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***Hospital Noise and Tinnitus-Induced Stress***

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## TABLE OF CONTENTS

<b>Thesis Outline</b> .....	<b>1</b>
<b>RESUMO</b> .....	<b>2</b>
Introdução.....	2
Métodos .....	2
Resultados .....	2
Conclusão.....	2
<b>Title Page</b> .....	<b>3</b>
<b>Abbreviations</b> .....	<b>4</b>
<b>ABSTRACT</b> .....	<b>5</b>
Introduction .....	5
Methods .....	5
Results .....	5
Conclusion .....	5
<b>INTRODUCTION</b> .....	<b>6</b>
<b>MATERIALS AND METHODS</b> .....	<b>8</b>
Statistical Methods.....	9
<b>RESULTS</b> .....	<b>10</b>
Noise Induced Hearing Loss.....	12
Noise levels in the ward .....	12
Tinnitus .....	14
<b>DISCUSSION</b> .....	<b>18</b>
<b>Agradecimentos</b> .....	<b>21</b>
<b>REFERENCES</b> .....	<b>22</b>
<b>Appendices</b> .....	<b>25</b>
Appendix I.....	25
Appendix II.....	26

## **THESIS OUTLINE**

This Master thesis in Medicine consists of an Original Scientific Article, written between March 2019 and April 2020, with bibliographic research until April 2020.

## **RESUMO**

### **Introdução**

Trabalhadores em ambientes com níveis de ruído elevados apresentam frequentemente acúfenos após exposição prolongada. O fluxo constante de pessoas, a presença de máquinas ruidosas e as rodas de carrinhos de comida tornam o hospital um ambiente ruidoso. O objetivo deste estudo é estudar a saúde auditiva de uma população de trabalhadores de uma enfermaria hospitalar, expostos a ruído, avaliando a presença de acúfenos e o stress por eles causado.

### **Métodos**

Foi estudada uma população de 31 trabalhadores do Hospital da Universidade de Coimbra. Um questionário com vista a obter a idade, anos de serviço e horas de trabalho diárias foi preenchido pelos participantes. Foi também colhida informação clínica de cada um e opinião sobre os níveis de ruído na enfermaria. Um segundo questionário foi preenchido por todos os participantes que reportavam acúfenos, de forma a quantificar o seu impacto. Dois grupos foram constituídos, com base na presença, ou não, de acúfenos, e comparados. A prevalência de acúfenos nesta população foi contraposta à de uma população considerada epidemiologicamente semelhante.

### **Resultados**

O número total de trabalhadores que experienciavam acúfenos foi 11, representando 35,5% da população estudada. O valor de prevalência de acúfenos nesta população foi significativamente superior ao esperado para uma população europeia. Os scores obtidos no "Mini-Tinnitus Questionnaire" indicam que a maior parte ( $0,587 < p < 0,980$ ) dos profissionais de saúde apresentam um stress causado por acúfenos compensado (score inferior a 7).

### **Conclusão**

Trabalhadores hospitalares expostos a ruído hospitalar com frequência diária estão em risco de adquirir acúfenos. Este estudo sugere que a elevada prevalência de acúfenos registada poderá estar relacionada com o nível de ruído medido na enfermaria, embora uma análise mais detalhada deva ser realizada. Os níveis de ruído nas enfermarias hospitalares devem ser reduzidos.

**Palavras-Chave:** *Acúfenos; Stress induzido por acúfenos; Trabalhadores hospitalares; Ruído hospitalar; Mini-Tinnitus Questionnaire; Saúde auditiva;*

APRIL/2020

## ***HOSPITAL NOISE AND TINNITUS-INDUCED STRESS***

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## **ABBREVIATIONS**

**C:** Cholesteatoma

**CHUC:** Coimbra's University and Hospital Centre

**MINI-TQ-PV:** Mini-Tinnitus Questionnaire - Portuguese version

**NIHL:** Noise induced hearing loss

**O:** Otitis

**OAEs:** Otoacoustic emissions

**OP:** Patient that frequently goes to the otorhinolaryngologist

**S:** Sinusitis

**SOD:** Seasonal otitis

**T:** Tonsillitis

**TO:** Tonsillitis and Otitis

**TP:** Tympanic perforation

## **ABSTRACT**

### **Introduction**

Workers of places with high noise levels should be considered at risk of acquiring tinnitus. The constant flow of people, noisy machinery and the rolling apparatus in the wheels of food carts, makes the hospital one of those places. This study aims to provide more insight on the auditory health of the workers of a ward, exposed to hospital noise on a daily basis. Tinnitus and tinnitus-induced stress will be assessed.

### **Methods**

A population of 31 hospital workers of the Coimbra's University and Hospital Centre was studied. The participants were asked to fill a simple questionnaire to survey the age, years of employment, average shift length, in hours, and relevant past medical history of each participant. The general opinion of the workers on noise levels in the ward was collected. A second questionnaire was then handed to those participants who reported experiencing tinnitus to quantify tinnitus-induced stress. Participants were divided into two groups, based on tinnitus report, and the two groups were compared. The tinnitus prevalence calculated for this sample was paralleled with European values.

### **Results**

The total amount of workers that described experiencing tinnitus was 11, representing 35,5% of the population studied. The value of tinnitus prevalence obtained for this population of ward workers is significantly higher than that of the European population. This population's "Mini-Tinnitus Questionnaire" scores indicate that most ( $0,587 < p < 0,980$ ) tinnitus in ward-working professionals are compensated (Score < 7).

### **Conclusion**

Ward workers exposed to hospital noise on a daily basis are considered at risk of developing tinnitus. The findings of this study suggest that tinnitus may be related to noise levels in the ward, although job-related stress should be ruled out in a posterior analysis. All precautions should be taken in order to diminish noise levels in hospital wards.

**Key Words:** *Tinnitus; Tinnitus-Induced Stress; Hospital Noise; Mini-Tinnitus Questionnaire; Healthcare workers; Auditory Health;*



## Introduction

High levels of occupational noise are considered by the World Health Organization (WHO) as a widespread risk factor in a number of psychosocial, psychiatric and auditory diseases (1). The correlation between these and high noise levels has long been established and described in a variety of articles and books (1-7). Concerning auditory pathology, tinnitus and Noise Induced Hearing Loss (NIHL) are the most commonly reported (2, 3, 5, 8).

Tinnitus can be defined as an auditory sensation that occurs in the absence of an external acoustic or electrical stimulus and has no subjective information content (9) . The etiology of tinnitus is a common subject of discussion, but it is generally accepted that noise exposure and NIHL are the most common causes (2, 10, 11). A stressful work environment is also associated with higher prevalence of this pathology (12). Tinnitus has significant impact in the quality of life, interfering in professional and personal functioning (13, 14).

Workers of places with high noise levels should be considered at risk of acquiring this pathology. The constant flow of people, noisy machinery and the rolling apparatus in the wheels of food carts, makes the hospital one of those places. (15-21)

Hospital noise levels are currently a source of concern for many authors. There is an increasing effort in promoting silence in hospital wards and, therefore, more and more studies are being developed on this matter(15-17, 22-25) . It is true, however, that the vast majority of these studies focus on the effect noise has in patients and not in healthcare professionals. It is key to find the consequences of hospital ward noise in the auditory health of the professionals who are daily exposed to it.

The high levels of noise measured in hospital wards, in addition to the fact that healthcare workers are a group of professionals exposed to high stress levels (26-28), justifies the assumption that healthcare workers are more prone to suffering from tinnitus and NIHL.

Some studies made on this topic include a 2016 analysis on the prevalence of tinnitus and noise-induced hearing loss in dentists, by Myers J., Andrew J. and Fruits T., who found a higher than expected prevalence of tinnitus based on demographics (29). Ullah, R., Bailie, N., Crowther, S., & Cullen, J., tested speech discrimination and the prevalence of tinnitus and hearing-loss in orthopaedic staff, concluding that intermittent exposure to noise may be a protecting factor (30). No published reports were identified concerning tinnitus and NIHL in ward working professionals.

The aim of this study is to provide more insight on the auditory health of the workers of a ward, exposed to hospital noise on a daily basis. Tinnitus, tinnitus-induced stress and NHIL will be accessed.

## Materials and Methods

A population of 31 hospital workers was studied, 22 nurses and nine auxiliary staff, who work full time in the A ward of internal medicine at Coimbra's University and Hospital Centre. This population was chosen based on the fact that this ward was the only one with available noise level measurements.

The participants were asked to fill a simple questionnaire with two sections.

The first section of the questionnaire was designed to survey the age, years of employment, average shift length, in hours, and relevant past medical history of each participant. Regarding the latter, the following was assessed: presence of otorhinolaryngologic disease, either in the past or in the present moment, medication habits and history of head trauma. Finally, to ensure that occupational noise was the main source of noise exposure, the participants were inquired about leisure activities with elevated noise levels.

The second section focused on [1] finding if the participants ever experienced symptoms of tinnitus and, in case of affirmative answer, its frequency and relation with working years, [2] summarizing the opinion of the workers on noise levels in the ward and the its impact in their work and [3] evaluating subjective perception of hearing loss.

A second questionnaire was then handed to those participants who reported experiencing tinnitus. The "Mini-Tinnitus questionnaire" (Mini-TQ-PV) , designed and tested in 2009 (31) , offers a simple and effective way of quantifying the distress caused by tinnitus. It consists of 12 sentences to which the patient has three possible options: true (2 points), partially true (1 point), and false (0 points). A final score is calculated, and a severity index is obtained. This index can be placed in one of four categories: compensated, for scores between 1 and 7; moderate distress, for scores between 8 and 12; severe distress, for scores between 13 and 18; and most severe distress, for scores between 19 and 24.

In order to assess potential etiology for tinnitus and whether tinnitus had influence in the answers given by the respondents, the participants were divided into two groups. The first group comprised all the participants that reported tinnitus (n=11) and the second comprised the ones that did not (n=20).

To compare the prevalence of tinnitus in this sample with the one in general population, a systematic review from 2016, by McCormack A. (32), was taken into consideration. Three studies (33-35) were selected amongst all the others, due to the population characteristics (Europeans in the range of 30-59 years of age), assuring that both populations were

epidemiologically similar. These studies stipulated values of prevalence of tinnitus between 7,3-14,4%.

To study NHIL, the pure-tone audiometry exam was chosen given its low cost and time expense and its high sensitivity in detecting early stages of hearing loss. Only three exams were realized due to the low availability of the workers.

A study from 2018, when three properly calibrated sound meters were placed in strategic places of the ward, was used to find the noise level range on an average day.

The CHUC Ethics Hospital Committee approved the study protocol. An Informed Consent was collected from every participant by means of a written, signed and dated form, assuring that all ethic and deontological aspects were respected and the information gathered was to be kept anonymous.

### **Statistical methods**

Categorical data was presented as frequency and percent. Continuous data was summarized as minimum value, maximum value and average. Standard deviation was not presented due to the small size of the sample.

To compare groups for categorical data, the Chi-Square or the Fisher-Exact tests were used. To compare groups for continuous data, the T-student or the Mann-Whitney tests were used. The analyses were performed with a significance level of 0,05.

For the prevalence of tinnitus and tinnitus-induced stress prediction studies, the One-sample binomial test was used, with a confidence interval of 95%.

## Results

The total number of participants was 31, with ages ranging from 30 to 59. The average age of the study was 39,9. Of these 74,2% (n=23) were women and 25,8% (n=8) were men. Years of employment went from 1 to 33, averaging 10,9. The average number of hours a day was 7,8.

Concerning the first section of the first questionnaire, otorhinolaryngologic past inquiry revealed 51,6 % (n=16) of participants had history of tonsillitis, of which 31,25% (n=5) were recurrent tonsillitis (considered 3 or more in 6 months). Otitis was reported in 32,3% (n=10). History of both otitis and tonsillitis was reported by 16,1% (n=5) of participants. Finally, one case (3,2%) was recorded for each one of the following: Sinusitis; Cholesteatoma; Tympanic perforation; Seasonal Otitis. Two participants, representing 6,4% (n=2) had regular appointments with an otorhinolaryngologist due to the condition described before.

Referring to present state of disease, 22,6% (n=7) answered positively, with the following pathologies being registered: Hashimoto Tiroiditis; Anemia; Lower extremity Lymphedema; Allergic Rhinitis with Dry Nasal Mucosa; Migraine; Insomnia and Vertiginous Syndrome; Regular medication inquiry revealed the use of Levotiroxin, Antihistamine, Broncho-vaxom, Oxitriptan, Trazodone and Antidepressant, each one being used by only one participant. Finally, one participant had history of head trauma. No participants reported exposure to loud noise leisure activities, such as hunting, motorcycling, and night clubbing, amongst others. Only 9,7% (n=3) of respondents reported having done an audiogram in the past, to which none of them had access for comparison purposes.

The answers to this first section of the questionnaire are summarized in table 1.

**Table I – Answers to the first section of the questionnaire.**

<i>Nº</i>	<i>Age</i>	<i>Years</i>	<i>Hours a day</i>	<i>Othorinologic past</i>	<i>Current Disease</i>	<i>Usual Medication</i>	<i>Other</i>
1	30	2	8	T	-		
2	31	2	8	-	-		
3	31	8	7	RT	-		
4	31	9	7	RT	-		
5	32	3	6	T	Hashimoto Tiroiditis	Levotiroxin	
6	32	3	8	T	-		
7	32	4	8	-	-		
8	33	8	7	TO TP (9yoAge)	-		
9	33	10	8	T	Anemia		
10	33	10	7	TO	-		
11	34	4	8	-	Dry Nasal Mucosa (Allergic Rhinitis)	Anti-Histamine	
12	34	5	8	T	-		
13	34	10	7	-	-		
14	34	10	8	O	-		
15	34	10	6	RT	-		
16	34	10	8	-	-		
17	35	1	8	SOD	-	Broncho-vaxom	
18	35	10	8	O & S	Lower extremity Lymphedema		OP
19	35	10	8	T	-		
20	37	3	9	RT	-		
21	37	15	10	O	Migraine	Oxriptan	
22	38	16	8	RT	-		
23	40	3	8	TO	-		
24	40	15	8	TO	-		
25	42	19	8	-	-		
26	45	24	8	TO	-		
27	49	15	8	-	Insomnia	Trazodone	
28	51	8	8	-	Vertiginous Syndrome	Antidepressant	History of head trauma
29	51	33	8	-	-		
30	56	25	8	-	-		
31	59	33	8	O & C	-		OP

Abbreviations (in order of appearance)

T- Tonsillitis; O- Otitis; TO- Tonsillitis and Otitis; S- Sinusitis; C- Cholesteatoma; SOD- Seasonal Otitis in Right ear; TP- Tympanic perforation; OP- Patient that frequently goes to the otorhinolaryngologist because of othorinologic condition described before

Concerning the second section of the first questionnaire, “workers’ opinion on noise levels in the ward”, 74,2% (n=23) of workers classified their working place as Noisy, 22,6% (n=7) described it as Very Noisy and 3,2% (n=1) classified it as Calm. No participants classified it as Silent. 58,1% (n=18) of workers Disagreed with the sentence “The noise in my workplace is suitable for a hospital”, 29,0% (n=9) Fully disagreed, 9,6% (n=3) agreed and 3,2% (n=1) neither agreed nor disagreed. 19,4% (n=6) fully agreed that their “productivity is affected by noise in the ward”, 45,2% (n=14) agreed, 19,4% (n=6) neither agreed nor disagreed, 12,9% (n=4) disagreed and 3,2% (n=1) fully disagreed. 16,1% (n=5) fully agreed that “there were moments where they couldn’t hear important sounds because of background noise in the ward”, 35,5% (n=11) agreed, 12,9% (n=4) neither agreed nor disagreed, 12,9% (n=4) disagreed and 22,6% (n=7) fully disagreed. Finally, 25,8% (n=8) fully disagreed that “their hearing has worsened since they started working at the hospital”, 41,9% (n=13) disagreed, 22,6% (n=7) neither agreed nor disagreed, 6,4% (n=2) agreed and 3,2% fully agreed (n=1).

All the answers are summarized in figure 1.

## **Noise Induced Hearing-Loss**

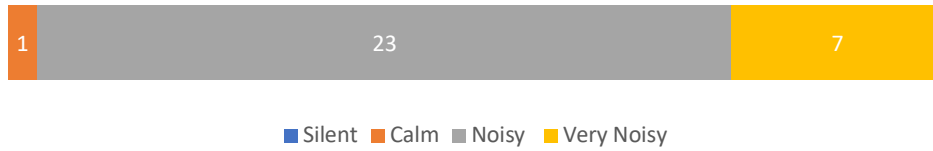
The number of pure-tone audiometry exams realized was below the considered adequate to make inferences about NIHL in the participants. In fact, due to issues concerning the availability of the participants, only three exams were performed.

The answers to the question “My hearing has worsened since I started working at the hospital” offered some perspective about subjective perception of hearing loss among the respondents. Only 9,6% (n=3) answered “agree” or “fully agree” to the question.

## **Noise levels in the ward**

Information collected from a 2018 study revealed a medium noise intensity between 54,7dB and 61,5dB, depending of the location of the sound meter. Maximum levels of noise (peaks) measured were 95,6 dB, 101,4 dB and 96,7dB for each location.

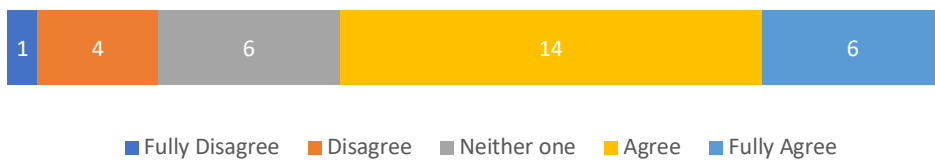
### HOW WOULD YOU CLASSIFY YOUR WORKPLACE?



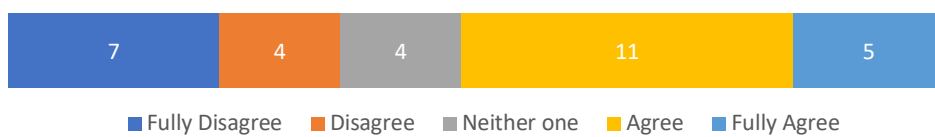
### THE NOISE IN MY WORKPLACE IS SUITABLE FOR A HOSPITAL



### MY PRODUCTIVITY IS AFFECTED BY NOISE IN THE WARD



### THERE ARE MOMENTS WHEN I MISS IMPORTANT SOUNDS FOR MY WORK (MACHINES BEEPING, COLLEAGUES TALKING) BECAUSE OF BACKGROUND NOISE



### MY AUDITION HAS WORSENERD SINCE I STARTED WORKING AT THE HOSPITAL

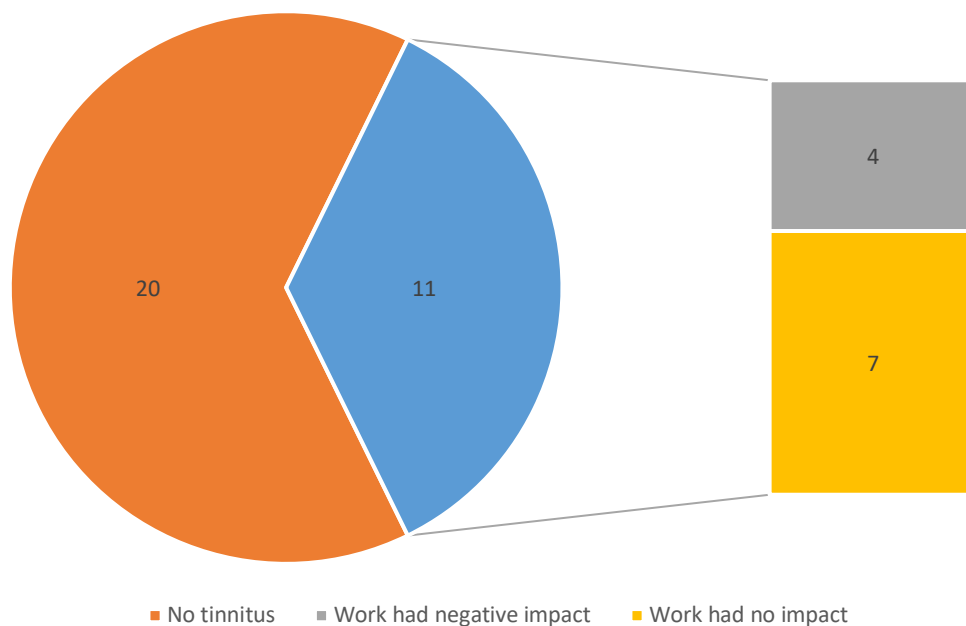


**Figure 1-** Workers' opinion on noise levels in the ward.



## Tinnitus

The total amount of workers that described experiencing tinnitus was 11, representing 35,5% of the population studied. All of these reported that their tinnitus was not constant, being noticed only during certain periods of the day. As to the period of the day in which the tinnitus was more intense, 9,1% (n=1) mentioned the morning, 54,5% (n=6) mentioned the night, 27,2% (n=3) mentioned at night when in bed, and 18,2% (n=2) at moments of silence. Finally, 36,4% (n=4) referred that work had a negative impact on tinnitus and 63,6% (n=7) mentioned that work had no impact on tinnitus.



**Figure 2-** Number of respondents reporting tinnitus.

The tinnitus prevalence by age interval was as follows: 36,4% (n=8) for ages under 40 years, 40% (n=2) for ages between 40 and 50 and 25% (n=1) for ages over 50. Tinnitus prevalence by years of work was 28,6% (n=4) for under 10 years of work, 46,2% (n=6) for work years between 10 and 20 and 25% (n=1) for more than 20 years of work.

In referral to the Mini-TQ-PV, the scores ranged from 0 to 12. The average score was 3,1. Of the 11 questioned, 18,2% (n=2) scored 0, 18,2% (N=2) scored 1, 27,3% (n=3) scored 2, 9,1% (n=1) scored 3, 9,1% (n=1) scored 4, 9,1% (n=1) scored 7 and 9,1% (n=1) scored 12.

Two groups, the one reporting tinnitus and the one reporting no tinnitus, were compared, according to multiple variables.

**Table II** - Comparison of categorical and continuous data between the group with tinnitus and the group without tinnitus.

	TINNITUS	
	YES	NO
<b>AGE</b>	38,45	37,45
<b>YEARS OF SERVICE</b>	12,73	9,90
<b>AVERAGE SHIFT LENGTH (HOURS)</b>	8	7,73
<b>WOMEN</b>	26,1% (n=6)	73,9% (n=17)
<b>MEN</b>	62,5% (n=5)	37,5% (n=3)

**Table III** – The group with tinnitus and the group without tinnitus, according to chosen variables. The “Mini-Tinnitus Questionnaire” score of the tinnitus group.

VARIABLE	TINNITUS				MINI-TQ-PV score	
	YES		NO		SCORES	AVG
	N	% (of 11)	N	% (of 20)		
<b>Age</b>						
<40	8	72,7	14	70	0-4	1,75
40 to 50	2	18.2	3	15	7;12	9,5
>50	1	9.1	3	15	1	1
<b>Years</b>						
<10	4	36.4	10	50	0-4	2
10 to 20	6	54.5	7	35	0-12	4,2
>20	1	9.1	3	15	1	1
<b>Shift length (hours)</b>						
6	0	0	2	10	-	-
7	2	18.2	3	15	1; 2	1,5
8	8	81.8	14	70	0-12	3,2
>8	1	9.1	1	5	3	3
<b>HOD</b>						
None	5	45.5	5	25	1-12	5,2
Tonsillitis	4	36.4	12	60	0; 2	1
Otitis	2	18.2	8	40	1; 2	1,5
TP	0	0	1	5	-	-
OP	1	9.1	1	5	1	1
<b>Current disease</b>						
Yes	4	36.4	3	15	0-7	3
No	7	63.6	17	85	0-12	3,1

Abbreviations (in order of appearance): AVG- average score; SCORES- Minimum and maximum scores  
HOD- History of Otorhinolaryngological Conditions

No significance was found in the correlation between tinnitus and the variables age ( $p=0,881$ ), years of work ( $p=0,569$ ) and shift length ( $0,577$ ).

**Table IV** – Answers to questions on noise levels in the ward by group (Tinnitus and No-Tinnitus)

QUESTION	TINNITUS		P-value	
	YES	NO		
Q1	Calm	0	1 (5%)	<b>0,067</b>
	Noisy	6 (54.5%)	17 (85%)	
	Very Noisy	5 (45.5%)	2 (10%)	
Q2	Agree / Fully Agree	0	3 (15%)	<b>0,369</b>
	Neither one	0	1 (5%)	
	Disagree / Fully Disagree	11 (100%)	16 (80%)	
	Disagree / Fully Disagree	0	5 (25%)	
Q3	Neither one	3 (27.3%)	3 (15%)	<b>0,225</b>
	Agree / Fully Agree	8 (72.7%)	12 (60%)	
	Disagree / Fully Disagree	3 (27.3%)	8 (40%)	
Q4	Neither one	1 (9.1%)	3 (15%)	<b>0,584</b>
	Agree / Fully Agree	7 (63.6%)	9 (45%)	
	Disagree / Fully Disagree	7 (63.6%)	14 (70%)	
Q5	Neither one	2 (18.2%)	5 (25%)	<b>0,704</b>
	Agree / Fully Agree	2 (18.2%)	1 (5%)	
	Agree			

Q1- “How would you classify your workplace?”; Q2- “The noise in my workplace is suitable for a hospital.”; Q3- “My productivity is affected by noise in the ward.”; Q4- “There are moments when I miss important sounds for my work (machines beeping, colleagues talking) because of background noise.” Q5- “My audition has worsened since I started working at the hospital.”

## Prevalence

The value of tinnitus prevalence obtained for this population of ward workers is significantly higher than the one estimated for the European population. The value used for the prevalence of tinnitus in the European population, 11,2%, was the one obtained by Axelsson, A. in 1989 (33), for a sample of “randomly selected adults between 30 and 59 years of age”. This value was considered representative based on all the other studies referred above, that found values between 7,3-14,4%.

**Table V** – Comparison between the prevalence of tinnitus in this population and the prevalence in the city of Gothenburg, measured in 1989, by Axelsson, considered representative of the European population.

<b>Hypothesis Test Summary</b>			
<b>Null Hypothesis</b>	<b>Test</b>	<b>Sig.</b>	<b>Decision</b>
<b>The categories defined by Tinnitus = (Y) and (N) occur with probabilities 0.112 and 0.888</b>	One-Sample Binomial Test	<b>.000</b>	<b>Reject the null Hypothesis</b>
Asymptotic significances are displayed. The significance level is .05 Abbreviations: Y- YES; N- NO;			

## Severity

The 95% confidence interval obtained for this population’s “Mini-TQ-PV” scores indicate that most ( $0,587 < p < 0,980$ ) tinnitus in ward-working healthcare professionals are compensated (Score under 7).

**Table VI** – Confidence Interval of the “Mini-Tinnitus Questionnaire” score obtained for the ward workers population, using the One-Sample Binomial Success Rate.

<b>Confidence Interval Summary</b>				
			<b>95% Confidence Interval</b>	
<b>Confidence Interval Type</b>	<b>Parameter</b>	<b>Estimate</b>	<b>Lower</b>	<b>Upper</b>
<b>One-Sample Binomial Success Rate (Clopper-Pearson)</b>	Probability (Compensated)	.091	.002	.413

## Discussion

This study gathered information from 31 participants, workers of the A ward of the Internal Medicine service of the Coimbra's University and Hospital Centre. It assessed past medical history, subjective opinion on noise in the ward, prevalence of tinnitus and tinnitus-induced stress. Data concerning measurement of noise levels in the ward was also analyzed. This study provided a new perspective on the consequences arising from a hospital's noisy working environment, particularly the ones regarding auditory health. To the best of our knowledge, no other study presented information about tinnitus and tinnitus induced stress in healthcare ward-workers.

The average noise levels recorded at the ward were, to say the least, concerning. Hospital day and nighttime noise has been rising over the past fifty years, and the measurements taken show that noise in CHUC is no exception. The average noise levels between 54,7 - 61,5 dB largely exceed the ones recommended by the *Journal of Acoustical Society of America* in 2005, of levels between 30-35 dB, as stated by Walker, L and Karl, CA (15).

The results obtained in the subjective opinion questionnaire about noise in the ward expose the alarming reality that noise is considered inadequate and harmful by the vast majority of workers. Only one in thirty-one respondents considered the hospital a calm place, opposing to all thirty that placed it in the "Noisy" or "Very Noisy" categories. Twenty (65%) respondents find their productivity affected by the noise and sixteen (52%) mention missing important noises due to background noise, revealing working conditions that are far from ideal. A possible explanation for the described above is the enormous amount of noise sources in a hospital ward, such as health professional and visitors' conversations outside the designated spaces and in an unreasonable intensity, beeping alarms, doors slamming without appropriate damping and wheels with inappropriate maintenance rolling on the floor. These findings are in accordance with the "pandemonium with settings of turbulence and frenzied activity" characterized by Grumet in 1993 (19) , in an article with many other identified noise sources and solutions to be developed, and with the dissatisfaction found by Bayo M.V. (22).

These noise levels and information provided by the respondents suggest the need for taking immediate action in order to eliminate unnecessary sources of noise, change personnel habits and eventually study the ward's arrangement. Krasnic, wrote a thorough text on solutions to this problem in 2012 (23) , many of which can be applied in the ward contemplated in the present study. The hospital should thrive to be a quiet place, where workers can think

and act without unnecessary noisy distractions and where patients can have a restful recovery. Only then will the workers' and patients' well-being be assured.

The information gathered on otorhinolaryngologic past revealed no participant had risk factors for tinnitus, such as unilateral hearing loss, bilateral hearing loss or abnormal tympanic membrane (11), with the exception of one participant with past medical history of cholesteatoma. No participant had history of treatment with ototoxic drugs, such as aminoglycosides, diuretics like furosemide or ethacrynic acid, salicylates or cytostatic. Other conditions reported included Thyroid disease, Insomnia and Migraine, related to a higher tinnitus prevalence. In fact, the patient with thyroid disease and the patient with migraine reported tinnitus, making these two conditions possible etiologies for the latter.

Hearing loss is one of the most common medical conditions in the adult population, therefore affecting nurses and other healthcare professionals. According to Spencer, C. S. (36), hearing plays a major role in the nursing practice and, therefore, nurses should be encouraged to maintain their hearing health by having their hearing screened every five years. In this study, 90,3% (n=28) of the participants reported not having undertaken an audiometry in the past, and the three that had no access to the past exam for comparison. This suggests that the appropriate measures to ensure the auditory health of the ward workers aren't being taken. Workers should be encouraged to test their hearing more frequently, especially if they show symptoms of hearing issues, such as speech recognition difficulty or inability to hear alarms.

As previously stated in the results section, the number of pure-tone audiometry exams carried out was insufficient to make inferences about NIHL in the participants. It is of interest to perform this exam in a posterior study. Another promising test, one with a higher sensitivity to detect NHIL, is the Otoacoustic Emission exam (OAEs). OAEs are proved to be more reliable in detecting changes in cochlear functioning than audiometry (37) and would be the ideal tool to detect harmful effects of noise exposure in a population of healthcare workers.

Survey responses reported in the tinnitus section raise some concern for the hearing health of the ward workers. A tinnitus rate higher than European averages was registered in this population of healthcare professionals. This can be considered significant with a 95% confidence interval, as shown in table V. The findings of this study suggest that tinnitus may be related to noise levels in the ward, although other variables such as job-related stress should be ruled out in a posterior analysis. Fortunately, the distress caused by this tinnitus seems to be widely compensated, as shown in table VI. This is consistent with the type of tinnitus described by the respondents, an intermittent buzz that mainly appears in times of silence such as in the morning right after waking up, or in bed at night. Tinnitus that is

considered the most bothersome is the one that affects the patient throughout the whole day, with little or no reduction in intensity, that can obfuscate exterior sounds causing a significant impact in social and professional functioning. All these findings are in accordance with what was described by Myers J (29), in a population of dentists.

Another important finding of the present study was the difference disclosed by the comparison between the tinnitus and no-tinnitus groups. Although no statistical significance was found, due to the insufficient potency of the tests for such a small sample, certain tendencies are worthy of notice. The group that reported tinnitus is composed by older and more experienced individuals, with more working years, who work longer shifts. Table IV also presents interesting results, implying that tinnitus is an important factor in noise level tolerance. Question 1 was close to show statistical significance (only significant for a 10% confidence interval), indicating that workers that suffer from tinnitus are probably more prone to finding the hospital a noisier place. Question 2 answers also suggest that the tinnitus group is more dissatisfied with noise levels in the ward. Other questions, such as 3 and 4, indicate a clear tendency, in the tinnitus group, to consider productivity is affected by noise in the ward and to miss important sounds due to background noise, although no statistical significance could be obtained. Finally, analyzing table III, tinnitus distress seems to be higher with working hours and longer shifts, but the population is too small to make valid inferences.

In order to clarify the findings stated above, another study with a bigger sample of hospital workers and with a more detailed questionnaire would be of interest to perform.

This study has several limitations that require some degree of comment. Firstly, the sample is of small dimensions. This is tied to the fact that sound measurements were only available for one ward in HUC hospital, making the population of workers of that ward the ones available for inquiry. Secondly, the group age distribution was not representative of all age intervals, since no worker was under 30 or over 60 years of age. Auditory pathology related to noise exposure tends to be more evident at older ages, so it is recommended that posterior studies select a larger sample, particularly if NIHL is studied. Thirdly, all the answers given to the questionnaire are of subjective nature, so the results collected can be influenced by the accompanying bias. Finally, all the participants belong to the same hospital, so the conclusions of the present studies might not be representative of hospitals where noise levels are lower.

In conclusion, ward workers exposed to hospital noise on a daily basis are considered at risk of developing tinnitus. Tinnitus prevalence in this population was higher than predicted by European averages. All the proper precautions should be taken to ensure that noise levels in hospital wards are kept in appropriate intervals.

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## APPENDICES

### APPENDIX 1

#### MINI-TINNITUS QUESTIONNAIRE—VERSÃO PORTUGUESA (MINI-TQ-PV)

O objectivo deste questionário é saber se os seus zumbidos têm algum efeito no seu humor, hábitos ou atitudes. Por favor coloque uma cruz (X) na resposta mais adequada para cada afirmação:

---

	Em parte	
	Verdadeiro	Falso
1. Eu sinto os zumbidos desde que me levanto até ao momento em que vou dormir.		
2. Por causa dos zumbidos, eu receio que exista algo de muito errado com o meu corpo.		
3. Se os zumbidos continuarem, não valerá a pena continuar a viver.		
4. Eu fico mais irritável com a minha família e com os meus amigos, por causa dos zumbidos.		
5. Tenho medo que os zumbidos possam prejudicar a minha saúde física.		
6. Tenho mais dificuldade em relaxar, devido aos zumbidos.		
7. Muitas vezes os zumbidos são tão maus que não consigo ignorá-los.		
8. Demoro mais tempo a adormecer, devido aos zumbidos.		
9. Fico mais propenso(a) a sentir-me “em baixo” devido aos zumbidos.		
10. Penso muitas vezes se os zumbidos alguma vez vão desaparecer.		
11. Sou uma vítima dos meus zumbidos.		
12. Os zumbidos têm afectado a minha concentração.		

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## PROJETO DE INVESTIGAÇÃO

### A SAÚDE AUDITIVA DA POPULAÇÃO TRABALHADORA DA ENFERMERIA A DE MEDICINA DO HUC

Investigador: Martim Costa Urbano, aluno do 6º ano do MIM

#### Identificação

Nome:

Idade:

Sexo:

Profissão:

# SECÇÃO 1

## História Patológica sucinta

Tem alguma doença diagnosticada? (quais e data do diagnóstico)

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Realiza alguma medicação habitual?

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---

Infeções na infância (quais e tratamentos)? Doenças do foro otorrinológico?

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## História Otorrinolaringológica

Alguma vez foi ao otorrinolaringologista? (se sim, porquê, se é seguido/a em consulta?)

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---

Tem alguma história de traumatismo craniano?

---

---

Alguma vez realizou um exame de audição, nomeadamente, audiograma?

---

---

Tem algum hobby onde esteja exposto a níveis elevados de ruído? (caça, motociclismo, atividades noturnas, outros)

---

---

## História Profissional

Anos de serviço:

Horas de permanência na enfermaria por dia:

Como descreve o seu local de trabalho a nível de ruído?

- Muito barulhento
- Barulhento
- Calmo
- Silencioso

Sente que o ruído no seu local de trabalho é adequado para um hospital?

- Concordo plenamente
- Concordo
- Não concordo nem discordo
- Discordo
- Discordo plenamente

Sente que o ruído no seu local de trabalho afeta a sua produtividade?

- Concordo plenamente
- Concordo
- Não concordo nem discordo
- Discordo
- Discordo plenamente

## SECÇÃO 2

### ACUFENOS:

Alguma vez presenciou a sensação de zumbido?

- Sim
- Não

Como descreve esse zumbido?

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O zumbido é constante ou intermitente?

---

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---

O seu zumbido é pior em que altura do dia?

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Grau de stress causado pelo zumbido (REALIZAR MINI-TINNITUS QUESTIONAIRE).

Sente que o seu trabalho causou agravamento do seu zumbido?

- Sim
- Não
- Não sei

### PERDA DE AUDIÇÃO:

Sente que a sua audição piorou desde que começou a trabalhar no hospital?

- Concordo plenamente
- Concordo
- Não concordo nem discordo
- Discordo
- Discordo plenamente

Sente que por vezes tem dificuldade em ouvir ruídos hospitalares importantes para o seu trabalho (máquinas, colegas) por haver demasiado ruído de fundo?

- Concordo plenamente
- Concordo
- Não concordo nem discordo
- Discordo
- Discordo plenamente

Tem alguma informação relevante a acrescentar?

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Está disposto/a realizar um audiograma?