

Study of pragmatic language ability in children with hearing loss

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Background

Pragmatic language refers to how language is used socially to achieve some purpose in communication. Pragmatic language impairment can be a disorder by itself, or as a sign of other accompanying disorders. Hearing-impaired children show less clear pragmatic communication functions. Knowledge of pragmatic abilities in children with hearing loss (HL) is lacking relative to that of children with normal hearing (NH).

Aim

The aim of this study was to examine the pragmatic language ability in Arabic-speaking children with sensorineural hearing loss in order to apply a proper intervention program to guard against the effect of early pragmatic language skill disorders on later academic and social abilities.

Participants and methods

Twenty-seven children with HL were subjected to pragmatic language assessment using the Arabic version of the Test of Pragmatic Language, 2nd edition and both the Observational Rating Scale and the Pragmatic Profile subtests of the Clinical Evaluation of Language Fundamental, 4th edition. The results obtained were compared with the results of 27 age-matched and sex-matched NH children.

Results

The results of this study revealed significantly lower pragmatic abilities in children with HL compared with children with NH. Male children were significantly more impaired compared with female children. There were significant correlations between the pragmatic variables and the degree of HL, speech discrimination ability, and the duration of auditory deprivation.

Conclusion

HL children had significantly lower pragmatic skills compared with NH children, with greater affection correlated with increasing severity of HL and the duration of auditory deprivation. The higher susceptibility to pragmatic impairment in this category of children as well as the importance of pragmatic skills for further social communicative and academic careers should be considered in their rehabilitative plan.

Keywords:

auditory deprivation, hearing loss, pragmatic disorders, pragmatic language, test of pragmatic language, 2nd edition

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Introduction

Pragmatic language refers to how language is used socially to achieve some purpose in communication [1]. It is considered the social use of language. Pragmatic communication behaviors involve the ability to introduce and maintain conversation, take turns, modify statements, and ask questions [2–4]. The important elements of pragmatic language include an awareness of how communication is affected by different contexts and audiences, an understanding of how messages are composed most effectively, and an ability to determine the best use of these different types of messages. In essence, pragmatic language involves not only what is said but also where, why, and to whom a matter is communicated. The purpose of language is communication. As such, it involves the sharing of intents between speakers [5].

Rinaldi [6] described pragmatic language as ‘the ability to interpret meaning as speakers intend.’ Linguistic and communicative competencies are two essential aspects of language ability. Linguistic competence refers to skill with expressive and receptive language in semantic, phonological, morphological, and syntactical areas, whereas communicative competence refers to the use of the social rules of language to convey or interpret intentions that are contextually appropriate.

Pragmatic evaluation refers to the capability of a speaker to monitor and appraise his or her own pragmatic language

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in an ongoing manner. Pragmatic evaluation skill develops through experience and requires competence in all components of pragmatic language [6]. Gallagher [7] reported that pragmatic evaluation is associated with executive control and metacognitive processing, allowing self-reflection, verbal mediation, response inhibition, and behavioral direction. This process involves continuous monitoring of how well communication is working for an individual and appraisal of the conversation so that the pragmatic goals are reached. The endpoint of this evaluation is successful use of social language. The understanding of social cues, social problem solving, affect identification, anticipation of social consequences, and the association of social consequences are all heavily language based and language facilitated.

Furthermore, language is used to define emotions, talk about them, share them with others, and examine the relationship among actions, intentions, feelings, and consequences for oneself and others. Effective assessment of pragmatic language ability requires a situation that reflects the dynamics of social interaction. A major purpose of evaluating the pragmatic language skills of children and adolescents is to identify individuals who have difficulty in social communication [6]. Pragmatic language impairment can actually be a disorder by itself, but it is more common as a sign of other accompanying language disorders. It can be associated with autism spectrum disorder, specific language impairment, Down's syndrome, attention deficit hyperactivity disorder, environmental deprivation, and hearing disorders [8]. Lederberg and Everhart [9] reported that children with hearing loss (HL) were less skilled at maintaining a conversation topic, used more instructions and fewer questions, and showed less clear pragmatic communication functions. Nicholas *et al.* [10] attributed the deficits in communication among young children with HL to their language delay.

Knowledge on the development of pragmatic abilities in children with HL is lacking [9]. Hence, the aim of this study was to examine the pragmatic language ability in Arabic-speaking children with HL in order to identify the pragmatic deficits among these children for applying a proper intervention program to guard against the effect of early pragmatic language skill disorders on later academic and social abilities.

Participants and methods

Participants

This study was conducted on 27 children with sensorineural hearing loss (SNHL). They were

presented at the Clinics of Phoniatrics or Audiology, Ain Shams University Hospitals, after parents' consent. They included 15 (55.6%) boys and 12 (44.4%) girls. Their mean age was 8.78 ± 2.04 years and ranged from 6 years and 3 months to 13 years and 3 months.

The criteria for inclusion were as follows: the children

- (1) had to have SNHL,
- (2) had to be using a regular binaural hearing aid,
- (3) had to have average intellectual ability as evidenced by the Stanford Binet Intelligence Test [11],
- (4) did not use sign language for communication,
- (5) had no other disabilities.

The children of the study group had HL that was detected at a mean age of 2.57 ± 0.9 years (range 1–4 years). The mean age at the time of fitting of hearing aids was 3.40 ± 0.98 years (range 1.6–5.3 years). The mean duration of auditory deprivation was 0.8 ± 0.2 years (range 0.3–1.5 years).

A control group of 27 age-matched and sex-matched normal children were selected randomly from among the relatives of the patients attending the Clinics of Phoniatrics or Audiology, Ain Shams University Hospitals, after taking their parents' consent. They had no subjective speech, language, mental, or hearing difficulties, or any other developmental disability according to parental reports. They were subjected to the same assessment procedures and used as a reference for their pragmatic language development. They included 14 boys (51.9%) and 13 girls (48.1%). Their mean age was 8.73 ± 2.26 years and ranged from 6 years and 1 month to 13 years and 9 months.

Procedures and clinical tools

Each individual of both study and control groups was subjected to the following assessment procedures.

Thorough history taking according to the protocol of language assessment of Kotby *et al.* [12], including full personal, family, medical, and developmental history with special emphasis on age at discovery of hearing impairment, age at commencement of use of hearing aids, and means of communication.

Patient examination: general examination, neurological examination, and vocal tract and ENT examination.

The Stanford Binet Intelligence Test [11] to assess mental ability. The intelligence quotient was determined as a percentage ratio of mental age to chronological age.

The Standardized Arabic Language Test to determine the percentage of total language score [12].

Assessment of pragmatic language ability using:

The Arabic version of the Test of Pragmatic Language, 2nd edition (TOPL-2), Alduais *et al.* [13].

The Arabic version of the Pragmatic Profile (PP), a subtest from the Clinical Evaluation of Language Fundamental, 4th edition (CLEF-4), Alduais *et al.* [13].

Observational Rating Scale (ORS), a subtest from the CLEF-4, Alduais *et al.* [13].

The Arabic version of Test of Pragmatic Language, 2nd edition (TOPL-2) [13]

It is an instrumental battery designed to measure pragmatic language ability in children and adolescents. Pragmatic evaluation involves the monitoring, awareness, and appraisal of social language. Effective assessment of pragmatic language ability requires a situation that reflects the dynamics of social interaction. To satisfy this critical requirement, the TOPL-s utilizes narratives and story contexts. It is appropriate for use in children and adolescents aged 6–18 years who can speak Arabic and understand directions. The materials needed for administering the TOPL-2 are the Examiners Record Booklet for the appropriate age range and the TOPL-2 Picture Book. The TOPL-2 Picture Book includes color picture prompts that are clearer, more likely to hold interest, and not as easy to misinterpret. These pictures reflect more accurately the environment of children and adolescents. The TOPL-2 is a 43-item book that is a comprehensive measure of pragmatic language ability. Most of the items are keyed to pictures that present social situations evaluated by examinees in formulating their responses. Children aged 6–7.11 years are scored on 1–17 items only and children aged 8 years or older are scored on all 43 test items. The time required to administer and score the test varies from 60 to 90 min. Usually, the test can be administered in one session. Younger children may require a short rest period or a snack during testing. The test is administered in a quiet room, with the administrator sitting with the child at a comfortable table. The TOPL-2 Picture Book is placed in a position that allows the child to view the pages easily. Sitting at a right angle to the student at the table allows the examiner to manage the Picture Book easily and record responses on the Examiner Record Booklet without being observed by the child.

Test administration: as a formal assessment, the Arabic version of TOPL-2 test was administered by the

researcher following all directions provided in the examiner's manual. The stimulus prompts are read aloud exactly as written in the Examiner Record Booklet; the child responds verbally to each prompt. Some items require a picture to be displayed to the child, and some do not. In the score column of the Examiner Record Booklet, a score of '1' is recorded for the correct answer and '0' for incorrect ones. General criteria for correct and incorrect responses appear in the Examiner Record Booklet under the column heading Correct Response Guidelines.

Scoring of the Arabic TOPL-2 test: the child was given 1 point for a correct answer and 0 points for an incorrect answer. The TOPL-2 provides one standard score, which is the Pragmatic Language Usage Index (PLUI). It is a standard score based on the sum of the scores of the 43 items for examinees 8 years of age or older and the sum of items 1–17 for examinees aged 6–7.11 years, which yields the raw score. The raw score is converted to a PLUI. In addition, the TOPL-2 provides descriptive ratings that correspond to the PLUI, as shown in Table 1.

Standard scores of PLUI from 90 to 110 are considered average and account for almost 50% of the population. Scores below that range may be problematic and warrant diagnostic attention. Average to high scores indicate that an individual is performing well in comparison with peers. Low scores indicate a potential deficiency in the appropriate use of pragmatic language. The TOPL-2 scores reflect competence in many areas of pragmatic language, and thus can be used to estimate general pragmatic language ability, identify children with good and poor pragmatic language skills, determine the individual's strengths and weakness among the different types of pragmatic skills, and document an individual's progress in pragmatic language as a consequence of special intervention programs.

The Arabic version of the Pragmatic Profile and the Observational Rating Scale (Alduais *et al.* [13]).

Table 1 Descriptive ratings for the Pragmatic Language Usage Index

PLUI score	Descriptive rating of pragmatic abilities
130	Very superior
121–130	Superior
111–120	Above average
90–110	Average
80–89	Below average
70–79	Poor
<70	Very poor

PLUI, Pragmatic Language Usage Index.

These are subtests from the CLEF-4. The PP is used for assessment of pragmatic ability and expected skills and the ORS is used for assessment of child performance and social interaction. The two subtests of the CLEF-4 (PP and ORS) were completed by the participants' parents as they are informal assessment tools. The parents took ~45–60 min to complete them. The parents completed the form according to their observations of their children.

Scoring of PP and ORS tests: the PP includes 52 items rated from 0 to 4, with 208 being the highest score and 52 being the lowest. The higher the participant's scores, the fewer the problems he or she has with pragmatic language. In the case of the ORS, the test includes 40 items, again rated from 0 to 4; the highest score is 160 and the lowest is 40. The lower the participant's scores, the fewer the problems he or she has with pragmatics.

All children were subjected to the following audiological evaluation.

History taking, including full medical and audiological history.

Pure tone, speech audiometry, and pure tone aided response with their fitted hearing aids, using two channel audiometer model (Grason-Statler Inc., USA), calibrated according to American National Standards Institute (1969).

Immittance-metry was performed to exclude middle ear problems using an acoustic immittance meter (model AZ27; Interacoustics, USA).

Pure tone audiometry (PTA) was performed to assess hearing threshold levels separately in each ear at octave frequencies of 250–8000 Hz. Speech audiometry included Arabic bisyllabic words for children (Soliman S. and El-Mahalawi T., unpublished data) to assess speech reception threshold, and phonetically balanced kindergarten words in Arabic language (Soliman S., El-Mahalawi T., unpublished data) to assess word discrimination score (DS%) (percent correct score). It is an open test composed of eight lists. Each list is composed of 25 CVC or CVCC monosyllabic words. Items of each list are phonetically balanced. Aided sound field testing (using own patient hearing aids) was performed. Aided threshold levels in dBHL were achieved using warble tones at 0° azimuth at a distance of 1 m from the loudspeaker at frequencies of 250–4000 Hz. The aided speech DS was assessed using phonetically balanced kindergarten words.

Statistical methods

Statistical analyses were performed using SPSS statistical package, version 18 (IBM Corporation, Chicago, Illinois, USA). Quantitative variables were presented as mean and SD. Qualitative variables were presented as frequency and percentage. Parametric variables were compared between two groups or more using the independent sample *t*-test. Nonparametric variables were compared between two groups using the χ^2 -test. Nonparametric variables were compared between two groups and multiple groups using the Mann–Whitney test. Correlation between parametric variables was ascertained using Pearson correlation coefficient. Correlation between nonparametric variables was ascertained using Spearman rank correlation coefficient. *P* values less than 0.05 were considered significant.

Results

Nine (33.33%) children in the study group had mild SNHL; eight (29.6%) had moderate SNHL; five (18.5%) had moderately severe SNHL; and five children (18.5%) had severe SNHL (Fig. 1). Their average PTA was 61.04±15.14 dB (range 30–80 dB) and average speech DS was 68.8±17.44%. All children in this group used bilateral hearing aids and had satisfactory aided responses. The average aided PTA was 25.96±6.39 dB (range 15–38 dB). All children with HL used spoken language sufficiently well to qualify for the study; they had no disabilities other than HL, and did not use sign language support. Sixteen children (59.2%) out of the study group were studying in regular classes with normal-hearing (NH) children.

Comparison between the group with hearing loss and the control group regarding the different demographic, language, hearing and intelligence data.

Both the study and control groups were matched as regards their chronological age and sex ($P>0.05$). Meanwhile, the intelligence quotient scores showed a nonsignificant difference between the two groups. There were significant differences between them in the percentage of total language scores and the average PTA and speech DSs, which were significantly lower in the group with hearing impairment ($P<0.05$) (Table 2).

Comparison between the group with hearing loss and the control group regarding the different pragmatic parameters

Children with HL revealed significantly lower scores on both the PLUI of the Arabic version of the TOPL-2 and the PP in comparison with NH children ($P<0.05$), reflecting their lower pragmatic language ability. Moreover, there was a significant difference

between the two groups as regards the scores of ORS, which were significantly higher in the group of children with HL ($P<0.05$), reflecting lower pragmatic ability in the study group (Table 3 and Fig. 2).

Comparison between the different parameters of the pragmatic language ability test among children with hearing loss as regards the degree of hearing impairment

Pragmatic language abilities were significantly affected in the group of children with moderately severe SNHL and severe SNHL in comparison with the group of children with mild and moderate SNHL ($P<0.05$) (Fig. 3).

Comparison between male and female children with hearing loss regarding the different pragmatic variables

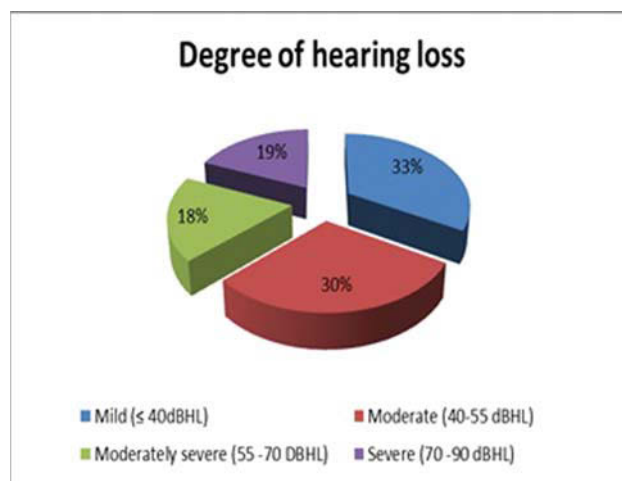
The scores of the pragmatic language ability test showed significant differences between male and female children with HL. These scores were found to be significantly affected in male children with HL than in female children ($P<0.05$). Otherwise, nonsignificant difference was detected as regards the rest of the measured parameters ($P>0.05$) (Table 4 and Figs 3–5).

The PLUI of female children with HL lay mostly between average and below average grades (80–110). Meanwhile, male children with HI had mostly poor pragmatic ability (70–79) (Fig. 4). The PP scores of female children with HL lay mostly between average and below average grades (80–110). Meanwhile, male children with HI had mostly poor pragmatic ability (70–79) (Fig. 5). The ORS scores of female children with HL lay mostly between poor and below average. Meanwhile, the ORS scores of male children with HL lay mostly between poor and very poor (<70–79) (Fig. 6).

Correlations between the different pragmatic parameters and the different parametric variables

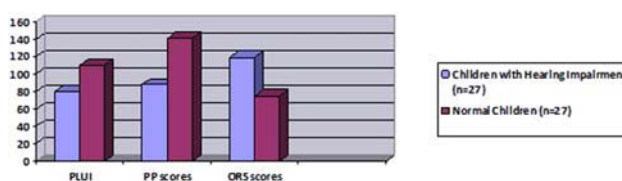
Correlation analyses were performed to study the relation between the different pragmatic scores and the different variables. There were significant negative correlations between each of the pragmatic test scores (PLUI and

Figure 1



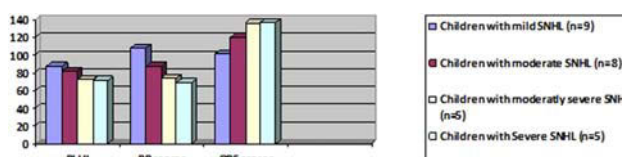
Degrees of sensorineural hearing loss in the study group.

Figure 2



Comparison between the two groups concerning the tests for evaluating pragmatic language abilities. ORS, Observational Rating Scale; PLUI, Pragmatic Language Usage Index; PP, Pragmatic Profile.

Figure 3



Comparison between the different parameters of the pragmatic language abilities among the children with hearing loss as regards the degrees of hearing impairment. ORS, Observational Rating Scale; PLUI, Pragmatic Language Usage Index; PP, Pragmatic Profile.

Table 2 Comparison between the children with hearing loss and the control group regarding the different demographic data and some clinical characteristics

The clinical characteristics	Children with HL G1 (n=27)	Normal children G2 (n=27)	P value	Significance
Chronological age (years)	8.78±2.04	8.73±2.26	0.933	NS
Sex				
Male [n (%)]	15 (55.6)	14 (51.9)		
Female [n (%)]	12 (44.4)	13 (48.1)	0.785	NS
Total language scores (%)	82.86±9.09	96.17±3.11	0.000	S
Average PTA (dB)	61.04±15.14	9.44±2.53	0.000	S
Speech discrimination (DS%)	68.8±17.44	98.22±2.26	0.000	S
IQ scores	89.07±4.82	91.37±5.83	0.12	NS

DS%, speech discrimination percent score; HL, hearing loss; IQ, intelligent quotient; NS, nonsignificant; PTA, pure tone audiometry; S, significant.

PP) and the average pure tone thresholds as well as the average aided PTA ($r=-0.785, -0.630, -0.800,$ and $-0.671,$ respectively; $P<0.05$). In addition, significant positive correlations were found between the ORS scores and both averages of PTA and aided PTA ($r=0.699$ and $0.649,$ respectively; $P<0.05$). Moreover, DS% showed significant positive correlations with both PLUI and PP scores ($r=0.722$ and $0.623,$ respectively; $P<0.05$), and significant negative correlations with the ORS scores ($r=-0.705;$ $P<0.05$) (Table 5). These findings denote that the more severe the HL with poorer speech discrimination and poorer aided response, the lower the pragmatic skills. Moreover, total language scores showed significant positive correlation with PP scores ($r=-0.405;$ $P=0.036$) (Table 5). The duration of auditory deprivation (duration between age at onset of HL, and age at HA fitting) showed significant negative correlation with the PLUI values ($r=-0.421;$ $P=0.029$), where the longer the duration of auditory deprivation, the lower the pragmatic skills. All other correlation results were nonsignificant (r values ranged from -0.344 to $0.351;$ $P>0.05$) (Table 5).

pragmatic communication behaviors are important for everyday interactions. Pragmatic behavior relates to the assortment of rules needed to use language appropriately and effectively to create interaction and transfer meaning in different conversational contexts, such as taking turns in conversation, continuing a topic, adding information, or asking questions [2]. Even when the child has age-appropriate vocabulary and syntax skills, she or he may not yet have learned how to use these skills in a socially appropriate manner for specific social purposes. Young children with NH acquire these skills rapidly between 3 and 4 years of age and are able to use these pragmatic language skills using complex language [14]. Researchers assumed that because children with HL are not exposed to natural communication interactions like children with NH they are likely to have fewer opportunities to acquire the range of pragmatic skills required for such interactions [1,15]. Without mastery of these skills, children will encounter significant challenges with literacy, written communication, and abstract conversational communication - all of which affect success in school and in getting along with peers [14].

Discussion

Pragmatic language skills are the most abstract and complex of all language skills [14]. Appropriate

This study is considered the first to be designed to assess the pragmatic skills of Arabic-speaking children with HL using the Arabic version of the TOPL-2 and both the ORS and PP subtests of the CIEF-4 [13].

Table 3 Comparison between the children with hearing loss and the control group regarding the pragmatic language abilities tests

Pragmatic language scores	Children with HL G1 (n=27)	Normal children G2 (n=27)	P value	Significance
TOPL-2				
PLUI scores	80.07±8.31	110.56±9.92	0.000	S
PP scores	88.33±22.58	140.74±20.75	0.000	S
ORS scores	119.63±19.71	75.07±14.82	0.000	S

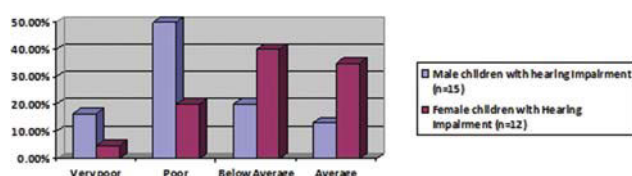
HL, hearing loss; ORS, Observational Rating Scale; PLUI, Pragmatic Language Usage Index; PP, the Arabic version of the Pragmatic Profile; S, significant; TOPL-2, the Arabic version of the Test of Pragmatic Language, 2nd edition.

Table 4 Comparison of pragmatic language abilities between male and female children with hearing loss

Parameters	Male children with HL (n=15)	Female children with HL (n=12)	P value	Significance
PLUI scores	69.67±8.09	82.33±8.88	0.021	S
PP scores	81.27±22.25	92.67±23.43	0.011	S
ORS scores	128.87±18.1	101.58±22.36	0.034	S

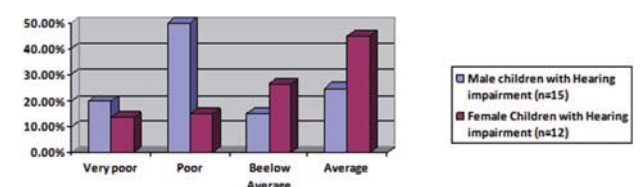
HL, hearing loss; ORS, Observational Rating Scale; PLUI, Pragmatic Language Usage Index; PP, Pragmatic Profile; S, significant.

Figure 4



Comparison of the rating grades of the Pragmatic Language Usage Index with respect to sex of the children with hearing impairment.

Figure 5

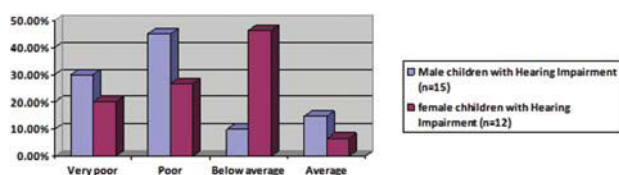


Comparison of the rating grades of the Pragmatic Profile with respect to sex of the children with hearing impairment.

Pragmatic evaluation skill involves the monitoring, awareness, and appraisal of social language, as well as other components of pragmatic language. The TOPL-2 includes a pragmatic evaluation ability component that focuses on the factors that the child considers while crafting an answer.

The results of this study indicated that children with HL had significantly lower pragmatic language skills in comparison with NH children ($P < 0.05$). Our findings are supported by previous research on pragmatic abilities that demonstrated differences in the development of children with HL with either a delayed or a different acquisition of pragmatic abilities versus those without HL [9,10,14,16]. These studies suggested that children's linguistic delay had an effect on their pragmatic abilities. Further, Guest *et al.* [17] showed that children with HL fell behind their peers

Figure 6



Comparison of the rating grades of the Observational Rating Scale with respect to sex of the children with hearing impairment.

Table 5 Correlation between the different pragmatic language parameters and the different variables in the group of children with HI: -0.119 to 0.405

Variables	r/ P	PLUI	ORS scores	PP scores
Average PTA (dB)	r -0.785 P 0.000*	0.699	0.000*	-0.630
Average aided PTA (dB)	r -0.800 P 0.000*	0.649	0.000*	-0.671
Age of onset of HL (years)	r -0.109 P 0.589	0.207	0.301	-0.029
Age of fitting of HA (years)	r -0.230 P 0.248	0.312	0.113	-0.119
Duration of auditory deprivation	r -0.421 P 0.029*	0.351	0.072	-0.314
Speech discrimination score (DS%)	r 0.722 P 0.000*	-0.705	0.000*	0.623
Duration of HL (years)	r -0.293 P 0.138	0.196	0.328	-0.309
Total language scores (%)	r 0.260 P 0.190	-0.340	0.082	0.405

DS%, speech discrimination percent score; HA, hearing aid; HL, hearing loss; IQ, intelligent quotient; ORS, Observational Rating Scale; PLUI, Pragmatic Language Usage Index; PP, Pragmatic Profile; PTA, pure tone audiometry. *Significant.

with NH in the use of conversational repair. Although children with NH could master 100% of the 45 items in the pragmatic checklist by age 6 years [14], children with HL mastered only 6.6% (three of 45 items) by age 6 years and 69% (31 of 45) of the items were mastered by age 7 years [14]. These results indicated that children with HL are slower in pragmatic language acquisition compared with NH children.

From trials on determining the causes of these lower pragmatic skills in HL children according to the variable clinical and demographic data, we could conclude that the pragmatic ability of effectively using repair strategies in cases of communication breakdown is necessary for individuals with HL, both as listeners and as speakers, because of lower speech intelligibility. Ciocci and Baran [18] reported that children with HL aged 4–7 years used revision as a repair strategy more often than did children with NH. Meanwhile, Duchan [19] suggested that children with HL may express difficulties in turn-taking during conversation because they miss relevant auditory cues. In other words, the children's difficulty results from the inaudibility of necessary cues and does not reflect an inability to take turns. Most *et al.* [1] reported that, although children with HL were able to express a variety of appropriate pragmatic behaviors during discourse, they were unable to fully or precisely use many of the various behaviors. In other words, they had not yet mastered the consistent appropriate usage of pragmatic abilities that their age-mates with NH exhibited.

Our finding of significantly lower pragmatic skills in HL children could be explained by the delayed pragmatic development in the HL group. The delayed pragmatic development in children with HL was supported by many previous studies [14,20,21]. Goberis *et al.* [14] mentioned that children who are deaf or hard of hearing acquire pragmatic skills much more slowly even with targeted intervention strategies. These delays and difficulties in pragmatic behaviors may be due to insufficient exposure to common daily discourse and underlying impoverishment in all components of language development [22]. Upon using the PP based on Dewart and Summers [23] in a study conducted by Lichtig *et al.* [20] the frequency of occurrence of the pragmatic skills was lower in the deaf groups, suggesting a delay in their acquisition and consequently in their use. With regard to communicative intention, severely and profoundly deaf children showed a lower percentage of utterances with skills of 'naming' and 'giving' information in comparison with their hearing peers.

The deaf children also exhibited more difficulty in responding to spoken input compared with NH children, especially for the anticipation function. In terms of interaction between the child and the examiner, the results showed that severely and profoundly deaf children contribute less than NH children to conversational interaction with respect to conversation extension, nature, and effectiveness. Even for children with cochlear implantation (CI), Rinaldi *et al.* [21] reported that CI may provide deaf children with a good opportunity to develop language skills, but severe difficulties in early social experiences and interaction mediated by language still remain. Delays in these aspects suggest that interventions improving pragmatic skills are recommended even in very young children with CI.

All the pragmatic tests used in this study revealed that HL children had poorer pragmatic skills than their peers with NH; even their language skills were significantly poorer when compared with the control group. Pragmatic skills are considered one aspect of the total linguistic abilities. Martin *et al.* [24] suggested that language development often serves to predict how well children will behave socially. The suggested relationship between HL and delayed language development and acquisition, especially in the case of HL during early childhood, may explain the lower pragmatic skills in our study group. This is supported by the study of Yoshinaga-Itano [25] in which young children with HL who were identified late demonstrated delay in expressive vocabulary development relative to NH peers, which would definitely delay their pragmatic development and affect their pragmatic use of language. This could support our finding of a significant and negative correlation between the duration of auditory deprivation (difference between age at onset of HL and age at HA fitting) and the scores of the PLUI in this study, where the longer the duration of auditory deprivation, the poorer the pragmatic skills. Meanwhile, the age at fitting of HA was not correlated with any of the applied pragmatic tests. This finding could be compared with the study of Most *et al.* [1] who detected no significant correlations between the age at CI and the percentage of appropriate pragmatic behaviors. However, other studies documented the influence of age at onset of HL on the language outcomes [26–29] and the effect of the age at which intervention for language skills was initiated [30,31], but did not report a direct relation between these two factors and pragmatic skills.

Of the factors that may explain the lower pragmatic skills in HL children is the period of auditory

deprivation that could lead to an early lack of social exposure due to HL, influencing language skills and resulting in immature and delayed social communication skills that would subsequently limit the use of common conversational strategies such as initiations, responses, and conversational repairs, as supported by Guest [17]. It was reported by Weisel *et al.* [32] that HL during early childhood and preschool years can contribute to difficulty finding and maintaining critical social relationships with NH peers. Because of these social interaction difficulties, children with HL may report limited popularity [33] and greater feelings of loneliness relative to those reported by peers with NH [24,34,35]. These deficits regarding social acceptance may further impede the pragmatic development of children with HL. Peer culture is one context in which identifiable rules are necessary for effective communication. For successful communication to be achieved, knowledge of the social rules within the peer culture is essential. Another important factor that could markedly affect the pragmatic skills of our studied HL children is the severity of HL. Despite having only 10 patients with moderate to severe and severe SNHL, pragmatic language abilities were significantly affected in groups of children with moderately severe SNHL and severe SNHL in comparison with groups of children with mild and moderate SNHL. This finding may explain the significant correlations detected between all of the pragmatic scores and average PTA and the average aided PTT in this study, thus reflecting the effect of the severity of HL on pragmatic abilities. Moreover, speech DSs showed significant positive correlations with both PLUI and PP scores and significant negative correlations with ORS scores. The severity of HL and poorer speech discrimination ability will affect the language outcome and consequently the social communication skills. This finding is supported by previous studies [36,37].

Significantly lower pragmatic skills were detected in male patients with HL compared with female patients. This could be based on the cultural factors/isolation and their effect on pragmatic skills in some Arabic societies with childhood sex segregation and power division by territory. Cultural isolation and marked sex separation with limited social interaction between both sexes may lead to some variable social and pragmatic responses especially when male patients are assessed by a female researcher. Prepubertal voice changes in some male patients [in this study 15 males (55.6%)] could also affect and limit their social interaction and pragmatic responses.

Conclusion

Children with HL had significantly lower pragmatic skills in comparison with NH children, with greater affection of male children and greater affection with increased severity of HL. Other factors worsening pragmatic impairment in children with HL include earlier HL, especially if compounded by delay in fitting of HA, thus increasing the duration of auditory deprivation. This higher susceptibility to pragmatic impairment in this category of children and the causative factors in children with HL, as well as the importance of pragmatic skills for further social communicative and academic careers, should be considered in their rehabilitative plan.

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Conflicts of interest

There are no conflicts of interest.

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