

## Early Detection of Hearing Defects among Newborn in Baghdad City

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### Abstract:-

**Background:** Hearing impairment is a global public health problem. It causes serious obstacle to the optimal development and education, including language development in both developing and developed countries. Around 2 to 4 in every 1000 neonates and infants have congenital sensor neural hearing impairment, making it a global public health problem.

**Objective:** To high light on the importance of newborn hearing screening as it is till now not included in Iraqi health care for newborns .

**Methodology:-** A cross sectional study with an analytic element was conducted in 25 primary Health Care Centers in Baghdad city during the period extending from 1st March to 1st September 2016 . A convenient sampling technique was used in the selection of health facilities which included newborns aged three months and below of both sexes.

The data was collected by direct interview with mothers or ( any accompanied relative ) using a special questionnaire and then application of the distortion product otoacoustic emissions test.

**Results:-** In this study, the test was applied to 1030 newborn , of whom 110 (10.7%) were positive to the test and referred to ear, nose and throat specialist for further assessment.

The results showed that the prevalence of newborns with hearing impairment and the test positive was 84.5/1000 ,positive predictive value of distortion product otoacoustic emissions test was 88.7%.

There was significant association between family history of hearing impairment and the test results, while other variables didn't show any association.

**Conclusion:** The distortion product otoacoustic emissions test can be used as a screening test to detect a newborn hearing impairment due to its ease to use which allows trained non-professional personnel to perform the test.

**Key words:-** Hearing defects, Newborn. Screening, Baghdad.

### Introduction:-

According to a range of studies and surveys conducted in different countries, around 2 to 4 in every 1000 neonates and infants have congenital or early childhood onset sensor neural deafness or severe-to-profound hearing impairment<sup>(1)</sup>.

Deaf and hearing-impaired children often experience delayed development of speech, language and cognitive skills, which may result in slow learning and difficulty progressing in school. Early detection is a vitally important element in providing appropriate support for deaf and hearing-impaired babies that will help them enjoy equal opportunities in society alongside all other children.<sup>1-3</sup> If the hearing impairment is identified and corrected in its early stage; Studies have been shown that the child speech and language skill will be comparable to his or her normal peers.<sup>2</sup>

Disabling hearing impairment is unequally distributed across the world. Population based studies are rare particularly in developing countries where newborns and children are not systematically screened for hearing impairment.<sup>4</sup>

Children who are identified with hearing impairment between birth and 6 months of age and have received immediate intervention (amplification, medical referral, family-centered programs, etc) have significantly higher developmental functions as compared to those with late detection and intervention.<sup>5</sup> Universal neonatal hearing screening program is the current standard practice in developed countries to detect hearing impairment among children at early age.<sup>6</sup>

There is a general agreement that a neonatal hearing screening program should be implemented so hearing impaired baby could be detected as early in life as possible and the rehabilitation process can take full advantage of the auditory plasticity of the developing sensory system.<sup>7</sup>

### Objectives:

To high light the importance of newborns hearing screening .

### Methodology

A cross sectional study with an analytic element was conducted in PHCCs from different localities in Baghdad city (AL-Karkh and AL-Rusafa sides ) Data collection was carried out from first March to first september 2016.

A convenient sampling technique was used in the selection of these centers.

The inclusion criteria were all newborn (age three months and below) of both sexes. The suggested sample size was approximately 1000 newborns.

Data were collected by direct interview using *questionnaire which include the following information:*

Age of the mother, family history of hearing impairments including (father, mother, sibling, uncle), history of infection during pregnancy, type of labor (normal vaginal, cesarean section). Weight at birth, gestational age, age of newborn at time of test, history of previous illness.

The researcher examined the newborns (clean the ears if needed) apply the distortion product

otoacoustic emissions(DPOAE) test was used for detection of hearing impairment bilaterally for both ears. By putting the probe of instrument inside the newborns ears and put the serial number of baby in that instrument and then apply the test. The final results was either pass or refer. The positives cases were referred to ENT specialist for further assessment Analysis of data was carried out using the available statistical package of SPSS-22 (Statistical Packages for Social Sciences- version 22). Data were presented in simple measures of frequency, percentage, mean, standard deviation, and range (minimum-maximum values).

**Statistical analysis**

The significance of association of HI with certain variables (qualitative data) were tested using Pearson Chi-square test ( $\chi^2$ -test) with application of Yate's correction or Fisher Exact test whenever applicable. Statistical significance was considered whenever the P value was equal or less than 0.05.

**Limitations of the study**

- The negative results (true negative & false negative) can not be followed up for more

intervention because of cost of testing and time constrains .

- Loss of follow up of numbers of newborns after referral to further assessment.

**Results:**

The study sample was consisted of 1030 newborn; their age ranged (4-12) weeks , male to female ratio was 1:1 Most of the studied newborn ( 85%) weighed 3000-4400 grams ,and more than them(57.4%).were full term (38-40) weeks as shown in Table half of 1. The results of this study reveal that the age of the mother of the studied sample ranged(17-40)years , most of them(90.5% ) aged 20-35 years, Pervious family history of hearing impairment was reported in 1.6% of them ,only 0.4% of mother reported history of prenatal infection and most of deliveries (95.3%) was by normal vaginal delivery.

Regarding the presence of a history of previous illness, the results showed that hyperbilirubinemia was reported in 5.7% of cases , 3.1% of newborns need incubator, cyanosis& dyspnea in1.3%, and convulsion in0.1% .

**Table (1) Distribution of the studied newborn according to birth weight , gestational age and age of newborns at time of test.(N=1030)**

		No	%
Birth weight (grams)	<2500	8	0.8
	2500---	131	12.7
	3000---	185	18.0
	3500---	452	43.9
	4000---	237	23.0
	=>4500	17	1.7
	Mean±SD(Range)	3591.2±473.0 (2100-4900)	
Gestational age (weeks)	36	53	5.1
	37	87	8.4
	38	103	10.0
	39	199	19.3
	40	289	28.1
	41	156	15.1
	42	143	13.9
	Mean ± SD (Range)	39.6±1.6 (36-42)	
Age at test(weeks)	4	131	12.7
	5	37	3.6
	6	60	5.8
	7	53	5.1
	8	165	16.0
	9	86	8.3
	10	234	22.7
	11	51	5.0
	12	213	20.7

**Distortion product otoacoustic emission test for the studied newborns**

The test was applied on 1030 newborns, of these 110 newborns (10.7%) were positive to the test and referred to ENT specialist for further assessment. The remaining were 920 newborns (89.3%) who were negative to the test .

During the study period ;out of 110 newborns referred to ENT specialist for further assessment, only 97 newborns were examined by ENT specialist and the remaining 13 were loss of follow up as shown in the figure.

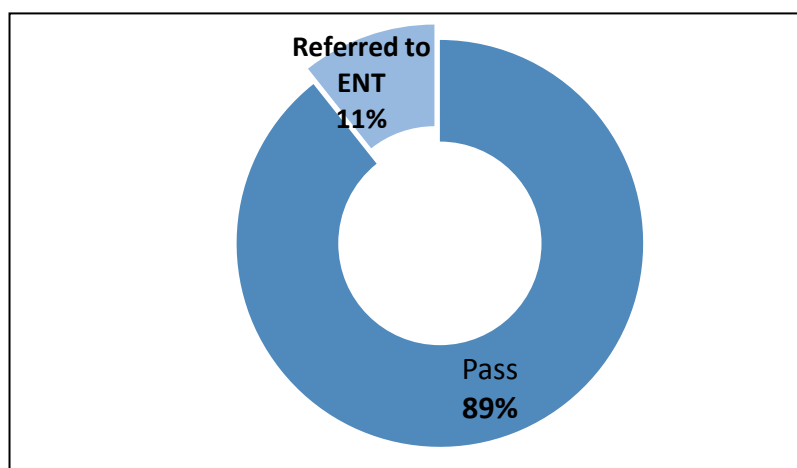
The results of DPOAE test for the studied sample and final examination by ENT specialist is

shown in Table (2) , where the cochlear and retro cochlear deficit were detected in 66% of referred cases or ( 6% from all studied sample ).

The percentage of otitis media with effusion are about 22.7% and the normal newborns (included wax) about 11.4% .

The prevalence of newborns with hearing impairment and the test positive is 84.5/1000.

The results revealed that there is a significant statistically association between family history of hearing impairment and the referred test results( P0.007),while other factors failed to reveal any statistical association as shown in table 3&4.



**The results of DPOAE test among the studied newborns**

**Table (2) Results of DPOAE tests and final examinations by ENT doctors of studied newborns.**

DPOAE (n=1017)	No	%
Pass	920	90.5
Referred to ENT	97	9.5
Referred neonates ENT exam (n=97)#	No	%
Cochlear deficit	60	61.9
Retro-cochlear deficit	4	4.1
Otitis media with effusion	22	22.7
Wax	9	9.3
Normal	2	2.1
#13 of the referred neonates were lost from follow up and not examined by ENT		

**Table (3) The distribution of newborns according to test results and some variables (N=1030)**

		DPOAE				P value
		Pass (920)		Refer(110)		
		No	%	No	%	
Maternal age (years)	<20	25	89.3	3	10.7	0.925
	20---24	355	88.5	46	11.5	
	25---29	218	89.0	27	11.0	
	30---34	273	90.7	28	9.3	
	=>35	49	89.1	6	10.9	
Family history of HI	Yes	11	68.8	5	31.2	0.007*
	No	909	89.6	105	10.4	
History of prenatal infection	Yes	3	75.0	1	25.0	0.353
	No	917	89.4	109	10.6	
Type of delivery	CS	40	83.3	8	16.7	0.169
	NVD	880	89.6	102	10.4	

\*Significant difference in proportions using Pearson Chi-square test

**Table (4) Association between the test results and newborns birth weight, gestational age and age at time of test.(N=1030)**

		DPOAE				P value
		Pass(920)		Refer(110)		
		No	%	No	%	
Birth weight (grams)	<2500	8	100.0	-	-	0.604
	2500---	112	85.5	19	14.5	
	3000---	167	90.3	18	9.7	
	3500---	404	89.4	48	10.6	
	4000---	213	89.9	24	10.1	
	=>4500	16	94.1	1	5.9	
Gestational age (weeks)	36	44	83.0	9	17.0	0.547
	37	81	93.1	6	6.9	
	38	93	90.3	10	9.7	
	39	180	90.5	19	9.5	
	40	260	90.0	29	10.0	
	41	136	87.2	20	12.8	
Age at test(weeks)	42	126	88.1	17	11.9	
	4	116	88.5	15	11.5	0.924
	5	33	89.2	4	10.8	
	6	57	95.0	3	5.0	
	7	47	88.7	6	11.3	
	8	147	89.1	18	10.9	
	9	75	87.2	11	12.8	
	10	207	88.5	27	11.5	
11	45	88.2	6	11.8		
12	193	90.6	20	9.4		

\*Significant difference in proportions using Pearson Chi-square test

**Discussion:-**

Hearing impairment can be considered as one of the most important birth defects<sup>8</sup>, most of the developed countries announced hearing screening programs for all neonates ;In Japan participation rate in the NHS was 88.8% in 2013,<sup>9</sup> the percentage of neonates that receive hearing screening is

typically greater in European countries that have done for more than 80% of births, in the United States all neonates are screened for hearing impairment,<sup>10</sup>but in developing countries newborns and children are not systematically screened for hearing impairment .<sup>3</sup> In Iraq this project do not planned yet!!.

The current study reveals that the prevalence of newborns with hearing impairment and the test positive is 84.5/1000 ( bilateral checking of babies ears ) which is very high than the results reported by other workers were : 1/1000 (Brazil, bilateral<sup>11</sup>), 1.83/1000 (United States, Washington DC).<sup>12</sup>

The DPOAE test (in this study) reveals that 89.3% of the examined newborns were negative to the test and 10.7% of them were positive to test (referral rate) , the negative results is much higher than the rate reported by Berg et.al in 2005 in New York which found (24.1%) passed OAEs bilaterally<sup>13</sup> , but the referred cases is lower than Maria et.al. in brazil (2014) which reported that referral rate was 18.6%.<sup>14</sup>

In this study, the positive predictive value was 88.7% ( the stimulus levels that used 40 dB ) , same finding was reported by Kirby et. al. (USA /2011).<sup>15</sup>

This study shows that 66% of referred cases had sensor neural hearing impairment and 22% of them had otitis media with effusion (conductive hearing loss), but the finding of Maria et.al.in brazil (2014) who reported that sensor neural hearing loss was found in 13.2% of infants and conductive in 26.4% of cases.<sup>14</sup>

The present study is carried out on 1030 newborns .Uus and Bamford (2006) reported that 0.01% of infants were identified with permanent bilateral moderate or greater hearing loss , The median age of identification for well baby was 10 weeks of age and males account for 51.4% of the population ,<sup>16</sup>this diversity with current study may be due to small sample size ( of the current work ) .

In this study , analysis of the referred cases showed that positive family history of hearing impairment, hadstatistically significant impact on the likelihood to hearing problems, which coincide with a study results of Acaet.al. that stated that history of familial congenital hearing loss were found to be significantly related to congenital hearing loss .<sup>17</sup>

Banjarat.al.<sup>18</sup> showed that Nonsyndromic sensory neural autosomal recessive deafness (NSRD) is the most common form of genetic hearing loss. Mielczarek et al<sup>19</sup> stated that the most frequent cause of hearing impairment in the deaf and profound sensor neural hearing loss children was a mutation in GJB2 gene.

The present study reveals no association between prenatal infection and the test results , same finding was reported by Austenget al in 2010 in Norway.<sup>20</sup>

In this work there was no association between type of delivery and the test results , this finding coincide with the results of AbuShaheen et al. in Jordan<sup>21</sup> , But other study disagree with this finding and found that the mode of delivery is associated with the risk of sensor neural hearing loss and other adverse birth outcomes that lie on the

causal pathways for potential developmental deficits.<sup>22</sup>

Studies showed that many perinatal factors as prematurity, hyperbilirubinaemia (kernicterus), anoxia (including apnea and cyanosis), severe neonatal sepsis, low birth weight and trauma are associated with very high risk of newborn hearing loss .<sup>23,24</sup> in the current work , no such association could be detected .

### Conclusion:-

The distortion product otoacoustic emissions test can be used as a screening test to detect a newborns hearing impairment due to its ease to use, high accuracy , and also it is automated using a pass/fail criterion , which allows trained non-professional personnel to perform the test , and also it is an objective and noninvasive test for cochlear function .

### References:-

1. Béatrice Duthey, Hearing loss. Background paper. February 2013 [www.who.int/medicines/areas/priority\\_medicines/BP6\\_21Hearing.pdf](http://www.who.int/medicines/areas/priority_medicines/BP6_21Hearing.pdf) date of access 25/10/2016.
2. Joint Committee on Infant Hearing . Position Statement: Principles and Guidelines for Early Hearing Detection and Intervention Programs. American Journal of Audiology, 9: 9-29 (2000). [http://www.asha.org/uploadedFiles/aud/InfoSeriesE\\_HDI.pdf](http://www.asha.org/uploadedFiles/aud/InfoSeriesE_HDI.pdf)
3. Mathers Colin, Smith Andrew, Concha Marisol. Global burden of hearing loss in the year 2000 World Health Organization (WHO) 2000.
4. HENDERSON D., BIELEFELD EC, HARRIS KC, HU BH. / THE ROLE OF OXIDATIVE STRESS IN NOISE-INDUCED HEARING LOSS. EAR HEAR. 2006; 27:1-19.
5. principles and guidelines for early hearing detection and intervention programs. <http://www.infanthearing.org/jcih/>.
6. Olusanya B. Highlights of the new WHO report on newborn and infant hearing screening and implications for developing countries. Int J Pediatric Otorhinolaryngology 2011;75:745-748.
7. Valerie Newton: Pediatric Audiological Medicine. 2<sup>nd</sup> ed. 2009. Wiley-Blackwell publications : P256
8. American Academy of Pediatrics. The Medical Home Policy Statement. Pediatrics 110. Retrieved Dec. 18, 2002 .
9. WHO Library Cataloguing / Newborn and infant hearing screening: current issues and guiding principles for action / ISBN 978 92 4 159949 6 / GENEVA, SWITZERLAND , 9-10 November 2009 .
10. Evans DB, Tandon A, Murray CJL, Lauer JA. Comparative efficiency of national health systems: cross national econometric analysis. BMJ 2001 ;volume issue 306 .

11. MARIA FRANCISCA COLELLA-SANTOS, THAÍANTONELLIDINIZ HEIN, GABRIELE LIBANO DE SOUZA, MARIA ISABEL RAMOS DO AMARAL, AND RAQUEL LEMECASALI/ NEWBORN HEARING SCREENING AND EARLY DIAGNOSTIC IN THE NICU / BRAZIL (2014), ARTICLE ID 845308, 11 PAGES
12. Berg, A.L., Spitzer, J.B., Towers, H.M., Bartosiewicz, C., & Diamond, B.E. Newborn hearing screening in the NICU: profile of failed auditory brainstem response/passed otoacoustic emission / New York / Pediatrics, (2005) 116, 933-938.
13. Uus, K., Bamford, J. Effectiveness of population-based newborn hearing screening in England: ages of interventions and profile of cases. Pediatrics, (2006) 117, 887-893.
14. Kirby BJ, Kopun JG, Tan H, Neely ST, Gorga MP. Do "optimal" conditions improve distortion product otoacoustic emission test performance? Ear and Hearing./USA / 2011;32:230-237.
15. Christensen, M., Thomson, V., Letson, G.W. (2008). Evaluating universal newborn hearing screening in Colorado: From population determinants to system improvement actions , 2008 Dec;35(6):594-7. doi: 10.1016/j.amepre.2008.09.007
16. Acar B, Ocak E, Acar M. Kocaöz D: Comparison of risk factors in newborn hearing screening in a developing country. The Turkish journal of pediatrics 2015 Jul-Aug;57(4):334-8.
17. Du Y, Huang L, Cheng X. : Analysis of compound heterozygous mutations in the GJB2 gene in Chinese infants and young children. Bioscience trends 2016 Jul 19 pg 2206.
18. Mielczarek M, Zakrzewska A, Olszewski J: GJB2 sequencing in deaf and profound sensorineural hearing loss children. The Polish otolaryngology 2016 Jun 30 pg 215.
19. Sever JL, Ellenberg JH, Ley AC, Madden DL, Fuccillo DA, Tzan NR et al. Toxoplasmosis: maternal and pediatric findings in 23,000 pregnancies. Pediatrics 1988; 82(2): 181-192.
20. AbuShaheen A, AlMasriM ,ElBakri N./ Prevalence and risk factors of hearing loss among infants in Jordan: initial results from universal neonatal screening. International journal of audiology 53:12 2014 pg 91520
21. AbuShaheen A, AlMasriM ,ElBakri N./ Prevalence and risk factors of hearing loss among infants in Jordan: initial results from universal neonatal screening. International journal of audiology, 2014 pg 91520
22. Bolajoko O Olusanya and Olumuyiwa A Solank e / Maternal and neonatal factors associated with mode of delivery under a universal newborn hearing screening programme in Lagos, Nigeria 2009 <http://bmcpregnancychildbirth.biomedcentral.com/articles/10.1186/1471-2393-9-41> date of access 14/1/2017
23. Gardner IA, Greiner M Receiver-operating characteristic curves and likelihood ratios: improvements over traditional methods for the evaluation and application of veterinary clinical pathology tests. Veterinary Clinical Pathology ,2006, 35:8-17.
24. Sever JL, Ellenberg JH, Ley AC, Madden DL, Fuccillo DA, Tzan NR et al. Toxoplasmosis: maternal and pediatric findings in 23,000 pregnancies. Pediatrics 1988; 82(2): 181-192.