SPEECH PERCEPTION TEST HINT BRAZIL IN GROUPS OF SUBJECTS EXPOSED AND NOT EXPOSED TO OCCUPATIONAL NOISE

Teste de percepção da fala HINT Brasil em grupos de sujeitos expostos e não expostos a ruído ocupacional

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ABSTRACT

Purpose: investigate the difference in the signal to noise ratio in subjects exposed and not exposed to occupational noise, with and without hearing loss using the Hearing in Noise Test, version in Portuguese of Brazil. **Method**: 206 subjects, 49 females and 157 males were evaluated and divided : 56 normal hearing without noise exposure (Group 1); 70 normal hearing exposed to occupational noise (Group 2); 80 exposed occupational noise with sensorineural hearing loss (Group 3). We analyzed the signal to noise ratio using the HINT Brazil in four presentation conditions: S-no noise, NF-noise front, NR-noise right, NL- noise left; RC-noise composite (weighted average of presentations with noise) and the results were recorded in dB. **Results:** the mean values obtained were: G1: 25.0 (S), –5.0 (NF), –12.3 (NR), –12.4 (NL) and –8.7 (NC); G2 : 26.4 (S), –4.7 (NF), –11.9 (NR), –11.9 (NL) and –8.3 (NC); G3: 34.1 (S) – 2.8 (NF), –8.9 (NR), –8.8 (NL), –5.8 (NC). **Conclusion:** there was significant difference between the values of the group of unexposed subjects (G1) with the above (G2) only on condition Noise Composite (NC). The group of subjects with hearing loss (G3) showed a significant difference in the groups G1 and G2, with worse performance in all conditions. The worst performance for speech understanding in noise was related to the degree of hearing loss and noise exposure.

KEYWORDS: Hearing; Speech Perception; Hearing Tests; Speech Discrimination Tests; Noise

INTRODUCTION

Speech perception investigation has become a widely discussed subject lately and the necessity of performing tests that simulates a real listening situation became fundamental in order to evaluate the impairment challenges of each subject[1].

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The analysis of the speech perception threshold reflects the recognizing abilities by simulating a daily hearing situation, when tested with a competitor noise[2,3].

Subjects with or without hearing loss exposed to noise seldom complain about this condition, but often complain about speech perception difficulties, especially in a noisy environment[4].

The necessity to observe the HINT technology results in the normal hearing group exposed and not exposed to occupational noise came from the findings of a previous study where a normal hearing group had the worst results in a speech perception test when exposed to noise[5]. Hearing loss affects speech identification in noise affecting two mechanisms: audibility, especially on high frequencies where the speech sounds are in a minor intensity, and distortion, which reduces the speech detection in noise[6]. Noise induced hearing loss (NIHL) is considered one of the worst health problems in workers[7], beyond the fact that is part of great discussions regarding public health in Brazil[8]. Speech recognition of sentences in silence and noise in workers with NIHL may appear in lower degrees of loss and increase significantly in higher degrees[9].

Speech perception tests with competitive noise in low redundancy situations that contemplate a wide analysis of hearing disabilities and amplify logo-audiometric tests findings, are not frequently used in the country, especially in subjects exposed to occupational noise[10,11].

The Hearing in Noise Test (HINT) appears as a strategy to improve the Speech Recognition Test (SRT) metering. Developed in 1994[12], it has been utilized in different languages and population groups. In Brazil, recently standardized in normal hearing groups[13], is based in an adaptive test technique, where the sentence presentation level increases or decreases accordingly to a spectral noise in own speech[14]. Speech perception test are realized with monosyllables or polysyllables routinely. It's really important the use of phonetic context sentences with HINT, word familiarity, intonation variation and influence level intelligibility in noise. In many countries HINT is used in workers screening, especially where hearing plays a vital or important role in the job[15,16].

The purpose of this study was to research the differences in speech to noise ratio in subjects exposed and not exposed to occupational noise with and without hearing loss by using the HINT, version in Portuguese from Brazil.

METHOD

After the approval of the local Research Ethic Committee, 206 subjects were analyzed at the Occupational Otorhinolaringology Ambulatory and were divided in 3 groups: G1 – 56 subjects with normal hearing non-exposed to occupational noise; G2 – 70 subjects with normal hearing exposed to occupational noise; G3 – 80 subjects with sensorineural hearing loss exposed to occupational noise.

G3 was initially divided in two subgroups: subjects exposed to suggestive and non-suggestive occupational noise NIHL in order to verify the homogeneity between these subgroups. Mann-Whitney statistical analyzes demonstrate homogeneity in every variable. Thus, G3 was classified as a hearing loss subject group. Below are the results.

Group	Variable	N	Average	SD	Minimum	Median	Maximum	p-value (Mann-Whitney)
non NIHL	Age	59	51,8	12,6	26,0	50,0	77,0	0,8396
	HINT- Q	59	35,3	8,7	17,6	34,9	61,3	0,0571
	HINT- NF	59	-2,5	2,6	-5,6	-3,2	6,0	0,1396
	HINT- NR	59	-8,6	3,7	-13,8	-9,8	3,5	0,2789
	HINT- NL	59	-8,5	3,5	-13,0	-9,4	2,9	0,1354
	HINT- NC	59	-5,5	2,9	-9,3	-6,2	3,6	0,1298
	M RE (512)	59	19,9	11,8	5	18,3	50	02157
	M LE (512)	59	21,7	16,1	3,3	16,7	81,7	0,5360
	M RE (346)	59	42,6	18,8	13,3	40,0	95,0	0,2329
	M LE (346)	59	43,8	18,0	15,0	43,3	91,7	0,0514
NIHL	Age	21	50,6	8,9	34,0	51,0	73,0	
	HINT- Q	21	30,9	8,4	21,4	31,8	51,8	
	HINT- NF	21	-3,6	1,2	-6,4	-3,7	-0,7	
	HINT- NR	21	-9,8	2,2	-13,3	-10,3	-4,0	
	HINT- NL	21	-9,7	2,8	-14,2	-10,1	-3,7	
	HINT- NC	21	-6,7	1,7	-9,5	-7,1	-2,9	
	M RE (512)	21	15,9	9,3	3,3	16,7	41,7	
	M LE (512)	21	17,0	10,3	0,0	18,3	41,7	
	M RE (346)	21	36,8	15,8	15,0	35,0	80,0	
	M LE (346)	21	35,1	11,9	18,3	33,3	61,7	

HINT application conditions: Q- Quiet; NF- Noise Front; NR- Noise Right; NL- Noise Left; NC- Noise Composite

Figure 1 – Descriptive analysis and variable comparisons from non suggestive and NIHL suggestive hearing loss subject group

500, 1000 and 2000 Hz average frequencies were used by serving as a daily hearing ability metering indicator. Over 2000 Hz frequencies, which help in speech perception, were also used[9]

The criteria used to determine the groups were:

- G1: adult, Brazilian Portuguese native speaker, presenting normal tonal hearing threshold until 25 dB, from 250 to 8000Hz[17], without speech perception impairment in noise, good comprehension of the instructions and non-exposed to noise.
- G2: adult, Brazilian Portuguese native speaker, working for a period longer than 1 year, 8 hours per day exposed to occupational noise, presenting normal tonal hearing threshold until 25 dB, from 250 to 8000Hz and good comprehension of the instructions.
- G3: adult, Brazilian Portuguese native speaker, working for a period longer than 1 year, 8 hours per day exposed to occupational noise, presenting sensorineural hearing loss. In other words, hearing threshold over 25 dB in at least one of the 250 to 8000Hz frequencies, bilaterally.

The exclusion criteria to every group were: neurological and/or verbal fluency changes, middle ear impairment, cerumen stopper or sentences hearing difficulty. To G1 and G2: adults or elderly with hearing loss and complains on speech perception in noise. To G3: adults or elderly with mixed or conductive and unilateral hearing loss.

In G1, a total of 56 subjects (57,1% females and 42,8% males) with 27,5 years average age (standard deviation = 9,2) were analyzed. G2 was composed by 70 subjects (8,5% females and 91,4% males) with 37 years average age (standard deviation = 10,9) and 11,2 years (standard deviation = 8,5) of exposure to noise. In G3, 80 subjects (13,7% females and 86,2% males) with the average age of 51,5 years (standard deviation = 11,9) and average exposure to noise of 19,5 years (standard deviation = 8,5) participated in this study.

An external auditory canal inspection was done in order to guarantee any change in the middle ear. Participants were submitted to a basic hearing anamnesis, threshold tonal audiometry, followed by the application of the speech tests using headphones. The results processed by the system were stored.

HINT utilizes a microprocessor HTD (Hearing Test Device) version 7.2 Audiometric System, produced by Bio-Logic, developed at House Ear Institute, Los Angeles, USA, in 1994[12].

HINT contains 12 lists of 20 sentences each, digitally recorded which can be presented in silence and noise. Those sentences are standardized accordingly to the language, difficulty, intelligibility and phonetic distribution.

The test application varies from 2 minutes for the 12 sentences list and 3-4 minutes for the 20 sentences list. Sentences were presented by a male speaker in quiet and in noise fixed at 65 dB (A), accordingly to the established standards.

The equipment presents the recorded sentences with a male professional voice and a competitive noise created from the same voice spectrum. It also conducts the whole test procedure, including the tonal audiometry.

Speech and noise were presented with headphones in four conditions: Quiet (Q), noise front (NF), noise right (NR) and noise left (NL). The processor also calculates the noise composite (NC) by the weighted average of the three noise results:

$$NC = 2 \times (NF + NR + NL) / 4$$

Each subject sits inside an audiometric booth in order to perform the test. The previously recorded signal and noise stimuli are played to the headphones by the equipment programmed to simulate the stimuli localization.

HINT selects randomly 1 in 12 sentence lists and its presentation follows the up-down strategy, which allows the determination of the speech recognition threshold (SRT) to the signal/noise ratio, established at 50%[14]. The first four sentences are presented with a rate of 4 to 4 dB which estimates the subject threshold. From the fifth sentence on, the rate is changed to 2 dB and the definite threshold is determined after the presentation of the 20 sentences to each condition of the test.

The participants must repeat the listened sentence completely in order to be accepted and the examiner must compute (yes or no) each presented sentence so that the program calculates the signal/noise ratio in the system.

Subjects were tested with headphones to compare the results of the normal hearing groups in Brazilian Portuguese and with other works involving the current material.

The results were calculated by the signal/noise metering. It's important to point that the more negative it is, greater is the difficulty of the test, due to the speech is lower than the presented noise.

A descriptive analysis with the presentation of frequency distribution tables to categorical variables and position and dispersion measurements to numerical variables was presented. In order to compare the proportion, we used the Qui-Quadrado test or Fischer exact test when necessary. To compare continuous or ordinal measurements between two groups we used Mann-Whitney test and between three groups, the Kruskall-Wallis test. To verify the linear association between the measurements, we used the Sperman Correlation Coefficient. This coefficient varies from –1 to 1 and the values close to the extremes indicate negative or positive correlation, while the values close to zero indicate no correlation. The significance level adopted to the statistical analysis was 5%[18].

RESULTS

The relation between HINT application conditions and noise exposure time in G2 showed significant difference in Spearman linear coefficient in S (c= 0,26568; p= 0,0262) e NC (c=0,29413; p= 0,0135). In G3, the statistical results were not significant.

Table 1 shows the distribution of 500, 1000, 2000, 3000, 4000 and 6000 Hz average thresholds in both ears of each group.

The average of 500, 1000, 2000, 3000, 4000 and 6000 Hz frequencies from both ears were compared to verify the threshold differences between the groups using Spearman linear correlation coefficient. A correlation between HINT performance and the averages described was found, showing that the worst is the average, worst is the HINT performance. In G1, correlation for the Q condition was found; in G2, correlation for the 500, 1000 and 2000 Hz averages in the conditions Q, NR, NL and NC, and for the 3000, 4000 and 6000 Hz averages in the condition NL were found. Such results are shown in the Table 2

Table 1 – Hearing threshold averages by frequency average and their respective standard deviation to the three groups

Group	Side	Freq.	Average 5/1/2 KHz	Average 3/4/6 KHz
G1	RE	AA	7,1	7,6
		SD	3,5	5,2
	LE	AA	6,9	7,6
		SD	4,3	5,1
G2	RE	AA	8,2	11,4
		SD	4,2	5,4
	LE	AA	7,8	11,3
		SD	4,2	6,0
G3	RE	AA	18,8	41,1
		SD	11,3	18,1
	LE	AA	20,4	41,9
		SD	14,9	16,9

Hearing threshold arithmetic averages (AA) and their standard deviation (SD) in groups: G1 – normal hearing group not exposed to noise; G2- normal hearing group exposed to noise and G3 – hearing loss subject group; right ear (RE) and left ear (LE)

Table 2 – HINT ratio in test conditions and averages (500/1000/2000 and 3000/4000/6000) to right ear and left ear in the groups

Groups			HINT-Q	HINT- NF	HINT-ND	HINT-NE	HINT-NC
G1	M 512 RE	Coefficient	0,50417				0,29920
		p-value	≤.0001				0,0119
	M 512 LE	Coefficient	0,48021				
		p-value	0,0002				
	M 346 RE	Coefficient	0,50417				
		p-value	≤.0001				
	M 346 LE	Coefficient	0,48021				
		p-value	0,0002				
G2	M 512 RE	Coefficient	0,34710		0,37261	030431	
		p-value	0,0032		0,0015	0,0104	
	M 512 LE	Coefficient	0,49069		0,22965	0,27896	
		p-value	<.0001		0,0558	0,0194	
	M 346 RE	Coefficient				0,36009	
		p-value				0,0022	
	M 346 LE	Coefficient				0,24435	
		p-value				0,0415	
G3	M 512 RE	Coefficient	0,52213	0,036221	0,37530	0,53950	0,45951
		p-value	<0,001	0,0010	0,0006	<0,0001	<0,0001
	M 512 LE	Coefficient	0,46763	0,33774	0,44732	0,43946	0,43871
		p-value	<0,0001	0,0022	<0,0001	<0,0001	<0,0001
	M 346 RE	Coefficient	0,31979	0,64303	0,54125	0,68287	0,66579
		p-value	0,0038	<0,0001	<0,0001	<0,0001	<0,0001
	M 346 LE	Coefficient	0,39958	0,60901	0,71893	0,66440	0,72628
		p-value	0,0002	<0,0001	<0,0001	<0,0001	<0,0001

Spearman linear correlation coefficient

A statistical difference (p=0,0001) was found only in the NC condition between G1 and G2 by performing a descriptive analysis and comparisons between the groups on HINT test performance with headphones using the Krukal-Wallis method..

Figure 2 shows the HINT Brazil values on each condition per group. Despite the answers beneath the normal thresholds for every group in the logo-audiometric tests, an inferior performance was found in G3 when compared to G1 and G2. This results shows that hearing loss subjects present an inferior relation signal/noise to the HINT Brazil test.

Comparative tests between G1 and G3, and also between G2 and G3 showed differences in every test conditions (p<0,0001) by the Kruskal-Wallis method.

The average values in normal hearing subjects in Brazilian studies considering the four conditions in HINT Brazil performance are described in the Table 4

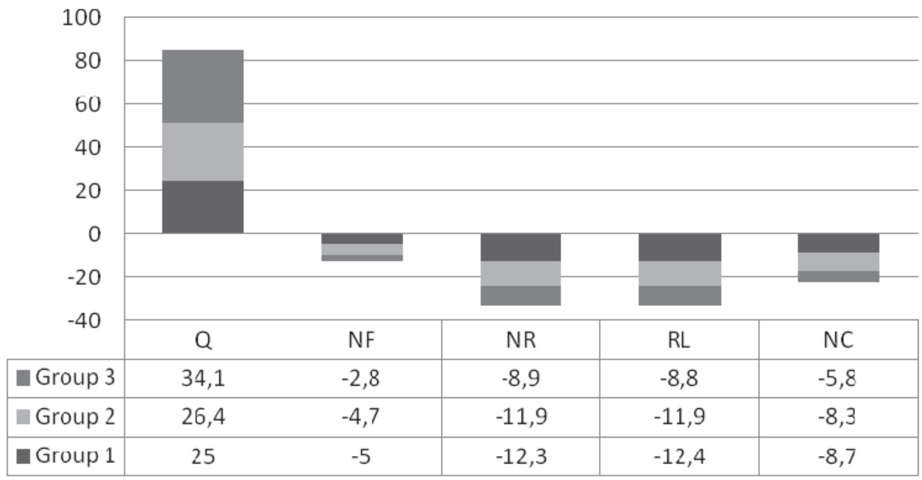

Figure 2 – HINT values to the conditions: Quiet (Q), Noise Front (NF), Noise Right (NR), Noise Left (NL) and Noise Composite (NC) for the three groups.

Table 3 – Descriptive analysis and HINT comparisons in the four test conditions

Group	N	Variable	Average	SD	Minimum	Median	Maximum	p-value (Kruskal-Wallis)
G1	56	HINT- Q	25,0	6,3	13,1	26,1	36,8	<0,0001
		HINT- NF	-5,0	0,9	-6,7	-5,1	-2,7	<0,0001
		HINT- NR	-12,3	1,1	-14,7	-12,5	-9,8	<0,0001
		HINT- NL	-12,4	1,1	-15,0	-12,3	-10,1	<0,0001
		HINT- NC	-8,7	0,8	-10,1	-8,7	-6,5	<0,0001
G2	70	HINT- Q	26,4	5,6	14,5	27,1	39,6	<0,0001
		HINT- NF	-4,7	1,0	-7,6	-4,8	-2,0	<0,0001
		HINT- NR	-11,9	0,9	-13,6	-11,9	-9,6	<0,0001
		HINT- NL	-11,9	1,1	-14,2	-12,0	-9,1	<0,0001
		HINT- NC	-8,3	0,8	-10,3	-8,3	-6,1	<0,0001
G3	80	HINT- Q	34,1	8,8	17,6	34,4	61,3	<0,0001
		HINT- NF	-2,8	2,3	-6,4	-3,4	6,0	<0,0001
		HINT- NR	-8,9	3,4	-13,8	-10,0	3,5	<0,0001
		HINT- NL	-8,8	3,4	-14,2	-9,6	2,9	<0,0001
		HINT- NC	-5,8	2,7	-9,5	-6,6	3,6	<0,0001

HINT application conditions: Q- Quiet; NF- Noise Front; NR- Noise Right; NL- Noise Left; NC- Noise Composite

Table 4 – Average values from HINT Brazil application conditions in national researches in normal hearing subject groups

HINT (with headphones)	Q	NF	NR	NL	NC
Present study- G1	25	-5,0	-12,3	-12,4	-8,7
Present study- G2	26,4	-4,7	-11,9	-11,9	-8,3
Bevilacqua[13]	15,3	-4,6	-12,2	-12,2	-8,4
Arieta[25]	25,7	-5,1	-12,3’	-12,3	-8,5

HINT application conditions: Q- Quiet ; NF- Noise Front; NR- Noise Right; NL- Noise Left; NC- Noise Composite

DISCUSSION

HINT has shown numerous clinical and research applications, besides allowing comparisons between different languages. As shown, HINT Brazil was applied in subjects exposed and not exposed to noise, with and without hearing loss in order to verify the differences in speech perception in noise.

Studies verify that the audiological evaluation fails to predict with precision the recognition speech performance in subjects from different ages due to the fact that it doesn't include competitive noise[19].

The criterion to G1 and G2 was to present audiometric thresholds inside the normality pattern, showing differences between them relative to the exposure or not to noise. This differentiation becomes important to not overestimate the results, because in G1 included normal hearing subjects in a widespread way. The subjects exposed could participate and elevate the hearing threshold[20].

When comparing G1 and G2, we observed a statistical difference (p<0,0001) in NC condition and the normal hearing performance was inferior.

Studies reveal inferior speech recognition in normal hearing groups exposed to noise when compared to a control group without exposure. The authors suggest that noise may cause significant distortions on the temporal processing[21]. These findings are similar to those found in this study, as we found significant speech perception change, considering the weighted average in NC, in the normal hearing group exposed to noise.

The exposure time was evaluated and we found significant change in Q and NC conditions in G2 and no difference was found in G3. However, we found that HINT worsens as time of exposure increases to the group of normal subjects exposed to occupational noise[22].

Increased risk of hearing loss inducted by noise was found in another study, when noise exposure was combined to hands and arms vibration[23]. Such study showed HINT values in noiseless condition (Q) of 25 dBA (G1), 26,4 dBA (G2) and 34,1 dBA (G3) respectively.

Findings from studies including speech sentences tests, not using HINT technology, showed noiseless sentences recognition values ranging from 18,5 to 26,7 dBA[9]; 23,9 ± 5,2 dBA[9], 14,6 and 31,4 dBA[24]

Studies performed in Brazil with HINT technology show that the signal/noise ratio in NF, NR, NL and NC conditions were similar to those obtained in the normal hearing group research, tested with headphones[13,25].

A study in normal hearing subjects with and without speech recognition impairment complains, using the noise sentences test recorded on a CD, found average values in speech/noise ratio to the group without complains of –6,26 (right ear) and –7,12 (left ear), and to the group with complains of –3,62 (right ear) and –4,12 (left ear). These results show that normal hearing subjects with speech recognition complains in noisy environments have worse performance when compared to subjects without complains[10].

Another study, performed in 53 subjects exposed to noise with NIHL diagnosis found sentences recognition threshold in silence average values of 23,9 dBA and signal/noise ratio of –2,7 dB. It was observed a worsens from 2,8 to 4,8 dB in NIHL group performance when compared to normal hearing[26]. These results are similar to those showed in this study where the average value of 34,1 dBA was found in hearing loss subjects in noiseless condition. A signal/noise ratio of –5,8 dB was found in NC condition, confirming the worsen of 2,9 dB (33% on HINT Brazil) in sentence recognition in hearing loss subjects when compared to normal hearing.

Exams involving 400 ears from subjects exposed to occupational noise with normal hearing or hearing loss induced by noise (different degrees) diagnosis were performed and the average values from the Silence Sentence Recognition Threshold (SSRT) test found were from 14,6 to 31,4 dBA without considering eventual differences due the hearing loss degree. The author found a signal/noise ratio variation from –5,09 to –0,1 dB[24]. Our study shows signal/noise ratio data of –5,8 dB, similar to those exposed to NC condition.

Researchers evaluated the sentence recognition threshold with and without competitive noise in a group with NIHL and compared the results with normal hearing subjects. To obtain the data, the researchers used the SSRT and Noise Sentence Recognition Thresholds (NSRT) tests. A total of 88 ears were examined (22 with normal hearing and the rest with different degrees of NIHL) and the results showed an inferior result in the answers of SSRT and NSRT in subjects with NIHL. Also, a tendency of escalation as NIHL increases was found[9]. These findings are like those found in the present study, where the performance of hearing loss subjects is worse when compared to normal hearing subjects, and becomes even worst in the presence of competitor noise.

The average values of SSRT in normal hearing subjects was 14,32 dBA and in the NIHL group ranges from 18,53 to 26,75 dBA, depending on the hearing loss degree, in the above study. The normal hearing group obtained average value of –6,31 dB and the group with different NIHL degrees presented signal/noise ratio average values from

–4,80 to –2,79 dB in the NSRT test. Thus, the authors showed a decrease of 2,7 dB (ranging from 1,88 to 4,88 dB) between the normal hearing and the NIHL groups averages.

It's important to remember that SSRT and NSRT use the same elements as HINT: fixed noise at 65 dB(A) and sentences with speech spectrum noise, but the difference is in the form they are applied, because HINT allows the sentences presentation in software, different test conditions, computes the signal/noise ratio fast and doesn't need to be applied by CD and/or audiometer. The authors also suggest routine tests application to measure the subject group speech perception.

The findings are similar to those found in a normal hearing and hearing loss subjects research regarding the worse speech perception performance from the hearing loss subjects when compared to normal hearing and these results are not detected in logo-audiometric tests applied in the clinic[27].

We observed correlation between HINT performance in Q condition and the audiometric thresholds averages, being in agreement with findings that indicate that both tests can predict the intelligibility. However, HINT offers more information as it evaluates the signal/noise ratio with speech spectrum noise sentence stimuli and enables a substantially precise measure in different population groups in different languages[28].

CONCLUSION

Our study found that there is difference regarding HINT Brazil test performance in normal hearing subjects exposed and not exposed to occupational noise in the Composite Noise condition. The worst HINT performance in every application condition was in the hearing loss group when compared to normal hearing subjects with and without noise exposure.

HINT using shows to be an efficient method to verify speech perception difficulties in noise in the hearing loss group. Nevertheless, further research are necessary in order to disseminate and apply HINT Brazil method in the clinic practice.

RESUMO

Objetivo: investigar a diferença da relação sinal/ruído em sujeitos expostos e não expostos a ruído ocupacional, com e sem perda auditiva, com a utilização do Hearing in Noise Test na versão em Português do Brasil. **Método**: 206 sujeitos, 49 do gênero feminino e 157 do gênero masculino, foram avaliados e divididos em: 56 normo-ouvintes sem exposição a ruído (Grupo 1); 70 normo-ouvintes expostos a ruído ocupacional (Grupo 2); e 80 expostos a ruído ocupacional com rebaixamento audiométrico sensorioneural (Grupo 3). Foi analisado a relação sinal/ruído com o HINT Brasil em quatro condições de apresentação: S- sem ruído; RF- ruído frontal; RD- ruído a direita; RE-ruído a esquerda; RC- ruído composto (média ponderada das apresentações com ruído) e os resultados foram anotados em dB. **Resultados**: os valores médios obtidos foram: G1: 25,0 (S), –5,0 (RF), –12,3 (RD), –12,4 (RE) e –8,7 (RC); G2: 26,4(S),-4,7(RF), –11,9(RD), –11,9(RE) e –8,3 (RC); G3: 34,1 (S), –2,8 (RF), –8,9 (RD), –8,8 (RE), –5,8 (RC). Observou-se diferença significante entre os valores do grupo de sujeitos não exposto (G1) com os do exposto (G2) apenas na condição Ruído Composto (RC). O grupo de sujeitos com rebaixamento audiométrico (G3) apresentou diferença significante em relação aos grupos G1 e G2, com pior desempenho em todas as condições de aplicação. **Conclusão**: o pior desempenho no entendimento da fala em ruído foi no grupo com perda auditiva quando comparado ao de normo-ouvintes com e sem exposição ao ruído.

DESCRITORES: Audição; Percepção da Fala; Testes Auditivos; Testes de Discriminação da Fala; Ruído

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