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Evaluation of The Effectiveness of Newborn Hearing Screening Program: A Center in Turkey*

Abstract

The present study aimed to analyze the effects of newborn hearing screening program in Turkey based on the age of diagnosis, amplification and initiation of education between 2000 and 2017. The study was designed as a retrospective study. The files of 997 children registered with a research and education center for children with hearing loss were analyzed. The findings indicated that the age of diagnosis, amplification and initiation of education significantly decreased after the national newborn hearing screening program was introduced throughout the years. However, the recommended universal standards were achieved only for a minority of children in terms of timely diagnosis and early intervention. Delay in amplification mostly observed in children with mild-moderate loses and late diagnosis, was found as related to the testing in more than two different clinics. The findings on late initiation of education were discussed based on the reports in relevant literature and monitoring problems after the diagnosis and the problems observed in early education system in Turkey.

Keywords: newborn hearing screening, age of the diagnosis, intervention age, obstacles to early intervention, loss to follow-up

Introduction

Hearing is the most effective modality for the development of spoken language, literacy and cognitive skills (Cole & Flexer, 2019; Moeller et al., 2013). Any type or any degree of congenital Hearing Loss (HL) in infancy or childhood could interfere with the development of a child's spoken language, reading and writing skills, and academic performance (Cole & Flexer, 2019), leading to further problems in adulthood such as low life satisfaction and limited job opportunities (Perkins et.al., 2015). Timely diagnosis and intervention could prevent these adverse effects of HL, leading to significantly better outcomes in language development when compared to delayed cases (Ching, 2015; Kasai et al., 2012**;** Sugaya et al., 2015) and reduces social costs in the long term (Burke, Shenton & Taylor, 2012; Chen et al., 2017). It was demonstrated that children with early intervention initiated in the first twelve months of life exhibited higher language scores when compared to those who received intervention at a later period. Moeller (2000), in her classic study on 112 five-year-old Nebraska children with only HL and no additional disabilities, found that the age of initiation of the intervention predicted 55.5% of the variance in

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language outcome. Similarly, the study conducted on Nebraska and Colorado Home Intervention Program demonstrated that the age of the first intervention (11.4%), level of parental involvement (35.2%), and nonverbal intelligence (2.5%) significantly predicted language outcome at five years-of-age (Yoshinago-Itano, 2003).). Recent studies confirmed these findings. Kasai, et al. (2012) reported a significant correlation between early education and language development among Japanese children with severe to profound HL. They also showed that participation in Newborn Hearing Screening Program (NHSP) and an early diagnosis may contribute to better language development to some extent, however this effect was not statistically significant. However, NHSP was significantly associated with early intervention. On the other hand, Sugaya et al. (2015) emphasized the importance of early amplification in their study. They demonstrated that use of hearing aids before the cochlear implantation significantly associated with the increase in language scores of school age children.

Considering the significance of early hearing aid fitting and initiation of education in the development of children with HL, newborn hearing screening became a regular practice in several countries during the 1990s and early 2000s to ensure timely diagnosis and intervention (Aurelio & Tochetto, 2010; Nikolopoulos, 2015), and the Joint Committee on Infant Hearing (JCIH) described the steps in a successful NHSP as follows: a) the newborn hearing tests should be conducted before the hospital discharge, b) HL should be confirmed within three months after birth, and c) the child should be fitted with hearing aids and start a family-oriented education program when the child is six months old or earlier (JCIH, 2007). Based on the criteria established by JCIH, NHSP implementation reduced the age of diagnosis to three months or younger in most developed countries and decreased the initiation of education to earlier than six months (Uhler, Thomson, Cyr, Gabbard &Yoshinaga-Itano, 2014; Percy-Smith et al., 2018). In the pre-NHSP period, the mean diagnosis age varied between two years six months and three years in European Union countries and North America (Harrison, Roush & Wallace, 2003; Yoshinaga-Itano, 2003). In developing countries, the conditions were even more critical; the diagnosis age ranged between two and seven years (Özcebe, Sevinç & Belgin, 2005; Jeddi, Jafari & Zarandy, 2012; Lin, Shu, Chang & Bruna, 2002).

Similar to other countries, NHSP became widespread in Turkey during 2000s. The first NHSP was initiated at Marmara University as a pilot project in 1999 and gradually transformed into a national program on December 2004 (Kemaloğlu, 2015). It was reported that by 2016, 98% of the newborns were screened throughout the country in 1000 screening centers (Kemaloğlu, 2018) and 61 reference centers were established for diagnosis (Külekçi-Uğur, 2018). Various centers reported significant decreases in diagnosis age (Vehapoğlu-Türkmen et al., 2013; Yılmazer et al., 2016), however the data on the age of amplification and initiation of education in the early intervention program have been limited in Turkey (Turan, 2018). Kemaloğlu et al. (2016) discussed Gazi Hospital findings and implied that there were delays in NHSP implementation in Turkey when compared to universal standards. Although a decrease was observed in age of diagnosis after the implementation of national NHSP, the data obtained in the above-mentioned study indicated that only 32% of the infants were diagnosed before they were 6 months old and hearing aid fitting was conducted after a delay of several months. Therefore, he questioned the efficiency of the NHSP based on the delay in amplification and initiation of education. On the other hand, certain other centers reported more optimistic findings. Şahlı (2018) reported that the mean diagnosis age was 5.8 months and the age of initiation of education was 6.7 months at Hacettepe University. Similarly, data collected in Istanbul Education and Research Hospital during the December 2010-March 2012 period indicated that the mean diagnosis age varied between 2.7 and 7.4 months for 86 infants and their intervention age varied between 3.8 and 9.6 months (Vehapoğlu-Türkmen et al., 2013). However, it should be noted that 70% of this population included infants under risk, which were usually diagnosed early due to potential risk factors (Dalzell et al., 2000). Similarly, the findings in Bakırköy Dr. Sami Konuk Education and Research Hospital demonstrated that the mean diagnosis age was 6.1 months, mean age of hearing aid fitting was 9.5 months for 53 infants diagnosed between December 2009 and August 2011 (Yılmazer et al., 2016). Only a few studies that explained the delay in diagnosis and the problems encountered in the screening program were conducted in Turkey. These studies reported a need for a more effective follow-up system in the NHSP (Kemaloğlu et al., 2016; Baş, Turan & Uzuner, 2019), and there were shortages for qualified personnel who could clearly and actively explain the findings to the parents (Özcebe, Sevinç & Belgin, 2005; Vehapoğlu-Türkmen et al., 2013) and work with the parents of infants with HL (Altınyay & Ertük, 2012).

Further data were required to analyze the effects of NHSP, to provide information about the current situation in Turkey, and to discuss the possible causes of late intervention in order to plan better services for infants with HL and their families. Thus, the present study aimed to identify the mean diagnosis, amplification and initiation of education ages between 2000 and 2017 in a group of children who were enrolled at an education and research center for children with HL, to compare the findings and quality indicators proposed by JCIH (2007), and to discuss the implications and effectiveness of NHSP in Turkey. The research questions were determined as follows:

1. What are the mean ages of diagnosis, hearing aid fitting, and initiation of education pre- and post- NHSP era at the research and education center for children with HL?
2. Are there significant decreases on the mean ages of diagnosis, hearing aid fitting and initiation of education after the implementation of the NHSP across the years?
3. What is the efficiency of NHSP in the investigated population?

Method

The study was designed as a retrospective case-control study. A retrospective study is conducted *a posteriori* with the event data that have taken place in the past. The cases with and without the condition of interest are identified and compared. In most cases, some or most of the data has already been collected and stored in a registry (Hess, 2004). A retrospective case-control design was preferred in the present study, since it aimed to analyse the impact of NHSP, which has already been initiated, and to compare the ages of diagnosis, amplification and education before and after implementation of NHSP. Furthermore, the study also aimed to analyse the differences between the registered cases based on regular and irregular attendance in the early intervention program.

Data Collection and Selection of the Cases

The data were collected in an education and research center for children with HL operated by a university in Turkey. The center serves as a day school for children with HL and has adopted an early intervention program. All files of the infants and children registered in the education center between 2000 and 2017 were included in the study. A total of 1230 registry files were accessed. In the first step, all files were analyzed based on diagnostic information. 237 (19.2%) files, which had no information on the hearing status of the child were excluded from the study. Remaining 997 files were classified based on the year to observe the short and long-term effects of NHSP: 2000-2004 (pre-NHSP); 2005-2009 (initial five years of implementation) and 2010-2017 (last eight years of implementation). In the second step, the remaining files were classified based on the availability of complete information on age of diagnosis, amplification and initiation of education. It was found that 397 (39.8%) files had incomplete information on diagnosis, amplification or initiation of education ages. These children only visited the research clinic for tests or hearing aid/implant fitting for a couple of times and missed the follow-up appointments. In the final step, the files were classified into two groups. The first group (GR1) included 600 files that included diagnosis, hearing aid fitting and initiation of education age information. The second group (GR2) included 397 files with missing information on any of the above-mentioned parameters or irregular attendance. GR1 and GR2 were compared to determine the differences between the ages of diagnosis, amplification and initiation of education, and to gain insight about the factors which may be associated with irregular attendance or unattendance in the follow-up sessions.

The data on the degree of HL, type of the HL, additional disabilities, possible cause of the HL, number of clinics attended, and the regions where the children resided during the diagnosis and intervention processes were also collected from the files where they were available. The correlations between these factors and the diagnosis, amplification and initiation of education ages were determined to identify whether there were any correlations between these variables that would explain the delayed cases.

Analysis of the Data

One-way ANOVA was used to compare mean diagnosis, amplification and initiation of education ages across the years for the whole group, GR1 and GR2 groups. Mann-Whithey U test was used for the comparison of GR1 and GR2 since the data were not normally distributed. The effect sizes were calculated and analyzed as described by Cohen (1988).

Results

The descriptive data on GR1, GR2 and group totals are presented in Table 1. As seen in Table 1, most subjects had sensorineural HL. The cause of HL was mostly genetic, the degree of HL was primarily severe to profound, and most subjects came from Central Anatolia and western part of Turkey. The ratio of additional disabilities was similar in both groups. Certain subjects visited several clinics until the diagnosis or amplification.

In Table 2, mean subject age at diagnosis, amplification and initiation of education is presented. The year ranges were categorized as *Group a* for 2000-2004, *Group b* for 2005-2009 and *Group c* for 2010-2017 for clearer representation of the data. As seen in Table 2, all variables decreased throughout the years of analysis.

One-way ANOVA was used for comparison of the means. As seen in Table 3, the differences were significant between the years for all variables. Large effect sizes were observed (Cohen, 1988), indicating newborn hearing screening test as an effective intervention method.

Post hoc Bonferroni multiple comparison tests indicated that the decreases in all variables were statistically significant between the groups at .000 level of significance.

Table 1.
General Descriptive Data for GR1, GR2 and the Whole Group

	GR1		GR2		Total	
	n	%	n	%	n	%
Severe/Profound hearing loss	485	80.8	214	53.8	699	70.1
Sensorineural hearing loss	548	91.3	356	89.4	904	90
Genetic causes of deafness*	246	41	170	42.7	416	41.7
Causes other than genetics**	103	17.1	88	22.1	191	19.1
Unknown causes	251	41.8	139	34.9	390	39.1
Additional disabilities	112	18.7	86	21.6	198	19.8
Residence area						
Central Anatolia	207	34.5	123	30.9	330	33.9
Agean	176	29.3	108	27.1	284	28.4
Marmara	158	26.3	84	21.1	242	24.2
Others	59	9.8	82	20.9	142	14.2
Attended clinics until diagnosis						
Less or equal to 2	531	88.5	288	72.4	819	82.1
More than 2	68	11.3	74	18.6	115	11.5
Unknown	1	0.2	36	9	31	3.7

Note.*=syndromes, high incidence of deafness in family history, reports indicating genetics, first cousin marriages with story of deafness in the family were classified as possible genetic causes.
Note.**=low birth weight, neonatal hyperbilirubinemia, ototoxic medication, infections (cmv, meningitis), intrauterine infections (herpes), severe hypoxia, convulsions were classified as causes other than genetics.

Table 2.
Mean Ages for Diagnosis, Amplification and Initiation of Education Across the Years for the Whole Group

	Diagnosis			Amplification			Initiation of Education		
Year Groups	n	x̄	SD	n	x̄	SD	n	x̄	SD
Group a	386	30.75*	24.81	342	35.37*	25.28	202	33.09*	19.07
Group b	313	21.62*	19.57	289	24.44*	18.90	194	23.32*	14.88
Group c	284	10.14*	12.14	272	13.62*	13.27	206	14.05*	10.92

Note.*=Age in months.

Findings related to GR1

The changes observed in diagnosis, amplification and initiation of education across the years for GR1 which included subjects with complete information are presented in Table 4. As seen in Table 4, decrease in mean ages and standard deviation were observed in all variables.

One-way ANOVA was conducted to compare the mean ages based on the year intervals. As seen in Table 5, the differences were statistically significant with large effect sizes for all variables (Cohen, 1988). Post hoc Bonferroni multiple comparison tests indicated that decreases were statistically significant in all variables between the groups (group a, group b, group c) at .000 level of significance.

Although the decrease was significant across the years; it should be noted that in Table 4 that the mean ages for diagnosis, amplification and initiation of education were still higher when compared to the ages recommended by JCIH even in the 2010-2017 period. Thus, we calculated the ratio of children who were in the recommended age range for the study variables.

Table 6 demonstrates the ratio of children who were diagnosed, amplified and initiated education at ages recommended by JCIH (2007) in GR1. The findings indicated that only a small group of children were diagnosed before they were 3 months old, fitted with hearing aids and started education before they were 6 months old even in the Group c, where long term effects should be observed.

Findings related to GR2

Table 7 demonstrates the data from the GR2 with incomplete information. Decreases were observed in all mean ages across the years in GR2 as well. Mean initiation of education age was not calculated in GR2 due to extensive missing data.

Table 3.

Comparison of the Mean Ages of Diagnosis, Amplification, Initiation of Education and Implantation Across the Years for the Whole Group

		Sum of squares	df	Mean square	F	*p*	n^2
Diagnosis	Between Groups	69542,98	2	34771,448	85,558	.000	.14
	Within Groups	398282,26	980	406,410			
	Total	467825,24	982				
Amplification	Between Groups	71961,65	2	35980,823	87,839	.000	.16
	Within Groups	368658,50	900	409,621			
	Total	440620,15	900				
Initiation of Education	Between Groups	36998,37	2	18499,186	78,920	.000	.20
	Within Groups	140408,91	599	234.406			
	Total	177407,28	601				

Table 4.

Mean Ages for Diagnosis, Amplification, Initiation of Education and Implantation for GR1 Across the Years

	Diagnosis			Amplification			Initiation of Education		
Year Groups	n	x̄	SD	n	x̄	SD	n	x̄	SD
Group a	201	22.28*	16.4	200	27.8*	18.62	202	33.09*	19.17
Group b	194	15.49*	12.45	194	18.79*	13.44	194	23.32*	14.88
Group c	205	7.68*	7.72	205	10.55*	9.19	206	14.05*	10.92

Note**:***=Age in months.

Table 5.

Comparison of The Mean Ages of Diagnosis, Amplification and Initiation of Education Across the Years for GR1

		Sum of squares	df	Mean square	F	*p*	n^2
Diagnosis	Between Groups	21665,126	2	10832,563	67,399	.000	.18
	Within Groups	95951,268	597	406,410			
	Total	117616,393	599				
Amplification	Between Groups	30111,658	2	15055,829	74,053	.000	.19
	Within Groups	121173,06	596	203,311			
	Total	151284,718	598				
Initiation of Education	Between Groups	36951,023	2	18475,511	78,570	.000	.20
	Within Groups	140383,602	597	235,148			
	Total	177334,625	599				

Table 6.
Ratio of Children Who Were Diagnosed, Amplified and Initiation of Education at Recommended Ages in GR1

Groups	Group a		Group b		Group c	
	n	%	n	%	n	%
Diagnosis at/before 3 mth.	2	1	27	13.9	70	34.1
Amplification at/before 6 mth.	2	1	40	20.6	95	46.3
Initiation of education before/at 6 mth.	-	-	21	10.8	59	28.8

One-way ANOVA was conducted to compare the variables. As seen in Table 8, the differences were significant for all variables with a medium effect size for GR2 (Cohen, 1988). Post hoc Bonferroni multiple comparison test indicated that the difference was significant between the groups based on the age of diagnosis and amplification at .00 level of significance.

Table 9 indicates the ratio of children who were diagnosed and amplified within recommended standards in GR2. As seen in Table 9, only 22.1% of the children were diagnosed and 15.1% were amplified within recommended standards in Group c.

Mann-Whitney U test was conducted to compare GR1 and GR2 based on diagnosis and amplification. Non-parametric Mann-Whitney U test was preferred in group comparisons since the data were not distributed normally and the number of participants in certain groups were small.

As seen in Table 10, the children in GR2 were diagnosed and fitted with hearing aids significantly later when compared to the children in GR1 across the years. The factors such as the degree of HL, type of the HL, additional disabilities, possible cause of the HL, number of clinics attended, and the regions where the children lived were further analyzed to find whether there were any correlations between these variables and timely diagnosis, amplification and initiation of education.

Table 7.
Mean Ages for Diagnosis, Amplification, and Implantation in GR2 Across the Years

	Diagnosis			Amplification		
Year Groups	n	x̄	SD	n	x̄	SD
Group a	185	39.95*	28.84	142	46.03*	29.34
Group b	119	31.61*	24.43	95	35.97*	22.87
Group c	79	16.51*	17.93	67	23.01*	18.51

Note:*Age in months.

Table 8.
Comparison of The Mean Diagnosis and Amplification Across the Years in GR2

Mean age*		Sum of squares	df	Mean square	F	*p*	n^2
Diagnosis	Between Groups	30574,815	2	15287,408	23,363	.000	.10
	Within Groups	248648,746	380	654,339			
	Total	279223,561	382				
Amplification	Between Groups	24578,535	2	12289,267	19,144	.000	.11
	Within Groups	193223,778	301	641,939			
	Total	217802,313	303				

Note:*Age in months.

Table 9.
Mean Ratio of Children Who Were Diagnosed, Amplified, and Initiation of Education at Recommended Ages in GR2

Groups	Group a		Group b		Group c	
	n	%	n	%	n	%
Diagnosis at/before 3 mth.	3	1.6	4	3.3	19	22.1
Amplification at/before 6mth.	1	0.5	4	3.3	13	15.1

Table 10.
Comparison of GR1 and GR Findings

Groups	Group a		Group b		Group c	
	N	U**	N	U**	N	U**
Diagnosis age*	386	11630	313	6641	284	5713
Amplification age*	342	8335	289	4852,5	272	4005

Note:* Ages in months, **Mann-Whitney U significant at *p*≤0.001

The findings indicated that there was a significant correlation between the degree of HL and the amplification (r= -.144; p <0,001), implying late amplification in children with less severe losses. This finding was confirmed when the degree of HL was compared between GR1 and GR2. 81% and 53% of the children had severe to profound HL in GR1 and GR2, respectively. The difference between the GR1 and GR2 was significant (χ^2=84,42; p<0.001).

The same trend was observed between the number of clinics attended and age of diagnosis (r=.188, p<0.001). 88.5% of children were tested in one or two reference centers in GR1 and remaining 11.5% visited several other clinics. On the other hand, 72% of children were tested in less than two different centers in GR2 and 28% were tested more than two different clinics. The difference between the groups was significant (χ^2=67,33; p<0.001). No significant correlations were determined among other variables.

Discussion

The present study findings indicated a significant trend towards earlier identification of HL, amplification and initiation of education across the years after implementation of NHSP. This finding was consistent with previous studies (Al-Sayed & Al-Sanosi, 2017; Aras-Öztürk et al., 2018; Bruijnzeel et al., 2017; Wasser, Roth, Herzberg, Lerner-Geva & Rubin, 2019). Comparison of the year periods demonstrated significant decreases in the whole group, GR1 and GR2. However, younger ages were observed in GR1 where complete patient information was available for all variables.

Although the decrease was significant, the mean ages in all categories were still above the standards recommended by JCIH (2007). These findings were consistent with other studies conducted in Turkey (Aras-Öztürk et al., 2018; Konukseven et al., 2017; Yılmazer et al., 2016) and some other countries (Holte et al., 2012; Jeddi et al., 2012; Kasai et al., 2012; Saki et al., 2018; Wasser et al., 2019). The time gap between the diagnosis and initiation of education almost seven months in GR1 even during the 2010-2017 period, where long term results were expected. This finding was similar to the results reported by Kemaloğlu et al. (2016). It should also be noted that in all measures, the standard deviation was high, indicating large variations among the subjects.

To explain the late diagnosis, we correlated several factors. Significant correlations were determined between the degree of HL and amplification age, and between the diagnosis age and number of centers attended. Correlations between the degree of HL and late amplification and late diagnosis were reported in certain previous studies (Fitzpatrick et al., 2016; Langagne, Leveque, Schmidt & Chays, 2010; Spivak, Sokol, Auerbach & Gershkovich, 2009). Our findings were further supported by comparison of GR1 and GR2. In GR2, children were significantly diagnosed and amplified later. When the degree of HL was compared for groups, it was found that higher number of children had mild to moderate HL in GR2. Based on this finding, it might be suggested that special attention should be paid in following the infants with mild to moderate HL for timely diagnosis and amplification. Confirmation testing should be organized immediately after the first testing of Auditory Brainstem Responses (ABR).

Attending different centers for confirmation of the HL obviously delays the diagnosis age due to waiting for the available test appointments in busy clinics, cancellation of the appointments due to different reasons, in addition to longer time requirement for ABR in young infants. Conducting ABR takes more time in young infants since the test should be repeated more than twice to confirm the HL, thus obtaining results may take longer even in one center. When families moved from one clinic to another repeating the same procedure, this may require significantly longer time and may delay the diagnosis (Özcebe et al., 2005; Zeitlin, Auerbach, Mason, Spivak & Erdman, 2019).

Considering the fact that the screening program was established country-wide, the most significant finding in the present study was the low rate of the children who were initiated education before or when they were 6 months old. Similar studies indicated several factors that could affect directly the length of the period between the diagnosis and initiation of education. The referral of the children to education by the health sector, the difficulties in scheduling the testing time, and absence of the patients were reported as main reasons for the increase in the time between the diagnosis and the intervention (Krishnan & Hyfte, 2014; Rodrigues, Loiola-Barreiro, Pereira & Pomilio, 2015; McLean, Ware, Heussler, Harris & Beswick, 2019). Further research should be conducted to understand and explain the obstacles specific to Turkey, however clinical observations of the authors were consistent with previously reported findings that implied serious problems in the referral of the patients to education by the legal regulations, and the significant disorganization between the service providers (Baş et al., 2019; Kemaloğlu, 2015; Vehapoğlu-Türkmen et al., 2013). Studies that investigated the special education services in Turkey supported these observations (Diken et al., 2012; Kumaş & Sümer, 2018).

Diken et al., (2012) analyzed *Special Education Services Regulations* (2009) in Turkey. They indicated that although there was a legal background for planning, providing and monitoring early intervention, no model that leads parents to family-oriented education programs was developed after the diagnosis. Early intervention services were defined in the regulations (2005; 2009), but the scope and standards of these services –for whom, by whom and how these services would be provided- were not clearly specified (Diken et al., 2012; Kemaloğlu et al., 2016). Usually when a child is medically diagnosed with a disability, they are referred to Guidance and Research Centers (GRC), which are public centers operated by the Ministry of National Education (MoNE). GRCs are responsible for organizing and providing special education services in each province, city or town for educational diagnosis to place the children in adequate educational institutions. In case of HL, there are no educated personnel in GRC to work with infants and their parents. The parents usually are directed to private rehabilitation centers, which usually employ no specialized personnel to work with children with HL or their parents (Altınyay & Ertürk, 2012). These problems could be resolved by establishing educational units within the diagnosis/referral hospitals. (Fitzpatrick et al., 2008; Serin, Gürbüz, Keçik, İncesulu & Tekin 2011). However, certain regulations should be enacted to organize for the employment of the personnel by a different legal authority (i.e., MoNE) in health institutions.

Furthermore, problems in the post-screening follow-up system were also reported in several studies. When the family leaves the hospital with diagnosis, they drop out of the follow-up system, which makes it impossible to monitor the status of the children' current situation (Baş et al., 2019). Sometimes, families spend a long time due to bureaucracy before they actually obtain the hearing aids and they may prefer not to attend to the provided education (Diken et al., 2012). Moreover, medical personnel who diagnose the child at the hospital do not have adequate knowledge on early intervention programs and they could not counsel and support the family (Baş et al., 2019). Thus, the parents may visit several private special education centers and lose time until they find a facility that suits their needs after the diagnosis (Diken et al., 2012). Unfortunately, these factors negatively affect the educational opportunities of very young children with special needs and may also explain the late initiation of education age found in the present study despite nation-wide screening. All these findings were supported by studies conducted other countries (Barker, Hughes & Wake, 2013; Cavalcanti & Guerra, 2012; Huang et al., 2013).

Our findings also indicated that the children in GR2, did not attend regularly to their appointments and after a while, dropped out of the monitoring system of the center, where the present study was conducted. They might have possibly attended other centers for clinical follow up, however parental inconsistency may also explain certain delayed cases determined in the present study. It should also be remembered that there was a higher number of children with mild-moderate HL in GR2 when compared to GR1. It was more likely that the parents of the children with mild to moderate HL visited several clinics to confirm the HL and were reluctant to use hearing aids. The parents of children with less severe HL usually find it difficult to accept the disability since their behavioral observations were not consistent with the diagnosis (Holte et al., 2012; Langagne et al., 2010). Thus, it could be suggested that clinicians who work in the diagnostic process should be aware of the fact that children with mild to moderate HL are more likely drop from clinical follow up. The parents should be informed meticulously about the detrimental effects of HL even in mild to moderate cases (Zeitlin et al., 2019; Langagne et al., 2010).

The descriptive data indicated that most of our subjects were children with severe-profound sensorineural HL. This finding could be explained by the characteristics of the research center which was originally established as an education center for children with HL. The studies conducted in other facilities such as schools for inclusive education or referral centers may lead to different compositions in the degree and type of HL. It should also be noted that the times of diagnosis and amplification were not particularly delayed for children with additional disabilities in the present study. This might be related to the general delay with respect to JCIH standards (2007) for children with no additional disabilities. However, the group may be analyzed separately and more descriptively in further studies.

The major limitation of this study was the lack of parent Socio-Economic Status (SES) information, since this information was not included in the clinical files of the children. Although there is a study with contradicting findings (Saki et al., 2018), previous studies mainly reported that SES of the parents had a significant effect on diagnosis, amplification and initiation of education age (Gopal, Hugo & Louw, 2001; Jeddi et.al., 2012; Özcebe et.al., 2005). Future studies on SES of the parents may further enlighten the problems related to irregular follow-up and educational attendance. It should also be noted that the results of this study reflects only one center. More data from different centers are needed to reach an exclusive explanation for the current situation in country-wide.

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