

# Prevalence of hearing problems and associated factors in an agricultural company in southern Brazil

## *Prevalência de problemas auditivos e fatores associados em uma empresa agropecuária do sul do Brasil*

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**ABSTRACT:** *Objective:* To describe the prevalence and to analyze the factors associated with hearing problems in an agricultural company. *Methods:* This was a cross-sectional study, and the participants consisted entirely of employees of an agricultural company in southern Brazil. The workforce of the company was composed of several different occupations. The research instrument was a semi-structured questionnaire administered by interview. *Results:* Of the 326 workers of the company, there were 273 (83.8%) respondents, and the prevalence of hearing problems was  $n = 42$  (15.4%) among the participants of the study. The hearing problems were associated with lower schooling, with the operating occupational group, the technical assistance group and the general services group. The self-reported health conditions associated with hearing problems were depression and nervousness or irritation. The occupational exposures associated with hearing problems were noise, dust, vibration, oils and solvents, and toxic gases. *Conclusion:* There was an intermediate prevalence of hearing problems in relation to other studies. It was possible to observe the need to implement strategies aiming at the prevention of hearing problems that primarily contemplate modifiable aspects, such as the use of personal protective equipment, as well as improvements in the conditions, organization and work environment.

**KEYWORDS:** Hearing loss. Occupational exposure. Occupational health. Epidemiology. Agricultural workers' diseases. Chemical compounds.

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**RESUMO:** *Objetivo:* Descrever a prevalência e analisar os fatores associados a problemas auditivos em uma empresa agropecuária. *Métodos:* Foi realizado um estudo de corte transversal, os participantes do estudo foram os trabalhadores de uma empresa agropecuária do sul do Brasil. A força de trabalho da empresa contava com as mais diversas ocupações. O instrumento da pesquisa foi um questionário semiestruturado aplicado por meio de entrevistas. *Resultados:* Dos 326 trabalhadores da empresa foram entrevistados 273 (83,8%) e foi encontrada uma prevalência de problemas auditivos de  $n = 42$  (15,4%) entre os participantes da pesquisa. Os problemas auditivos foram associados com níveis mais baixos de escolaridade e ao grupo ocupacional operacional, técnico assistencial e serviços gerais. As condições de saúde autorreferidas com associação para problemas auditivos foram depressão e irritação ou nervosismo. As exposições ocupacionais associadas aos problemas auditivos foram barulho, pó, vibrações, óleos e solventes e gases tóxicos. *Conclusão:* Houve uma prevalência intermediária de problemas auditivos em relação a outras pesquisas. Observou-se a necessidade da implantação de estratégias que visem à prevenção de problemas auditivos que contemplem principalmente os aspectos modificáveis, como a utilização de equipamento de proteção individual, e melhorias nas condições, organização e ambiente de trabalho.

**Palavras-chave:** Perda auditiva. Exposição ocupacional. Saúde do trabalhador. Epidemiologia. Doenças dos trabalhadores agrícolas. Compostos químicos.

## INTRODUCTION

Globalization and the expansion of economies around the world result in great impact on the health of workers, for they impose higher productivity and loads of adverse occupational exposures to workers, especially to the hearing system. Hearing may be considered one of the most important senses, being mostly in charge of communication, and generates the psychosocial development of people<sup>1</sup>. Hearing conditions will be one of the ten most common health problems in the world up until 2030<sup>2</sup>.

Hearing problems, especially the ones that might be related to work, must be considered in the context of occupational health, for the impaired social communication may reduce productivity at work, besides compromising the quality of sleep for workers. It is noticeable in this sense the importance and great socioeconomic impact these problems may bring upon society<sup>3</sup>.

Hearing problems are generated by several associated factors, with multiple causes, such as noise, occupation, working hours, chemicals, solvents, toxic gases, among other labor issues<sup>3-6</sup>. Such aggravations may be associated to other health conditions, such as mental and cardiovascular disorders<sup>7-9</sup>. There are studies indicating the prevalence of 10 to 15% people affected by hearing problems in the overall population<sup>2</sup>. Part of these studies also analyzes hearing problems in relation to gender and age.

Studies assessing hearing problems of occupational origin under the light of several aspects are of great relevance, once that such studies are scarce in Brazil and the workforce in the country increases, with approximately 96 million workers nowadays<sup>10</sup>. The objective

of this study was to describe the prevalence and to analyze the factors associated to hearing problems in an agricultural company in Southern Brazil.

## METHODS

This is a quantitative, observational, cross-sectional study. It is part of the research project from the Nursing School at Universidade Federal de Pelotas, Rio Grande do Sul. It was carried out in a midsized agricultural company, in Southern Brazil, and it is connected to the Ministry of Agriculture, Livestock and Supply. The participants of the study were all workers from the aforementioned company, aged 18 years old or older. For the inclusion of participants, the following criterion was used: being an effective worker in the company. The informed consent form was signed by the participants of the research. The population of agricultural workers included the following fields: administrative assistance, supervision/management, operational, scientific technician, assistencial technician, research and general services. The sectors were divided into support, research, laboratory and field.

A brief description was given for the composition of occupational groups: administrative assistance (secretary, administrative auxiliary and board counselors); supervision/management (supervisors, managers and company managers); operational (machine and vehicles operators, general staff, drivers, doormen, guards, telephone operators, filders and "laborers"); research (researchers from several fields in the company); scientific technician (workers with academic education); assistencial technician (mid-leveled workers with a technical course in a working field); general services (workers responsible for the cleaning and sanitization of the company).

As for sectors, they were divided into support sector (regarding administration, management, financial, communication, marketing, culture, purchasing and human resources areas); research sector (regarding the different areas of proficiency involved in animal and vegetal agricultural research, genetic improvements, agroecology, climatology and agrometeorology); laboratory sector (regarding the most numerous laboratories for analysis from the company); field sector (includes all work performed in the field, regarding the treatment of animal in research; planting, growing and harvesting of the vegetal specimens researched).

The instrument used for data collection was multidimensional, semi-structured with open and closed questions, consisting of socioeconomic and demographic questions about lifestyle, occupation, organization and work conditions, occupational exposure/load, perception of overall morbidity related to work<sup>11</sup>. The interviews were conducted in the company during the work shift with a previous authorization from the company. For data collection, nursing school students were skilled to conduct the interviews. The period of data collection was between the months of June and October, 2008. In the case of workers who were not at the company at the moment of the interviews, there were at least three other attempts of approaching these workers.

After the end of data collection, procedures such as correction of the questionnaires and quality control of the interviews were performed. A database was created with the information

collected through the questionnaires. The data were inserted through independent double typing, using the Epi Info software, version 6.04. After verification and correction of errors and inconsistencies, data analysis was performed by the STATA software, version 12.

Qualitative variables such as dichotomous, polytomous and continuous ones were analyzed. The variables analyzed were: gender; age / age range (up to 44 years of age, 45 – 50 years of age, 51 years of age onward); schooling (elementary school, high school, higher education and higher education with post-graduation). The occupational groups and job sectors in the company, as well as time working in the occupation (up to 72 months, 73 – 240 months, and from 241 months on) were also analyzed. The occupational aggravation of hearing problems, exposures due to the process and organization of work, and the comorbidities were guided by the following questions: Do you think your job usually causes you difficulties hearing/ buzzing (yes/ no)?; Did you have hearing problems within the last 30 days (yes/ no)?; Do you endure the following situations at work (yes/ no)? (noise, exposure to dust, vibrations, use of oils and solvents, exposure to smoke or toxic gases); Do you think your job usually causes you to feel irritation or nervousness (yes/ no)?; Do you have any of these diseases (yes/ no)? (depression, congestive heart failure [CHF], cardiac arrhythmia).

Data analysis used absolute and relative frequencies for the socioeconomic, demographic and work organization variables; besides, the 95% confidence interval (95%CI) was calculated, for the occupational aggravation hearing problems related to work. For the variable age and time of work we calculated the mean, median, standard deviation, maximum and minimum value.

The calculation of prevalence ratio (PR) was performed to obtain the measure of effect for association<sup>12</sup> with 95%CI between the dependent variable (hearing problems related to self-reported work) and the variables independent of occupational exposure (noise; exposure to dust; vibrations; use of oils and solvents at work; exposure to toxic gases). The PR of hearing problems was also measured with other health conditions or comorbidities, such as irritation or nervousness related to work; self-referred depression; CHF; cardiac arrhythmia; considering  $p < 0.05$  to be significant.

After gross analysis, an adjusted analysis was performed with the Poisson regression<sup>13</sup> for the variables occupational exposure and comorbidities mentioned for the variables with potential confounding factors for the outcome, hearing problems, the variable gender, and especially age because of the presbycusis which might occur within older age ranges<sup>14</sup>, considering  $p < 0.05$  to be significant; 95%CI was described. The variables that obtained  $p < 0.20$  in the Gross analysis were maintained.

Perason's  $\chi^2$  test was used in order to compare the differences in the proportions of hearing problems as for gender, age range, schooling, hearing problems in the last 30 days, occupational groups, working sectors of the workers and the time of work in the occupation, considering  $p < 0.05$  to be significant

The research project was sent to the Research Ethics Committee of the School of Dentistry at *Universidade Federal de Pelotas*, Rio Grande do Sul, in accordance to Resolution 196/96 of the National Health Council (CNS), endorsed under n. 011/2008 on April 18<sup>th</sup>, 2008.

## RESULTS

In the period of the interviews the company had 326 workers, from which 10 were on leave for professional improvement and technical trips, 8 were on leave for medical reasons and 4 were on vacation, totaling 304 workers who performed activities in company ground at the time of data collection. Between losses and refusals, this research had the participation of 273 (83.8%) workers. In the results found in Table 1, regarding the sociodemographic characteristics of the company, there is prevalence of male workers (79.1%). The average age of the workers was 47.6 years, the median was 49 years of age, the standard deviation (SD) was 8.2 years of age, the minimum age was 19 and the maximum was 69 years of age. Almost one third of the workers (27.8%) have a graduation degree when it comes to schooling level. The mean time in the function was 167.3 months, the median was 132 months, the SD was 127.2 months, the minimum time was 1 month and the maximum was 624 months in the function (Table 2).

The prevalence of hearing problems related to work in the company was 15.4% (95%CI 11.3 – 20.2). For the variable gender, the difference between men and women for hearing problems was not significant; males were more often affected, with 17.2% (n = 37), and for females we found 8.9% (n = 5) of workers with hearing problems. The age range which has drawn more attention for hearing problems was from 51 years of age onward (17%). As to schooling level, there was a significant difference (p = 0.011) between groups, showing that the ones with elementary school (17.2%) and high school (26.9%) were mostly affected by hearing problems related to work. And 42.9% (n = 18) of the workers with hearing problems related to work referred having had hearing problems within the last 30 days before the interview, whereas only 0.9% (n = 2) who did not report the aggravation had hearing problems within the last month, with a significant difference (p < 0.001).

According to Table 2, it is observed that there was a significant difference (p = 0.01) between occupational groups for hearing problems related to work, prevailing in the operational group (25%), in the assistencial group (24.2%) and in the general services one (23.1%). For the remaining variables described in this table we did not find significant differences between the groups. The working sector which had fewer problems was the research one (9.2%) and in the other sectors the occurrence was similar, at around 18%. The time in the function often related to hearing problems was from 6 to 20 years (19.4%).

In Table 3 it is observed that the results from occupational exposures and comorbidities which presented most significant association in the analysis were: exposure to noise with PR of 4.22 (95%CI 2.02 – 8.82), and toxic gases with PR of 3.07 (95%CI 1.67 – 5.66); as for health conditions irritation or nervousness due to work with PR of 2.72 (95%CI 1.47 – 5.04) stood out, and depression with PR of 2.36 (95%CI 1.08 – 5.13). In the adjusted analysis with the introduction of gender and age variables for CHF there was a reduction of the association of approximately 11%.

Table 1. Prevalence of hearing problems and the distribution of workers according to gender, age range, schooling level and hearing problems within the past 30 days (n = 273), Southern Brazil, 2008.

Variable	Total n (%)	Hearing problems		p-value
		Yes n (%)	No n (%)	
<b>Gender</b>				
Male	216 (79.1)	37 (17.2)	178 (82.8)	0.127*
Female	57 (20.9)	5 (8.9)	51 (91.1)	
<b>Age range</b>				
Up to 44 years of age	83 (30.4)	12 (14.6)	70 (85.4)	0.872*
45 to 50 years of age	90 (33.0)	13 (14.6)	76 (85.4)	
51 years of age onward	100 (36.6)	17 (17.0)	83 (83.0)	
<b>Schooling level</b>				
Elementary school	70 (25.7)	12 (17.1)	58 (82.9)	0.011*
High school	69 (25.4)	18 (26.9)	49 (73.1)	
Higher education	56 (20.6)	6 (10.7)	50 (89.3)	
Post-graduation	77 (28.3)	6 (7.8)	71 (92.2)	
Lost records	1			
<b>Hearing problems within the last 30 days</b>				
Yes	20 (7.4)	18 (42.9)	2 (0.9)	< 0.001*
No	251 (92.6)	24 (57.1)	227 (99.1)	
Lost records	2			

\*Pearson's  $\chi^2$  test.

## DISCUSSION

This study presented a prevalence of 15.4% (95%CI 11.3 – 20.2) hearing problems and associations especially with low schooling, occupational group, exposure to noise and health conditions, such as irritation due to work and depression.

In other countries around the world the prevalence of hearing problems varied. In Switzerland it was 31%<sup>2,15</sup>. In Norway, in a research conducted with various occupations, the prevalence of this problem was 16.4%<sup>3</sup>, In the United States it was 16.1%<sup>8</sup>, and in Korea, it was 10%<sup>16</sup>. Despite the low number of studies on hearing problems in Brazil, especially

Table 2. Prevalence of hearing problems and distribution of workers according to the variables of the occupational group, work sector and time of work in the function (n = 273), Southern Brazil, 2008.

Variable	Total n (%)	Hearing problems		p-value
		Yes n (%)	No n (%)	
Occupational group				
Administrative assistance	29 (10.7)	1 (3.6)	27 (96.4)	0.013*
Supervision/managing	18 (6.6)	2 (11.1)	16 (88.9)	
Operational	57 (20.9)	14 (25.0)	42 (75.0)	
Research	67 (24.6)	4 (6.0)	63 (94.0)	
Scientific technician	26 (9.6)	3 (11.5)	23 (88.5)	
Assistance technician	62 (22.8)	15 (24.2)	47 (75.8)	
General services	14 (4.8)	3 (23.1)	10 (76.9)	
Lost records	2			
Work sector				
Support	115 (42.9)	20 (17.5)	94 (82.5)	0.422*
Research	65 (24.3)	6 (9.2)	59 (90.8)	
Laboratory	38 (14.2)	7 (18.4)	31 (81.6)	
Field	50 (18.7)	9 (18.4)	40 (81.6)	
Lost records	5			
Time of work in the function				
Up to 72 months	97 (35.5)	13 (13.5)	83 (86.5)	0.447*
73 to 240 months	93 (34.1)	18 (19.4)	75 (80.6)	
From 241 months on	83 (30.4)	11 (13.4)	71 (86.6)	

\*Pearson's  $\chi^2$  test.

related to work, in this country the prevalence varied a lot, from 5.66 to 45.9% among workers<sup>17,18</sup>. In a population-based study<sup>7</sup>, a prevalence of 5.21% of hearing problems was found. Other analyses showed different prevalence rates from the previous ones, one involving farmers, in which the prevalence was 15.7%<sup>6</sup>, and another one, that surveyed workers of several occupations undergone combined exposures of carbon monoxide, noise

Table 3. Gross and adjusted analysis for gender, age of association of the hearing problems according to the variables of exposure and comorbidities (n = 271), Southern Brazil, 2008.

Variable	Gross analysis		Adjusted analysis	
	PR* (95%CI)	p-value	PR** (95%CI)	p-value
Noise	4.22 (2.02 – 8.82)	< 0.001	4.25 (2.00 – 9.01)	< 0.001
Dust	2.17 (1.11 – 4.24)	0.023	2.12 (1.09 – 4.15)	0.028
Vibrations	2.72 (1.49 – 4.99)	0.001	2.54 (1.35 – 4.76)	0.004
Use of oils, solvents at work	2.39 (1.29 – 4.44)	0.005	2.38 (1.28 – 4.41)	0.006
Toxic gases	3.07 (1.67 – 5.66)	< 0.001	3.00 (1.62 – 5.54)	< 0.001
Irritation or nervousness at work	2.72 (1.47 – 5.04)	0.001	3.09 (1.65 – 5.79)	< 0.001
Self-referred depression	2.16 (1.00 – 4.68)	0.050	2.36 (1.08 – 5.13)	0.031
Congestive Heart Failure	3.12 (1.11 – 8.76)	0.030	2.82 (0.98 – 8.11)	0.054
Cardiac arrhythmia	1.92 (0.85 – 4.34)	0.115	1.89 (0.83 – 4.31)	0.126

PR: prevalence ratio; 95%: confidence interval of 95%; \*gross; \*\*adjusted by Poisson regression.

and smoking, found 15% of prevalence for hearing deficit<sup>19</sup>. Such results corroborate the findings of this research.

Hearing problems more often affect males. According to some studies<sup>3,15,20-23</sup>, this susceptibility related to male gender for hearing problems may be explained due to the protective functions of estrogens in women, considering estradiol is an important regulator of hearing in females<sup>15</sup>.

As for other sociodemographic questions, the low schooling levels may be associated to higher occurrence of hearing problems<sup>8</sup>. In this study, the highest occurrence of hearing problems was in low schooling levels, this relation was associated significantly ( $p = 0.11$ ). This may have occurred because workers with low schooling levels were in positions of higher exposure and consequently more vulnerable to hearing problems. Another significant association was the one of workers with hearing problems in relation to the recurrence of hearing problems within the last 30 days, with  $p < 0.001$ .

The difference in the prevalence of hearing problems among professionals in the same occupational group may be similar, however, when different occupational groups are compared, these data may vary, considering the difference between them for the multiplicity of occupational exposures and response doses to which each one is submitted. The operational workers, assistencial and general service technicians, crane operators, miners, metal board handlers, mechanics, tractor operators, among others have higher chances of having hearing

problems in relation to those who have administrative, teaching and research professions<sup>3,18</sup>, similar to the results of this research.

In relation to time of work in the occupation, studies<sup>1,5,19,24</sup> show that as the time of work progresses, the workers have worse hearing function. This fact is understandable, as there is higher exposure to risk factors in relation to the shorter time of work in the function. In this study it was observed, in relation to the time in the function, that the workers affected had from 6 to 20 years of time in the function, without significant associations.

In this research we found some occupational exposure which stood out with significant association with hearing problems of work, dust, vibrations, oils and solvents, toxic gases and irritation or nervousness caused by the work, considering that the hearing problems of occupational origin may be associated with other exposures besides noise<sup>25</sup>.

The noise in its different qualities may be harmful and one of the main occupational causes of hearing problems related to work, which were found in other studies and corroborate our results<sup>1,5,14,17,22,24,26,27</sup>.

The exposure to excessive noise may histologically change cochlea hair cells, or even lead to the hair loss, among other vascular damages and damages to the neural structures responsible for hearing<sup>28</sup>. In Brazil there are rules for the prevention of diseases related to work, such as *Norma Regulamentadora 15 (NR-15)*, which establishes the parameters of limits of tolerance for continuous or intermittent noise among labor risks, considering that this is one of the main factors for hearing loss of occupational origin<sup>29</sup>. *Norma Regulamentadora 6 (NR-6)* regards the use of Personal Protective Equipment (*equipamentos de proteção individual – EPI*), which is a set of tools against one or more occupational risks. In the case of hearing diseases originated at work, one of the main EPI is an earplug protector, a very effective barrier against noises<sup>30</sup>.

This study showed that the vibration is associated to hearing problems, despite the lack of studies confirming this finding. The vibrations, whether focused on an anatomical regions or throughout the body, have been related to hearing deficit<sup>14,27</sup>.

The ear and neurotoxicity of chemical agents from dust, oils and solvents, for example, toluene, benzene, styrene and others, may cause damage both to the peripheral and central hearing systems, in general being absorbed by the respiratory system and skin, also being able to cause cochlear dysfunction<sup>4,31,32</sup>. The gases and toxic smokes, such as carbon monoxide, carbon disulfide and pesticides with high toxicity levels, have ototoxic effects and induce deleterious changes to hearing, especially when the prolongs exposure of the worker to this risk factor occurs<sup>16,19,28</sup>.

The irritation or nervousness caused by organization situations at work may lead to high cortisol levels in blood and consequently to stress; and when it occurs in a continuous way it may cause work diseases such as the Burnout syndrome, in addition to hearing deficit without apparent organic cause<sup>3,7,15</sup>.

In this study there were comorbidities or health conditions associated to hearing problems, such as irritation or nervousness and depression; and for the CHF there was a trend for association. The increasing risk for hearing problems may be related to factor of

emotional and psychosocial origin<sup>3,9</sup>. The psychopathologies may be related to hearing loss, as a result from exhaustion of cognitive reservation, social isolation or a combination of those aspects<sup>7,21</sup>. Still, cardiovascular diseases may be associated to hearing problems, according to researches<sup>8,9</sup>.

Among the limitations of the study, the potential for memory biases is stressed, since it is a cross-sectional study. Another limitation was the losses, accounting for 16.2% of the workers in the company, which enables the biases of possible selection, however difficult in which the sample effect of a "healthy worker" occurred, once the losses occurred mostly due to the license to professional capacitation, vacation or work. The instrument dealt with hearing problems in general in a non-specific way. However, there was the advantage of the instrument being multidimensional and having the "blind" effect between interviewee and interviewed, for the alternance of subjects during the interview<sup>33</sup>. The guarantee for anonymity may have reduced the information bias. This study is hard to be generalized, once it was carried out only in one company and with losses.

In the period of the research, the company used to have the *Serviço Especializado em Engenharia de Segurança e em Medicina do Trabalho* (SESMT) and the *Comissão Interna de Prevenção a Acidentes* (CIPA). The SESMT consisted of two technicians in work security and one work engineer. Besides that, they fulfilled NR-6, providing EPI and monitoring work practices of workers as much as possible. The company had more than two work substations, in addition to occupying an extense territorial area, which possibly hinders the simultaneous and constant monitoring of the workers.

The company researched adopts the Policy of 100% Tobacco-Free Environments (*Política de Ambientes 100% Livres de Tabaco*), through the federal Law No. 9.294/96, in order to avoid passive smoking and to promote a healthier work environment; and for the prevention of comorbidities in general and to avoid the potentialization of work diseases. For such, actions such as distributions of information and posters throughout the company on the subject are performed, mapping of the amount of smokers in the company and of educational talks to workers.

## CONCLUSION

This study presented a intermediate prevalence of self-related hearing problems (15.4%) among agricultural workers in relation to the literature found. The low levels of schooling, the groups of operational workers, assistance technicians and general services presented higher proportion of hearing problems in a significant way. As for the exposures and health conditions, the ones with the highest association were noise, toxic gases and vibrations, irritation or nervousness and self-related depression.

The results of this study enable initially tracing the plan and strategies of prevention of hearing problems among workers of the company with the SESMT and the CIPA teams, using specially the NR-6 and the NR-15 for this construction, considering the factors which

associate best to the aggravation. The performing of talks and workshops to company employees in general on this subject may be one of the strategies for building awareness of self-care in work activities, especially the ones more susceptible to the aggravation.

There is a need for new studies on occupational hearing aggravations, especially for the establishment of cause between the different and possible work risk factors and hearing problems.

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