Visual reinforcement audiometry in infants who born term and preterm: minimum response level

Audiometria de reforço visual em lactentes nascidos a termo e pré-termo: nível mínimo de resposta

Audiometría de refuerzo visual en infantes nacidos a término y pre – término: nivel mínimo de respuesta

Laís Ferreira[*]
Amália El Hatal de Souza[*]
Bianca Bertuol[*]
Inaê Costa Rechia[*]
Eliara Pinto Vieira Biaggio[*]

Abstract

Objective: *To analyze the Minimum Response Level (MRL) in infants, born term and preterm, considering some variables. In addition to investigating the relationship between MRL and different Risk Indicators for Hearing Loss (RIHL).* ***Methods:*** *The sample consisted of 114 infants who had result "pass" in Newborn Hearing screening, from six to eight months old, distributed into two groups according to gestational age. Term group: 75 infants and Preterm group: 39 infants. The Visual Reinforcement Audiometry (VRA) was made with a pediatric audiometer, seeking the MRL.* ***Results:*** *There was no statistically significant difference in the MRL regarding the side of the presentation. The MRL's in 2 khz and 4 khz in the Term Group were lower in female babies. Comparing the MRL between the two*

*Universidade Federal de Santa Maria – UFSM – Santa Maria-RS – Brazil.
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Correspondence address: Laís Ferreira. **E-mail:** laaisferreira@hotmail.com
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groups there was not statistically significant difference. The higher MRL's are among the infants with the following RIHL: Intensive care unit (ICU) hospitalization, use of ototoxic drugs, mechanical ventilation and tabacco use by the mother during pregnancy. ***Conclusion:*** *There was no statistically significant difference in the MRL regarding the side of the presentation of the stimuli and between groups. It was observed that the female infants of the term group had lower mrls in the frequencies of 2khz and 4KHZ. Some RIHL influenced the performance of infants in the VRA.*

Keywords: *Audiometry; Hearing; Infant Behavior; Infant*

Resumo

Objetivo: *analisar os Níveis Mínimos de Respostas (nmrs) em lactentes, nascidos a termo e pré-termo e investigar a relação entre os nmrs e os diferentes Indicadores de Risco para Deficiência Auditiva (irdas).* ***Método:*** *a amostra foi composta por 114 lactentes que apresentaram resultado "passa" na Triagem Auditiva Neonatal (NHS), de seis a oito meses de idade, distribuídos em dois grupos conforme a idade gestacional. Grupo Termo: 75 lactentes. Grupo Pré-termo: 39 lactentes. Realizou-se a Audiometria de Reforço Visual (VRA) com o audiômetro pediátrico, buscando os nmrs.* ***Resultados:*** *não houve diferença estatisticamente significante entre NMR em relação ao lado de apresentação. Os nmrs em 2khz e 4khz no Grupo Termo foram menores nos bebês do gênero feminino. Ao comparar nmrs dos dois grupos, não houve diferença estatisticamente significante. Os maiores nmrs apareceram entre os lactentes que apresentaram os seguintes RFHL: permanência na Unidade de Terapia Intensiva (UTI), uso de medicação ototóxica, ventilação mecânica e uso de fumo pela mãe durante o período gestacional.* ***Conclusão:*** *não houve diferença estatisticamente significante nos nmrs em relação ao lado de apresentação dos estímulos e entre os grupos. Observou-se que os lactentes do gênero feminino, do Grupo Termo, apresentaram menores nmrs nas frequências de 2KHZ e 4KHZ. Alguns irdas influenciaram no desempenho dos lactentes na VRA.*

Palavras-chave: *Audiometria; Audição; Comportamento do Lactente; Lactente.*

Resumen

Objetivo: *Analizar los Niveles Mínimos de Respuesta (NMR) en niños, nacidos a término y pretérmino, e investigar la relación entre el NMR y los diferentes indicadores de riesgo para la pérdida auditiva (IRPA).* ***Métodos:*** *La muestra se compuso de 114 niños que aprobaron en la Tamizaje Auditivo en Recién Nacidos (NHS, del inglés), con seis a ocho meses, divididos en dos grupos según la edad gestacional. Grupo Término: 75 niños y grupo pretérmino: 39 niños. La Audiometría por Refuerzo Visual (VRA) se realizó con el audiómetro pediátrico, buscando el NMR.* ***Resultados:*** *No hubo diferencia estadísticamente significativa entre los NMR con relación al lado de la presentación. El NMR en 2kHz y 4kHz en el Grupo Término fueron inferiores en bebés del sexo femenino. Al comparar el NMR entre los dos grupos, no hubo diferencia estadísticamente significativa. Los bebés que presentaron los IRPA: estancia en la unidad de terapia intensiva (UTI), el uso de medicamentos ototóxicos, la ventilación mecánica y el uso de tabaco por la madre durante el embarazo presentaron mayores NMR.* ***Conclusión:*** *No hubo diferencia estadísticamente significativa en los NMR con relación al lado de la presentación de los estímulos y entre los grupos. Se observó que los bebés del sexo femenino del Grupo Término presentaban NMR más bajos en la frecuencia de 2kHz y 4KHZ. Algunos IRPA influyen en el rendimiento de los niños en la VRA.*

Palabras claves: *Audiometría; Audición; Comportamiento del Niño; Niño.*

Introduction

The development of listening skills is due to the maturation of the central nervous system[1,2,3]. It is known that the auditory system is formed up to the 20th week of pregnancy, allowing the first sounds to be heard even inside the womb[4]. It is important to add that the auditory experience over the first few months are critical to the development of auditory skills, of detection, discrimination, location, recognition and understanding[4.5].

An important aspect related to the hearing of newborns and infants is the knowledge of Risk Factors for Hearing Loss (RFHLs), as these can influence the development of children's auditory function, even in cases where there is peripheral auditory integrity. Thus, the research of IRDAs is necessary, since children with such comorbidities are more likely to have some hearing impairment, including the development of auditory skills[5,1,2,6,7,8].

To assess the integrity of auditory function in early life, it is necessary to perform the Neonatal Hearing Screening (NHS), with objective procedures for the testing of neonates, preferably before hospital discharge[6.7]. It should be noted that in cases of "pass" in NHS, for neonates with RFHL, it is recommended to monitor the hearing function. This can be achieved through behavioral measures, such as evaluation of the sound front location ability to instrumental sounds and Visual Reinforcement Audiometry (VRA), which can be easily performed with the pediatric audiometer or through insert earphones or above- aural, coupled to conventional audiometer[9,6,10,11,12,13,3]. VRA search to find the minimum response level (NMR), which is to identify the lowest intensity in which the infant has behavioral response due to the sound stimulus[14.13].

Note that this procedure is used to assess hearing sensitivity of infants[10.13], and you can also check auditory maturation in the first months. Based on psychoacoustic development[15], the VRA's principle assess audibility associated with a visual reinforcement. It is conceptualized as a test "gold standard" for hearing assessment of infants with cognitive aged between six months and three years, but can also be used in the evaluation of children with other problems associated[15,16].

During the course of VRA, the infant is positioned sitting between the two speakers or headphones, depending on the choice of the examiner. Thus, a sound stimulus is presented.When there is the infant's response, observed by changing the look or lateralization of the head toward the sound, it is presented as positive reinforcement, a lighted toy, for example[1.15].

The stimulus is usually used pure tone modulated frequency *warble*[2]. It can be done prior training before behavioral assessment, in order to teach the infant to carry out the assessment and maintain the response area. When the assessment is carried out in sound field, are obtained in response to hearing thresholds corresponding to the better ear, with the disadvantage that it is impossible to evaluate the unilateral and / or asymmetric hearing loss. To set the thresholds for each ear separately, it is necessary that the evaluation is carried out through headphones[1.15].

There is a national classic reference [1] on the MRL and the pattern of auditory development, in which the authors evaluated 499 infants from zero to 13 months, featuring the pattern of auditory development stages of hearing ability of location and answers on VRA. It is considered that an infant has normal hearing development when it shows evolution of auditory skills, presenting behavioral responses appropriate to their age range front to acoustic stimuli[1,3]. From birth, the infant has sound attention responses, starting at three months searching for the source. At five months, the infant is able to locate the sound stimulus in the lateral plane and thus perform VRA by immediately turning their head toward the sound stimulus. From nine months, indirectly located down and at 12 months, it has direct and indirect location down to up. At 18 months, the infant performs direct location, and recognize simple verbal commands[1,2].

Audiological findings in the study were: infants from zero to four months had NMR between 60 and 80 dB HL; infants four to six months, between 40 and 50 dB HL; infants six to nine months, between 30 and 40 dB HL and infants from nine to 12 months, between 20 and 40 dB HL. Thus, there was a decrease of NMR with advancing age, demonstrating proper development of hearing[1].

In clinical practice, it is observed that variables such as gestational age and the presence of IRDAs can somehow influence the behavioral responses of children facing the sound stimuli. However, the literature brings no works that relates the MRL with such variables. Moreover, there is evidence of an appreciation of the electrophysiological evaluation

procedures in more recent studies, however such procedures require high-tech equipment often not available at all locations that perform hearing assessment. Therefore, studying MRL in infants is a means of enhancing knowledge in Audiology Pediatric and disclosing a simple and inexpensive procedure for the assessment of this population.

This study aimed to analyze MRL in infants aged six to eight months, with the result "pass" in NHS, born at term and preterm, considering the following variables: the side of sound stimulus, gender and gestational age. Furthermore, this research aimed to investigate the relationship between MRL and the different IRDAs.

Methods

This research consists of a transversal quantitative study approved by the Research Ethics Committee of the Institution of origin. The research was regulated by Informed Consent signatures (IC) of parents of selected subjects and met all the mandatory recommendations for research involving human beings (Resolution No. 466/12).

The target population was infants with a "pass" result in the Neonatal Hearing Screening (NHS), aged between six and eight months, term infants and preterm considering corrected age, attended the NHS program at a university hospital.

Criteria for the composition of the samples included infants: (1) aged or with corrected age from 6 to 8 months; (2) bilateral presence of auditory brainstem response (ABR) in NHS; (3) tympanometric curve type A in the assessment, carried out with the 226Hz probe. Exclusion criteria for participation in the study: (1) present neurological or organic commitment evident that prevented him from performing the assessment procedure selected for this study; (2) does not collaborate / condition for the conducting of VRA.

Considering the eligibility criteria, the sample consisted of 114 infants divided into two groups according to gestational age: Term Group with 75 infants and Preterm Group with 39 infants.

The infants were evaluated by two examiners, in an acoustically treated environment. It should be noted that infants in the sample were assessed in only one session. To start the evaluations, we carried out the visual inspection of the external auditory canal using an otoscope *(Mikatos),* in order to ascertain the occurrence of any impairment in the outer ear, which could interfere with the test results proposed in this study. Tympanometry with *Otoflex 100* equipment was conducted, *Madsen,* to assess middle ear *integrity.* VRA was performed with the pediatric audiometer, portable in soundfield, PA[2], *Interacoustics,* with pure tone modulated frequency *(warble)* at frequencies 500 Hz, 1 kHz, 2 kHz, 4 kHz and intensities 80, 60, 40 and 20dB HL. They were presented in decreasing order of intensity, using the visual stimulus-response-reinforcement conditioning (three bright spots).

During conditioning, parents were asked to put the infant on their lap so positioned facing one of the examiners, who performed the distraction technique and observation of responses. The second examiner was responsible for the presentation of sound stimuli and visual reinforcement. To this end, it was considered: 1) at least four seconds of sound stimulus duration;. 2) visual reinforcement positioned approximately 90° from the midline; 3) stimulus presented at 20 cm from the subject's ear and 4) sound stimulus preceding the visual reinforcement. The sound stimulus was presented outside the visual infant field, first the right and then the left and, at times, alternating sides. There was also switching frequencies. The room in which the assessment was conducted had no other visual stimuli, avoiding the presence of distracting events, which could become competitive to the attention of the subject.

For response, the following parameter was acceptable: full turn of the head toward the sound source and visual reinforcement, considering that the VRA has as a prerequisite the lateral location of the audio signal. It was considered as NRMs the lowest intensity in which the infant presented detection skills and sound localization.

The survey of IRDAs obeyed JCIH recommendations (2007)[6] and the Multidisciplinary Committee on Health Hearing-COMUSA[7], and such investigation took place in dialogue with parents and / or guardians, and the infant's medical record analysis on the service.

The statistical model used in this study included the *Student*'s *t* test and *Mann-Whitney U test.* A 0.05 significance level (5%) was determined and all confidence intervals built along the work. They were built with 95% statistical confidence.

Results

The sample consisted of 51 female infants (35 term infants and 16 preterm) and 63 males (40 term infants and 23 preterm). Of these, 74 infants had RFHL, 41 term infants and 33 preterm and 40 without IRDAs, 34 term infants and preterm[6].

As for the behavioral auditory responses, it was established that the differences between the average MRL with pure tones modulated often found between the right and left sides of the presentation of stimuli were not statistically significant in the four evaluated frequencies (500Hz, 1kHz, 2kHz and 4 KHz) in both groups. In Term Group, the average NMR to 500Hz frequency was 38,93dBNA in OD and 38,66dBNA in OE with p value of 0.893; to 1kHz 37,06dBNA both OD and OE with ap value of 1.000; to 2 KHz 38,40dBNA in OD and OE with p value of 1.000 and 4 KHz both ears with 38,13dBNA with p value of 1.000. This was also observed in the Preterm Group, in which the average NMR to 500Hz frequency was 39,48dBNA in OD and OE with p value of 1.000; at 1kHz was 39,48dBNA in OD and 40,00dBNA in OE with p value of 0,833; to 2 KHz 38,48dBNA both OD and OE with p value of 1.000 and 4 KHz 38,48dBNA in the OD and 40,00dBNA in OE with p value of 0.833. For this comparison we used the Student's t test. Therefore, we have concluded that the MRL obtained with the presentation of sound stimuli to the right are similar to those obtained on the left, with no statistically significant difference between the sides presentation in both groups. Thus, it was decided to group the sample, disregarding the side presentation variable.

We analyzed the MRL in relation to gender (male and female), and the results are presented in the following groups (Tables 1 and 2).

Table 1. Minimum response level in the four frequencies evaluated in relation to the variable gender in the TERM group (n = 75)

	500 Hz		1 kHz		2 kHz		4 kHz	
	Fem.	**But C.**	**Fem.**	**But C.**	**Fem.**	**But C.**	**Fem.**	**But C.**
MEAN (dB HL)	36.57	41.00	34.28	40,00	34.97	41.00	34,45	40,50
MEDIAN	40	40	40	40	40	40	40	40
MINIMUM	20	20	20	20	20	20	20	20
MAXIMUM	60	60	60	60	60	60	60	60
STANDARD DEVIATION	13.27	11.94	13.34	12.81	14.56	11.94	13.80	12.39
P VALUE	0.132		0.062		0.050 *		0.049 *	

Test *t student.* 5% significance level.
Legend: dBNA - Decibel Hearing Level; kHz - thousand Hertz; Fem - female.; But C. - male;
* - Statistically significant (p - value ≤ 0.05)

Table 2. Minimum response level in the four frequencies evaluated in relation to the variable gender PRETERM group (n = 39)

	500 Hz		1 kHz		2 kHz		4 kHz	
	Fem.	**But C.**	**Fem.**	**But C.**	**Fem.**	**But C.**	**Fem.**	**But C.**
MEAN (dB HL)	37.50	40,00	36.87	40.86	36.87	40.43	36.87	40.86
MEDIAN	40	40	40	40	40	40	40	40
MINIMUM	20	20	20	20	20	20	20	20
MAXIMUM	60	60	60	60	60	60	60	60
STANDARD DEVIATION	10.00	13.48	10.14	12.76	10.14	12.96	10.14	12.76
P VALUE	0.532		0.303		0.364		0.303	

Test *t student.* 5% significance level.
Legend: dBNA - Decibel Hearing Level; kHz - thousand Hertz; Fem - female.; But C. - male;
* - Statistically significant (p - value ≤ 0.05)

It is also studied the difference between the MRL Term Group and the Preterm group, considering the four evaluated frequencies (500Hz, 1kHz, 2kHz and 4kHz), as shown in Table[3].

It is noteworthy that, as there was no statistically significant difference between the MRL of the two groups, we decided to group the sample and analyze the influence of IRDAs the MRL obtained by VRA pediatric audiometer, always in the four frequencies evaluated and entire sample (N = 114). All IRDAs were analyzed, but are presented in Table 4 only IRDAs that influenced the MRL.

Table 3. Minimum response level in the four evaluated frequencies: comparison between groups (n = 114)

	500 Hz		1 kHz		2 kHz		4 kHz	
	TERM	**PRETERM**	**TERM**	**PRETERM**	**TERM**	**PRETERM**	**TERM**	**PRETERM**
MEAN (dB HL)	38.66	39.48	37.06	39.74	38,40	39.48	38.13	39.74
MEDIAN	40	40	40	40	40	40	40	40
MINIMUM	20	20	20	20	20	20	20	20
MAXIMUM	60	60	60	60	60	60	60	60
STANDARD DEVIATION	12.44	12.55	13.02	12.24	12.63	12.34	12,80	12.24
P VALUE	0.738		0.296		0.728		0.540	

Mann-Whitney U test. 5% significance level.
Legend: dBNA - Decibel Hearing Level; kHz - thousand Hertz; * - Statistically significant (p - value ≤ 0.05)

Table 4. Minimum response level in the four evaluated frequencies: the influence of Risk Indicators for the Hearing Impairment (n = 114)

RFHL	500Hz			1kHz			2kHz			4 KHz		
	20dBHL	**40dBHL**	**60dBHL**	**20dBHL**	**40dBHL**	**60dBHL**	**20dBHL**	**40dBHL**	**60dBHL**	**20dBHL**	**40dBHL**	**60dBHL**
STAYING IN ICU (longer than 5 days)												
(n) NO (%)	19	44	4	24	39	4	21	42	4	21	42	4
	16.67%	38.60%	3.51%	21.05%	34.21%	3.51%	18.42%	36.84%	3.51%	18.42%	36.84%	3.51%
(n) YES (%)	6	26	15	6	27	14	6	26	15	6	26	15
	5.26%	22.81%	13.16%	5.26%	23.68%	12.28%	5.26%	22.81%	13.16%	5.26%	22.81%	13.16%
P VALUE	> 0.001 *			> 0.001 *			> 0.001 *			> 0.001 *		
ototoxic MEDICATION												
(n) NO (%)	16	47	5	21	42	5	18	44	6	19	43	6
	14.04%	41.23%	4.39%	18.42%	36.84%	4.39%	15.79%	38.60%	5.26%	16.67%	37.72%	5.26%
(n) YES (%)	9	23	14	9	24	13	9	24	13	8	25	13
	7.89%	20.18%	12.28%	7.89%	21.05%	11.40%	7.89%	21.05%	11.40%	7.02%	21.93%	11.40%
P VALUE	0.026 *			0,010 *			0.034 *			0,015 *		
MECHANICAL VENTILATION												
(n) NO (%)	22	54	8	27	49	8	24	52	8	24	52	8
	19.30%	47.37%	7.02%	23.68%	42.98%	7.02%	21.05%	45.61%	7.02%	21.05%	45.61%	7.02%
(n) YES (%)	3	16	11	3	17	10	3	16	11	3	16	11
	2.63%	14.04%	9.65%	2.63%	14.91%	8.77%	2.63%	14.04%	9.65%	2.63%	14.04%	9.65%
P VALUE	0,001 *			> 0.001 *			> 0.001 *			> 0.001 *		
TOBACCO												
(n) NO (%)	22	69	19	26	66	18	23	68	19	23	68	19
	19.30%	60.53%	16.67%	22.81%	57.89%	15.79%	20.18%	59.65%	16.67%	20.18%	59.65%	16.67%
(n) YES (%)	3	1	0	4	0	0	4	0	0	4	0	0
	2.63%	0.88%	0.00%	3.51%	0.00%	0.00%	3.51%	0.00%	0.00%	3.51%	0.00%	0.00%
P VALUE	0,020 *			0,003 *			0,002 *			0,002 *		

Mann-Whitney U test. Level 5% significance.Legend: UTI- intensive care unit; dBNA - Decibel Hearing Level; kHz - thousand Hertz; % - Percentage; n = number * Statistically significant (p - value ≤ 0.05)

Discussion

It notes that the sample was selected from the age of six months, because at this age infants already have sound localization ability in the lateral[1,13,3,15], which allows the execution of the selected procedure for such research. As mentioned earlier, all infants in the sample were evaluated in only one session and used always two examiners. In a study of[17], it was found that, to obtain adequate results in the realization of the VRA, the presence of two observers is required. Thus, in addition to being responsible for the distraction infant, examiners should ensure the same attention in the midline and should also control the evaluation, guiding the attitudes of the infant.

By analyzing the average MRL with the *warble* tone in the sample, regardless of the group in the four evaluated frequencies, there was no difference between the sides show. This finding suggests a symmetry between the sides NRMs show. This was expected since once the eligibility criteria sought only infants with normal hearing. Other studies have also found no statistically significant differences between the NMRS with stimuli presented in the right and left side, confirming such symmetry[9,10].

By observing the MRL relationship and the gender variable (Tables 1 and 2), in this study it was shown that females obtained the lowest MRL for frequencies 2 and 4KHZ only at the end group. This difference of MRL between genders is consistent with previous studies[9], in which the authors found that female infants have lower values in MRL compared to males.This difference was also mentioned by other authors[1].

In contrast, another study [10] evaluated 50 children, 29 of age from six months to 12 months. In it, there was no statistically significant difference between genders and the use of modulated pure tone, but the use of another type of sound stimulus (Sonar System), the MRL had to be lower than in males at 500 and 2kHz.

A possible reason for this finding is that females show distinct biological characteristics of males. This issue has been highlighted by previous studies[1]. According to research, women are the areas associated with language (Broca and Wernicke) higher than men[18]. Female students show better performance in school, getting higher grades and greater ease in activities involving mathematical tasks associated with the production and understanding of language compared to male students[19]. The author also notes that the ability to process information and phonological performance in verbal learning tests, females have more easily[19]. It is also noteworthy that the frequency range that contains most of Brazilian Portuguese phonemes are in the higher frequency range. Thus, whereas the females have greater ease in the acquisition of speech, it is hypothesized that this may be the reason for the findings of responses with lower values in the MRL for the range of 2K and 4K Hz in this genre.

This study found the MRL in Groups Term Pre Term (Table 3), and the MRL obtained in the Term Group had an average of 38.66 dB HL (500 Hz); 37.06 dB HL (1000 Hz); 38.40 dB HL (2000 Hz); 38.13 dB HL (4000 Hz). These data are similar to findings from another study[10], evaluated 29 infants aged 6 to 12 months with normal hearing and without risk factors. The authors found 40 dB HL (500 Hz); 32.74 dB HL (1000 Hz); 31.72 dB HL (2000 Hz) and 33.10 dB HL (4000 Hz). However, in another study [9] MRL values were found below the present study, a survey conducted with earphones. This difference is acceptable since such surveys were conducted with different transducers.

Another study [20] evaluated 30 infants from six to twenty-four months without hearing loss through VRA and found that audiological findings were between 20 and 40 dB HL, confirming the patterns described in the literature and in this study. In addition, the study said the VRA is an effective method in NMR research in infants aged from 6 to 24 months[1,15].

In the Preterm group were found above the MRL Term Group (Table 3), although this difference was not statistically significant, because it was considered the corrected age of those born preterm. Moreover, many of the infants in the Preterm group, in that service, are accompanied by a multidisciplinary team of early stimulation. It is hypothesized that such a strategy can minimize the effects of prematurity including the auditory responses of these subjects. However, other authors[1,] conducted a comparative study among children of low and high risk (with and without RFHL) observed the existence of statistically significant differences between these groups, indicating a predominance of lower intensity of responses in the low risk group.

It is noteworthy that the presence of IRDAs can damage the hearing of infants and is indispensable hearing monitoring in these cases[6]. In the present study, we found that the presence RFHL infants influences the performance of the embodiment of the VRA (Table 4). Infants who had some type of RFHL showed MRL higher than infants who did not have RFHL.Among infants with RFHL, those who remained in the ICU, who made use of ototoxic medication and mechanical ventilation and who had smoking mothers during pregnancy were those with the highest NMR.

As stated above, we did not find in the literature any studies to examine this relationship. The studies generally observed the relationship between RFHL and own hearing impairment and / or in cases of failure NHS[21,22,23].

However, it is known that some RFHL are closely linked to serious health problems that can compromise the newborn's survival, especially in the ICU. These problems, in many cases, could cause a delay in the global development, which would justify such findings. Gestational age and birth weight are aspects that generate interference in the development of[24,25,26,27] babies. Some authors[26] observed a significant difference in language, cognition and motor development in 274 premature infants evaluated in your search.

Conclusion

No statistically significant difference in the MRL and the side of stimuli presentation has been found. This difference was not noticed for the groups, thus it was not possible to infer that maturation has affected the auditory responses of infants at six months.

It was observed that female infants on the Term Group had lower MRLs in the frequencies of 2kHz and 4KHZ.

It is noteworthy that the IRDAs, ICU, use of ototoxic drugs, mechanical ventilation and maternal smoking during pregnancy affect the performance of infants on VRAs because they demonstrate higher MRL.

This study highlights the need for further research on RFHL and its influence in the auditory abilities in different stages of childhood.

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