

Mean Length of Utterance as a Linguistic Marker of Expressive Language in Gujarati-Speaking Children with Down Syndrome

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ABSTRACT:

Expressive language delay is a well-documented challenge in Down syndrome, yet little is known about how well Mean Length of Utterance (MLU) marks grammatical growth in Gujarati-speaking children with the condition. This cross-sectional study examined MLU as a linguistic marker of expressive language development in fifteen Gujarati-speaking children with Down syndrome, aged 5 to 10 years, divided into mild, moderate, and severe language-impairment groups of five each, based on Brown's MLU method. As the data did not meet parametric assumptions, non-parametric methods were used throughout, including descriptive statistics, the Kruskal-Wallis test, Dunn's post hoc test with Bonferroni correction, Spearman's rank correlation, and the Mann-Whitney U test. MLU differed significantly across the three severity groups ($H = 12.50$, $p = 0.002$), with the mild group showing the highest average MLU; post hoc comparisons confirmed a significant difference between the mild and severe groups ($p = 0.001$), though mild-moderate and moderate-severe comparisons did not reach significance. Age and MLU were strongly correlated ($\rho = 0.907$, $p < 0.001$), while gender showed no significant effect ($U = 19.0$, $p = 0.336$). These findings support MLU as a meaningful, reliable marker of expressive language development in this population, particularly given its strong association with age, although its ability to differentiate moderate severity levels needs further validation in larger studies.

Keywords: Down syndrome, Mean Length of Utterance (MLU), Expressive language, Gujarati, Brown's developmental stages.

1. Introduction

As a result of an additional copy of chromosome 21, the most prevalent chromosomal cause of intellectual disability is Down syndrome (DS). Among the many physical, cognitive, and developmental characteristics seen in children and adults with Down syndrome, delayed language development is perhaps the most noticeable and concerning. While receptive language is usually more reliably retained, expressive language is frequently severely impaired,

leading to issues with intelligibility, grammar, sentence structure, and vocabulary. In turn, these difficulties with expression can have far-reaching consequences, impacting one's social life, scholastic achievement, and quality of life in general (Brown, 1973; Chapman, 1995; Chapman et al., 1998; Abbeduto et al., 2007; Roberts et al., 2007).

Children with Down syndrome typically have a comprehensive speech-language evaluation that includes testing their expressive language abilities. Mean Length of Utterance (MLU) is a

popular and effective measure for gauging grammatical growth among the tools that are available. Originally suggested by Brown, MLU is determined by dividing the total number of utterances in a language sample by the number of morphemes uttered. It provides a measurable and objective view into the capacity for expression. Marques & Limongi (2011), Caselli et al. (2008), Carvalho & Limongi (2014), and Martin et al. (2009) all state that MLU has been used for a long time to monitor language development and intervention results in children with developmental problems and generally developing children.

Previous studies have shown that children with Down syndrome had lower MLU scores, which suggests that they continue to struggle with expressive output and grammar. Though there is some evidence regarding Down syndrome in children from English-speaking or Western samples, there is a significant lack of data regarding children from India, especially those who speak Gujarati (Chapman, 1995; Chapman et al., 1998; Marques & Limongi, 2011; Carvalho & Limongi, 2014).

It is still not apparent how well this metric holds up across different linguistic and cultural situations since standard MLU values have not been established across all languages and regions. Given the many morphological and grammatical ways in which Gujarati differs from English, it is worthwhile to investigate if MLU can be a valid indicator of expressive language ability in Gujarati-speaking Down syndrome children. Also, within this particular demographic, there is a lack of study on the relationships between MLU and variables including gender, chronological age, Brown's developmental stages, and the severity of language impairment.

“Given this background, the current study aimed to investigate the ability of Gujarati-speaking children with Down syndrome to use Mean Length of Utterance as a measure of their expressive language development. The study's secondary objectives included investigating the correlation between MLU

and age, gender, Brown's developmental stages, and the severity of the participant's language impairment.

2. Methodology

Study Design: Mean Length of Utterance (MLU) was investigated in this cross-sectional observational study of Gujarati-speaking children with Down syndrome to determine how their expressive language skills have progressed.

Study Setting: The study was carried out at the Vadodara, Gujarat, India, over a six-month period from April to September 2025. Ethical clearance was obtained from the Institutional Ethics Committee (SVIEC) prior to data collection (Approval No. SVIEC/O.N/DASLP/B/N/PG/24/Feb/25/05). All speech samples were recorded in a quiet clinical setting to keep conditions consistent across sessions.

Participants/Sample: With the use of selective sampling, we were able to enroll fifteen children who spoke Gujarati and had a verified diagnosis of Down syndrome. The study included 7 males and 8 females, with ages ranging from 5 to 10 (mean age 7.98 ± 1.66 years). Five kids each represented moderate, severe, and mild language impairment, according to their test scores and the corresponding level of Brown's developmental model.

Inclusion Criteria: Participating children had to meet certain criteria: they had to be 5–10 years old, native Gujarati speakers, able to generate language samples through spontaneous speech, and a parent or guardian had to be willing to give written informed consent.

Exclusion Criteria: In order to ensure that all children were given an equal opportunity to participate, we excluded those with the following conditions: a severe visual impairment that could impact testing, a major psychiatric or behavioural condition that limited participation, a profound hearing impairment that would likely impair speech and

language performance, any developmental or neurological condition other than Down syndrome, or any inability to finish the full assessment protocol.

Speech Sample Collection: Individual speech samples were obtained in a calm, child-friendly setting by a certified speech-language pathologist. The child's age and communication skills were taken into consideration while designing activities to elicit spontaneous language samples. These activities included visual description, storytelling, and discussion. We audio-recorded every session and transcribed them word-for-word so we could analyse the language.

Instruments - Mean Length of Utterance

Analysis: MLU was calculated using Brown's method, which estimates grammatical development using formula i.e number of morphemes uttered and divided by the total number of utterances ($MLU = \text{Number of Morphemes uttered} \div \text{Total Number of Utterances}$). Each child's transcribed sample was used to derive an individual MLU score, which was then mapped onto Brown's developmental stages to determine the child's level of grammatical and expressive language maturity.

Outcome Measures: This study's major outcome measure was MLU. Since both the total number of utterances and the total number of morphemes were input into the MLU calculation, they were considered supplementary outcome measures. Classification criteria, rather than research results, were utilised to categorise individuals based on Brown's developmental stage and the severity of their language impairment.

Data Analysis: Python 3.10, along with the SciPy and NumPy libraries, was used to execute all statistical analyses. Categorical variables are shown as frequencies and percentages,

whereas continuous variables are given as median, minimum, and maximum values, as well as mean $\pm$ standard deviation (SD). We employed non-parametric approaches consistently since our data did not conform to the assumptions needed for parametric testing. After determining that there was a statistically significant difference in MLU between the mild, moderate, and severe groups, we used Dunn's post hoc test with Bonferroni correction to determine which specific group pairs differed. The Kruskal-Wallis H test was used for this purpose. Using Spearman's rank correlation coefficient (ρ), we looked at the age-MLU association. The Mann-Whitney U test was used to compare MLU scores between male and female individuals. Effect size for the Kruskal-Wallis test was calculated using epsilon-squared (ϵ^2), with a p-value below 0.05 considered statistically significant.

Ethical Considerations: Ethical approval for this study was obtained from the Institutional Ethics Committee (SVIEC) (Approval No. SVIEC/O.N/DASLP/B/N/PG/24/Feb/25/05) prior to the commencement of data collection. Written informed consent was obtained from the parent or legal guardian of each child prior to enrolment in the study. The research followed the ethical guidelines outlined in the Declaration of Helsinki and ensured that participant confidentiality was preserved throughout.

3. Results

Fifteen children with Down syndrome who speak Gujarati were included in the study; five children each from the mild, moderate, and severe groups were assessed for their degree of language impairment. The sample had a mean age of 7.98 ± 1.66 years and included 7 males and 8 females. Table 1 shows the demographics, MLU profile, correlation, and gender-based results for each severity category.

Table 1. Demographic Characteristics, Mean Length of Utterance, and Associated Statistics According to Severity Group (N = 15)

Severity	Participants	Age (years), Mean $\pm$	Male/Female	Mean MLU $\pm$	Median
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Group	(n)	SD		SD	MLU
Severe	5	6.40 ± 1.16	3/2	1.59 ± 0.21	1.64
Moderate	5	8.10 ± 1.38	2/3	2.28 ± 0.21	2.30
Mild	5	9.43 ± 0.80	2/3	3.33 ± 0.20	3.34

Note. SD = Standard Deviation; MLU = Mean Length of Utterance; * $p < 0.05$.

MLU declined steadily as severity increased, moving from a mean of 3.33 in the mild group down to 1.59 in the severe group. Age was also closely tied to expressive output - children who were older tended to produce longer utterances, reflected in a strong positive correlation ($\rho = 0.907$, $p < 0.001$; Figure 2). Nevertheless, there was no statistically significant difference between the sexes in terms of MLU scores ($U = 19.0$, $p = 0.336$).

To compare MLU among the three groups, a Kruskal-Wallis H test was used instead of parametric alternatives because to the small sample sizes of each severity group (five children each). If this test did indicate a difference overall, we used Dunn's post hoc test with Bonferroni correction to identify which group pairs were responsible for the difference.

Table 2. Kruskal-Wallis Test and Dunn's Post Hoc Comparisons of MLU Across Severity Groups

Pairwise Comparison (Dunn's, Bonferroni)	Mean Rank Difference	z	P value
Mild vs Moderate	5.00	1.768	0.231
Mild vs Severe	10.00	3.536	0.001*
Moderate vs Severe	5.00	1.768	0.231

Note. * $p < 0.05$; df = degrees of freedom; Bonferroni correction applied for 3 comparisons.

The overall test confirmed that MLU was not distributed by chance across the three groups ($H = 12.50$, $df = 2$, $p = 0.002$). The effect size was notably large ($\epsilon^2 = 0.875$), suggesting severity level explains a considerable share of the variation seen in MLU (Table 2). Digging into the pairwise comparisons, though, only the mild-versus-severe contrast held up after

Bonferroni correction ($p < 0.001$). The mild-versus-moderate and moderate-versus-severe gaps, while numerically similar in rank difference, fell short of significance ($p = 0.231$ for both) - a result that may simply reflect how little statistical power five participants per group can offer, rather than a true absence of difference.

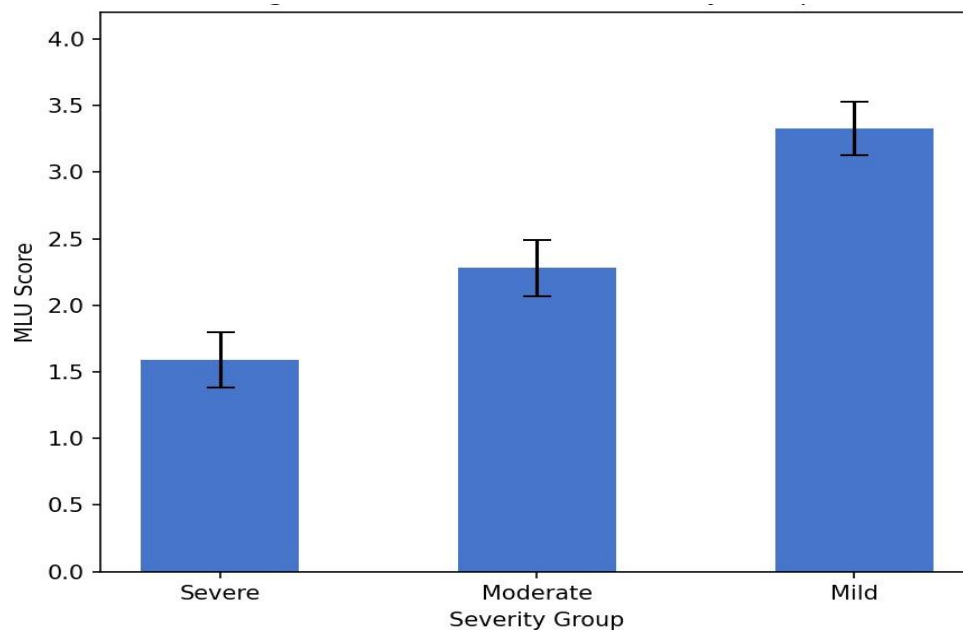


Figure 1. MLU across severity groups.

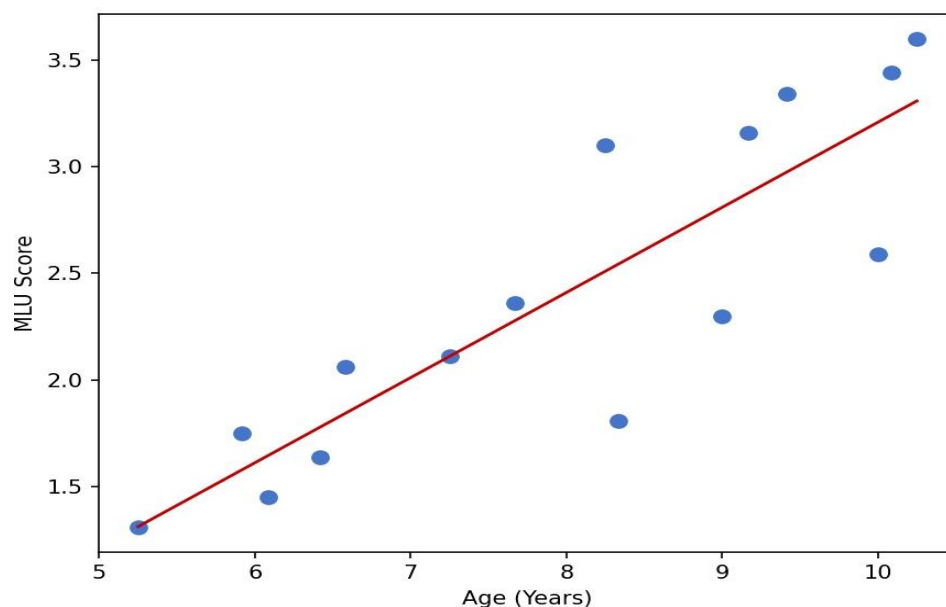


Figure 2. Scatter plot showing the relationship between age and MLU.

Looking beyond severity groupings, MLU was also mapped against Brown's developmental stages as represented in this sample. The trend was clearly upward - children at Stage I averaged an MLU of 1.38, climbing steadily to 3.43 by Stage V+. That said, several stages in this sample were represented by just one to three children, so these figures are best read as descriptive snapshots rather than statistically tested comparisons.

4. Discussion

The purpose of this study was to use a small clinical sample of fifteen Gujarati-speaking children with Down syndrome using non-parametric methodologies appropriate to the Mean Length of Utterance (MLU) to determine how well it tracks expressive language development. The results of the study are discussed in turn below: MLU varied considerably across severity categories, had a substantial correlation with age, and did not exhibit any discernible gender difference.

Children with less severe impairment consistently generated longer utterances, and there was a clear relationship between severity group and MLU overall, lending credence to the idea that MLU is a reliable indicator of grammatical and expressive development. However, with this reduced sample size, the moderate group failed to distinguish between the mild and severe categories; only the pairwise comparisons between those two categories held water. Put simply, MLU is still capable of accurately differentiating between children with mild and severe cases, even in small samples. However, it seems to be less adept at picking up subtler differences in between, so we should approach this finding with care.

This pattern is consistent with what is already known about how Down syndrome affects language development. Expressive abilities lag behind receptive ones and are one of the more persistently impacted domains throughout development, as pointed out by Chapman (1995). Children with Down syndrome had lower MLU scores because their sentences were shorter and simpler than what would be predicted for their cognitive level, according to Chapman et al. (1998). Although Abbeduto et al. (2007) found that language abilities do improve with time, many children with Down syndrome still struggle with expressive skills. The use of objective tools such as MLU in therapeutic settings is supported by Roberts et al. (2007), who also found that this group continues to struggle with grammar and sentence building.

The large effect size found here ($\epsilon^2 = 0.875$) suggests a genuinely strong link between severity and MLU variation, even in this smaller sample. Martin et al. (2009) also discovered that children with Down syndrome had lower MLU scores and more difficulties communicating. Similarly, Marques and Limongi (2011) found that children with Down syndrome had shorter utterances than typically developing peers, suggesting a delay in grammatical development. Further research by

Carvalho and Limongi (2014) demonstrated that MLU successfully differentiated children with varying degrees of expressive disability, demonstrating the measure's value as a therapeutic tool. Additionally, this study provides evidence from a Gujarati-speaking group that MLU's discriminating capacity appears to be most robust at the extremes of severity rather than in the middle, which adds to the existing picture.

It is worthwhile to methodologically unravel the loss of significance in the mild-versus-moderate and moderate-versus-severe comparisons following Bonferroni correction. As is often known, the power of non-parametric pairwise tests decreases with decreasing group sizes. Moreover, just because a Kruskal-Wallis result is significant doesn't mean that all pairwise comparisons will also follow suit. Caselli et al. (2008) found that children with Down syndrome made incremental improvements in expressive language as their language abilities developed, and Laws and Bishop (2003) demonstrated that children with developmental language disorders could be significantly differentiated based on their ability to communicate verbally. In that larger context, the present results address the extremes of severity; nevertheless, they also imply that a larger sample size would be required to detect more nuanced differences.

Despite the small sample size, there was a robust positive correlation between age and MLU, indicating that expressive language continued to increase with age. Evidence from Chapman (1995), Channell et al. (2015), and Thurman et al. (2021) supports the idea that children with Down syndrome do, in fact, add to their vocabulary, grammar, and sentence length as they become older, albeit at a slower rate than their typically developing peers. The findings further support the idea that children should get speech-language assistance throughout their childhood, instead of using a shorter intervention window.

Consistent with previous research showing small and unreliable gender effects on

expressive language in Down syndrome children, this sample did not identify a significant correlation between gender and MLU (Masoon-Apps et al., 2020). This indicates that gender is not the most important factor in determining expressive language results in this population, and that intervention strategies don't necessarily need to take gender into account.

These findings have some practical significance for speech-language pathologists. Because it does not require any specialised equipment and can be calculated immediately from spontaneous speech, MLU is still a clinically straightforward and objective metric. While it can assist clinicians in identifying children with more severe expressive issues, monitoring their progress, and creating personalised intervention plans, its capacity to distinguish between levels of intermediate severity might be compromised in extremely small clinical samples (Brown, 1973; Martin et al., 2009).

Many strengths are present in this study. Using standardised language-sampling methods and statistical approaches appropriate to its small sample, this study adds to the limited body of literature by examining MLU in Gujarati-speaking children with Down syndrome. The study also benefits from drawing on a linguistic group that is under-represented in the literature. Nonetheless, a number of caveats should be noted." The non-significant results for mild-versus-moderate and moderate-versus-severe indicate that the sample size is too small (20 children across 3 groups) to draw firm conclusions on the relationship between severity levels. Due to the study's cross-sectional design, it was also impossible to track children's language development over time. Additionally, it is important to exercise caution when using stage-wise estimations from Brown's developmental stages, as some merely featured one or two children. This cohort would benefit from larger, multicenter, longitudinal investigations that might validate the reliability of MLU as a clinical measure over the whole severity spectrum.

"Overall, the results reveal that MLU is a reliable indicator of expressive language development in Gujarati-speaking children with Down syndrome, especially for distinguishing between moderate and severe impairment, and it exhibits a strong and continuous correlation with age. Yet, larger research will need to determine if it can reliably capture finer gradations of severity.

5. Conclusion

This study suggests that Mean Length of Utterance (MLU) is a clinically significant measure of expressive language development. The data is based on fifteen Gujarati-speaking children with Down syndrome. As shown by the Kruskal-Wallis test, there was a significant difference in MLU across severity groups. Dunn's post hoc analysis confirmed that MLU could reliably differentiate between children with mild impairment and those with severe impairment. However, at this sample size, it was unable to distinguish between the moderate group and either extreme. A high positive correlation was found between age and MLU (Spearman's $\rho = 0.907$), suggesting that expressive language skill improves with age. On the other hand, gender did not have any discernible impact on MLU scores.

Collectively, these results demonstrate that MLU is a useful objective evaluation tool for speech-language pathologists, but they also highlight the importance of selecting samples with sufficient power to distinguish between nearby severity levels." To further evaluate these findings and to assist in establishing severity-based cut-offs and normative MLU data for Gujarati-speaking children with Down syndrome, larger, multicenter, longitudinal investigations are recommended moving forward.

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8. Author Declaration

Originality: The authors confirm that this manuscript is original, has not been published previously, and is not under consideration for publication elsewhere.

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Conflict of Interest: The authors report no conflicts of interest in relation to this study.

Ethical Approval: Prior to commencement, the study protocol was reviewed and approved

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Author Contributions: Shikha Sukumaran: conceptualization, data collection, data analysis, interpretation of results, and manuscript preparation. Santosh Kumar: study design, supervision, critical revision of the manuscript, and final approval of the manuscript.