Original Article

Artigo Original

Mean length utterance (MLU) as a measure of language development of children with Down syndrome

A extensão média do enunciado (EME) como medida do desenvolvimento de linguagem de crianças com síndrome de Down

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Keywords

Down syndrome
Language development
Child development
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ABSTRACT

Purpose: To characterize the mean length utterance in morphemes (MLU-m) and words (MLU-w) produced by children with Down syndrome (DS), and to verify the effectiveness of using EME-w as a measure of general language development of children with DS. **Methods:** Participants were 15 children with ages between 5 and 12 years, who were submitted to a free interaction situation. They were divided into three groups, according to chronological and mental age, as established by the results of the Primary Test of Nonverbal Intelligence. The first 100 utterances were analyzed considering: number of grammatical morphemes (GM) for articles, nouns and verbs (GM-1), and pronouns, prepositions and conjunctions (GM-2); mean length utterance for morphemes (MLU-m) and words (MLU-w). **Results:** The between-groups comparison showed that the MLU averages were higher for older groups, and differences were found for all variables, except for GM-2. The same results were obtained in the within-group comparison, for all variables. There was a strong correlation between MLU-m and MLU-w. **Conclusion:** MLU-w can be used as an identification measure of general linguistic development. However, it is emphasized that the use of all MLU variables provides more efficacy in the characterization of linguistic development and the analysis of language impairments.

Clinical Trials registration number NCT00952354.

Descritores

Síndrome de Down
Desenvolvimento da linguagem
Desenvolvimento infantil
Criança
Linguística
Estudos da linguagem
Transtornos da linguagem

RESUMO

Objetivo: Caracterizar a extensão média de enunciados em morfemas (EME-m) e palavras (EME-p) produzida por crianças com síndrome de Down (SD) e verificar a eficácia da utilização da EME-p como medida do desenvolvimento linguístico geral de crianças com SD. **Métodos:** Participaram 15 crianças com SD, com idades entre cinco e 12 anos, que foram submetidas à situação de interação livre. As crianças foram divididas em três grupos, com base na idade cronológica e mental, a partir da aplicação do *Primary Test of Nonverbal Intelligence*. Os 100 primeiros enunciados foram analisados quanto a: número de morfemas gramaticais para artigos, substantivos e verbos (MG-1) e pronomes, preposições e conjunções (MG-2); extensão média dos enunciados considerando-se morfemas (EME-m) e palavras (EME-p). **Resultados:** A comparação intergrupos mostrou que quanto maior a idade, mais altas foram as médias obtidas, havendo diferença para todas as variáveis, com exceção de MG-2. Os mesmos resultados foram obtidos na comparação intragrupo para todas as variáveis. Houve forte correlação entre EME-m e EME-p. **Conclusão:** A EME-p pode ser utilizada como medida de identificação de desenvolvimento linguístico geral. No entanto, ressalta-se que a utilização de todas as variáveis relacionadas à extensão média de enunciados fornece maior eficiência na identificação do desenvolvimento linguístico e na análise de suas alterações.

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INTRODUCTION

Speech sample analysis is a descriptive method used to comprehend and evaluate children's linguistic abilities. The Mean Length Utterance (MLU)[1] is one of the many instruments that can be used with this purpose. It has been used in Brazilian studies, referred as *Extensão Média do Enunciado* (EME). MLU constitutes a language measure that has the objective to obtain data regarding syntactic and morphologic aspects of the performances of both children with typical development (TD) and children with communication disorders[1-4].

Mean Length Utterance in morphemes (MLU-m) was purposed[1] as an index for the verification of grammatical development. International studies[5-7] have shown a relationship between chronological age and MLU. It is also considered the possibility that MLU results might predict chronological age. Age and vocabulary[8] can interact in the prediction of grammatical development, even though there are no studies that indicate the lexical effect over grammar development and that could increase with age. Hence, children first demonstrate sensibility for grammatical principles and regularities, and then use them in language production.

Then, MLU would serve the purpose of monitoring children's language development, and favoring indication of cases of language disorders. These ideas are corroborated by a study[6,7] that show that the findings resulting from MLU analysis can be used as indicators of both language deficits and outcomes obtained from language intervention.

Besides MLU-m, a few studies have suggested the analysis of the mean length utterance in words (MLU-w). This measure could provide data regarding the child's general language development. Based on a study[9] that found high correlation between MLU-m and MLU-w, the latest was indicated as a more reliable measure to calculate segment extension, and a more sensitive measure to children's language complexity[10].

The correlation between MLU-m and MLU-w was also high in a study[11] with children with typical language development between 3 years and 3 years and 10 months. The authors related their findings to the fact that small children use a relatively small number of grammatical morphemes, which influence in MLU values. Moreover, they state that the opportunities to use grammatical morphemes in data collection situation are few, exactly because that is an unnatural situation[12]. Other studies[7,13-15] strengthen this idea, and suggest more relaxed situations for data gathering directed to analyzing language and lexical development, favoring a more active participation from the enrolled children.

There are international researchers that are dedicated to studying the linguistic abilities of children with Down syndrome (DS) based on MLU-m and MLU-w analyses[16-20]. In Brazil, studies that approach linguistic issues of children with DS based on MLU are just beginning. Preliminary results on the theme indicate that both MLU-m and MLU-w might be effective for this population[21,22].

Therefore, based on observations and literature findings, the aims of the present study were to characterize the MLU produced by children with DS computed in morphemes (MLU-m) and words (MLU-w), and to verify the efficacy of MLU-w as a general language development measure for these subjects.

METHODS

The study was approved by the Ethics Committee for the Analysis of Research Protocols of the Clinical Board of the Hospital das Clínicas and the School of Medicine of Universidade de São Paulo, under protocol number 0940/07. All parents or legal guardians read and signed the Free and Informed Consent.

Participants were 15 children with Down syndrome (DS) with ages between 5 and 12 years, divided into three groups of five children, based on their chronological and mental age.

To evaluate the mental age it was used the Primary Test of Nonverbal Intelligence (PTONI)[23], which provides the non-verbal intelligence index for cognitive abilities and the correspondent mental age. Groups were composed as it follows: G1 – children with chronological age between 5 years and 1 month and 7 years and 6 months (mean of 6 years and 3 months) and mental age between 3 years and 3 years and 11 months (mean of 3 years and 3 months); G2 – children with chronological age between 7 years and 7 months and 10 years (mean of 8 years and 4 months) and mental age between 4 years and 4 years and 11 months (mean of 4 years and 4 months); G3 – children with chronological age between 10 years and 1 month and 12 years and 6 months (mean of 10 years and 9 months) and mental age between 5 years and 5 years and 11 months (mean of 5 years and 3 months).

The following inclusion criteria were considered: karyotype for simple trisomy of chromosome 21; normal social hearing; absence of severe cardiopathy and other comorbidities; use of oral language as the main communicative mean; at least one year enrolled in speech-language pathology intervention process at the institution.

Speech samples were transcribed in specific protocols, based on recorded interaction situations between speech-language pathologist and child during symbolic play. Analysis considered: number of grammatical morphemes regarding articles, nouns, and verbs (GM-1); number of grammatical morphemes regarding pronouns, prepositions and conjunctions (GM-2); mean length utterance considering the number of morphemes (MLU-m); mean length utterance considering number of words (MLU-w). The first five minutes recorded were considered an adaptation period of the child to each observation situation, and therefore were not considered in the analysis.

Speech samples comprised the first 100 segments (utterances) produced by the child after the five minutes discarded. For the correct division of these utterances, we adopted the criteria proposed by other study conducted with Brazilian children[2].

For reliability analysis of the transcribed data, 20% of the speech samples, randomly selected, were compared by two judges (one with master degree and one with a PhD), both speech-language pathologists with extensive experience working with linguistic aspects of children with DS. These transcriptions adopted the same criteria and used the same evaluation protocol.

For the purposes of the present study, scoring procedures in the specific protocol attended the items MLU-m, GM-1, GM-2, MLU-w. Standardized data in MLU measures for normally developing Brazilian Portuguese speakers[2] were used for comparison.

Data were statistically analyzed using the following tests: ANOVA, Tukey's Multiple Comparison test, Paired Student's T-test, and Correlation test. The significance level adopted was 0.05.

RESULTS

Results were compared within- and between-groups. Differences were found between the three groups regarding the variables studied, except for GM-2. The older the subjects in the group, the higher the mean score (Table 1).

In order to determine with more precision were these differences occurred, groups were compared by pairs. This analysis indicated differences between G1 and G3 for GM-1 (p=0.006), GM-total (p=0.007), MLU-m (p=0.007), and MLU-w (p=0.006). Tendencies towards significant differences were found between G2 and G3. In both comparisons, no differences were found regarding the variable GM-2.

Within groups comparisons between GM-1 and GM-2 found differences in G1, G2 and G3, and also in the whole group, composed by all participants. The older the subjects in the groups, the higher were the mean scores obtained by them (Table 2).

Within-groups comparisons also showed differences between MLU-m and MLU-w in G1, G2 and G3. The older the subjects, the higher were their mean scores (Table 3).

Results showed a strong correlation between MLU-m and MLU-w (Table 4).

Comparison between the mean scores obtained by the subjects for the studied variables and the scores presented by children with typical development, based on literature data[2], are presented in Table 5.

Results showed that children with DS had lower scores when compared matched to their peers, according to mental age.

Table 1. Comparisons of the variables GM-1. GM-2. GM-total. MLU-m. and MLU-w between groups

Between-groups		Mean	Median	SD	VC	CI	p-value
GM-1	Group 1	194.2	165	71.2	37%	62.4	0.007*
	Group 2	264.8	232	51.0	19%	44.7	
	Group 3	402.0	425	116.6	29%	102.2	
GM-2	Group 1	17.6	11	12.9	73%	11.3	0.190
	Group 2	31.4	28	15.4	49%	13.5	
	Group 3	42.8	32	29.0	68%	25.5	
GM-total	Group 1	211.8	182	79.1	37%	69.4	0.008*
	Group 2	296.2	279	57.1	19%	50.0	
	Group 3	444.8	459	138.3	31%	121.2	
MLU-m	Group 1	2.12	1.82	0.79	37%	0.69	0.008*
	Group 2	2.96	2.79	0.57	19%	0.50	
	Group 3	4.45	4.59	1.38	31%	1.21	
MLU-w	Group 1	1.51	1.35	0.37	24%	0.32	0.007*
	Group 2	2.10	2.17	0.37	18%	0.33	
		3.04	2.79	0.94	31%	0.83	

* Significant values (p≤0.05) – ANOVA

Note: GM = grammatical morphemes; MLU-m = mean length utterance in morphemes; MLU-w = mean length utterance in words; VC = variation coefficient; CI = confidence interval; SD = standard deviation

Table 2. Comparison between GM-1 and GM-2 in G1, G2, G3 and general (all participants) groups

Within-groups	General		G1		G2		G3	
	GM-1	GM-2	GM-1	GM-2	GM-1	GM-2	GM-1	GM-2
Mean	287.0	30.6	194.2	17.6	264.8	31.4	402.0	42.8
Median	258	28	165	11	232	28	425	32
SD	118.5	21.7	71.2	12.9	51.0	15.4	116.6	29.0
VC	41%	71%	37%	73%	19%	49%	29%	68%
CI	60.0	11.0	62.4	11.3	44.7	13.5	102.2	25.5
p-value	<0.001*		0.004*		<0.001*		0.001*	

* Significant values (p≤0.05) – Paired Student's T-test

Note: GM = grammatical morphemes; G = group; VC = variation coefficient; CI = confidence interval; SD = standard deviation

Table 3. Comparison between MLU-m and MLU-w, in G1, G2, G3 and general (all participants) groups

Within-groups	General		G1		G2		G3	
	MLU-m	MLU-w	MLU-m	MLU-w	MLU-m	MLU-w	MLU-m	MLU-w
Mean	3.18	2.22	2.12	1.51	2.96	2.10	4.45	3.04
Median	2.79	2.12	1.82	1.35	2.79	2.17	4.59	2.79
SD	1.35	0.87	0.79	0.37	0.57	0.37	1.38	0.94
VC	42%	39%	37%	24%	19%	18%	31%	31%
CI	0.68	0.44	0.69	0.32	0.50	0.33	1.21	0.83
p-value	<0.001*		0.043*		0.002*		0.005*	

* Significant values (p≤0.05) – Paired Student's T-test

Note: G = group; MLU-m = mean length utterance in morphemes; MLU-w = mean length utterance in words; VC = variation coefficient; CI = confidence interval; SD = standard deviation

Table 4. Correlation between MLU-m and MLU-w in groups 1, 2 and 3

	Correlation	p-value
General	97.5%	<0.001*
Group 1	94.3%	0.016*
Group 2	94.4%	0.016*
Group 3	95.7%	0.011*

* Significant (p≤0.05) – Correlation test

DISCUSSION

Literature indicates great variability in the performance of individuals with DS, considering both cognitive and linguistic aspects (and linguistic subsystems)[16,20,24,25]. Researches with the aim to study the language development of children with DS[7,16,19,24,26] organize their participants according to mental age, lexical or morphosyntactic development, exclusive or inclusive. It must be considered that these researchers, especially Americans, can count with the precious help of tests standardized for English, which is not the case in Brazil. In this sense, the participants in this study were organized in groups based on mental age, besides chronological age, with the aim to characterize the MLU-w. It is emphasized the fact that control over these variables frequently restricts the number of participants, but also provides greater reliability to the results obtained.

Authors[16,17,20,24,26] have stated that there is no synchrony among performances on different language subsystems. Many are unanimous indicating a relationship between vocabulary and grammar, not only in children with typical development[8,27], but also in children with DS[16,24,26,28,29]. It is also considered that lexical development, at least initially, must occur before grammatical development, because children must have a minimum amount of words in their vocabulary so that syntactic construction can happen[8,27].

In studies with children with typical development, authors have stated that it is not possible to consider the lexical increase that happens with age as a factor of direct influence and prediction in grammatical development[8]. These data indicate that the acceleration in lexical growth coincides with combination of words, although there is a slowing down tendency after combinations of words continue to increase. In children with DS, it is considered that vocabulary continues increasing more than morphosyntax[16,20,24,26,28,29]. Morphosyntactic difficulties are easily observed, even if there is an increase of words combinations to form syntactic structures. The performances obtained by the subjects in this study are similar to the data found in literature.

The studied variables GM-1, GM-2, MLU-m, and MLU-w can be considered reliable measures, which indicate indexes to be used in order to observe grammatical development in children with DS. Hence, GM-1 and GM-2 describe the use possibilities of open and closed word classes; MLU-m describes grammatical development, because it refers to the study of the use of morphemes; and MLU-w describes general linguistic development, as referred in national and international literature[1,4,9-12,17,19,20].

The analysis of participants' general performance showed that scores increased with age in all studied variables. These results corroborate other studies carried out with children with typical development[4-8] and children with DS[16,9,28]. In this sense, it is important to emphasize that greater differences were found between 4- and 5-year-old subjects for GM-1, MLU-m and MLU-w. These findings corroborate what is found in literature regarding children with typical language development[2],

Table 5. Distribution of means obtained by typically developing children and research groups

Groups	GM-1		GM-2		GM-total		MLU-m		MLU-w	
	TD	DS	TD	DS	TD	DS	TD	DS	TD	DS
3 years	305	194.2	67.2	17.6	372.2	211.8	3.72	2.12	2.83	1.51
4 years	355.4	264.8	99.6	31.4	455	296.2	4.55	2.96	3.52	2.10
5 years	476.6	402.0	124.7	42.8	601.3	444.8	6.01	4.45	4.73	3.04

Note: GM = grammatical morphemes; MLU-m = mean length utterance in morphemes; MLU-w = mean length utterance in words; TD = typical development; DS = Down syndrome

although the gap between these children and children with DS are maintained.

The difference between mean GM-1 and GM-2 for the three groups studied is also found in researches carried out with typically developing children, speakers of Brazilian Portuguese[2-4,30]. Such difference is explained, according to the authors, by the fact that GM-2 represents closed class words, which express more syntactic than semantic functions. That is, these words behave as phrasal connection elements, and are less recurrent in the language. For children with DS, the difficulty with morphosyntactic comprehension is added to these factors[16,17,19,28].

By relating the morphosyntactic difficulties presented by children with DS, authors state that one of the aspects related to this issue is the comprehension deficits this population presents, especially syntactic comprehension[16,17,19,20]. These deficits reflect in the use of representative elements of GM-2, as commented before, which can be observed in some types of sentences used by children with DS referred, in literature, as telegraphic[16,20,24,28], exactly because they do not present elements that indicate relation, or connectives.

Authors that have used MLU as an instrument to observe children's linguistic development affirm that the results validate and confirm its usefulness. They mention the possibility not only to evaluate the language acquisition index in typical development, but also to compare research samples. Moreover, it can be used as indicators of language deficits and of outcomes of speech-language intervention[6,7,28].

A few authors have emphasized that, depending on some factors, precaution is recommended in the exclusive use of morphemes analysis. Among these factors are the following: young children that use a relatively small number of grammatical morphemes[10,11]; data collection situations that are not natural, even if spontaneous, in a way that not all opportunities of use of grammatical morphemes are frequent[12,13,17]; interaction partner in the data collection situation, in which is observed that children, even those with typical development, produce more utterances and more different words when interacting with adults, especially with their parents[13,15]; in this same situation, children with language impairments produce more utterances when interacting with speech-language pathologists, since they use strategies that favor oral production[13]; children with language disorders, regarding they're morphosyntactic difficulties[7,11,14], or speech difficulties, focused on articulation[29]. Such factors must be considered when subjects under analysis are children with DS.

Another issue that deserves attention is related to the influence of language when calculating the use of morphemes. Some authors have presented comparisons between English and Italian, Spanish and French[5,8]. The last three, for their structures, are relatively richer, more regular, and grammatically marked, which would indicate lesser synchrony between lexical and morphosyntactic developments for children with DS[16,28]. Portuguese, the mother tongue of the participants in this study, can also be considered in this sense, since it is a Latin language that has similar structure to the others mentioned.

Based on these ideas, authors have indicated the use of MLU-w[9,10,12]. A study carried out with young children with typical development indicated correlation between use of morphemes and words to measure utterance length[1]. Such correlation was also found in children with Specific Language Disorder (SLI)[7], both in measuring lexical diversity[1] and in the comparison with other measures (number of sentences produced, number of different words, and proportion of complete and intelligible sentences)[13].

The option for using MLU-w is reinforced, in some studies, for some advantages, such as: eliminating arbitrary decisions that must be made in the analysis of morphemes use[11]; eliminating the increase of MLU scores in highly inflected languages[5,9]; facilitation in the comparison of languages and dialects[10,11]; facilitation in calculating the measure and readiness to document the structural development of the language[11].

Regarding children with DS, literature indicate the use of MLU as a measure to verify the linguistic development of this population, mainly in the composition of research groups[16,19,26,28] and for comparisons with other populations[7,21]. When difficulties regarding morphosyntactic comprehension, the use of representative elements of GM-2, the articulation difficulties that could interfere in speech unintelligibility, and issues related to working memory are considered[16,19,20,24,26,28,29], questioning regarding the efficacy of the use of MLU-w for this population rises. The results of the present study indicated correlation between data obtained with MLU-m and MLU-w, with participants organized in groups according to mental and chronological age. This fact is corroborated by studies carried out with children with typical development[9-11,15] and by a study with children with DS, Italian speakers, also a Latin language[16]. Data obtained in the present study strengthen results already suggested by other studies carried out by our group[21,22].

CONCLUSION

The results obtained suggest that MLU-w can be used as an identification measure of general language development of children with DS, besides offering the advantages of being quick and simpler to analyze. However, it is emphasized that the use of all variables related to mean length utterance provide better efficacy in the identification of language development and the analysis of its alterations. Further studies regarding MLU-m and MLU-w are important, since the group of participants in the present study was restricted.

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