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Original articles

Epidemiological and audiometric profile in a Clinical Audiology Department

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ABSTRACT

Purpose: to characterize and associate variables of epidemiological and audiometric profile of a population of a city in the interior of the Minas Gerais State, Brazil.

Methods: a descriptive analytical documentary study carried out by means of the analysis of medical records form the department of audiology in a clinic, from 2014 to 2017. Pearson's chi-squared test and the test for equality of two proportions were used, adopting a significance level of 5% ($p<0.05$).

Results: there was a predominance of female and elderly patients. Between 2015 and 2017, there was hegemony of normal hearing results, and in 2014 the mixed loss predominated. In these four years, there was an increase in the number of referrals from otorhinolaryngologist, occupational and Auditory Health Care Service doctors. From 2014 to 2017, there was a significantly greater proportion of normal results in relation to the various degrees of loss, except for a mild degree, in 2015. There was a significantly higher frequency of elderly people presented with various types of loss, especially sensorineural and mixed ones, and of adults with conductive loss and auditory thresholds within standards of normality, with a difference in relation to the those in other age groups.

Conclusion: most of the patients investigated had hearing loss when all hearing losses were added together. When comparing the degree of hearing loss separately with that of normally hearing individuals, normality prevailed. When normal hearing was excluded, mild, mixed, and bilateral hearing losses were most common.

Keywords: Hearing; Epidemiology; Hearing Loss

INTRODUCTION

Hearing is fundamental to interpersonal communication, language, learning and other day-to-day activities. Hence, hearing loss is considered one of the most impairing deficiencies for the person to live in society[1].

According to the World Health Organization (2018)[2], there are 466 million people in the world with hearing loss, which can have an impact on the quality of life, such as social isolation, loneliness and frustration. Among the factors for hearing loss, genetic causes, infectious acute and chronic ear diseases, use of ototoxic medication, exposure to high sound pressure levels and aging can be mentioned.

The Instituto Brasileiro de Geografia e Estatística - IBGE (Brazilian Institute of Geography and Statistics), in 2013, identified 2,239.12 million people with hearing loss in Brazil, of whom 127.96 thousand in the North Region, 598.05 thousand in the Northeast Region, 950.50 thousand in the Southeast Region, 415.13 thousand in the South Region, and 147.47 thousand in the Central-West Region. In the Minas Gerais State, Brazil, 221.63 thousand people were identified with hearing loss[3].

On September 28, 2004, through the Regulatory Law GM/MS no. 2,073, the Ministry of Health established the National Policy of Auditory Health Attention, conducting actions of auditory health promotion, prevention and early identification of auditory problems, diagnoses, hearing exams, auditory rehabilitation, and indication of use of hearing aid and/or cochlear implant surgery[4].

Epidemiology is the study that analyzes the distribution of occurrences, the causes of the diseases and their factors related to health in human communities. By means of the epidemiologic studies, it is possible to determine sources of information that are fundamental to the researcher's investigation, as well as to good professional practice. Therefore, epidemiology is fundamentally relevant to the application in any field of health, both to research and to the professional practice at the services[5].

Thus, it is necessary to conduct epidemiological surveys to characterize the population sent to the centers they are referred to, with the purpose of implementing public policies in relation to the audiometric care in the municipality.

Due to the consequences caused by hearing loss in human communication, this research aims at characterizing and associating the epidemiologic and audiometric profile in the population of a city in the interior of Minas Gerais State, Brazil, according to gender, age, origin of referral, and audiometric diagnosis (type of loss, degree of loss and laterality).

METHODS

This research was approved by the Research Ethics Committee of the Centro Universitário do Cerrado Patrocínio under protocol number 20181450F0N001. It is a descriptive analytical documentary study. The research was carried out in a health center of a university that works as a teaching clinic, situated in the interior of Minas Gerais.

Those who participated in the study were patients attending the Audiology Department of a teaching clinic, so that, for the selection, inclusion and exclusion criteria were established. Concerning the inclusion criteria, all the medical records of patients attending the abovementioned health center from 2014 to 2017 were included. As for the exclusion criteria, the patients whose data sheet were not satisfactorily filled out, whose exams were incomplete or with whom an audiometric diagnosis classification was used other than that considered in this research were excluded.

The research was conducted based on medical records, anamnesis records and audiometric exam reports, from which information on gender, age group, origin of referral, and patient's audiometric diagnosis (type of loss, degree of loss and laterality: unilateral and bilateral) was collected.

For the classification of audiometric diagnosis, the audiometric findings regarding degree and type of loss were divided by individuals and not by ears; as for the type of hearing loss, Silman and Silverman's classification (1997)[6] was adopted; concerning the degree of hearing loss, the classification adopted was that of Lloyd and Kaplan (1978)[7] for adults, and the one of Northern and Downs (2002)[5] for children up to 7 years old.

This study complies with the Resolution no. 466 of the Conselho Nacional de Saúde (National Health Council), of December 12, 2012. All the requirements of the Research Ethics Committee were met, and all the documents necessary for this project to be conducted were properly filled out, as well.

The data collection from the medical records only took place after it had been duly approved by the Research Ethics Committee and authorized by the President of the Institution. Since this paper is a retrospective documentary on medical records, and no participant was directly approached, the use of the Informed Consent Form (ICF) was deemed unnecessary.

The data were analyzed through descriptive and inferential statistics, with the use of Statistica 13.0 software. For the inferential analysis of the variables, Pearson's chi-squared test was used to associate the data, as well as the test for equality of two proportions, to compare the proportions of the categories of answer to each variable, based on that of greatest proportion. The level of significance adopted for all the analysis was of 5% ($p < 0.05$).

RESULTS

A total of 1,115 medical records of patients attending the Audiology Department were analyzed, thus, divided: in 2014 (n = 58; 5.20%), 2015 (n = 173; 15.52%), 2016 (n = 479; 42.96%), and 2017 (n = 405; 36.32%).

In Table 1, the variables referring to year, gender, age group and origin of referral are described.

Table 1. Descriptive analysis of the variables: year, gender, age group, origin of referral.

Variable	Category	N	%
Year	2014	58	5.20
	2015	173	15.52
	2016	479	42.96
	2017	405	36.32
Gender	Females	633	56.77
	Males	482	43.23
Age group	Elderly	484	43.41
	Adults	432	38.74
	Youth	83	7.44
	Adolescents	60	5.38
	Children	56	5.02
Origin of referral	Otorhinolaryngologist, occupational and AHS doctors (SUS)	855	76.68
	Doctor - PSF	15	1.35
	Speech-language-hearing therapists (Policlínica)	183	16.41
	Unicerp	58	5.20
	Clínica Unicerp	4	0.36

Legend: n = number (relative frequency); % = percentage; AHS = Auditory Health Care Service; SUS= Sistema Único de Saúde (Public Health System); PSF= Programa Saúde da Família (Family Health Program)
Source: Data from the research

The sample counted on a greater frequency of female patients (n = 633; 56.77%), elderly (n = 484; 43.41%), and patients referred by otorhinolaryngologist, occupational and Auditory Health Care Service (AHS) doctors (n = 855; 76.68%).

In the total of all hearing losses (n = 716; 64.22%), there was a greater frequency in relation to normal hearing. When analyzed separately with normal hearing, in relation to degree of hearing loss, there was a greater frequency of patients with a normal (n = 399; 35.78%) or mild result (n = 189; 16.95%). As for type of hearing loss, there was a greater frequency of patients with a normal result (n = 399; 35.78%) or mixed hearing loss (n = 262; 23.50%). Concerning laterality, bilateral loss (n = 651; 58.39%) manifested in most of the results.

Regarding gender, the female predominated in a great part of the period of the study. In 2014, the female participation was of 58.62%; in 2015, it came to 63.01%; in 2016, it decreased to 53.86%; and, in 2017, it rose to 57.28%.

Concerning age group, in 2015 the results were significantly predominant among the elderly (34.10%), followed by the adults (8.09%), adolescents (2.31%) and children (6.36%). In 2016 and 2017, there was a greater proportion of elderly, followed by adults

(36.33%; 36.05%), then youth (8.35%; 6.17%, respectively), adolescents (5.64%; 5.43%, respectively) and at last the children (2.71%; 7.16%, respectively).

In all the years, there was a significant increase of referrals from otorhinolaryngologist, occupational and AHS doctors. In 2014, the referrals from such doctors were 75.86%; in 2015, it went up to 76.88%; in 2016, they reached 79.12%; and, in 2017, it fell back to 73.83%. The referrals from speech-language-hearing therapists corresponded to 24.14% in 2014, 23.12% in 2015, 11.06% in 2016 and 18.77% in 2017. Moreover, beginning in 2016, both the university and the teaching clinic started to refer the patients to speech-language-hearing therapists. In 2016, 7.10% of the referrals came from the university, and 0.21% from the teaching clinic; as for 2017, a total of 5.93% of the patients were referred by the university, and 0.74% by the teaching school.

The results from the sample of this study showed a significantly higher number of patients with a normal hearing result in 2015 (35.84%), 2016 (36.33%) and 2017 (35.06%), significantly higher than all types of hearing loss, except for mixed hearing loss, in 2014 (39.66%).

Table 2. Descriptive analysis of the variables: laterality, type and degree of loss

Variable	Category	n	%
Without alteration	Normal	399	35.78
With alteration	Total of losses	716	64.22
Laterality	Unilateral	65	5.83
	Bilateral	651	58.39
Type of loss	Normal	399	35.78475
	Conductive	65	5.829596
	Sensorineural	158	14.1704
	Mixed	262	23.49776
	Conductive and Sensorineural	38	3.408072
	Conductive and Mixed	71	6.367713
	Sensorineural and Mixed	122	10.9417
Degree of loss (the classifications of Lloyd and Kaplan (1978) foradults, and Northern and Downs (1984) for children up to 7 years old were considered)	Normal	399	35.78
	Mild	189	16.95
	Moderate	77	6.91
	Moderately severe	178	15.96
	Severe	78	7.00
	Profound	34	3.05
	Slight and Mild	1	0.09
	Mild and Moderate	33	2.96
	Mild and Moderately severe	26	2.33
	Mild and Severe	14	1.26
	Mild and Profound	2	0.18
	Moderate and Moderately severe	32	2.87
	Moderate and Severe	14	1.26
	Moderate and Profound	2	0.18
	Moderately severe and Severe	23	2.06
	Moderately severe and Profound	7	0.63
	Severe and Profound	6	0.54

It is noted (Table 3) that in 2014 there was a significantly higher proportion of normal results in relation to the following degrees of hearing loss: severe (p = 0.018), slight and mild (p = 0.024), mild and moderate (p = 0.018), mild and moderately severe (p = 0.024), mild and severe (p = 0.024), mild and profound (p = 0.018), moderate and severe (p = 0.024), moderate and profound (p = 0.018), moderately severe and severe (p = 0.024), moderately severe and profound (p = 0.018), and severe and profound (p = 0.024). In 2015, 2016 and 2017, there was a significantly higher proportion of normal results, in relation to the remaining degrees of loss, except for mild degree, in 2015 (p = 0.078). The classifications considered were those of Lloyd and Kaplan[10] (1978) for adults, and Northern and Downs[11] (1984) for children up to 7 years old.

Table 3. Analysis of the degree of loss variable, by year of attendance

Category	Year 2014			Year 2015			Year 2016			Year 2017		
	n	%	p-value	n	%	p-value	N	%	p-value	n	%	p-value
Normal	21	36.21%	Ref.	62	35.84%	Ref.	174	36.33%	Ref.	142	35.06%	Ref.
Mild	3	5.17%	0.147	39	22.54%	0.078	76	15.87%	<0.001*	71	17.53%	0.004*
Moderate	10	17.24%	0.147	18	10.40%	0.020*	17	3.55%	0.003*	32	7.90%	0.001*
Moderately severe	10	17.24%	0.147	18	10.40%	0.020*	99	20.67%	0.005*	51	12.59%	0.001*
Severe	0	0.00%	0.018*	13	7.51%	0.023*	37	7.72%	<0.001*	28	6.91%	0.001*
Profound	4	6.90%	0.131	4	2.31%	0.008*	16	3.34%	0.004*	10	2.47%	0.018*
Slight and Mild	1	1.72%	0.024*	0	0.00%	<0.001*	0	0.00%	0.003*	0	0.00%	0.012*
Mild and Moderate	0	0.00%	0.018*	2	1.16%	0.015*	13	2.71%	0.007*	18	4.44%	0.004*
Mild and Moderately severe	1	1.72%	0.024*	5	2.89%	0.029*	11	2.30%	0.011*	9	2.22%	0.022*
Mild and Severe	1	1.72%	0.024*	1	0.58%	0.010*	6	1.25%	0.040*	6	1.48%	0.045*
Mild and Profound	0	0.00%	0.018*	0	0.00%	<0.001*	0	0.00%	0.003*	2	0.49%	0.015*
Moderate and Moderately severe	4	6.90%	0.131	3	1.73%	0.011*	14	2.92%	0.006*	11	2.72%	0.014*
Moderate and Severe	1	1.72%	0.024*	3	1.73%	0.011*	2	0.42%	0.014*	8	1.98%	0.027*
Moderate and Profound	0	0.00%	0.018*	0	0.00%	<0.001*	0	0.00%	0.003*	2	0.49%	0.015*
Moderately severe and Severe	1	1.72%	0.024*	2	1.16%	0.015*	9	1.88%	0.018*	11	2.72%	0.014*
Moderately severe and Profound	0	0.00%	0.018*	2	1.16%	0.015*	3	0.63%	0.010*	2	0.49%	0.015*
Severe and Profound	1	1.72%	0.024*	1	0.58%	0.010*	2	0.42%	0.014*	2	0.49%	0.015*

*p < 0.05 – test for equality of two proportions
Legend: n = number (relative frequency); % = percentage; Ref.= proportion of reference for comparison
Source: Data from the research

There was a significantly higher proportion of bilateral type of laterality in all the years of attendance analyzed. In 2014, bilaterality corresponded to 60.07% of the cases; in 2015, to 54.34%; in 2016, to 59.71%, and finally, in 2017, to 58.02%.

It can be observed (Table 4) that there was a significantly higher frequency of elderly with the following types of hearing loss: conductive and mixed, sensorineural, sensorineural and mixed, conductive and sensorineural, and mixed; of these, the highest was the sensorineural and mixed, and adults with conductive hearing loss with auditory thresholds within standards of normality, with difference in relation to the other age groups (p < 0.001).

Table 4. Analysis of association between the variables: type of loss and life cycle

Life cycle		Conductive and Mixed	Sensorineural	Sensorineural and Mixed	Mixed	Normal	Conductive	Conductive and Sensorineural	Total	p-value
Elderly	n	40	104	81	169	54	13	23	484	<0.001
	%	56.34%	65.82%	66.39%	64.50%	13.53%	20.00%	60.53%		
Adults	n	25	48	38	71	203	33	14	432	
	%	35.21%	30.38%	31.15%	27.10%	50.88%	50.77%	36.84%		
Youth	n	4	2	0	9	55	13	0	83	
	%	5.63%	1.27%	0.00%	3.44%	13.78%	20.00%	0.00%		
Adolescents	n	2	3	3	8	40	4	0	60	
	%	2.82%	1.90%	2.46%	3.05%	10.03%	6.15%	0.00%		
Children	n	0	1	0	5	47	2	1	56	
	%	0.00%	0.63%	0.00%	1.91%	11.78%	3.08%	2.63%		
Total		71	158	122	262	399	65	38	1115	

*p < 0.05 – Pearson's chi-squared test
Legend: n = number (relative frequency); % = percentage
Source: Data from the research

DISCUSSION

Epidemiology is the structure of public health. It furnishes support to assess preventive measures, provides clues for the diagnosis of communicable and noncommunicable diseases, and makes it easier to verify the consistency of causality hypotheses[8].

In the findings, there was a greater frequency of female patients (n = 633; 56.77%), and elderly (n = 484; 43.41%), which diverges from the incidence in men and women (8.85 for 100,000 men, 7.79 for 100,000 women) in studies conducted in Taiwan from 1998 to 2002[9]. Nevertheless, the incidence in Germany was higher, up to 160 for every 100,000 people in Dresden, in 2004[10]. In the United States, it was of 27 for every 100,000 people from 2006 to 2007 (with an increase of 66,000 new cases every year)[11].

The incidence is likely underestimated, since many affected people recover quickly without ever looking for medical care[10,11]. The reported yearly incidence varies greatly, from five to 30 for every 100,000 people, in general[9-11].

Although Brazil is a country of predominantly young population, with the advancements in biotechnology, medicine and health preservation, life expectancy has been increasing, contributing to a longer and healthier life, and, consequently, to the increase of the elderly population. According to the IBGE, the evident aging process the Brazilian population has been undergoing reverberates in the increase of the relative participation of the older population, as the elderly portion of the population reached 4.8% in 2010, and such number tends to keep on growing[12]. Such data agree with the analysis in this research, in which, regarding age group, a greater demand of the elderly population was observed in the last two years researched.

The possible risk factors discussed, associated with hearing loss, are: smoking, increase in alcohol consumption, and genotype associated with sudden sensorineural hearing loss in adults, based on a systematic review of 22 observational studies evaluating risk factors for adult sudden sensorineural hearing loss in 30,077 adults, in addition to factor V Leiden polymorphism, prothrombin G2021A polymorphism, C677T methylenetetrahydrofolate reductase polymorphism, A1298C methylenetetrahydrofolate reductase polymorphism, and hypertension not associated with the increased risk of sudden sensorineural hearing loss[13].

In relation to the years analyzed, it was noted that 2016 and 2017 were the ones with the greatest populational demand, due to the increase in the number of referrals for audiometric exams. The increase in the number of students enrolled in the undergraduate speech-language-hearing program in the city where the study was conducted enabled an increase in the attendance carried out at the teaching clinic, which can be observed as an indication of the growth of this profession.

In this research, a greater demand of referrals from otorhinolaryngologist, occupational and AHS doctors was noted. In these referrals, it was observed that the otorhinolaryngologist doctors were the ones who most referred patients to audiometric exams. According to Mitre (2003)[14], speech-language-hearing therapists and

otorhinolaryngologist doctors are closely connected professionals, either, due to otorhinolaryngological diagnosis that need speech-language-hearing practice, or to the anatomo-functional knowledge, pathology clarifications, and important diagnostic data provision for the speech-language-hearing therapeutic planning. A study[15] led speech-language-hearing therapists to perceive that otorhinolaryngologist doctors are the professionals that most refer patients to the speech-language-hearing services.

In the referrals from speech-language-hearing therapists, those that work in the public health network are included. According to Evaluation Report no. 26 of February 16, 2006, of the Conselho Federal de Fonoaudiologia (Federal Speech-Language-Hearing Council), audiological exams can be requested by health and education professionals, and not only by doctors[16]. In the referrals from doctors of the Programa Saúde da Família (Family Health Program), general practitioners who attend at the community health centers are included. The Programa Saúde da Família works as an attempt to reorganize primary care as a pivot in reorienting the assistive model based on promoting quality of life and intervention on the factors that put it at risk, by incorporating more encompassing pragmatic actions and developing interdepartmental actions[17]. Auditory health attention in primary care aims to perform actions promoting auditory health and protection, as well as prevent and identify hearing difficulties as early as possible, and refer to specialized services and rehabilitation[18].

The referrals from the city's university included the periodic occupational exams of people hired by the academic institution who are exposed to high sound pressure levels. These periodic exams make possible the comparison of auditory thresholds of audiometric exams of each worker throughout their time of employment in the institution where they work, with the purpose of preventing hearing loss[19]. Hearing losses caused by high sound pressure levels lead to irreversibility and gradual progression according to the time they are exposed to the risk[20]. It is important that the employees who are exposed to loud noises make regular use of personal protective equipment (PPE), such as hearing protection device and earmuffs, for the risk of hearing loss, as well as its progression, is diminished once the exposure is ended.

The referrals form the teaching clinic included the patients referred by the interns from the other health programs working at the university health care center. It is known that interdisciplinarity is primordial for the development of health professionals; thus, the professionals need to work in teams, exploring each other's abilities, aiming at improving the quality of the attention given, as well as the outcomes of their work[21].

According to Momensohn-Santos and Russo (2011)[22], mixed hearing losses result from conductive and sensorineural elements in the same ear, the sensorineural hearing losses are consequences of disorders involving the cochlea or the auditory nerve, and the conductive hearing losses result from pathologies that affect the outer and/or middle ear. Studies[23-25] indicate that the most found hearing loss is the sensorineural, occurrence that does not agree with type of hearing loss most found in this study, in which, apart from normal hearing, the mixed hearing loss was present more often.

In the sample considered, excluding the normal degree classification, the mild degree of hearing loss was the one that came closest in relation to the normal degree in 2015, and in relation to all years analyzed, the normal degree obtained greater relevance. In the study by Jardim, Iwahashi and Paula (2010)[23], 51.3% of the individuals were found with mild degree of loss, and in the study by Gondim, Balen, Zimmermann, Pagnossin, Fialho and Roggia (2012)[24], 18.9% of the individuals were found with this type of loss. According to the classification of Lloyd and Kaplan (1978)[7], the normal degree classification is the one in which the tonal thresholds of 500 kHz, 1 kHz and 2 kHz of the audiometric exam are of 25 dB HL or lower, and the person has no difficulty to hear. As for the mild degree, hearing loss is the one in which the mean of the tonal thresholds of 500 kHz, 1 kHz and 2 kHz of the audiometric exam range from 26 to 40 dB HL, and they characteristically present difficulties in hearing quiet or distant talk.

Regarding laterality, studies[23,25] found results similar to the ones in this study, in which the bilateral type was the most detected one in all the years analyzed. It is fundamental to stimulate both ears of individuals with bilateral hearing loss, as this ensures the maximum development of the auditory pathways, furnishes advantages of the binaural hearing, reduces the difficulties found in speech perception, and improves the quality of life[26].

In the association between age group and type of hearing loss, the elderly presented mostly sensorineural and mixed hearing loss, and the adults, except for the auditory thresholds within standards of normality, mostly had conductive hearing loss. The most found

type of hearing loss in the elderly population is the sensorineural, in which the audiometric alterations resulting from age can be analyzed beginning at the age of 40 years, with progressive worsening of the auditory thresholds as people get older and, usually, present complaints regarding speech comprehension when they need to follow a conversation in noisy and reverberating environments. The conductive hearing loss may have been more frequent in adults due to its etiology, as the most common causes of this type of hearing loss are impacted cerumen, otitis, tympanic perforations and tube dysfunction. It is important to highlight that these factors are found, more often, in children, adolescents and adults than in the elderly[27,28].

As the associations between the variables year and laterality, year and gender, and type of loss and gender were verified, there was no relationship between them; therefore, they were not presented in this study.

The epidemiological studies are important to produce information that works as a parameter to prevent, control and treat diseases, stipulating priorities based on the findings. Hence, strategies can be outlined in public health, setting adequate policies for auditory health for the population.

CONCLUSION

This study showed a prevalence of females in relation to males in the whole period analyzed. The otorhinolaryngologist, occupational and AHS doctors were the most prevalent origin of referrals in all the years. There was a prevalence of elderly people as the age group which had most audiometric exams made in all the years. In the audiometric diagnosis, it was made evident that most of the patients investigated presented hearing loss, when all the types of loss were added up. When comparing the degree of hearing loss, separately, with that of normally hearing individuals, normality prevailed. The most found degree of hearing loss was the mild one, and there was also a prevalence of mixed hearing loss and, as for laterality, the bilateral type.

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