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Regional differences of Turkey in risk factors of newborn hearing loss

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ABSTRACT

Objective: The aim of this study was to discover Turkish regional differences in the risk factors of newborn hearing loss.
Method: A multi-centered retrospective design was used. A total of 443 children, registered to the national newborn hearing screening programme, with bilateral hearing loss, from five different regions of Turkey, were evaluated in terms of the types of hearing loss, the degree of hearing loss, the types of risk factors, parental consanguinity, age at diagnosis and age of auditory intervention, respectively.
Results: There was no significant difference in the prevalence of hearing loss between regions ($\chi^2 = 3.210$, $P = 0.523$). Symmetric Sensorineural Hearing Loss (SSHL) was the most common type of HL in all regions (91.8%). Profound HL was the most common degree of HL in all regions (46.2%). There were statistically significant differences between regions in terms of types of HL ($\chi^2 = 14.151$, $P = 0.000$). As a total, 323 (72.9%) of subjects did not have any risk factors. There were statistically significant differences between regions in terms of the types of risk factors (pre, peri and post-natal) for SSNHL ($\chi^2 = 16.095$, $P = 0.000$). For all regions, the age of diagnosis was convenient with the JCIH criteria. However the age of hearing aid application was prolonged in some regions. There were statistically significant differences between regions in terms of the age of diagnosis ($\chi^2 = 93.570$, $P = 0.000$) and the age of auditory intervention ($\chi^2 = 47.323$, $P = 0.000$). The confounding effects of gender, age of diagnosis, age of hearing aids applications, HL in the family, types of risk factors for HL on SSNHL were detected.
Conclusion: To reach the goal of a high quality newborn hearing screening, there is a need to develop an evidence-based standard for follow up guideline. In addition, risk factors should be re-evaluated according to regional differences and all regions should take their own precautions according to their evidence based data.

1. Introduction

The National Newborn Hearing Screening Program (NNHSP) had first begun to be applied in Turkey in 1994. There are 950 hearing screening centers throughout the country with a screening rate of 93.4% [1] which is very close to the benchmark (95%) [3]. In Turkey, a three-stage screening protocol was implemented consisting of an initial screening with TEOAE followed by a second-stage screening, also with TEOAE, 1 or 2 weeks later. If a baby does not pass the second-stage screen, he/she was evaluated for diagnostic testing [2]. NNHSP is executed in three different types of hospitals which are distinguished depending on the available type of diagnostic

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equipment (1st, 2nd and 3rd centers). In the 3rd step center; it was aimed to diagnose at around 3 months of age, by electrophysiological and behavioral tests, and then hearing aid fitting and orientation training started. The number of births/year in Turkey is 1.290.000. Hearing loss occurs in 2–3 children per 1000 live births [1].

It is a crucial part of NNHSP to consider the risk factors of newborn hearing loss, given that deafness incidence is higher in children with risk factors, according to the recommendations of the Joint Committee of Infant Hearing (JCIH) [3].

The geographical regions of Turkey comprise seven regions, which are defined merely for geographic, demographic, and economic purposes. The seven official geographical regions are the Central Anatolia Region, the Black Sea Region, the Aegean Region, the Mediterranean Region, the Southeastern Anatolia Region, the Eastern Anatolia Region and the Marmara Region. Diversity in public health issues is observed due to the presence of 7 regions in Turkey.

In this study, the risk factors of newborn hearing loss by geographical regions were analyzed. It is aimed to reveal regional differences so that evidence-based precautions can be taken.

2. Materials and method

2.1. Subjects

A retrospective study design was used. In total 443 subjects from six, 3rd step centers in 5 different regions of Turkey were evaluated. These regions are as follows: 1) Central Anatolia Region, 2) Black Sea Region, 3) Aegean Region, 4) Mediterranean Region, 5) South-East Anatolia Region. Retrospectively examined data were derived from 443 children (238 male and 205 female) with bilateral hearing loss who registered at NNHSP between April 2004 and April 2011. The study was designed and performed according to the Declaration of Helsinki [4].

2.2. Procedure

Data provided from the archives of six referral tertiary audiology centers from five regions in Turkey. Data was including; types of hearing loss, the degree of hearing loss, parental consanguinity, risk factors for HL, age at diagnosis and age of auditory intervention. Types of HL other than SNHL is very rare, so, patients with HL other than SNHL were excluded. The risk factors for HL [3] were listed on Table 1. For easy understanding of the results, the detected risk factors were presented under the pre, peri and post-natal categories.

2.3. Statistical analysis

All statistical analysis was performed with the Statistical Package for the Social Sciences (SPSS) for Windows version 20.0 (IBM SPSS; Chicago, IL, USA). Chi–square analysis was used to analyze and compare the hearing screening performance between regions. Spearman correlation analysis was performed to find the correlation between the parameters (gender, age at diagnosis and hearing aid application, parental consanguinity, risk factors and SSNHL). To identify the most important confounding factors affecting SSNHL, Linear Regression Analysis was used. Statistical significance was determined to be a p-value of <0.05.

3. Results

In total, the data of 443 infants (238 male (54%) and 205 female (46%)) from 5 Turkish regions were evaluated. The gender of the subjects, types of HL, degree of HL and types of risk factors are summarized in Table 2.

There was no significant difference in the prevalence of hearing loss between regions ($\chi^2 = 3.210$, $P = 0.523$). There were no gender differences in the incidence of hearing loss between regions ($\chi^2 = 3.210$, $P = 0.523$). However, there were statistically significant differences between regions in terms of types of HL ($\chi^2 = 14.151$, $P = 0.000$). Symmetric Sensorineural Hearing Loss (SSHL) was the most common type of HL in all regions, especially in region 1 with a ratio of 95.6% and region 2 with a ratio of 94.8% (Fig. 1).

The difference between regions with regard to the degree of SSNHL was not significant ($\chi^2 = 2.533$, $P = 0.111$). The most detected degree of HL was profound and severe SSNHL with ratios of 46.2% and 22.3% respectively (see Table 2, Fig. 2).

There were statistically significant differences between regions in terms of the types of risk factors (pre, peri and post-natal) for SSNHL ($\boldsymbol{\chi^2} = 16.095$, $P = 0.000$). As a total, 323 (72.9%) of subjects did not have any risk factors. However, 42 (31.1%) subjects from region 1 had post-natal risk factors, 16 (13.8%). Subjects from region 2 had pre-natal risk factors, and 7 (28.0%) subjects from region 5 had peri-natal risk factors (see Table 2).

Risk factors under the categories of pre, peri and post-natal for HL are summarized in Table 3. The most common pre-natal risk factor was maternal diseases ($n = 18$), the most common peri-natal risk factor was premature delivery ($n = 18$) and the most common postnatal risk factor was Hyperbilirubinemia ($n = 34$).

Risk factors of familial hearing loss and parental consanguinity marriages (1st degree, 2nd degree and distant relatives) are shown in Table 4. There was not significant difference between regions in terms of familial hearing loss and parental consanguinity marriages ($\chi^2 = 0.889$, $P = 0.346$). There was not familial hearing loss for most of the subjects ($n = 314$). But if present, familial HL was observed in the highest rates in first degree relatives, (11.1% for region 1, 17.2% for region 2, 3.1% for region 3 and 25.7% for region 4). There was not significant difference between regions in terms of consanguinity marriages ($\chi^2 = 2.176$, $P = 0.014$). However the highest consanguinity marriages ratio was in region 4 (44.3%). The ratio for region 1 was 27.4%, for region 2 was 17.2% and for region 3 was 0.1%.

The age of diagnosis and the age of auditory intervention for children with hearing loss by regions is demonstrated in Table 5. There were statistically significant differences between regions in terms of the age of diagnosis ($\chi^2 = 93.570$, $P = 0.000$). The age of diagnosis for HL was between 0 and 3 months for 34.3% of infants, between 3 and 6 months for 29.1% of infants, between 6 months and 1 year for 25.5% of infants, between 1 and 2 years for 7.67% of infants and above 3 years for 1.13% of infants. In region 2, the age of diagnosis was 0–3 months with a ratio of 76.7% which is the highest value. There were significant differences between regions in terms of the age of auditory intervention ($\chi^2 = 47.323$, $P = 0.000$) (Table 5). As a total, the time for auditory intervention was commonly between 6 months and 1 year (26.5%), while 29.1% infant did not have any auditory intervention. In region 1, the time for auditory intervention was commonly between 3 and 6 months (45.1%); in region 2, the time for auditory intervention was commonly between 6 month and 1 year (43.1%); in region 3, the time for auditory intervention was commonly between 3 and 6 months (18.5%); in region 4, the time for auditory intervention was commonly between 3 and 6 months (28.5%); in region 5, there were no children who had auditory intervention (Table 5).

Familial HL, types of risk factors and parental consanguinity in relation to the degree of HL were evaluated for infants with SSNHL ($n = 385$) (Table 6). There was no significant difference between familial hearing loss and the degree of SSNHL ($\chi^2 = 0.630$, $P = 0.427$). (Table 6). There was no significant difference between the types of risk factors and the degree of SSNHL ($\chi^2 = 0.092$,