CP, which represent around 4.2% of the CP types,[12] is characterized by dyssynergic movements and wide-based, lurching, staggering gait,[13] and its classical signs constitute hypotonia, dysmetria, action tremor, and nystagmus.[1]

The speech of the spastic CP is characterized by low pitched breathy hypernasal voice[14] and monotony of stress patterns.[15] They experience more difficulty on fricative and glide sounds than on other sound classes, on back sounds than on frontal sounds, on voiced consonants than on their voiceless counterparts, and show more sound omissions than substitutions.[16] As far as their respiratory abnormalities, the reduced vital capacity can impair the overall speech function only when it interact with laryngeal, velopharyngeal, and articulatory dysfunctions.[8] Their vocal quality ranges from aphonia to harsh voice, due to poor glottal valving, to struggle-strangled voice, due to hypertonic vocal folds.[1] Velopharyngeal dysfunctions are common in spastic CP resulting in hypernasal speech. Nevertheless, Love,[1] in her review of the literature, noted that normal speech function might be achieved despite the spastic impairment in articulators control.

The athetoid CP have impairments in all components of the speech mechanism including irregular respiratory cycles, mainly diaphragmatic; low pitched monotonous breathy weak vocal quality, due to insufficient glottal closure;[8] and irregular articulatory breakdown, unmonitored loudness, and voice stoppage.[2] Some of them experience laryngeal hyperadduction that result in strained quality with limited pitch variation.[1] Their speech is characterized by slow transitions during sound production and by distorted speech sounds as the tongue movements rely heavily on the mandibular elevation.[17] All five subjects in Kent and Netsell[17] study had some dysfunction in velopharyngeal closure.

The speech signs of the ataxic CP were described as speech retardation; slow rate; imprecise articulation, inconsistent substitutions and omissions; dysrhythmia and dysprosody; and harsh voice.[15,18,19] However, Love[1] related the severity of the ataxic speech disorder to the general intellectual abilities rather than to the degree of the oral-motor disability, and the ataxic dysarthria is a mild form when compared to spastic or athetoid dysarthria.

It is noteworthy that the speech of the of the spastic CP might deteriorate as they grow as their respiratory support for speech become more impaired due to posture and positioning abnormalities. On the contrary, the speech of the athetoid CP improves as they grow and gain control.[14]

Prior knowledge of the associated problems of each type of CP has significant clinical applications. Proper medical diagnosis provides the speech clinician with many expectations that he or she has to address during evaluation of speech and language. In addition, the clinician has to be aware of the interference between the motor abilities and the concurrent deficits in other sensory and cognitive

Table I. Classification according type of CP, the part of the body involved, and the presence of dysarthria

CP Type		Part of the body		Associated Dysarthria	
Spastic	110 (44.3%)	Quadriplegic	35 (14.1%)	Dysarthria (Marked)	161 (64.9%)
Athetoid	50 (20.3%)	Diplegic	45 (18.1%)	Residual Dysarthria (minimal)	25 (10.1%)
Ataxic	35 (14.1%)	Right hemiplegic	15 (6.1%)		
Spastic + Athetoid	38 (15.3%)	Left hemiplegic	15 (6.1%)	Not Dysarthric	62 (25.0%)
Spastic + Ataxic	10 (4.0%)	Whole body (tetraplegic)	138 (55.6%)		
Athetoid + Ataxic	5 (2.0%)				

Table II. The mental abilities and other disabilities of the Jordanian CP study group

Mental Abilities		Other involvements	
Normal IQ	98 (39.5%)	Severe visual impairment	5 (2.0%)
Slow learners	52 (21.0%)	Eye squint	34 (13.7%)
Mild MR	54 (21.8%)	Epilepsy	52 (20.1%)
Moderate MR	29 (11.7%)	Severe behavioral problem	5 (2.0%)
Severe MR	15 (6.0%)	Conductive hearing loss	30 (12.1%)
		Sensorineural hearing loss	6 (2.4%)

abilities as well as environmental stimulation provided by the care givers. The Arabic speech system is unique and requires extra motor demands for individuals with physical disabilities. Examples are the pharyngeal and emphatic sound classes, which characterize the Arabic language.

The objectives of the present study were to identify the speech abilities of various types of CP children and young adults and to relate them to their age, intellectual abilities, and the associated dysarthria.

Methods

A retrospective analysis of the medical records of all CP cases seen at the Royal Rehabilitation Center between 1990 and 2005 were analyzed. The study group consisted of 248 cerebral palsied children and young adults. All of them had moderate gross motor limitation and the majority of them came from middle class families. They were classified according to type of CP, the presence of dysarthria, age, and intellectual level. The associated hearing levels as well as the presence of feeding problems were documented. The results of oral examinations, language comprehension, expressive abilities, and articulation competency were recorded.

Reports of the hearing evaluation and IQ testing were related to the type of the CP. The receptive abilities of younger subjects were assessed using a culturally modified version of the Assessment of Children's Language Comprehension.[19] The receptive abilities of older subjects were assessed using a battery that consisted of the Arabic Picture Vocabulary Test[20] and a set of pictorial stimuli and structured commands that are relevant to the subjects' age and physical abilities. The expressive abilities of verbal CP subjects were assessed using naming and description of structured pictorial stimuli that cover main Arabic grammatical structures. The articulation of speech sounds was evaluated by the Diagnostic Articulation Test of the Arabic Sounds. [21]

Communication abilities were classified as "functional speech", "moderate disability", or "marked disability". The CP speech is labeled functional if it is highly intelligible and close to normal speech in terms of quality, resonance, prosody, and articulation proficiency. Moderate disability refers to relative involvement of one or more of the phonatory, resonatory, prosodic, or articulatory domains. Marked disability refers the lack of functional language.

The subjects of the present study was divided into two age groups; the first group included 5 years old or younger, while the second group included cases

Table III. The speech abilities of Jordanian CP cases 5 years old or younger

	Spastic CP				Athetoid CP				Ataxic CP				Mixed CP			
	Dysarthric		Normal Oralmotor		Dysarthric		Normal Oralmotor		Dysarthric		Normal Oralmotor		Dysarthric		Normal Oralmotor	
	IQ > 70	IQ < 70	IQ > 70	IQ < 70	IQ > 70	IQ < 70	IQ > 70	IQ < 70	IQ > 70	IQ < 70	IQ > 70	IQ < 70	IQ > 70	IQ < 70	IQ > 70	IQ < 70
Total No.	10	9	14	8	7	7	3	2	1	4	0	3	6	1	3	2
Functional speech	3	1	5	1	0	0	2	0	1	0	0	0	0	0	1	0
Moderate disability	6	2	9	1	2	0	1	0	0	0	0	0	4	0	2	2
Marked disability	1	6	0	6	5	7	0	2	0	4	0	3	2	1	0	0

Table IV. The speech abilities of Jordanian CP cases older than 5 years

	Spastic CP				Athetoid CP				Ataxic CP				Mixed CP			
	Dysarthric		Normal Oralmotor		Dysarthric		Normal Oralmotor		Dysarthric		Normal Oralmotor		Dysarthric		Normal Oralmotor	
	IQ > 70	IQ < 70	IQ > 70	IQ < 70	IQ > 70	IQ < 70	IQ > 70	IQ < 70	IQ > 70	IQ < 70	IQ > 70	IQ < 70	IQ > 70	IQ < 70	IQ > 70	IQ < 70
Total No.	20	15	19	15	19	8	2	2	11	6	6	4	26	11	3	1
Functional speech	0	0	9	2	0	0	0	0	0	0	0	1	3	0	1	0
Moderate disability	13	14	10	7	10	0	2	0	11	4	6	2	23	1	2	1
Marked disability	7	1	0	6	9	8	0	2	0	2	0	1	0	10	0	0

older than 5 years old. The speech proficiency for the total study group and each age group was tabulated, for later statistical analysis, according to the CP type, the presence of oral-motor disabilities, and the Intelligence Quotient (IQ). Regression Analysis and Pearson correlations between various factors of the study were carried our using SPSS 10.

Results

The mean age of the study group was 6.6 + 3.2 years and the age range was between 1.6 and 22 years. Male to female ratio was 2 : 1 as males constituted 66.9% (N= 166) while females constituted 33.1% (N= 82). Table I shows the relative percentage of each of the four main types of CP, the part of the body involved, and the percentage of the associated dysarthria. Spastic, athetoid, ataxic, and mixed CP represented 44.3%, 20.3%, 14.1, and 21.3%, respectively. Tetraplegia (whole body), quadriplegia, and diplegia were found in 55.65, 14.1%, and 18.1%, respectively. Right and left hemiplegias were represented by 6.1% each.

The reported hearing testing revealed that 30 (12.1%) of our total study group had conductive hearing problems on the day of assessment, and 6 cases (2.4%) had sensorineural hearing loss, five of them were athetoid CP. As shown in Table II, around 60% of our subjects had an IQ above 70 despite their physical limitations, which supposedly interfere with their learning experiences. On the other hand, around 40% were reported to have mental backwardness.

Oral motor coordination was assessed mainly by oral exam, diadochokinetic rate, and deglutition. As shown in Table I, marked dysarthria was present in 161 (64.9%) cases. An additional 25 cases (10.1%) showed signs of mild residual dysarthria as demonstrated by a somewhat slow diadochokinetic rate.

Table V. The speech abilities of Jordanian CP cases of all age groups

	Spastic CP				Athetoid CP				Ataxic CP				Mixed CP			
	Dysarthric		Normal Oralmotor		Dysarthric		Normal Oralmotor		Dysarthric		Normal Oralmotor		Dysarthric		Normal Oralmotor	
	IQ > 70	IQ < 70	IQ > 70	IQ < 70	IQ > 70	IQ < 70	IQ > 70	IQ < 70	IQ > 70	IQ < 70	IQ > 70	IQ < 70	IQ > 70	IQ < 70	IQ > 70	IQ < 70
Total No.	30	24	33	23	26	15	5	4	12	10	6	7	32	12	6	3
Functional speech	3	1	14	3	0	0	2	0	1	0	0	1	3	0	2	0
Moderate disability	19	16	19	8	12	0	3	0	11	4	6	2	27	1	4	3
Marked disability	8	7	0	12	14	15	0	4	0	6	0	4	2	11	0	0

Table VI. Total study group according to oral motor abilities and IQ level

	Oral-motor abilities		IQ level	
	Dysarthric	Normal	IQ > 70	IQ < 70
(1)	8	22	25	5
Functional speech	(5.0%)	(25.3%)	(16.7%)	(5.1%)
(2)	90	45	101	34
Moderate disability	(55.9%)	(51.7%)	(67.3%)	(34.7%)
(3)	63	20	24	59
Severe disability	(39.1%)	(23.0%)	(16.0%)	(60.2%)

Table VI. Pearson correlations between various factors of the study group

Correlations

		Type	Age	Dysarthria	IQ	Speech
Type	Pearson Correlation	1.000	.137*	-.254	-.085	.039
	Sig. (2-tailed)		.031	.000	.184	.542
	N	248	248	248	248	248
Age	Pearson Correlation	.137*	1.000	-.125*	-.077	-.106
	Sig. (2-tailed)	.031		.049	.225	.094
	N	248	248	248	248	248
Dysarthria	Pearson Correlation	-.254**	-.125*	1.000	.045	-.298**
	Sig. (2-tailed)	.000	0.49		.478	.000
	N	248	248	248	248	248
IQ	Pearson Correlation	-.085	-.077	.045	1.000	.400**
	Sig. (2-tailed)	.148	.225	.478		.000
	N	248	248	248	248	248
Speech	Pearson Correlation	.039	-.106	-.298**	.400**	1.000
	Sig. (2-tailed)	.542	.094	.000	.000	
	N	248	248	248	248	248

*Correlation is significant at the 0.05 level (2-tailed) ** Correlation is significant at the 0.01 level (2-tailed)

Sixty two (25.0%) cases showed normal or reasonable oral-motor abilities. Ten (4.0%) cases could not be tested due to severe mental retardation.

The speech characteristics of each CP type were analyzed according to both the presence of marked oral-motor involvement and cognitive abilities. In addition, since the symptomatology of CP children change as they grow, analysis was further refined according to age groups, those who are 5 years or younger and those who are older than five years. Tables III and IV summarize the speech abilities of our subjects according to above criteria.

Eighty one (32.7%) cases in our study group had limited functional speech or were non verbal. Main etiologies of the lack of verbal language were combinations of the mental retardation, severe oral

Table VII. Regression analysis of the factors of the study groups

Correlations[a]						
		Unstandardized coefficients			Standardized coefficients	
Model		**B**	**Std. Error**	**Beta**	**T value**	**Sig.**
1	Constant	2.332	.220		10.586	.000
	Type	2.028 E-03	.031	.006	.099	.092
	Age	-.160	.076	-.117	-2.108	.036
	Dysarthria	-.442	.076	-.330	-5.807	.000
	IO	.532	.072	.406	7.389	.000

motor involvement, apraxia of speech, and/or sensorineural hearing loss. Eleven of the verbal cases experience severely interrupted speech due to excessive laryngeal spasm affecting coordination between airflow and phonation.

As shown in Tables III through VI, the speech characteristics of each CP type were related to the presence of dysarthria and the IQ level. The Pearson Correlation analysis (Table VII) showed that the speech abilities of our study group were correlated with the presence of dysarthria (- 0.298; $\alpha \leq 0.001$) and the IQ level (0.40; $\alpha \leq 0.001$), but not with CP type (0.039; $\alpha = 0.542$) or age (- 0.106; $\alpha = 0.094$). Regression analysis (Table VIII) revealed a significant correlation between speech characteristics and dysarthria ($\alpha \leq 0.001$), IQ level ($\alpha \leq 0.001$), and, to a less degree, the age group ($\alpha = 0.036$). The negative correlation refer to the fact that better speech was, as expected, related to less involvement of the dysarthria.

Discussion

Despite the language and culture differences, the speech characteristics of the Jordanian CP study group of the present study are similar to those reported in the literature for other languages.[2,8,16] However, the relatively high prevalence of speech dysfunction in our study group can be partly explained by the fact that this study was carried out on referred CP cases to the speech clinic due to their speech and swallowing problems rather than on national screening. The same explanation can be offered to the difference in the prevalence of each type of CP. Our results showed that 20.3% of our study group were athetoids and 14.1% were ataxic. Evidently, this is different from the 5 to 10% reported for athetosis and 4.2% for ataxia.[11,12] Again, the latter two types of CP seem to experience relatively more speech dysfunction and hence were represented more in the referral list.

Also, the results of this study are in concordance with similar studies that showed that there were no specific characteristics that differentiate different CP types.[1,14] Finally, the present study supported previous findings[16,22,23] that articulation patterns did not distinguish the spastic group from the athetoid group in terms of error scores and error patterns. It was found that the severity of the oromotor involvement and the IQ level were more critical on the speech and language abilities of the Jordanian CP children and young adults. The slight but significant superiority in the speech abilities of the older CP subjects is explained by maturation and possible previous speech therapy.

Conclusion

Our results showed that mental retardation had a severe impacton the development of speech and language in CP children. On the other hand, dysarthria, when present in isolation, does not create a barrier for functional communication and intelligibility unless, apparently, when accompanied with apraxia of speech. These findings highlight the need for comprehensive evaluation of the severity of the oral motor involvement and other possible limitations as a substrate for better management and parent counseling of individuals with CP.

Further studies using multivariate analysis are needed to relate the speech abilities with the severity of the CP and the side of the body involved. In addition, smaller age groups have to be addressed.

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