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Research Article

Investigating the Use of Gestures Among Children with Down Syndrome in India

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ABSTRACT

Introduction: Gesture is a form of non-verbal communication. Down syndrome (DS) is one of the most common congenital syndromes in which speech and language deficits are prominent. Earlier studies have revealed mixed results regarding the advanced use of gestures among children with DS in Western literature. Indian culture influences parent-child interactions and gesture use differently. This study aims to assess whether a gesture advantage exists among DS children in the Indian context.

Materials and Methods: In this case-control study, 5 Tamil-speaking children with DS and 5 typically developing (TD) language-age-matched controls were observed. Their spontaneous interactions with their mothers were analyzed for type and frequency of gestures and gesture-word combinations using a checklist.

Results: Except for the frequency of deictic (requesting, giving) gestures, all the other gestures, namely deictic (pointing, showing), symbolic and representational gestures, and word-gesture combinations (equivalent, complementary, and supplementary) were observed much less frequently in DS children, although only pointing had a statistical significance. Also, fewer types of gestures were observed among DS children.

Conclusion: Children with DS in the Indian context do not exhibit a gesture advantage. This study highlights the importance of gesture assessment and intervention among these children.

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1. Introduction

Gestures are non-verbal modes of communication that can be a representation of cognitive skills. Children begin to use gestures to express their needs before expressing them verbally. Gesture development in typically developing (TD) children has been strongly related to later language development. For example, the development of early words was related to the emergence of early gestures [1]. Larger diversity in gestures at an early age has also been related to a larger vocabulary at a later age [2]. Thus, the early gesture development in TD children predicts the age of the onset of first words and word combinations along with the diversity in later vocabulary. Although language development has been extensively studied, fewer studies have explored gesture development in children with language impairments.

Down syndrome (DS) is one of the most common congenital syndromes which causes intellectual disability. Speech and language deficits are a prominent characteristic among these children. Lexical development starts late and proceeds slowly in children with DS. Although there is wide variability among these children ranging from no speech to very minimal impairment in language, the majority of these children exhibit a marked difference between their comprehensive and expressive vocabulary. Their comprehension skills may often be proportionate to their mental age, but they may also present with severe delays in expressive language. These difficulties could be attributed to middle ear infections and speech-motor coordination deficits, in addition to cognitive deficits.

In terms of non-verbal communication among children with DS, studies have examined the development of gestures and their relationship to language development. The type and frequency of gestures [3], commenting in gestural modality [4], non-verbal requesting [5, 6], joint attention and social interaction [6], and baby signs have all been reported to be related to later expressive language [7]. In addition, the use of gestures may increase with advancing language skills [8]. Accordingly, gestures may serve as an early clinical marker to identify language delays at a later age among children with DS.

Earlier studies have assessed gesture use among children with DS compared to TD children. Some studies using parental questionnaires have reported gesture advantage in children with DS when compared to TD children matched for word comprehension [8], mental age, and gender [9, 10]. On the other hand, studies have also directly observed children with DS. For example, using a picture naming task, Stefanini et al. (2007), reported an overall higher frequency of gestures and use of advanced cognitive gestures among children with DS when compared to both developmental-age-matched and chronological-age-matched children [11]. Lorang et al. (2018) reported more frequent use of gestures among children with DS during natural interactions when compared to TD children [12].

Contradicting evidence suggests that there may not be a gesture advantage in children with DS. Some of the earlier studies suggest a nonverbal deficit in joint attention skills [5] and requesting [6, 13] when compared to mental-age-matched TD children. Chan and Iacono (2001) observed no gestural advantage during the prelinguistic period [14]. Özçalişkan et al. (2016) reported deficits in the use of gestures among children with DS [7]. Iverson et al. (2003) reported a comparable frequency of gestures between children with DS and language-age-matched TD children; however, differences in the type of gestures and word-gesture combination with DS having a smaller repertoire of representational gestures [15]. Meanwhile, representational gestures are used less frequently by younger children [16]. To summarize, the presence of gesture advantage among children with DS when compared to TD children is unclear.

Disparities in the types and frequency of gestures used by children with DS have also been reported. For example, Mundy (1989) found that children with DS use gestures less frequently for requesting but more frequently for social interaction [17]. Differences in gesture usage among parents, with mothers of children with DS preferring to show rather than point, have also been reported [18].

Accordingly, these studies have been conducted in the western countries. The Asian, particularly, the Indian culture is distinctively different. Indian culture places importance on collectivism and interdependence [19]. In terms of parenting, parents from South Asia less often follow their child's lead and exhibit an adult-directed play style [20]. They were also found to be more authoritarian and adult-centered, and encourage interdependence among children [21].

Culture in addition to influencing several aspects of parenting, such as the parent-child interaction, parent's responsiveness, and child-directed speech may also influence gesture development [22, 23]. Thus, we were interested to find out whether there is a difference in the use of gestures and specifically a gesture advantage among children with DS when compared to TD children in the Indian context.

The objective of the study was twofold. At first, we aimed to examine various types and frequencies of gestures and gesture word combinations in children with DS. Secondly, we aimed to compare them to language-age-matched TD children to better understand the possible differences in the relationship between gestures and language. In particular, this study aims to assess whether children with DS with advanced chronological age when compared to their language age-matched TD children show a gesture advantage

2. Materials and Methods

Study participants

This study was approved by the Institutional Ethics Committee. A total of 5 children with DS and 5 TD children participated in this case-control study. All the children came from upper-middle-class families living in Chennai, a Southern District in India, and were native speakers of Tamil. The children with DS were recruited from the National Institute of Empowerment of Persons with Multiple Disabilities, Chennai, from January to February 2021. TD children were chosen from the nurseries in the same locality. Written informed consent was obtained from all the participating parents.

The TD children were matched for language age, gender, birth order, and maternal education to children with DS. All the mothers were native speakers of Tamil and spoke Tamil at home with their children. All the mothers could also read, write, and speak English fluently. Meanwhile, 4 of the mothers held an undergraduate degree and one of the mothers had a postgraduate degree. Three children were first born and 2 children were second born. Of the 5 children, 3 were females and 2 were males. Language age was determined using the communication DEALL developmental checklists [24].

This assessment tool was developed in India and is focused on 8 domains, including receptive and expressive language, for children between the age of 0 to 6 years. Children were matched on expressive language. All of the children with DS had a cytogenic report for confirmation of trisomy 21. None of them were exposed to gesture training. None of the children had hearing problems at the time of observation. All of them had normal/corrected vision. The mean chronological age of children with DS and TD was 58 months and 25.4 months, respectively. The demographic data of the participants are provided in Table 1.

Study procedure

Children were videotaped for 40 min on 2 consecutive sessions as they interacted spontaneously with their mothers during a free play session which consisted of toys appropriate to their age level. The toys included a cooking set, doll, farm animals, books, vehicle toys, wind-up toys, and blocks. Some of the toys were also within the child's view but out of their reach. The mother was instructed to follow the child's lead during the interaction. The mother took the toy that the child selected to the table where the child played with it.

The mothers interacted with the children in their native language and actively participated in the interaction during the recording session. Mothers were asked to interact with their children in the most natural way possible. Both groups were observed in a clinical setting. To avoid interference in the parent-child interaction, the observer was outside the room and watched through a one-way mirror.

The checklist analyzed the type and frequency of gestures along with gesture and word combinations. To be considered a word or gesture, the act must have a clear communicative

Table 1. Chronological and language age of the study subjects

Down Syndrome Children			Typically Developing Children		
Group	Chronological Age (m)	Expressive Language (m)	Group	Chronological Age (m)	Expressive Language (m)
DS 1	78	30-36	TD 1	32	30-36
DS 2	72	24-30	TD 2	30	24-30
DS 3	49	24-30	TD 3	24	24-30
DS 4	49	18-24	TD 4	22	18-24
DS 5	42	12-18	TD 5	19	12-18

DS: Down syndrome; TD: Typically developing.

intention. Also, to be acknowledged as a word, the utterance must closely resemble the actual phonological production of the word in the native language. Data analysis focused on 3 types of gestures, namely deictic, symbolic, and representational. Deictic gestures involve referring to a particular object or event among other objects in the environment. It includes showing, requesting, pointing, and giving. Symbolic gestures use an object to represent another object or event (for instance, using a comb as a phone or pretending to comb with a toy comb). Representational gestures use body or hand movements to represent the characteristic of an object or an event (for instance, turning hands to indicate driving). The type and frequency of gestures were recorded.

Subsequently, the gesture-word combinations were analyzed. Gesture plus word combinations were divided into 3 categories, namely equivalent, complementary, and supplementary [25, 26]. Equivalent combinations are when the word and the gesture refer to the same object and do not add further meaning (for instance, saying "hi"+waving hands). Complementary combinations are similar to equivalent, in which both gesture and word refer to the same object; additionally, either the gesture or the word helps identify the particular object to which it is referred (for instance, gesture book and pointing to one particular book). Supplementary combinations are when the gesture and word refer to different elements of information, thus when combined add information (for instance, point to shoes+baby). Gestures and intelligible words produced by children were transcribed from video recordings by 2 independent researchers. The researchers who were trained to identify the different types of gestures were blind to the hypothesis of the study. The inter-rater reliability was obtained at 98% for speech and 96% for gestures.

Statistical analysis

To compare whether a gesture advantage exists in Tamil-speaking children with DS during observation, the occurrence of different type of gestures were compared between the two groups. Mean of the frequency of the gestures and gesture word combinations were compared. The Mann-Whitney test was performed to test whether a significant difference exists between the two groups. SPSS software, version 26 (IBM NY, USA) was used for statistical analysis.

3. Results

This study aimed to understand whether a gesture advantage exists among Tamil-speaking children with DS when compared to language-age-matched TD children. We will first describe the results for the type and frequency of gestures, followed by the frequency and type of gesture- word combinations.

The type and frequency of different types of gestures were analyzed by 2 independent observers. Three types of gestures were analyzed, namely deictic, symbolic, and representational.

Deictic gestures

During the observations, all types of deictic gestures (pointing, showing, giving, and requesting) were exhibited by all the TD children; however, they were seen only in 3 of the 5 children with DS (one child did not exhibit pointing and showing and the other child did not exhibit pointing and requesting). Children with lower language age exhibited fewer types of gestures. Next, we analyzed the frequency of different types of gestures. The total number of deictic gestures among DS and TD were 60 and 82, respectively, with a mean of 12 and 16.4, respectively. Although the overall frequency of deictic gestures was higher among TD children when compared to DS children, the difference was not statistically significant ($P>0.05$).

Next, we examined the differences in the types of deictic gestures. The results revealed that children with DS used requesting the most, followed by giving, pointing, and showing, respectively. On the other hand, TD children used the pointing gesture most frequently, followed by giving, showing, and requesting, respectively. Even though the overall frequency of the use of deictic gestures was comparable across the 2 groups, the type of gestures varied between the groups.

The Mean±SD of deictic gestures among DS and TD were as follows: Pointing (DS: 1.8±1.789; TD: 5.2±2.387), showing (DS: 1.6±1.517; TD: 3.8±2.588), requesting (DS: 4.4±4.561; TD: 3.2±3.271), giving (DS: 4.2±4.147; TD: 4.2±2.049) (Table 2).

The DS children used the pointing and showing gestures less frequently when compared to TD children. However, requesting was more frequently observed among children with DS. The mean frequency of the use of giving gestures was the same among both groups.

There was a significant difference only in the frequency of use of pointing between the 2 groups (used more frequently by TD children) ($P<0.05$). The overall difference between the two groups in the use of deictic gestures was not statistically significant.

Table 2. Frequency of deictic gesture among the subjects

Down Syndrome Children					Typically Developing Children			
Expressive Language	Deictic Gestures				Deictic Gestures			
Months	Pointing	Showing	Requesting	Giving	Pointing	Showing	Requesting	Giving
30-36	2	1	1	1	6	1	2	5
24-30	3	1	3	1	9	8	9	6
24-30	4	4	7	11	4	3	2	6
18-24	0	2	0	3	3	4	2	2
12-18	0	0	11	5	4	3	1	2
Mean	1.8	1.6	4.4	4.2	5.2	3.8	3.2	4.2

JMR

Symbolic and representational gestures

Symbolic gestures were used by all TD children, while it was observed only among 4 of the children with DS. Representational gestures were used by 4 of the TD children, while it was observed in only 1 child with DS.

The Mean±SD frequency of symbolic gestures in DS and TD children was 4.0±3.16 and 5.80±0.44, respectively. Representational gestures also occurred more frequently in the TD group 1.4±0.89 when compared to children with DS 0.4±0.89. However, statistically, there was no significant difference between the two groups across the two types of gestures (Table 3).

Word-gesture combinations

Words+gestures combinations were divided into 3 categories (equivalent, complementary, and supplementary). Equivalent combinations were used by all TD children, while it was used by only two children with DS. A complementary combination was observed in all the TD children, while it was observed in only 2 of the children with DS. Supplementary combination was observed only among three TD children and it was absent in children with DS.

The Mean±SD of equivalent combinations was higher among TD children (5.80±0.837) when compared to children with DS (2.40±3.57). Similarly, complementary combinations were more frequent among TD children (2.80±1.304) when compared to children with DS (1.00±1.732). Supplementary combinations occurred less frequently among TD children (1.00±1.0) and were absent among children with DS (Table 4).

All the 3 types of gesture+word combinations were observed among most of the participants in the TD group.

Table 3. Frequency of symbolic and representational gestures among the subjects

Expressive Language (m)	Down Syndrome Children		Typically Developing Children	
	Symbolic	Representational	Symbolic	Representational
30-36	4	0	6	2
24-30	2	2	6	2
24-30	8	0	5	2
18-24	6	0	6	1
12-18	0	0	6	0
Mean	4.00	0.4	5.80	1.4

JMR

Table 4. Frequency of word+gesture combination among the subjects

Expressive Language (m)	Down Syndrome Children			Typically Developing Children		
	Equivalent	Complementary	Supplementary	Equivalent	Complementary	Supplementary
30-36	0	0	0	6	4	2
24-30	4	1	0	7	3	2
24-30	8	4	0	5	4	1
18-24	0	0	0	6	2	0
12-18	0	0	0	5	1	0
Mean	2.4	1	0	5.8	2.8	1

JMR

In addition, they were also observed more frequently in the TD children when compared to the DS children; however, the differences were not statistically significant (P>0.05).

4. Discussion

This research was designed to examine whether a gesture advantage exists in children with DS during the early stages of communicative development when compared to language-age-matched TD children in the Indian context.

The results revealed differences in the type and frequency of gestures between the two groups of children. Although the overall frequency of deictic gestures was comparable between the two groups, there were differences in the specific types of gestures used. The frequency of use of requesting, giving, and showing gestures was comparable to that of TD children. However, the pointing gesture was observed much less frequently in children with DS and the differences were statistically significant.

Children with DS used the pointing gesture less frequently. Pointing is often used to refer to objects at a distance, whereas showing is used to refer to immediate objects, thus distance may be a barrier. Meanwhile, as the study was conducted in a clinical setting in a room, the limited space may have contributed to the lower frequency of pointing. In addition, mothers of DS children were reported to use showing more frequently compared to pointing [18]. Accordingly, they may have had fewer opportunities to observe them in use and may exhibit a similar type of gesture to which they were exposed. In addition, Mundy et al. (1988) reported that children with DS use pointing for declarative function but not for imperative-instrumental function. On the other hand, TD children point for both declarative and imperative functions [17]. This could also be a factor for the lower frequency of pointing among DS children in the current study.

The frequency of occurrence of giving, requesting, and showing was comparable between the two groups. Thus, at a similar expressive language age, children from both groups tended to show a similar pattern, despite the advanced chronological age among children with DS.

Requesting serves to obtain the desired object; therefore, it serves as instrumental function. Children with DS may also request for social interaction in addition to instrumental needs. Similar to the current findings, Smith and Von Tetzchner (1986) reported that although children with DS exhibited difficulties in nonverbal joint attention, they did not exhibit difficulties in non-verbal requesting when compared to mental-age-matched TD children [5]. Thus, children with DS may effectively convey their needs both social and instrumental, by the use of requesting gestures.

Symbolic and representational gestures also occurred in fewer children and had lower frequency among DS children, even though the difference was not statistically significant. Symbolic gestures are strongly related to language skills, implying the underlying relationship between cognition and language. Thus, at similar language levels, both groups did not show a difference in the use of symbolic gestures. Representational gestures were observed less frequently among both groups. Representational gestures are less frequent among younger children [16]. Their use could be even more difficult than words [23]. These gestures are more complex than deictic gestures. Iverson et al. (2003) reported fewer repre-

sentational gestures when compared to deictic gestures among children with DS [15]. Similarly, DS children have been reported to exhibit a higher frequency of deictic gestures when compared to iconic, conventional, and interactive gestures [11].

Iverson et al. (1994) described 3 stages in gesture-language development. In the first stage, children predominantly exhibit gestures, especially deictic gestures. In the second stage, children exhibit a similar frequency of gestures and words. And, in the third stage, the use of gestures decreases while the use of words increases [27]. Similarly, Miller (1992) reported a gesture advantage around 17 months which disappears around 20-23 months when children begin to produce both words and gestures equally, and gesture use further reduces after 26 months when children's verbal skills increase [28]. Thus, children in the current study may have been in the second stage with the language age of 20-23 months with equal use of both gestures and words, along with a predominant use of deictic gestures and fewer use of symbolic and representational gestures.

All three types of word-gesture combinations were found much less frequently in DS, with supplementary gestures being absent, even though the differences between the groups were not statistically significant. The complementary combinations and supplementary combinations cognitively convey more information compared to equivalent combinations; therefore, the DS children may have exhibited complementary and supplementary combinations much less frequently as compared to equivalent combinations. Similar findings have also been reported by Iverson et al. (2003) who found complementary and supplementary combinations less frequently when compared to the equivalent combinations among children with DS [15]. Thus, at similar language levels, children exhibit a comparable pattern in word-gesture combinations.

The current study did not find a gesture advantage. The overall gesture use among children with DS was similar or fewer when compared to the TD children. This data is in contrast with the findings of previous studies [8-10, 12, 29]. The reason for the present finding could be because, in the present study, children with DS were matched with TD children based on their language age. When compared to chronologically-age-matched children, there could be vast differences in language skills, thus children may compensate with gestures for the severe deficits in expressive language. There were differences in the method used for data collection. Parental questionnaires may be limited to the type of gesture whereas in the present study both the type and frequency were studied through observation during the play session.

The difference may also be attributed to the difference in culture. In the Indian context, with the differences in parenting, for example, being more authoritarian and adult-centered, children may have had fewer opportunities to initiate communication. Children might be expected to follow commands and directions from adults and thus may have exhibited a lower level of gesture use. This was reflected in the fewer use of gestures even among the TD children. Similarly, Callaghan et al. (2011) reported lower scores among Indian infants in compare with Peru and Canada [30].

In addition, Indian parents may emphasize care for children with disabilities rather than their education [20]. Accordingly, their needs may often be met before communicating, resulting in fewer initiations from children with DS. They may also have fewer opportunities to watch other adults use gestures. Accordingly, children with DS may have very limited gesture use in terms of repertoire and frequency.

Some of the limitations of the present study are as follows. The current study was qualitative and considered only a limited number of participants; therefore, future studies may focus on a larger sample of individuals. In addition, only the findings from direct observation were considered. This could have been influenced by environmental factors, such as the clinical setting and fatigue. As parents may have a thorough knowledge of the child's abilities and the child may not have exhibited all the gestures during the session, it would be interesting to examine the results of both the direct observation of gestures and the report of the parental questionnaire. Because of the unavailability of standard tests in Tamil, the children were language-age-matched based on a developmental checklist. Future studies may also focus on children across different age groups to examine a developmental trend in gesture use.

Accordingly, in the Indian context, children with DS do not exhibit a gesture advantage during the early stages of language development when compared to TD children. Rather, they may exhibit deficits in certain types of gestures and differences in the type and distribution of gestures. Hence, in addition to providing language stimulation, parents may also provide gesture stimulation. Children may be given special training in the use of gestures as it may be an easier task when compared to learning oral language. Given their difficulties in speech

motor control, frequent middle ear infections, difficulties in auditory processing, and deficits in short-term memory for verbal information, it could be difficult to elicit expressive language among these children. On the other hand, gestures may not require a high degree of precision as in the production of speech and may also reduce the cognitive demands by reducing the memory demands required for verbal language. Given the DS children's relative strength in visual short-term memory, gestures may be a more accessible choice for communication. Systematic training in gestures has also been shown to improve language comprehension and gesture production [31].

5. Conclusion

The use of gestures and gesture word combinations among children with DS were similar or lower when compared to the language-age-matched TD children in the Indian context. Thus, the children with DS failed to show a gesture advantage. Hence, in addition to language delay shown by children with DS, they may also present with deficits in gesture development. Understanding the gestural abilities will help to thoroughly describe the nature and characteristics of nonverbal abilities and the nature of communication abilities among children with DS. In addition, understanding the gestural abilities may, in turn, help understand their relationship with language development, and help in predicting later language development. Thus, in addition to providing language stimulation, parents may also provide gestural stimulation. Improving gesture use may in turn help children move forward in language.

Ethical Considerations

Compliance with ethical guidelines

All ethical principles are considered in this article. The participants were informed of the purpose of the research and its implementation stages. They were also assured about the confidentiality of their information and were free to leave the study whenever they wished, and if desired, the research results would be available to them. A written consent has been obtained from the subjects. Principles of the Helsinki Convention was also observed.

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Authors' contributions

All authors equally contributed to preparing this article.

Conflict of interest

The authors declared no conflict of interest.

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