ORIGINAL ARTICLE

https://doi.org/10.61910/ricm.v8i2.383

Notifications of noise-induced hearing loss between 2007-2022: an analysis of healthcare actions in Minas Gerais

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ABSTRACT

Introduction: Noise-Induced Hearing Loss (NIHL) is a condition of progressive decrease in hearing acuity resulting from exposure to high levels of sound pressure. Among the main risk factors for NIHL, noise in the occupational environment stands out. There is a lack of public action to promote hearing conservation at work, coupled with a scenario of irregularities and poor notification of this condition. Objectives: To analyze the quantitative evolution of NIHL notifications in the state of Minas Gerais from 2007 to 2022 and describe the socio-epidemiological profile related to notifications. Methods: Retrospective cross-sectional study of secondary databases via the Notifiable Diseases Information System with descriptive analysis of NIHL notifications and related socio-epidemiological variables between 2007 and 2022. Results: 1017 cases of NIHL were reported in the state. The year 2017 presented the highest number of records (13.3%), and 90.1% of notifications occurred with male individuals. The most affected age group was 50 to 64 years old (44.4%), and many cases were treated on an outpatient basis (79.4%). In 53.5% of notifications, there was no change adopted, and most cases did not adopt collective protection (56.0%) or individual protection (40.4%). Conclusion: There was significant incompleteness in filling out the notification forms, as well as inadequate implementation of preventive measures for noise in the workplace. The precarious adoption of individual and collective protection measures demonstrates non-compliance with hearing health promotion measures.

Palavras-chave: Hearing Loss, Noise-Induced; Disease notification; Health information systems.

INTRODUCTION

Noise-induced hearing loss (NIHL) is a condition characterized by a progressive decrease in hearing acuity resulting from exposure to high occupational sound pressure levels[1]. NIHL is a global public health problem, accounting for 16% of cases of disabling hearing loss in adults worldwide[2, 3]. It develops gradually after approximately 6 to 10 years of exposure and typically manifests as a progressive sensorineural loss that begins at high frequencies and is commonly bilateral and symmetrical 4. NIHL is known to be caused by any sound exposure that exerts an average of 90 dB, eight hours a day, regularly over several years[4]. It is an irreversible condition with a progressive evolution, although it is preventable[5].

Noise in the workplace stands out as the main risk factor for NIHL, but other causal agents can cause noise-induced hearing loss, such as ototoxic chemical agents, vibrations, and even industrial dust[1,6]. Studies also show that high noise levels can act as a predisposing factor for the occurrence of work accidents and be an aggravating cause of cardiovascular and endocrine disorders through the action of the autonomic nervous system[5,6]. The diagnosis of occupational NIHL depends on the evaluation through an audiogram and confirmation of noise exposure in the workplace[7].

The Ministry of Health established the National Policy for Hearing Health Care (PNASA) in 2004, aiming to improve hearing health actions of the Unified Health System (SUS) by organizing an integrated network for diagnosis and auditory rehabilitation, as well as for the promotion and protection of auditory health[8]. PNASA provides support for the implementation of the Hearing Conservation Program (PCA) in occupational environments. The PCA consists of a set of actions that aim to preserve hearing and prevent NIHL in workers exposed to harmful noise levels, encompassing actions related to noise control, collective and individual protection, and education in hearing health[1,8].

However, hearing conservation programs present several gaps, especially regarding the results and impacts on the hearing health of the professionals involved. Currently, the literature is scarce regarding studies that evaluate the effectiveness of programs and public policies aimed at hearing conservation[8]. Furthermore, although NIHL is a notifiable condition within the Notification of Diseases Information System (SINAN), there are evident irregularities and inadequate notification and diagnosis of NIHL events in Brazil[9]. Reporting is an important measure to be taken, as it helps to understand the reality of this condition in the country and allows for the targeting of public policies to mitigate it.

Thus, this study aims to identify the quantitative evolution of the numbers of NIHL notifications in the state of Minas Gerais after the implementation of the National Policy for the Promotion of Hearing Health, specifically from 2007 to 2022, in addition to identifying the socio-epidemiological and occupational profile related to the cases of notification of this condition in the state.

METHOD

Study Design

This is an observational, cross-sectional, and retrospective study. It was conducted through the collection and analysis of data available through the "Tabnet" tool from the Department of Informatics of the Unified Health System (DATASUS). This tool allows the online tabulation of data and generation of spreadsheets on various SUS data, allowing access to information on epidemiological and assistance data within the scope of public health. The period from 2007 to 2022 was considered, as it encompasses the period after the implementation of PNASA and corresponds to the period in which the tabulation of data regarding PAIR notifications began in DATASUS.

Sample

The study in question was based on the collection of public domain data, referring to NIHL notification forms in the state of Minas Gerais, originating from the Notifiable Diseases Information System (SINAN). The data were accessed through the "Tabnet" portal.

The inclusion criteria for analysis were: NIHL notifications from SINAN; and data covering the period from 2007 to 2022 in the state of Minas Gerais. The exclusion criteria were notifications related to NIHL in other federative units

Instruments and Procedures

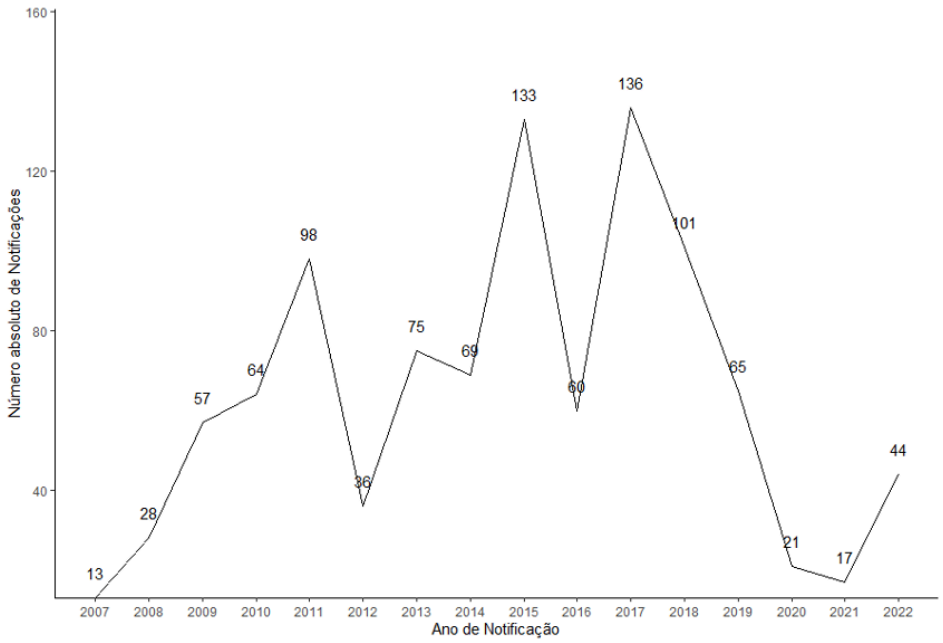
Data from 2007 to 2022 sourced from SINAN were analyzed via "Tabnet" to compare the quantitative evolution of NIHL notifications recorded in the state of Minas Gerais after the implementation of PNASA in absolute numbers. Additionally, socio-epidemiological and occu-

pational data related to NIHL notifications in the state of Minas Gerais from 2007 to 2022 were also collected. The following variables were analyzed: sex, age group affected, duration of noise exposure, treatment regimen adopted, and actions taken—whether or not there was a work leave, whether or not there was a job change, and whether or not collective and individual protective measures were adopted. Data analysis was conducted using Microsoft Excel software, version 2019 (16.0.6742.2048), and R software, version 4.0.3. Categorical variables were presented in the form of absolute and relative frequency tables, describing the socio-epidemiological and quantitative profile of NIHL notifications in Minas Gerais. To characterize the sample, simple frequency and percentage frequency were used to represent the variables of interest over time; thus, based on the variations of these rates, it was possible to measure the socio-epidemiological distribution over time.

RESULTS

The number of eligible notifications, after applying the inclusion and exclusion criteria, was 1017 notifications between the years 2007 to 2022. Figure 1 illustrates the historical series related to the absolute number of notifications between the aforementioned years

Figure 1: Evolution of absolute numbers of notifications of Noise-Induced Hearing Loss in the state of Minas Gerais from 2007 to 2022.



Between 2007 and 2022, there was an average variation of around 33%. Between 2007 and 2008, there was an increase in the number of absolute notifications from 28 to 13 (approximately 115%), while between 2021 and 2022, there was an increase from 28 to 57 (159%) in the number of notifications. The years 2017, 2015, and 2018 recorded the highest absolute numbers of notifications, with 136 (13.3%), 133 (13.0%), and 101 (9.9%) cases reported in the state, respectively. There was a considerable decrease in the number of notifications from 2018 to 2021, from 136 to 17 notifications (with an average variation of around 87.5%). Between 2019 and 2020 there was a reduction from 65 to 21, that is, 68% in the number of notifications.

Table 1 presents the main results of the study variables, presenting the simple frequencies and percentage frequencies relative to the 16-year historical series, covering the period from 2007 to 2022. Of the total of 1,017 notifications

analyzed, approximately 90.1% (916) of the NIHL notifications occurred with male individuals and 9.9% (101) with female individuals. The same table indicates that the most affected age group was 50 to 64 years, accounting for 44.4% (452) of the cases, followed by the age group of 35 to 49 years with 38.9% (396) of the cases. The age group of individuals over 80 years old did not register any notifications in the period analyzed.

Regarding the duration of noise exposure, it was observed that the most frequent duration of exposure was "years", with 53.4% (543) of the cases. The completion of the exposure time in the notification forms was "ignored" in 41.0% (417) of the cases. Furthermore, most of the cases were treated on an outpatient basis, with 79.4% (808), while 1.1% (11) of the notifications had hospital treatment and the completion of the treatment regimen was ignored in 19.5% (198) of the cases.

Many notifications did not show a work leave in 62.3% (634) of cases (Table 1). Additionally, most cases did not adopt a change of conduct in 53.5% (544) of the cases, followed by conduct changes that were ignored in 31.8% (323) of cases. Regarding the adoption of collective protection, most cases did not adopt collective protection in 56.0% (570) of notifications, followed by ignored collective protection in 32.3% (328) of those analyzed. Finally, most cases did not adopt individual protection in 40.4% (411) of cases, followed by ignored individual protection in 29.3% (298).

Table 1: Simple frequencies and percentage frequencies associated with the variables of interest in the study.

Simple frequencies and percentage frequencies associated with the study variables

VARIÁVEIS	FREQUÊNCIA ABSOLUTA E PERCENTUAL (%)
SEXO	
MASCULINO	916 (90,1)
FAIXA ETÁRIA	
15 -19	11 (1,1)
20 - 34	114 (11,2)
35 - 49	396 (38,9)
50 - 64	452 (44,4)
65 - 79	44 (4,3)
80	0 (0,0)
TEMPO DE EXPOSIÇÃO	
IGNORADO	417 (41,0)
HORAS	24 (2,4)
DIAS	5 (0,5)
MESES	28 (2,8)
ANOS	543 (53,4)
REGIME DE TRATAMENTO	
IGNORADO	198 (19,5)
AMBULATORIAL	808 (79,4)
HOSPITALAR	11 (1,1)
AMBOS	0 (0,0)
AFASTAMENTO DO AGENTE	
SIM	57 (5,6)
NÃO	634 (62,3)
IGNORADO	326 (32,1)
MUDANÇA DE CONDUTA	
SIM	150 (14,7)
NÃO	544 (53,5)
IGNORADO	323 (31,8)
CONDUTA PROTEÇÃO COLETIVA	
SIM	119 (11,7)
NÃO	570 (56,0)
IGNORADO	328 (32,3)
CONDUTA PROTEÇÃO INDIVIDUAL	
SIM	411 (40,4)
NÃO	308 (30,3)
IGNORADO	298 (29,3)

Table 2 demonstrates the growth and decrease of the variables measured in percentages. In the case presented, the year 2007 does not appear, as it was used as a reference, that is, every study was considered a variation from 2007 to 2008. Regarding the absolute number of notifications, there was an increase of approximately 238% from 2007 to 2022. Over this period, notifications involving male individuals showed an increase of 290% in this interval. Concerning age groups, the greatest variation occurred among those aged 20 to 34 years, highlighted by a 460% increase in the number of notifications involving this variable in the year 2015. The age group of 65-79 years old also deserves to be highlighted in the years 2016 and 2017 with a variation in notifications of 1100%.

Additionally, in Table 2, the exposure time recorded as "ignored" exhibited the highest variation in records, with decreases and increases in the completion of notification forms throughout the analyzed period. Regarding the treatment regimen, it is worth noting that the greatest variation was from 2012 to 2013, with a 600% increase in notifications involving outpatient treatment regimens.

Table 2: Growth and decrease behavior in the percentage of each variable analyzed in the study between 2007 and 2022.

Years	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Number of notifications	115%	104%	12%	53%	-63%	108%	-8%	93%	-55%	127%	-26%	-36%	-68%	-19%	159%
SEX															
Masculine	160%	100%	17%	51%	-63%	115%	-21%	110%	-57%	130%	-32%	-30%	-64%	-43%	225%
Feminine	-33%	150%	-40%	100%	-67%	0%	450%	0%	-36%	100%	29%	-61%	-100%		0%
AGE GROUP															
15 -19		-100%		-100%				200%	-67%	0%	100%	-50%	-100%		
20 - 34	200%	33%	25%	120%	-82%	150%	0%	460%	-86%	300%	-38%	0%	-80%	0%	200%
35 - 49	75%	64%	26%	38%	-58%	94%	-12%	55%	-60%	156%	-11%	-49%	-52%	-60%	350%
50 - 64	150%	190%	-3%	57%	-61%	100%	0%	56%	-32%	69%	-28%	-34%	-76%	14%	75%
65 - 79			0%	200%	-100%		-100%		-75%	1100%	-67%	0%	-50%	50%	100%
80															
EXPOSURE TIME															
Ignored	20%	217%	-74%	920%	-96%	3650%	-77%	318%	-83%	242%	12%	-26%	-65%	-92%	1900%
Hours		-100%						200%	-44%	-60%	0%	-100%			
Days	-100%							-50%	-100%		-100%				
Months			200%	33%	-100%			500%	-67%	300%	-88%	0%	-100%		
Years	200%	76%	51%	-23%	-21%	-100%		0%	-11%	105%	-38%	-42%	-70%	78%	31%
TREATMENT REGIMEN															
Ignored		-50%	200%	333%	-92%	600%	-29%	140%	-42%	286%	111%	-42%	-64%	-100%	
Outpatient	100%	115%	9%	38%	-61%	106%	-7%	90%	-56%	104%	-60%	-28%	-71%	78%	50%
Hospital					100%	-100%		0%	-100%		0%	0%	-100%		100%
AGENT REMOVAL															
Yes		400%	-80%	1000%	-82%	100%	50%	-50%	-33%	350%	-11%	-63%	-100%		
No	111%	100%	55%	-3%	-54%	154%	-20%	17%	-19%	72%	-52%	-24%	-74%	75%	7%
Ignored	100%	75%	-71%	650%	-73%	-38%	100%	580%	-88%	413%	27%	-40%	-58%	-77%	800%

CHANGE OF CONDUCT															
Yes	-100%		-45%	167%	-75%	25%	0%	120%	27%	79%	-4%	-38%	-87%	50%	167%
No	138%	74%	67%	-11%	-51%	171%	-18%	2%	-26%	68%	-60%	-30%	-63%	57%	18%
Ignored	125%	44%	-77%	1000%	-76%	-38%	120%	518%	-91%	633%	14%	-38%	-61%	-75%	667%
COLLECTIVE PROTECTION CONDUCT															
Yes	0%	-100%			-90%	100%	200%	183%	-35%	64%	39%	-40%	-87%	50%	133%
No	125%	128%	46%	-8%	-51%	148%	-22%	4%	-26%	85%	-66%	-24%	-68%	83%	18%
Ignored	125%	78%	-75%	725%	-76%	-25%	83%	464%	-85%	389%	16%	-39%	-58%	-77%	700%
PERSONAL PROTECTION CONDUCT															
Yes	275%	33%	-30%	171%	-76%	478%	-33%	43%	-26%	27%	-28%	-38%	-76%	80%	133%
No	75%	200%	124%	-38%	-28%	-5%	15%	-4%	-14%	147%	-64%	-18%	-79%	100%	33%
Ignored	20%	167%	-81%	933%	-81%	-50%	267%	455%	-93%	950%	19%	-40%	-57%	-85%	650%

DISCUSSION

Noise-Induced Hearing Loss (NIHL) is a progressive, sensorineural, and irreversible condition resulting from prolonged exposure to high noise levels in the workplace[10]. Occupational hazards arising from exposure to intense noise affect not only the productivity of companies but also the health of workers. Regular health monitoring, understanding of environmental risks, and application of control measures can prevent harm and promote a safer workplace[11].

Thus, this study showed that NIHL, in the period analyzed, was predominantly in males, accounting for 90.1% of cases, compared to 9.9% in females. Regarding age, the most susceptible individuals were between 50 and 64 years old, accounting for 44.4%. The epidemiological profile evidenced in the state aligns with current literature, which indicated that NIHL notifications over 14 years showed higher incidence among men aged 50 to 59 years[12]. The male predominance of hearing loss is associated with the unequal division of labor, and the prevalence of cases suggestive of NIHL increases with age[13].

However, epidemiological data on hearing loss in Brazil are limited and restricted to specific sectors, which prevents a comprehensive characterization of the situation. The available information offers only a partial view of the risk associated with hearing loss[14]. In the Brazilian context, NIHL is associated with the industrial sector, especially in segments involving noisy production processes[15].

In this study, 75.2% of workers with NIHL received outpatient treatment, aligning with data from the Ministry of Health from 2006. This treatment includes hearing assessments, rehabilitation, and prosthesis fitting, as well as information on prevention. Approximately 19.6% of patients had no identified treatment, possibly due to the chronic nature of the disease. Inpatient treatment was used in 5.2% of cases, mainly in severe situations and for complications such as chronic infections. In advanced or acute stages, inpatient supervision may be preferable for intensive monitoring and specialized care.

It was also observed that workers diagnosed with NIHL were not adequately removed from the environment that caused this hearing condition. Depending on the case, the lack of preventive measures can significantly worsen

hearing loss. Furthermore, the lack of noise control results in an average increase of 2 dB in hearing loss over five years, while workers who take preventive measures maintain or even improve their hearing over this period[16].

Prolonged noise exposure can damage auditory cells and cochlear structures, resulting in irreversible hearing changes[16]. Regarding data on the conduct and adoption of changes in the work environment, it was observed that in most cases, no changes were implemented, and in a considerable number of reports, this issue was ignored.

The data reveal a lack of adoption of protective measures at both individual and collective levels, indicating a minimal proportion of cases that implement protections. This is related to the perception that collective measures are costly and technologically challenging, while the use of Hearing Protection Equipment (HPE) stands out as being more viable and economical[17]. A study with 278 workers exposed to noise levels above 80 dB showed a poor perception of the need for PPE, resulting in underutilization of these devices18. To prevent occupational hearing damage, it is crucial to increase awareness and implement strategies that promote hearing self-care[13].

According to the data obtained from the study, there is a large number of notifications with ignored requirements, raising doubts about the adequacy of the completion of these records. The lack of accurate information compromises the real understanding of the situation of PAIR in the state. According to data from the Ministry of Health (2006), morbidity and mortality in Occupational Health are still generated in a limited way throughout Brazil. This context is conditioned by the low frequency and agility with which epidemiological surveillance returns analyzed information and added useful technical recommendations, in addition to the lack of qualification of the professionals who make notifications so that, based on them, public health measures can be implemented[15].

Underreporting of NIHL has impacts on public health, prevention, and occupational safety policies, making it difficult to understand its true prevalence and compromising the implementation of effective measures. This can lead to underestimation of cases, resulting in inadequate programs and limiting the formulation of public policies to protect workers from harmful noise.

Other studies evaluated converge on the evolution of NIHL in the sense that the prevalence and incidence of hearing loss increase with age and length of service[19,20]. Furthermore, it was shown that training and education programs are highly effective in gaining knowledge, changing behavior, and improving workers' practices[21]. It is concluded that increasing workers' knowledge about the risks and health effects of excessive noise exposure also improves their perception of the severity of this health condition[21, 22].

As a limitation of the study, it is worth highlighting the fact that the data collected came from a secondary database, which is subject to incompleteness and errors in filling out some fields, therefore it is not possible to confirm determination or cause-effect relationships.

CONCLUSION

Given the findings of this review, there was no adequate implementation of preventive and safety measures for noise in the occupational environment, both collectively and individually. This result corroborates what was found in other articles[10, 20,21]. It is also worth noting that a considerable number of notifications had ignored requirements, which questions the adequacy and completeness of the completion of these notifications, compromising the obtaining of a faithful view of the reality and prevalence of the condition. The absence of preventive measures can significantly aggravate hearing loss and reflect the neglect of the problem. Therefore,

it is expected that this study will encourage appropriate reporting practices and that the information can support the development of public policies that promote occupational health in the country.

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THE AUTHORS DECLARE THAT THERE IS NO CONFLICT OF INTERESTS IN RELATION TO THIS ARTICLE.