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# Prevalence of Hearing Loss in Babies Referred to Audiology Clinic of Al-Mawasat Hospital

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## Abstract

Background and Aim: Hearing loss (HL) significantly affects the development of speech, language and social relations, especially when it occurs before the stage of speech recognition, i.e. in childhood. Some children born with a hearing impairment (HI) have risk factors for hearing loss, while others do not have any. Nevertheless, it is not easily noticed.

The aim of this study was to estimate the prevalence of hearing loss in babies with hearing loss or lack of language development according to parent complaint and to find the contribution of each of the known risk factors to the occurrence of hearing loss at audiology clinic of Al-Mawasat Hospital-Syria.

Methods: This cross-sectional and retrospective Clinical study was conducted in the audiology clinic at Al-Mouwasat University Hospital-Syria. Babies with Hearing loss complaint or lack of language development underwent a two-step protocol using Otoacoustic Emission (OAE) and Auditory Brainstem Responses (ABR). Babies 1-18 months old who referred in OAE completed a diagnostic test using (ABR).

Result: Out of the 520 babies , 83 (15.96 %) babies 1 to 18 months old were diagnosed with hearing loss. 64(77.1%) of which had sensory neural hearing loss (SNHL) more than 30 dB. 67.2% of them had high risk factors for HL. 34.4% of which had positive History of hereditary childhood hearing impairment.

Conclusion: The prevalence of HL in babies Referred to audiology clinic was 15.96% and profound SNHL was the commonest degree of HL. There was an increased risk of hearing loss in those with history of hereditary hearing loss problem. These findings confirm the necessity of early detection and intervention of hearing loss especially those they have hereditary hearing loss problem.

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**Keywords:** Sensory Neural Hearing Loss, Hearing Loss, Risk Factors, Otoacoustic Emission, Auditory Brainstem Responses.

# معدل انتشار نقص السمع عند الأطفال المراجعين لعيادة السمعيات في مشفى المواساة الجامعي

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## الملخص

يؤثر نقص السمع على تطور الكلام واللغة والعلاقات الاجتماعية وخاصة عندما يحدث في سن الطفولة، بعض الأطفال يولدون بإعاقة سمعية ولديهم عوامل خطورة مؤهبة لذلك بينما بعضهم الاخر ليس لديهم أي عوامل خطورة لحدوث نقص السمع إلا أنه لا يمكن ملاحظة نقص السمع عندهم مبكراً.

تهدف هذه الدراسة الى تقدير معدل انتشار نقص السمع عند الأطفال الذين لديهم نقص السمع او عدم تطور لغة وفقا لشكوى ذويهم من ثم إيجاد مساهمة كل عامل من عوامل الخطورة في حدوث نقص السمع.

الطريقة: تمت هذه الدراسة السريرية المقطعية التراجعية في عيادة السمعيات في مشفى المواساة الجامعي –سوريا. خضع الأطفال الذين يعانون من نقص السمع او عدم تطور اللغة الى تقييم السمع عبر بروتوكولين (البث الصوتي الاذني وتخطيط جذع الدماغ). فالأطفال الذين تتراوح أعمارهم من 1–18 شهر والذين لم يجتازوا البث الصوتي الاذني تم توجيههم الى اختبار جذع الدماغ لاستكمال التقييم السمعي.

النتائج: أظهرت النتائج أن (15.96 %) 83 طفل تتراوح أعمارهم من 1–18 شهر تم تشخيصهم بنقص السمع من 520 طفل راجعوا عيادة السمعيات. حيث بلغت نسبة الأطفال المصابون بنقص سمع حسي عصبي أكبر من (30) ديسبل (77.1%) 64 طفل ومن بينهم 67.2% طفل لديه عوامل خطورة عالية لحدوث نقص السمع. وبلغت نسبة الأطفال المصابون بنقص السمع ولديهم سوابق عائلية لحدوث نقص السمع 34.4%.

الاستنتاج: بلغ معدل انتشار نقص السمع عند الأطفال المراجعين لعيادة السمعيات (15.96%) وكانت درجة الإصابة بنقص سمع حسي عصبي عميق هي الأكبر. وتبين ان

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الأطفال الذين لديهم سوابق عائلية لحدوث نقص السمع الأكثر خطورة في حدوث نقص السمع. تؤكد هذه النتائج ضرورة الكشف المبكر عن نقص السمع من اجل الإسراع في تدبيره خاصة عند الأطفال الذين لديهم قصة عائلية لحدوث نقص السمع.

**الكلمات المفتاحية:** نقص السمع الحسي العصبي ،نقص السمع، عوامل الخطورة، اختبار المعاوقة السمعية، اختبار جذع الدماغ.

# 1. Introduction:

Hearing loss is one of the most common chronic health disorders in the world [1, 2].It significantly affects language development , speech and social relations, especially when it occurs before the stage of speech recognition, i.e. in childhood [3, 4]. Some children born with a hearing impairment have risk factors for hearing loss, while others do not have any [5,6 ].

The Joint Committee on Infant Hearing (JCIH) endorses early detection and early intervention for all infants who are at risk of being or becoming, deaf or hard of hearing. The goals of early hearing detection and intervention (EHDI) are to maximize language and communication competence, literacy development, and psychosocial well-being for children who are deaf or hard of hearing. Without appropriate language exposure and access, these children will fall behind their hearing peers in communication, language, speech, cognition, reading, and social-emotional development, and delays may continue to affect the child's life into adulthood [17].

Early detection of hearing impairment and appropriate intervention, especially during the first six months of life, reduces lifelong Language & speech deficits, and avoids poor academic performance, as well as emotional / social difficulties [7, 8, 14].

When infants are very young or experiencing severe developmental Disabilities, The American Speech-Language-Hearing Association ASHA and the American Academy of Audiology (AAA) recommend that the testing of infants or children should rely primarily on physiologic measures of auditory function, such as auditory brainstem response (ABR) using frequency- specific stimuli to estimate the audiogram. In addition, Otoacoustic emissions (OAE) and acoustic immittance measures should be used to supplement ABR results [24].

Various studies are published to investigate the prevalence of hearing impairment and the impact of the known risk factors for hearing loss [7-11]. These studies follow different protocols and different use of instruments and tests. According to Aseel et al. (2015, Kuwait) study of 200 newborns, the prevalence of hearing impairment in high-risk infants was 11.5%. About 43.48% had severe prematurity (gestational age <30 weeks) was the main risk factor of hearing loss [9].

In a study by Oliveira et al. (2013, Brazil), the prevalence of hearing loss in newborns from private hospitals was two cases per 1,000 evaluated patients. The use of ototoxic drugs, admission to Intensive Care Unit and family history of hearing loss were the most common risk factors for hearing loss in the studied population [10].

In another study on newborns (2020), the estimated prevalence of unilateral and bilateral permanent hearing loss worse than 40 dB varied from 1 to 6 per 1000, and the overall prevalence was 2.21 per 1000 [12]. While a study of infants (2014, china), there were 31 (18.6%) infants diagnosed as conductive hearing loss (CHL), and 99 cases (59.3%) diagnosed as SNHL [13]. According to Pourarian et al. (2012, Iran) study Among the 124 neonates included in the study, 17 (13.7%) had hearing loss [11].

The developed countries have relied on early detection of hearing loss and quick determination of the appropriate audiological rehabilitation as one of the priorities of health care standards before reaching six months of age [14-18]. In Syria, the Ministry of Health release the first newborn audiometric screening program project in December 2021.

Every day, many patients with a variety of ages visit the audiology clinic in Al-Mouwasat University Hospital from multiple governorates with cases of Language development and speech delays due to permanent, congenital or undetected hearing loss at an early age [25]. There is also limited studies exploring the prevalence of babies hearing loss in Syria. According to study by Amin (2016), the percentage of hearing impairment in children with high risk factor is very high (21.1%) in comparison with children without high risk factors (1%) and the important risk factors by order

of frequency were prematurity (36%), consanguineous marriage (33%) the perinatal hypoxia(18%)[26]. Therefore, the aim of this study was to estimate the prevalence of hearing loss in babies with hearing loss or lack of language development according to parent complaint and to find the contribution of each of the risk factors to the occurrence of hearing loss in audiology clinic of Al-Mawasat Hospital-Syria.

## 2. Methods:

Ethical approval for this cross-sectional and retrospective clinical study was obtained from Ear, Nose and Throat Diseases and Surgery Department Council in Faculty of Medicine in Damascus University.

This study included (520) babies from multiple Syrian governorates with hearing loss or lack of language development according to parent complaint referred to the Audiology Clinic at Al-Mouwasat University Hospital-Syria from January 2020 until January 2022. This study does not include any procedure that may pose a risk to the patient.

The inclusion criterion was babies who aged between 1 to 18 months with hearing loss or lack of language development according to parent complaint.

At first, the case history was taken from the parents (age, gender, and risk factors); a baby is considered at risk if they have at least one of the ten known risk factors for hearing loss according to the criteria set by the Joint Committee on Infant Hearing (2019) [17]:

1. history of hereditary childhood hearing impairment.
2. congenital perinatal infection such as rubella or other nonbacterial fetal infection like cytomegalovirus, and herpes.
3. craniofacial anomalies.
4. Birth weight less than 1500 grams.
5. A bilirubin level greater than 20.
6. Bacterial meningitis and severe asphyxia
7. Premature delivery (gestational age < 34 weeks).
8. Taking medicines that are toxic to the ear during pregnancy.
9. Syndromes that are known to be associated with hearing loss.
10. Neurological disorders .

Then babies were examined by an Otoscope to evaluate the status of the ear canal and the tympanic membrane.

All babies were tested in a quiet room and the order of hearing tests was as below:

- A tympanometry test ( GSI 39 - Grason Stadler , United State): it was used to record the acoustic impedance in the external auditory meatus as a function of air pressure within the external auditory meatus. Since we did not find many babies under 7 months, a low-frequency probe tone of 226 Hz was utilized with a positive to negative pressure sweep of 200 daPa at a pump speed of 50 daPa/s. According to previous studies [19-21] tympanometric curves were classified into normal (type A) or altered (types C and B) using a 226 Hz probe tone [22]. Most routine immittance tests use a 226 Hz (or 220 Hz) probe tone. Low-frequency probe tones such as these were originally chosen because they are sensitive to changes in stiffness reactance, comprising a major part of the normal ear's impedance. In addition, admittance devices are calibrated in terms of the admittance of an equivalent volume of air [22].
- OAE test (GSI Corti™ -Grason Stadler, United State): When the patient is under spontaneous sleep, a probe covered with disposable ear tips is placed in the ear canal to send sound "click". When the test was done and there was OAE response, the results were displayed as "PASS" (3-15 dB signal-to-noise ratio at least in four frequencies from 2,000 to 5,000 Hz) on the screen and if there was no response to a stimulus as "REFER" [22]. If a child had a response in OAE, we retain the test after two months.
- ABR test (Vivosonic Integrity™ V500, Canada): It measures the function of the ear to brain pathway and can help detect where along that pathway a problem exists. It can show if

the brain doesn't receive any signal or if it requires a loud stimulus to receive a signal.

- Babies who had normal tympanogram (type A) and abnormal result of OAE (refer) completed a diagnostic test using ABR [22].
- when babies were under spontaneous sleep, the Noninverting electrode was placed on the upper part of the forehead, the ground electrode was placed on the forehead with at least 3 cm between the proximal electrode margins and the inverting electrodes was placed on each mastoid. ABR were recorded using click stimuli from (20 to 90 dBnHL ) with 2000 clicks at the analysis time of 25ms. Intensities varied in 10 dB steps to estimate threshold if responses were observed. The impedance was kept as low as possible and the electrical activity was kept at a minimum. The least intensity at which a replicable and robust wave V was seen was considered as the threshold [23]. The babies who were diagnosed with SNHL using the ABR were referred for hearing rehabilitation either with hearing aids or with cochlear implants.

The results of all previous testes were analyzed through the statistical program SPSS using the odds ratio, Crosstabs, descriptive statistics and frequencies.

## 3. Results:

A total of 520 babies were screened using Tympanometry and OAE followed by ABR in audiology clinic at Al-Mouwasat Hospital, 83 (15.96 %) babies 1 to 18 months old of both genders (44 male, 39 female) with a mean age of $(11 \pm 4.3)$ months were diagnosed with hearing loss. Nineteen (22.9%) cases of which had CHL and 64(77.1%) of the cases had SNHL more than 30 dB of both genders (35 male, 29 female).

In our study, the prevalence of SNHL in the examined babies was found to be 64 (77.1%), in normal born babies was 21(32.8%), and in high-risk babies was 43(64.7%) according to the criteria of the Joint Committee on Infants Hearing (2019). 62(96.9%) of the cases had bilateral HL. Table 1 shows the Clinical characteristics of babies with SNHL.

**Table (1) Clinical characteristics of babies with SNHL**

| Babies with SNHL | | Frequency | Percent | Total Babies with SNHL | p-value |
|---|---|---|---|---|---|
| Gender | male | 35 | 54.7 | 64 | 0.29 |
| | female | 29 | 45.3 | | |
| Defected ear | unilateral | 2 | 3.1 | 64 | - |
| | bilateral | 62 | 96.9 | | - |
| Risk factors | NO | 21 | 32.8 | 64 | - |
| | one or more risk factors | 43 | 64.7 | | - |

In order to estimate the contribution of each of the risk factors to the occurrence of hearing loss, the odds ratio is calculated using Crosstabs, then we find the relationship between the prevalence of hearing loss and the risk factors for hearing loss using person correlation as shown in table 2.

**Table (2) Risk Factors for babies with hearing loss.**

| No. | Risk Factors | Frequency | Percent | Odd Ratio | p-value |
|---|---|---|---|---|---|
| 1 | Severe asphyxia | 2 | 3.1 | 1.57 | 0.05* |
| 2 | Syndromes that are known to be associated with H.L | 1 | 1.6 | 1.56 | 0.15 |
| 3 | Neurological disorders | 3 | 4.7 | 1.30 | 0.04* |
| 4 | A bilirubin level greater than 20 | 9 | 14.1 | 1.03 | 0.03* |
| 5 | History of hereditary childhood hearing impairment | 22 | 34.4 | 1.03 | 0.42 |
| 6 | Premature delivery | 1 | 1.6 | 0.77 | 0.23 |
| 7 | Congenital perinatal infection | 2 | 3.1 | 0.77 | 0.15 |
| 8 | Bacterial meningitis | 3 | 4.7 | 0.76 | 0.10 |

*: Correlation is significant at the 0.05 level (1-tailed).

The prevalence of history of hereditary childhood hearing impairment was found in 34.4% cases, 4.7% of them had Bacterial meningitis, and 3.1% of the cases have had severe asphyxia. We found Syndromes that are known to be associated with hearing loss in 1.6% of those babies, likewise, 4.7% of the cases had Neurological disorders and 3.1% of the cases had congenital perinatal infection, while 1.6% of the cases went through premature delivery as shown in table 2.

We note in table2 also, the odds ratio for hearing loss as follow: Severe asphyxia (1.57), Syndromes that are known to be associated with H.L (1.56), Neurological disorders (1.30), A bilirubin level greater than 20 (1.03), History of hereditary childhood hearing impairment (1.03), Premature delivery (0.77), Congenital perinatal infection (0.77) and Bacterial meningitis (0.76).

There was a statistically significant relationship between hearing loss and bilirubin level greater than 20 and Neurological disorders ($p < 0.05$). Hearing loss had no significant statistical relationship with gender ($p>0.05$) that is shown in Table 1.

**Table (3) auditory assessment results of hearing-impaired babies through ABR**

| | | normal | mild | Moderate | Moderate to severe | severe | profound | total |
|---|---|---|---|---|---|---|---|---|
| ABR-R | Frequency | 1 | 1 | 2 | 1 | 3 | 56 | 64 |
| | Percent | 1.6 | 1.6 | 3.1 | 1.6 | 4.7 | 87.5 | 100 |
| ABR-L | Frequency | 2 | 2 | 2 | 0 | 3 | 55 | 64 |
| | Percent | 3.1 | 3.1 | 3.1 | 0 | 4.7 | 85.9 | 100 |

The results of the auditory assessment through ABR shown in the table 3. We also found that the majority of babies with SNHL had a profound hearing loss, while babies with mild SNHL represent a low percent of the same table.

## 4. Discussion:

Early detection of hearing loss is primary based on screening. In the current study, screening babies for hearing loss used objective tests, which are OAEs, tympanometry and then we completed diagnostic evaluation using ABR. The tympanometry was used to evaluate the middle ear (M.E) function on each baby distinguishing between normal M.E (type A) and type B indicating conductive hearing loss using a low-frequency probe tone of 226 Hz because we did not find many babies under 7 months. While OAEs are very sensitive to hearing loss and very practical because they are cheap, quick, easy to obtain without any invasive procedures and reliably obtained in normal infants and young children. ABR for identifying babies with SNHL and estimating hearing threshold.

In this study, the prevalence of HL for babies 1 to 18 months old admitted to the audiology clinic at Al-Mouwasat Hospital was 15.96%. Our prevalence is different from the results of the study by (2012, Iran) [11]. However, the low number of babies who had completed the diagnostic test may explain the high prevalence in our study. Moreover, we did not perform universal hearing screening.

There is a higher percentage of SNHL in males (54.7%) compared to females (45.3%) which is comparable with the results of the study by Zhang et al. (2014, china)[13]. 67.2% of them had high risk factors for hearing loss. The largest percentage was for babies with bilateral hearing loss (96.9%).

The percentage of babies with SNHL combined with one of the risk factors is greater than the percentage of babies who do not have any. Nonetheless, the percentage of babies affected and who do not have risk factors must be taken into consideration.

Of the 10 known risk factors, eight significant factors were found to have higher prevalence among the Syrian babies as shown in table 2: history of hereditary childhood hearing impairment, a bilirubin level greater than 20mg/dL, Bacterial meningitis and severe asphyxia, Syndromes that are known to be associated with hearing loss, Neurological disorders, congenital perinatal infection and Premature delivery. SNHL by Premature delivery and Syndromes have been found in a small proportion of babies (1.6%), but history of hereditary childhood hearing impairment is a commonly found risk factor for hearing impairment (34.4%) that is comparable with the study by Oliveira et al. (2013, Brazil) [10]. In the study of Aseel et al. (2015, Kuwait), the risk factors of hearing loss in infants were gestational age of less than 30 weeks [9]. While in study by Oliveira et al. (2013, Brazil), The use of ototoxic drugs, admission to Intensive Care Unit and family history of hearing loss were the most common risk factors for hearing loss in the studied population [10].

On the other hand, there was no significant relationship between hearing loss and sex ($p<0.05$) as shown in table1,while the association between hearing loss and bilirubin level greater than 20 and

Neurological disorders was significant ($p < 0.05$) as shown in table 2.

In our study, we found that Severe asphyxia, Syndromes that are known to be associated with H.L, Neurological disorders, a bilirubin level greater than 20 and History of hereditary childhood hearing impairment had the most probability of hearing loss risk factors as shown in Table 2. We also found that the majority of babies with SNHL had a profound hearing loss as shown in Table 3, while babies with mild SNHL represent a low percent of the same table. Therefore, it is necessary to guide healthcare providers of the importance of early detection of hearing loss in babies to reduce the development of hearing loss in babies and to start the management as soon as possible.

## 5. Conclusion:

The prevalence of HL in babies 1 to 18 months old seen in the audiology clinic at Al-Mouwasat University Hospital was 15.96% and profound SNHL was the commonest degree of HL. There was an increased risk of hearing loss in those with history of hereditary hearing loss problem.

These findings confirm the necessity of early detection and intervention of hearing loss especially those they have hereditary hearing loss problem.

We hope that those findings be incorporated into protocols for healthcare system in Syria.

## 6. Ethics Statement:

This study was carried out in accordance with the recommendations of the Declarations of Helsinki and Tokyo for human. The Ear, Nose, Throat (ENT) Diseases and Surgery Department Council in Faculty of Medicine in Damascus University approved it.

## 7. Acknowledgments

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