

Research Paper: The Effects of an Early Family-centered Tele-intervention on the Preverbal and Listening Skills of Deaf Children Under tow Years Old



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ABSTRACT

Objectives: Achieving optimal outcomes in deaf children's communication skills depends on the availability of early specialized high-quality intervention services. Early intervention services through teletext technology could respond to this need. The development of teletext technology has led to the creation of new formats for family-centered services. Such measures could address the hearing, speech, and language needs of young deaf children. This study aimed to investigate the effects of teleintervention for providing early interventions to the families of newborns and deaf children.

Methods: This was a quasi-experimental study with a pre-test/post-test and a control group design. In total, 30 deaf children aged 0-2 years, and their parents were selected by purposive sampling method. Then, they were randomly assigned to the experimental and control groups. The experimental group received the teleintervention program through the internet in 36 individual and group sessions (24 group sessions & 12 individual sessions). The control group received the same intervention program directly at the rehabilitation centers for deaf children. To investigate the hearing and pre-verbal skills, the Preverbal Communication Skills Scale and the Listening Skills Scale were used. The obtained data were analyzed using Analysis of Covariance (ANCOVA).

Results: The provided teleintervention program was effective in increasing the scores of hearing and pre-verbal skills in the studied samples. The intensity of the effect on hearing and pre-verbal skills were 0.57 and 0.28, respectively.

Discussion: The present study demonstrated the effect of teleintervention program on hearing and pre-verbal skills in the explored subjects. It also indicated that the provided teleintervention was more effective than direct intervention. Therefore, implementing this program is recommended for therapists, the parents of deaf children, and rehabilitation centers for this population.

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Highlights

- Tele-intervention was an effective communication approach; thus, it could be a valuable solution to typical barriers, such as distance and the shortage of trained interventionists for deaf children.

Plain Language Summary

Parents believe that it is convenient to have the sessions in their homes, as it helps to reduce travel time and expenses. Besides, their children interact more comfortably in their own homes. They find it a more beneficial experience for them and their children.

1. Introduction

Considering the importance of early years of life in obtaining speech and language skills, early diagnosis and intervention for deafness have attracted great interest. Hearing screening and early diagnosis programs include three major parts; neonatal screening, diagnostic assessment, and early intervention. Furthermore, the national Early Hearing Detection and Intervention (EHDI) 1-3-6 goals state that all newborns are screened for hearing before the age of one month. Besides, by the age of three months, the final diagnosis should be confirmed, and deaf children receive early intervention programs before the age of 6 months. This trend is recognized as the 1-3-6 process [1].

The advancement of technology for the diagnosis of the deafness in early postpartum period has led to an increase in the population of deaf infants and children. Early diagnosis with advanced hearing-related technology (e.g. cochlear implant & hearing aids) and employing early interventions effectively in improved deafness outcomes [2]. However, accessing professionals in this field is key to improve the outcomes in these children. In addition to the number of children diagnosed with hearing impairment, most families have to choose a communication approach for their children. 80%-90% of families whose children are identified with hearing impairment choose the expressive and received language communicative approach if available [3]. However, there is a lack of trained professionals to provide specialized services, including the development of hearing skills and technology, for the families who chose this communication approach [4].

Almost half of the children who receive no hearing screening at the time of birth are often not recruited. This is because of the difficulties of accessing hearing aids by them. It is even more challenging for the families living in villages or districts long distanced from experienced

hearing therapists. Numerous families require such services and have long distances to urban areas; however, there is a lack of trained specialists in this field. As a result, teleintervention sessions significantly affect early hearing services provision to deaf children's families. Tele-intervention, providing teleservices (through technology) is a promising trend of early intervention. Early intervention service, part c, was designed to support the special needs of deaf babies and to increase the capacity of families to strengthen their children's development [5]. Furthermore, reducing the age of diagnosis and intervention requires further attendance from parents in rehabilitation programs. The home is considered as the main location of the service provision; multiple programs introduced it as an essential pillar for providing services in a natural environment under the law for improving training individuals with disabilities [6].

The Individuals with Disabilities Education Act (IDEA) specifies that these services should be family-based. Besides, families should be strongly involved in determining the objectives and implementation of the intervention. Parental information requirements also affected their parenting styles [7]. The role of the provider, as a "mentor" to support the families of children with disabilities, is an essential part of family-based services; it creates more opportunities for child development through family-based activities in their daily routines [8]. Diagnosis and early intervention could generate deaf children's interaction with surroundings in a natural process through voice reception. Moreover, children's hearing and verbal responses provide appropriate feedback for adults to continue the natural pattern of communication [9].

Tele-intervention refers to employing telecommunication technology to address speech-related pathologies. The professional tele-audiovisual services provided by connecting a specialist to a client to assess, intervene and provide consultation [10].

Peterson et al. indicated that this education pattern requires a partnership in which the role of parents, as a person who knows the interests of his/her child better than the others, is emphasized [11]. Justic and Vakelich argued that the quality of parent-child interaction is the most essential part of education and most relevant to the child's progress [12]. Swanepoel and Hall signified the possibility of screening, diagnosis, and hearing teleintervention in different ages and patient populations [13]. McCarthy et al. reported that family satisfaction and strong contributors lead to increased participation and the use of parents' coaching curriculum and reduced session cancellation in teleinterventions [14]. Behl et al. demonstrated that teleintervention was associated with more access to specialized services (e.g. audioverbal therapy), increased flexibility, and reduced travel for families [15].

Cason indicated that the potential benefits of teleintervention and service delivery models with the Office of Special Education Programs (OSEP) function indicators are placed in moderate level; such measures illustrate the positive impact of approving this service model for states to overcome personnel shortages and increase demand for early services [16]. Olsen et al. suggested that education (i.e. manners to talk with parents, listen to the parents' comments, prove activities & communication- facilitating strategies & feedback) is considerably performed during VHV's, compared to the face-to-face conventional home visits [17].

Constantinescu compared children who received audioverbal therapy with those who participated in conventional visits. Their obtained data revealed the same results in speech and language assessment in both groups [18]. Hamren and Quigley stated that parent coaching is a central component of this service delivery model, as the format of teleintervention necessitates parents' active participation [19]. Blaiser et al. conducted a randomized study on 27 families, infants, and toddlers with hearing impairments. They concluded that expressive language scores significantly improved in the teleintervention group.

Concerning the received language and family results, they received similar scores to the presence group. In addition, the study revealed that family interaction significantly increased the effects of the teleintervention group intervention [20]. Howston et al. revealed that during teleintervention sessions, parents learn to be the first facilitator of communication, language, and behavior of the child [21]. Behl et al. (performed a randomized study on 48 children and their families. Accordingly, they argued that the scores of received language, the standard general lan-

guage scores, and other language scores were significantly higher in these subjects, compared to the home visit group.

Moreover, the teleintervention group received higher scores in terms of responding to the provider and parental involvement, compared to the home visit group [22]. The American Association for Speech, Language, and Hearing (ASHA) provides a teleintervention group that offers high-quality telemedicine services. The acceptance of the telemedicine delivery model is evident, especially in speech therapies.

There are no studies on teleintervention in Iran. Teleintervention could be used to overcome existing barriers in Iran. Such matters include the shortage of trained early-intervention providers and the high costs of delivering services to geographically-dispersed families of children with hearing loss. The present study aimed to investigate the effects of early family-centered teleinterventions on the hearing and verbal skills of under tow Years old hearing-impaired children.

2. Methods

This was a quasi-experimental study with a pre-test/post-test and a control group design. The statistical population of the study consisted of all mothers and their deaf children under the age of tow Years from all over the country. Based on the experimental design, 30 children with mild to severe deafness who used a hearing aid or a cochlear implant were randomly selected from a Telegram group of 200 individuals, including the mothers of deaf children. Then, they were assigned to the experimental and control groups by a purposive sampling approach.

To conduct the research, a pre-test was performed for both study groups. Through the Telegram, the Little EARS Auditory Questionnaire and Preverbal Communication Skills Scale were provided to the parents. Moreover, responding instructions were explained to them through the Telegram application. LEAQ reflects the main milestones of preverbal auditory behavior. The three major areas of preverbal auditory development are reception, understanding and adequate response, and the vocal-verbal production of linguistic stimuli. These basic domains, receptive, and semantic auditory behavior and expressive-vocal behavior were considered in the questionnaire [23].

The Pre-Verbal Skills Questionnaire was designed by Azizi and Hassanzadeh, according to the paper by Heinz (2005) as well as PVCS. The questionnaire consists of

27 questions that measure 4 skills; pointing, joint attention, turn-taking and imitation, and asking parents about children's questions.

Then, by contacting through IMO application, the child was evaluated by questionnaires and examined more precisely. The study inclusion criteria were the confirmation of severe deafness, the full-time use of hearing aids or cochlear implant prostheses, the age of <2 years, and access to the internet and IMO and Telegram applications.

The experimental group subjects received an aural-verbal rehabilitation program and preverbal skills through telecommunications, via the IMO and Telegram applications. The control group received the same intervention directly in the deaf children's rehabilitation centers. After completing the sessions, a post-test was performed for both research groups.

From April 2017, the parents in the experimental group received complete information regarding the hearing-impaired children's counseling. They received 24 group sessions by Telegram; then, during 12 weekly individual sessions and according to the children's impairment level, preverbal skills to strengthen joint attention, pointing, turn-taking, and imitation; auditory rehabilitation using avt method in hearing skills, receptive language, expressive language, and speech programs were provided to them through Telegram and IMO. Initially, the exact time of the IMO connection was coordinated with the mothers through Telegram.

The means of providing interventions to achieve speech and language and hearing skills (e.g. toys, books, voice recorders, etc.) were reminded to the mother through Telegram to provide them during the intervention session. Moreover, the objectives planned for each session were sent to the mother via telegram before IMO calling. The IMO connection was held weekly and for 45 to 60 minutes. Accordingly, the parental therapist observed the parents; the parents observed the therapist during modeling a solution.

The investigated parents could exhibit their new skills. Besides, during the session, the essential events and the changes required to achieve the goals of the intervention were explained to parents. Moreover, audit and linguistic goals were virtually taught to the parents. Following the activities of each session, the mother was given adequate time to express concerns about the child's progress and her problems. The control group received the same training except that they received a clinic-based conventional intervention once per week (conventional face to face visits in the clinic).

After each IMO contact, the goals and facilitating solutions modeled and trained during the session were summarized for the parents in Telegram. Furthermore, the tasks for the week were reminded to them. In the following week, new communication objectives were expressed in proportion to the level of the child's progress and function. According to the study design, the collected data were analyzed in SPSS using Analysis of Covariances (ANCOVA).

3. Results

To analyze the obtained data and respond the research questions, Independent Samples t-test (to examine the homogeneity of variances in the experimental and control groups at the pre-test stage), and one-way ANCOVA (to evaluate the effectiveness of early family-centered teleinterventions on the hearing and preverbal skills of deaf children) were used.

Emphasizing the obtained F-values, there was a significant relationship between the dependent variable (hearing skills) and the co-variance variable (pre-test) at the level of 0.01. Therefore, considering that the significant effect of the pre-test variables is of co-variance nature and is referred to as the control variable, the effects of the pilot variable of early family-centered teleinterventions, as a source of change, could be emphasized.

Ultimately, F-value equaled 36.05 in the source of the changes for identifying the effects of early family-centered

Table 1. One-way ANCOVA results associated with the effects of early tele family-based interventions on deaf children's hearing skills

Changes Source	Total Squares	df	Mean Squares	F	P	Effect Severity
Pe-test	2817.50	1	2817.50	177.80	0.001	
Group	571.37	1	571.37	36.05	0.001	0.57
Error	427.83	27	15.84			
Total	21207	30				

Table 2. One-way ANCOVA data concerning the effects of early family-based teleinterventions

Changes Source	Total Squares	df	Mean Squares	F	P	Effect Severity
Pre-test	221.64	1	221.64	42	0.001	
Group	55.97	1	55.97	10.60	0.003	0.28
Error	142.48	27	5.27			
Total	18626	30				

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teleinterventions on hearing skills in the explored deaf children at a significance level of 0.01; thus, early-stage family-centered teleinterventions were effective in improving the hearing skills of these children. The intensity of the effect was measured as 0.57 (Table 1); therefore, the effect of early-stage family-based teleinterventions was optimal on the hearing skills of the deaf children.

Emphasizing the obtained F-values, a significant relationship was found between the dependent variable (pre-verbal skills) and the co-variance variable (pre-test) at the level of 0.01. Therefore, considering that the significant effect of the pre-test variables is of co-variance nature and is referred to as the control variable, the effects of the experimental variable of early family-centered teleinterventions as a source of change, could be emphasized.

Eventually, considering that $F=10.60$ in the source of the changes, identifying the effects of early family-centered teleinterventions on the preverbal skills of the deaf children at $\alpha=0.01$ specifies that such interventions were effective in the preverbal skills of the explored deaf children. The intensity of the effect was calculated as 0.28 (Table 2); thus, the effect of early-stage family-based teleinterventions was optimal on the preverbal skills of the investigated deaf children.

4. Discussion

This study was conducted based on the hypothesis that early family-centered teleintervention is effective in the hearing skills of deaf children. The obtained data indicated that in families and children who receive telemedicine services, the impact of teleinterventions is optimal and significant on the deaf children's hearing skills. This finding corresponds to the results of studies on the effectiveness of teleintervention on the hearing skills of deaf children. It is also consistent with the results of several teleintervention studies [7, 9, 11, 12, 19, 21, 22].

Deafness is associated with characteristics, such as the age of hearing impairment and the age of diagnosis and intervention. Timely diagnosis and the use of hearing aids or cochlear implantation merely fail to improve the communication and language skills of deaf children. Besides, these children are unable to acquire hearing and speech skills without receiving training in the natural growth process. Accurate diagnosis and early interventions could provide the possibility of deaf children's interaction with surroundings in a natural process through voice reception. Furthermore, children's hearing and verbal responses provide appropriate feedback for adults to continue the natural pattern of interaction and communication.

This finding was consistent with those reported by Tait and associates [9]. In humans, there is a certain period in which brain capacity is maximized for hearing growth; if there are sufficient hearing stimuli at this stage, the development of hearing skills, and consequently, the acquisition of language occurs naturally. Additionally, the literature does not deny the role of the environment in the development of language and speech; proper social interactions seem necessary for language acquisition. Children's social behaviors could also be effective in language learning.

The parents of hearing-impaired children require extensive information about hearing loss. The present research results were in line with those of Movallali and Lotfi's research on the difficulties in the parenting of hearing-impaired children [7]. Parenting education is an essential part of providing services since teleintervention requires parental involvement. During teleintervention sessions, parents learn to be the first facilitator of communication, language, and behavior of the child. These results were consistent with those of Houston et al. on providing telepractice to improve deaf children's conditions [21]. Although an expert is not in the room with the child and cannot take control of the session; through

teleintervention, it is almost impossible for parents to passively watch an expert interacts with a child [19].

The current research results were similar to the conclusions regarding telemedicine by Justice and Vukelich. They reported that the specialist should establish a cooperative relationship with the parents and allow the formation of an educational relationship [12]. The specialist, through an educational relationship with the reinforcement of hearing and verbal language goals during game-related activities, increases the parents' self-esteem and interactive skills. With the growth in self-esteem among parents, the same hearing and speech strategies should be included in a child's daily routines. For example, parents could learn to provide a language model for their child during a baking activity and develop linguistic skills in them. By enhancing the vocabulary and language goals during these routine activities at home, parents' skills become usual to them and could be easily used in other common activities, such as bathing, dressing, or setting a dinner table. This education pattern requires a partnership in which the role of parents, as individuals who recognize the interests of their child better than the others is emphasized. This was reported previously by Peterson and associates [11].

The present research explained the effects of early family-based teleintervention on the preverbal skills of hearing-impaired under 2-year-olds. The collected data indicated the moderate and significant effect of the provided program on the studied subjects. In this study, strategies for increasing joint attention skills, pointing, vocal and motion imitation, turn-taking, and the babblings of children were taught to the parents. Accordingly, the knowledge of families was increased regarding preverbal skills and their necessity. Furthermore, enhancing the parent-child interaction strengthened preverbal skills. Generating preverbal and hearing skills in neonates is the basis for the development of expression and received language in a semantic context.

As the hearing system develops, the baby's voice becomes more rhythmic and combines different frequencies, i.e. to some extent similar to those of the mother's voice. In addition, babbling is a suprasegmental component of speech. They are based on maternal language and imitated to phonological information and speech rhythm. It is also among the most critical predictors of language and speech development. In hearing-impaired children, the babbling appears with significant delay and different quality, compared to their healthy counterparts. It is therefore ideal that the hearing-loss children be identified at this pre-verbal stage. A language is a com-

munication tool whose primary basis is revealed in non-verbal development and preverbal skills. The preverbal communication system, as the prerequisite for the development of spoken language, has a social nature and aims at communicating with others; it is formed in the child-adult interaction in the early years of the child's life.

The parent-child relationship influences on pre-communication skills [24]. The child needs to classify the environmental stimuli and adjust his/her responses, accordingly. Parents, through voicing and nonverbal behaviors, reinforce the sounds produced by the baby. They act as a mirror against the gestures and sounds produced by their infants and reinforce them; thus, the child becomes aware of his/her nature through the same daily activities and a basis for future communication is provided.

In this study, the sample size was sufficient for experimental studies; however, a larger sample size increases the statistical power and the possibility of generalizing the results. Some families in this study had no appropriate IMO connection and only received services through Telegram. Hearing screening, diagnosis, and successful intervention programs that represent integrated care systems are rapidly developing in Iran [25]. Therefore, further research on teleintervention is recommended for those involved in the common treatment plans in Iran. Besides, we have to plan for the development of such an intervention in the country. It is recommended to use this method for children with the cochlear implant prosthesis needing rehabilitation and living in deprived areas.

5. Conclusion

The present study indicated that teleintervention could be an effective method for providing successful services to support deaf children who are learning spoken language. The obtained linguistic results acquired by the children were following the criteria of progress and overtaking them. Besides, the teleintervention program indicated better results, compared to the presented direct intervention in the clinic. Moreover, parents became more confident in their role as the first facilitator of language. In this study, the proposed effective early intervention was optimal in terms of costs and time; accordingly, it could be a practical approach to strengthen the parts c system in providing services to families with young hearing-impaired children. Tele-intervention approaches are useful for deaf or hearing-impaired children and families who encounter the challenge of providing appropriate services by qualified service providers. Moreover, speech therapists and audiologists could use teleintervention techniques to rehabilitate deaf children.

Ethical Considerations

Compliance with ethical guidelines

All ethical principles are considered in this article.

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Authors' contributions

All authors Contributed in preparing this article.

Conflict of interest

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