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Original Research Article

Pragmatic abilities of children with severe to profound hearing loss

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ABSTRACT

Background: Western studies indicate that children with hearing impairment (CHI) are at risk of pragmatic delay due to their delayed language development. Pragmatics is influenced by culture. Hence the objective of the study was to compare the pragmatic skills of Marathi speaking CHI using hearing devices and typically developing children (TDC) matched according to their expressive language age, chronological age, and hearing age.
Methods: Group I included 40 CHI using a hearing device having a chronological age range of 24 to 68 months, with an expressive language age of 6 to 48 months on receptive-expressive emergent language scale (REELS) and with a hearing age in the range of 12 to 36 months. Group II consisted of 40 TDC in the age range of 6 to 48 months. Checklist for assessment of pragmatics of pre-schoolers was administered for assessment of pragmatics to children in both the groups.
Results: Statistical analysis using unpaired t test indicated that there was a significant difference in pragmatic skills of the two groups when they were matched on the basis of their chronological and expressive language age ($p<0.01$), but there was no significant difference between the two groups when they were matched on the basis of their hearing age ($p>0.01$).
Conclusions: Pragmatic ability is delayed in CHI and is more a function of hearing age than chronological age or expressive language age. Thus, pragmatic abilities should be assessed and intervention provided if required for CHI even if they have good expressive ability.

Keywords: Pragmatic ability, Hearing impairment, Hearing age

INTRODUCTION

Pragmatics is the use of language in social situations. Pragmatic development involves children's acquisition of communicative competence, means learning how to use language to communicate and understand others appropriately and effectively in a wide range of social contexts.[1,2] Development of pragmatics thus becomes very important as it is the main essence from which the structural aspects of language develop in children. Without the development of appropriate communication behaviours, the structural language serves minimal purpose. Pragmatic language impairment can actually be a disorder by itself, but it is more commonly a sign of other accompanying language disorders. It can be associated with autism spectrum disorder, Down syndrome, Specific language impairment, attention deficits hyperactivity disorder and hearing loss.[3-8] Hearing loss or deafness in early childhood and the pre-school years are often associated with a higher risk of social development delay, and children with a hearing impairment may fall behind their peers with typical hearing in social communication.

This may be due to the role hearing ability plays on overall language and vocabulary acquisition among other factors. In general, there are at least three reasons why children with hearing loss do not learn conversational pragmatics very well. First, they do not receive extensive practice in using language. Their unfamiliarity with many language structures and their reduced vocabulary limits their ability to converse. Second, they cannot overhear their parents or other people talking. Thus, they do not receive the everyday, incidental models of how to use language. And finally, they may not receive the same formal instruction as children who have normal hearing.

There are many negative effects of hearing loss on communication development in children with a hearing impairment which can be prevented or at least substantially minimized, if intervention and training are initiated early in life.[9-10] Many studies have reported that, early diagnosis and appropriate intervention for infants with hearing aids is associated with improvements in receptive and expressive language skills.[11-13] With the help of technological advances in hearing aids and cochlear implants, about 96% of children with hearing impairment who are fitted early with an appropriate hearing device can reach normal language development in terms of vocabulary, semantics and syntax.[14-16] Although there are studies on structural language development of children with hearing impairment, there is a dearth of information on pragmatic language development of children with hearing impairment. Pragmatics is highly influenced by the culture and structure of the language, and thus the development is highly culture specific. Hence it becomes important to study the development of pragmatics of children with hearing impairment in India.

Aim of the research was to study the pragmatic skills of children with severe to profound hearing loss.

Objectives

Objectives of the study were to compare the pragmatic skills of children with severe to profound hearing loss using hearing devices (hearing aid or cochlear implant) and typically developing children when they were matched according to: expressive language age, chronological age, and hearing age.

METHODS

Study design

This cross sectional prospective study was conducted in School of Audiology and Speech Language Pathology, Bharati Vidyapeeth (Deemed to be University), Pune, Maharashtra, India during the period of January 2018 to March 2019 after getting approval from the institutional ethical committee.

Convenient sampling method was used for collection of data.

Participants

A total of 80 children participated in this present study. Parental consent was obtained for all the participants. The participants were segregated into two groups. Group I included 40 children with hearing impairment, and Group II included 40 typically developing children. The inclusion and exclusion criteria for group I and II were as given below:

Inclusion criteria for group I consisted of **c**hildren with – normal development milestones (motor); severe to profound hearing loss (as confirmed by ABR/ASSR/VRA/CPA results); hearing device (hearing aids/cochlear implant) for minimum of 6 months and; mother tongue Marathi.

Exclusion criteria for group I consisted of – children with known syndrome, intellectual deficits or any developmental disorder were excluded.

Inclusion criteria for group II consisted of children with – normal development milestones (motor and speech language); chronological as well as expressive language age of >6 months and ≤48 months, language age was assessed on the receptive expressive emergent language scale; mother tongue Marathi and; normal hearing sensitivity as screened through transient evoked otoacoustic emissions (TEOAE).

Exclusion criteria for group II consisted of children – with any known significant pre natal, natal or post natal history, developmental anomaly or sensory motor impairment were excluded.

Procedure

The primary caregiver of every participant was interviewed about the participant's early developmental history. Additionally, for the children with hearing impairment, audiological history (type and degree of hearing impairment, age of fitting of hearing device, and use of the device) was taken. Receptive-expressive emergent language scale (REELS) was used to rule out the presence of any significant language delay in group II (typically developing children) and for matching the expressive language age of group II to that of children in group I (hearing impaired children).[17] Checklist for assessment of pragmatics of pre-schoolers was used to assess the pragmatic ability of children in both the groups.[1] The checklist uses the framework of pragmatic profile for preschool children and the order of responses in checklist is as per the pragmatic development of typically developing Marathi speaking children as discussed by Thakur and Waknis.[18,19] The checklist was developed but not published at the time of data collection, and has been published in the year 2020.

The complete checklist is divided into four sections – section I (communication functions) has a total of 17

questions; section II (response to communication) has a total of 10 questions; section III (interaction and communication) has a total of 9 questions and; section IV (contextual variation) has a total of 8 questions.

The checklist includes a total of 44 questions which has max score of 220.

The checklist was administered by interviewing the children's primary caregiver and confirmed with the actual observations of the children. For every question, a set of answers in developmental order describing various pragmatic behaviours that the children in the age group of 0 to 4 years are expected to do are given. Scoring was done as per the instructions given by the authors of the checklist. Individual section scores and total test scores were calculated and entered in data sheets for statistical analysis.

Statistical analysis

Statistical analysis was done with statistical package for the social sciences (SPSS) version 20 software. Descriptive statistics (mean and standard deviation) was determined. Parametric statistical methods were used for analysis of data as the data was normally distributed (Shapiro Wilk's test- $p<0.05$). For comparison of the two groups and the subgroups unpaired t test was used. 95% of confidence interval percentage was considered for the study and result was considered significant if the p value was less than 0.05.

RESULTS

Objective 1

Comparison of pragmatic skills of children with severe to profound hearing loss using hearing devices and expressive language age matched typically developing children

Table 1 indicates the mean and SD scores obtained by group EAI (children with severe to profound hearing loss) and group EAII (expressive language age matched typically developing children) across all sections of the tool and across all age groups when children were matched on basis of their expressive language age and the results of unpaired t test for comparison of children of group EAI and EAII across the age ranges.

Statistical comparison of the scores of groups EAI and group EAII revealed that the scores of groups EAI are significantly higher than group EAII in all four sections as well total scores when the expressive language of the two groups is in the range of 6 to 12 months. However, in the expressive language age range of 12 to 24 months, the scores of children of EAI are higher than children in EAII only for section II of the test. The performance of both the groups is similar when the expressive age range is 24 to 36 months. And in the expressive language range of 36 to 48 months performance of children in EAI is significantly worse than EAII in section III, section IV and total score of the checklist. Thus, the children with severe to profound hearing loss outperform the typically developing children when the expressive language age is below 12 months, but as the expressive language increases, they lag in some areas of pragmatics even when their expressive language is at par with the typically developing children.

Comparison of pragmatic abilities of children fitted with cochlear implant and children using hearing aids when matched according to their expressive language age

Better auditory speech perception abilities have been reported in children using cochlear implants which should make achievement of optimum language skills easier.[20] However, it is important to understand whether these results in better usage of the language skills in children fitted with cochlear implants as compared to children using hearing aids. Hence the group of children with hearing impairment (EAI) was divided into two sub groups as per their device usage and then their pragmatic abilities were compared. Percentage of children having pragmatic skills above, below and appropriate to their expressive language skills was determined by comparing it with the norms of the checklist[1]Results are indicated in Figures 1 and 2 which reveal that almost similar percentage of children across the two subgroups were delayed in overall pragmatic scores, however the profiles of the two groups appeared to be slightly different with respect to the sections of the tool.

Objective 2

Comparison of pragmatic skills of children with severe to profound hearing loss using hearing devices and chronological age matched typically developing children

For this objective the children of group I (children with hearing impairment) were regrouped as per participant's chronological ages. There were no children with severe to profound hearing loss whose chronological age was between 6 to 24 months. Although there were 10 and 11 children respectively in the age range of 48 to 60 months and 60 to 72 months, the checklist used for studying the pragmatic development was meant for children below four years of age, hence chronologically matched typically developing children could not be assessed in this age range. Thus, only two age groups of children were considered for the purpose of comparison, 24 to 36 months and 36 to 48 months. Thus, comparison was done across two groups of participants group CAI (children with severe to profound hearing loss) (n=19) and group CAII (chronological age matched typically developing children) (n=20). Mean and SD scores obtained by groups CAI and CAII across all sections of the tool and across all age groups and results of unpaired t test for comparison of the two groups is given in Table 2.

Results revealed that the mean scores of group CAI were significantly lower than the mean scores of groups CAII in all four sections as well as total scores in the chronological age range of 24 to 36 months and 36 to 48 months ($p<0.05$). Thus, there was a significant delay in pragmatic development of children with hearing impairment using hearing device when compared to chronologically age matched typically developing children in the age range of 24 to 36 months and 36 to 48 months.

Comparison of pragmatic abilities of children fitted with cochlear implant and children using hearing aids when matched according to their chronological age

Further, the scores obtained by the group of children using hearing aids and cochlear implant were compared and results are depicted in Figures 3 and 4. Comparison with the normative data of the tool revealed that almost all the children using either of the devices (except one child in either group in single section of the tool) had a delay in pragmatic development when compared to the normative data of the checklist.[1]

Objective 3

Comparison of pragmatic skills of children with severe to profound hearing loss using hearing devices and hearing age matched typically developing children

For this objective, the children of group I were regrouped as per participants' hearing ages. Hearing age was determined by subtracting the participant's chronological age at the time of hearing device fitting from their chronological age at the time of study. Group HAI included children with severe to profound hearing loss (n=24) and group HAII (n=20) included hearing age matched typically developing children. Both groups had children in the hearing age range of 12 to 24 and 24 to 36 months.

Results as presented in Table 3 revealed that the scores of group HAI appear to be slightly higher than group HAII in all four sections as well as total scores in the hearing age range of 12 to 24 months. However no significant difference was found when the two groups were compared using unpaired t test across the two hearing age ranges. Hence the pragmatic skills of children with severe to profound hearing loss using hearing device (HA or CI) are similar to hearing age matched typically developing children.

Comparison of pragmatic abilities of children fitted with cochlear implant and children using hearing aids when matched according to their hearing age

On comparison of scores of children with hearing impairment across the device use it was seen that, 50% of the children with cochlear implant (n=17) had scores above the normative range with only 3 children having a delay in section II of the checklist and one child with a delay in section III (Figures 5 and 6). Among the children using hearing aids, 25% or more of the children had a delay in all sections of the tool, 25% of children had a delay in all sections and total score except in section III where 17% children had a delay. Thus, children fitted with cochlear implant appear to have comparatively better scores as compared to children using hearing aids when the two groups were matched based on their hearing age.

Table 1: Descriptive statistics and results of unpaired t test for comparison of children of group EAI and EAII across the age ranges.

ELA and groups	Mean and SD	Sections of the tool				
		I	II	III	IV	Total
>6 and <12 months						
Group EAI	Mean	39.83	26.50	18.58	11.83	96.75
	SD	5.96	7.81	7.16	4.85	22.22
Group EAII	Mean	24.10	17.50	10.40	6.60	58.60
	SD	11.31	7.86	4.97	2.22	25.72
Unpaired t test	t	4.181	2.683	3.046	3.135	3.734
	df	20	20	20	20	20
	P	< 0.001	0.014	0.006	0.005	<0.001
>12 and <24 months						
Group EAI	Mean	49.58	33.66	20.83	37.00	119.25
	SD	8.91	5.78	3.97	3.16	20.31
Group EAII	Mean	44.90	29.00	21.40	15.20	109.80
	SD	8.14	3.88	2.95	3.25	16.19
Unpaired t test	t	1.275	2.170	0.373	0.022	1.188
	df	20	20	20	20	20
	P	0.217	0.042	0.713	0.983	0.249
>24 and ≤36 months						
Group EAI	Mean	59.66	37.00	26.00	22.11	144.78

Continued.

ELA and groups	Mean and SD	Sections of the tool				
		I	II	III	IV	Total
	SD	7.56	3.16	1.22	4.70	13.01
Group EAII	Mean	61.00	37.00	27.30	20.90	146.20
	SD	10.26	4.05	5.20	5.15	22.54
Unpaired t test	t	0.319	0.000	0.729	0.533	0.166
	df	17	17	17	17	17
	P	0.754	10.00	0.476	0.601	0.870
>36 and ≤48 months						
Group EAI	Mean	72.42	44.00	32.00	23.14	171.57
	SD	4.64	2.82	3.87	4.94	13.02
Group EAII	Mean	75.50	46.10	36.60	28.30	186.60
	SD	3.59	2.84	4.08	2.83	11.54
Unpaired t test	t	1.538	1.501	2.332	2.739	2.508
	df	15	15	15	15	15
	P	0.145	0.154	0.034	0.015	0.024

Table: 2 Descriptive statistics and results of unpaired t test for comparison of children of group CAI and CAII across the chronological age ranges.

CLA and groups	Mean and SD	Sections of the tool				
		I	II	III	IV	Total
>24 and < 36 months						
Group CAI	Mean	40.75	26.75	15.12	10.37	93.00
	SD	7.44	8.27	4.94	3.20	21.85
Group CAII	Mean	61.00	37.00	27.30	20.90	146.20
	SD	10.26	4.05	5.20	5.15	22.54
Unpaired t test	t	4.67	3.45	5.04	5.03	5.04
	df	16	16	16	16	16
	P	<0.001	0.003	<0.001	<0.001	<0.001
>36 and < 48 months						
Group CAI	Mean	50.63	34.54	24.09	17.09	126.36
	SD	8.39	4.84	3.85	3.67	14.52
Group CAII	Mean	75.50	46.10	36.60	28.30	186.60
	SD	3.59	2.84	4.08	2.83	11.54
Unpaired t test	t	8.66	6.57	7.21	7.77	10.44
	df	19	19	19	19	19
	P	<0.001	<0.001	<0.001	<0.001	<0.001

Table 3: Descriptive statistics and results of unpaired t test for comparison of children of group HAI and HAII across the age ranges.

HA and groups	Mean and SD	Sections of the tool				
		I	II	III	IV	Total
>12 and < 24 months						
Group HAI	Mean	52.86	34.73	23.46	17.26	128.33
	SD	11.93	8.19	7.08	5.43	29.92
Group HAII	Mean	44.90	29.00	21.40	15.20	109.80
	SD	8.14	3.88	2.95	3.25	16.19
Unpaired t test	t	1.84	2.05	0.87	1.08	1.78
	df	23	23	23	23	23
	P	0.079	0.052	0.394	0.293	0.088
>24 and < 36 months						
Group HAI	Mean	62.77	38.44	26.44	21.33	149.00
	SD	13.57	8.17	5.17	6.22	30.38
Group HAII	Mean	61.00	37.00	27.30	20.90	146.20

Continued.

HA and groups	Mean and SD	Sections of the tool				
		I	II	III	IV	Total
	SD	10.26	4.05	5.20	5.15	22.54
Unpaired t test	t	0.324	0.496	0.359	0.166	0.230
	df	17	17	17	17	17
	P	0.750	0.626	0.724	0.870	0.821

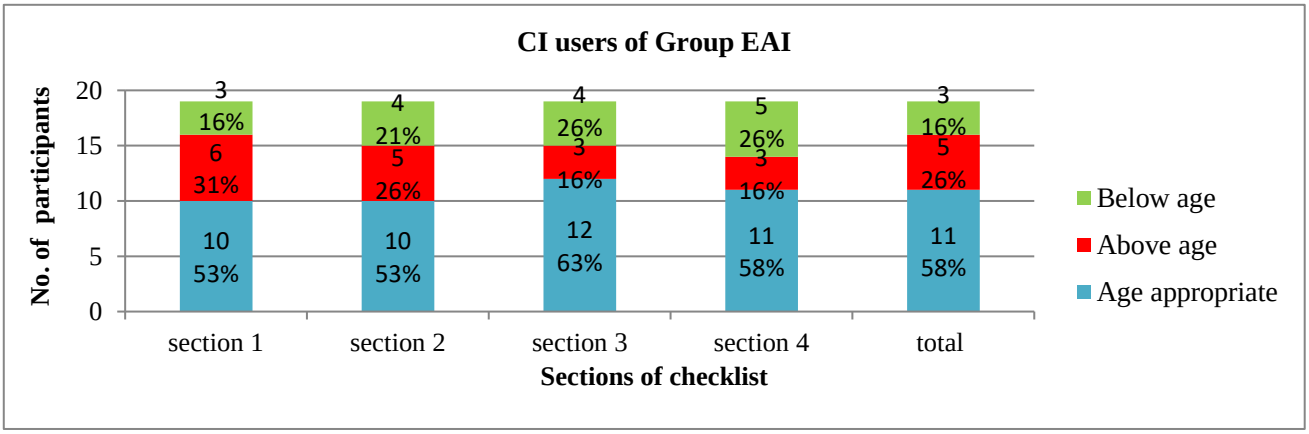

Figure 1: Percentage bar graph depicting the pragmatic skills as function of expressive language age for cochlear implant users of group EAI.

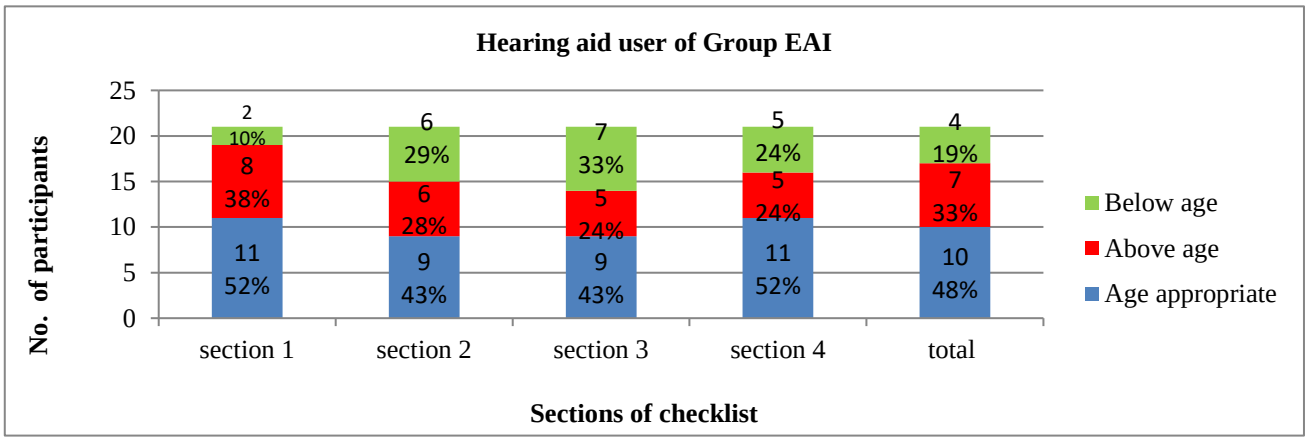

Figure 2: Percentage bar graph depicting the pragmatic skills as function of expressive language age for hearing aid users of group EAI.

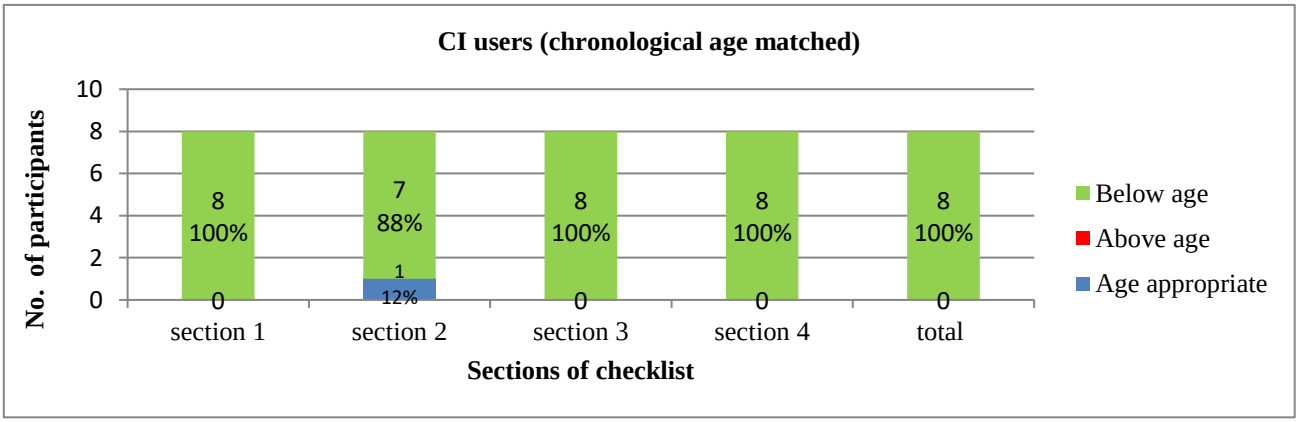

Figure 3: Percentage bar graph depicting the pragmatic skills as function of chronological age for cochlear implant users of group CAI.

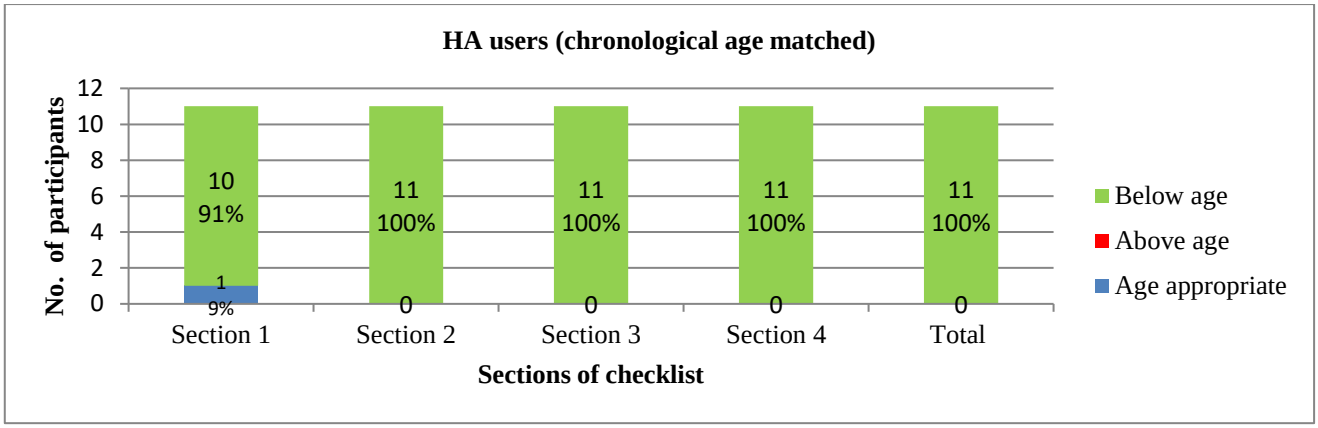

Figure 4: Percentage bar graph depicting the pragmatic skills as function of chronological age for hearing aid users of group CAI.

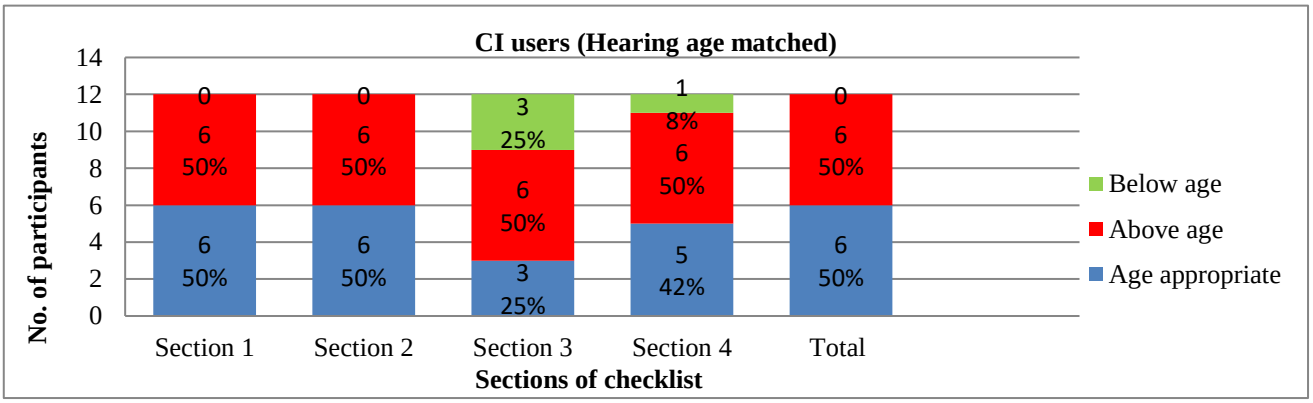

Figure 5: Percentage bar graph depicting the pragmatic skills as function of hearing age for cochlear implant users of group HAI.

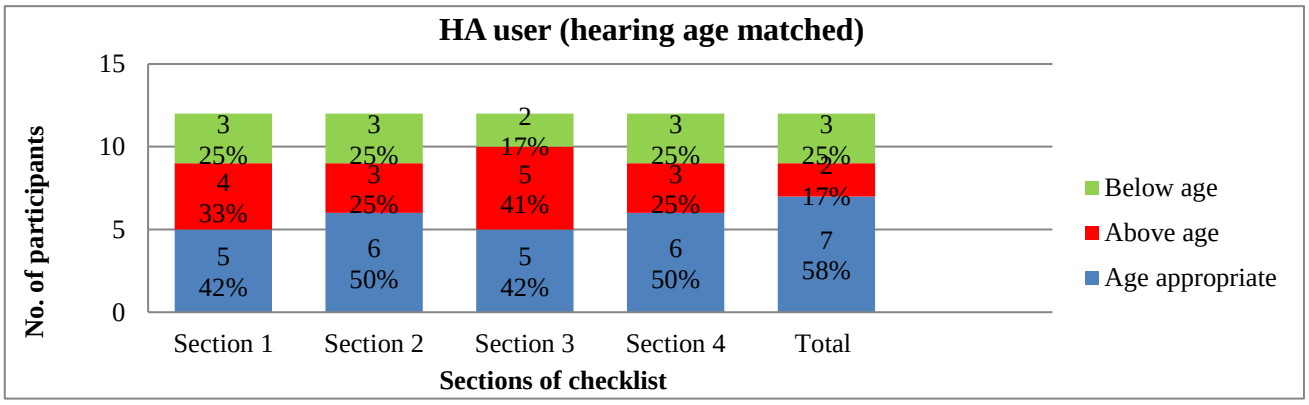

Figure 6: Percentage bar graph depicting the pragmatic skills as function of hearing age for hearing aid users of group HAI.

DISCUSSION

On comparison of the pragmatic skills of children with severe to profound hearing loss using hearing devices and expressive language age matched typically developing children it is found that, the pragmatic abilities of children with hearing impairment were better in the expressive language age range of 6 to 12 months than typically developing children. This is a preverbal stage of language development where the children communicate by crying, facial expressions, body language, primitive gestures, pointing, and vocalizations. Since the children with hearing impairment of group EAI were significantly older, they were physically and cognitively more matured and thus although the verbal expression was in the age range of 6 to 12 months, their non-verbal modes of communication were better than the typically developing

children. Further, in the expressive language age range of 12 to 24 months, the scores of children with hearing impairment were higher than the expressive language matched typically developing children only for section II of the test. In this age range, the language expression of both groups of children is verbal and is limited to single words or two words phrases. Since all the children with hearing impairment were verbal in this group, and were fitted with hearing device, insistence on using the verbal mode without reinforcing the nonverbal modes could have led to use of speech for the purpose of communication thus restricting the range of communication functions only to the ones that can be expressed using the limited speech. Further, the speech and communication models provided by others for the children could also be restricted as people 'tune in' to the linguistic abilities of children. This has been found in the studies in literature on mother child interactions in children with hearing impairment.[21,22] Thus, the range of communication functions expressed, interactions and conversations, and contextual variations of the two groups are found to be similar. However, in the expressive language range of 36 to 48 months, performance of the children with severe to profound hearing impairment is significantly worse than the typically developing children in section III, and section IV. This could be explained by the fewer interaction opportunities that the children with hearing impairment get as compared to the typically developing children. Also, peer interactions may be affected due to their reduced speech intelligibility. Similar findings have also been reported in the literature where children with hearing loss differed from those with normal hearing on their use of repair strategies, even though their linguistic levels were matched based on standard tests.[23] Children with hearing impairment may have age-appropriate vocabulary and syntax skills but they might not have learned how to use these skills in socially appropriate way.[24,25] The same is reflected in the present study.

When comparison was attempted in the pragmatic abilities of children fitted with cochlear implants and children using hearing aids it was observed that, almost similar percentage of children were delayed in overall pragmatic scores, however the profiles of the two groups appeared to be slightly different with respect to the sections of the tool. Among the cochlear implant users, section III and section IV appear to be affected in more number of children as compared to the other two sections. Among the hearing aid users, more number of children appeared to be having difficulties with section II, followed by section III. Thus, although the profiles of the participants appear to be different based on the device used, section III (conversation and interaction) appears to be affected in both the groups in more number of participants.

Children with severe to profound hearing loss performed significantly below chronological age matched typically developing children, in the age range of 24 months to 48 months in all the sections of the tool. All the children had scores below the expected scores as per the norms of the tool except one child (HA user) who performed above norms for section I and one child (CI user) who performed above norms for section II of the tool. A strong positive correlation has been reported between expressive language ability and pragmatic abilities of typically developing children.[26] This could explain the delay in pragmatic abilities of the children. Many studies in literature support this finding.[27-29]

The age of fitting of appropriate hearing aid device (HA or CI) has been known to have a significant impact on the language and speech abilities of children with hearing impairment. Hearing age thus becomes an important variable when the language of the children with hearing impairment is studied. Hence as a third and last objective of the study, comparison of the pragmatic abilities of children with severe to profound hearing loss was done with hearing age matched typically developing children (24 to 48 months). The children with hearing impairment were older than the typically developing children but did not have a significant difference in the expressive language age ($p>0.05$). Results of the study indicated that there was no difference in the mean scores of the two groups. However, when comparison of the scores of individual child was done with the normative data provided with the tool for the four sections of the tool, it was found that 19% (n=6) of the children performed below expected normative scores for section I and II of the tool and 25% (n=8) of the children had scores below the normative for sections III and IV of the tool. None of the children who were cochlear implanted had a delay in sections 1 and II of the tools and only one child had a delay in section IV. However, 3 children (25%) with cochlear implants had a delay in section III. Thus, interaction and conversation were delayed in few children with cochlear implant although they total scores were within normal range. However, 25% (n=3) of the children using hearing aids had a delay in all sections and total pragmatic scores except Section III where two children had a delay. Thus, more children fitted with hearing aids have a delay in development of pragmatic abilities as compared to children with cochlear implants when the two groups were matched on hearing age. However, the number of children using the two devices was limited. Hence statistical analysis could not be done and the study needs to be conducted on larger number of participants. Studies in literature have reported better language achievements in terms of comprehension as well as expression in children with cochlear implants as compared to hearing aid users.[30-35] Present study indicate that, hearing age appears to be a more important determinant of pragmatic performance than chronological age or expressive language abilities.

CONCLUSION

It can be concluded that the pragmatic abilities of Marathi speaking children with severe to profound hearing loss is statistically similar to the pragmatic abilities of hearing age matched typically developing children, but is delayed in some aspects of pragmatics than expressive language

matched children and chronological age matched typically developing children. Interactions and conversations appear to be more difficult than other pragmatic areas like communication functions, response to communication and contextual variations for the hearing-impaired children. There appeared to be a difference in the pragmatic development of the children using hearing aids and children fitted with cochlear implants only when the two groups were matched according to their hearing age but not when they were matched according to their chronological age or expressive language age. Thus, hearing age appears to be a more important determinant of pragmatic performance than chronological age or expressive language abilities for the development of pragmatic abilities of children with hearing impairment. Also, children fitted with cochlear implant appear to develop their pragmatic abilities faster than children fitted with hearing aids. In future, this particular study should be done on large number of participants with hearing impairment using hearing devices like hearing aids and cochlear implants across the degrees of hearing loss.

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