

Analysis of the structure of medical reports concerning hearing loss due to exposure to noise as an occupational disease in Poland in the years 2017-2018

Ireneusz Drożak¹, Elżbieta Pachucka-Włas¹, Anna Nowosad-Sugier¹, Paulina Drożak²,
Martyna Drożak²

1. Wojewódzki Ośrodek Medycyny Pracy Centrum Profilaktyczno-Lecznicze w Lublinie
2. Medical University of Lublin

Abstract

Introduction and purpose. Hearing impairment caused by noise is defined as a symmetrical, slowly progressing, permanent, receiving loss of hearing, of cochlear or sensoneurinal type, which concerns especially high frequencies. Hearing loss develops within the space of many years of exposure to high levels of noise which causes it to be an occupational disease of those who work in such conditions for a long period of time. The aim of this work was to analyse the structure of medical reports concerning hearing loss as an occupational disease in Poland in the years 2017-2018.

Material and method. An analysis concerned cases of diagnosis of hearing loss diagnosed as an occupational disease based on Centralny Rejestr Chorób Zawodowych Instytutu Medycyny Pracy.

Results. The occurrence of cases of hearing loss due to occupational factors decreased in 2017 and 2018 compared to 2016. Almost all cases of hearing loss as an occupational disease concerned male workers. This problem is almost non-existent among female workers. Hearing loss was the most prevalent among workers at pre-retirement age and those who worked more than 20 years in exposure to noise. Compared to other occupational diseases, hearing loss is not common in Poland.

Conclusions. A decrease in cases of hearing loss as an occupational disease suggests that a system of periodic examination which is 1 examination each year during first 3 years of employment with medical appointment and a reminder of hearing protection works very well.

Actions taken by all services (doctors, nurses, Occupational Health and Safety inspectors and employers) responsible for the protection of a worker cause a proper downward trend of diagnoses of hearing loss as an occupational disease among employees in Poland.

Key words: hearing loss; occupational diseases

Introduction

Hearing impairment caused by noise is defined as a symmetrical, slowly progressing, permanent, receiving loss of hearing, of cochlear or sensorineural type, which concerns especially high frequencies. Hearing loss develops within the space of many years of exposure to high levels of noise. The dynamics of hearing impairment is relatively fast during the first 10 years of exposure, after which it slows down. [1]

The noise damages the receptor of the organ of hearing which is placed in the cochlea, hence the term “receiving of cochlear type”. Simultaneously, it means that the conduction of sound from its source through the outer ear and middle ear is unaffected, whereas the reception of sound is impaired (the process of changing the sound stimulus into electrical impulse). This process takes place in the cochlea which is located in the internal ear.

The term sensorineural hearing loss means a damage of both cochlear sensory cells (sensory element) and the dendrites of the cochlear nerve as well as, partly, the nuclei of the spiral ganglion which are degenerated secondarily after many years of exposure to noise. [1]

During an exposure to noise, metabolism of the cells which take part in the processing of an acoustic signal is increased. This in effect activates oxidative stress which results in death of the cells engaged in the process of hearing. Hearing impairment may also be caused by mechanical trauma, especially by the pulse noise which is a noise that lasts less than 1 second. During this process the tympanic membrane is ruptured and the auditory ossicles are broken. Sometimes, as a result of exposure to abnormal noise, the capillaries of the structures in the internal ear might contract which results in ischemia and anoxia of the cells.

Noise also damages the auditory cells of the organ of Corti, especially the hair cells which become deformed, disorganized and eventually decline. An exposure to noise also influences a degeneration of the fibers of vestibulocochlear nerve which intensifies the process of hearing loss among patients. [1]

According to WHO (World Health Organization), a hearing loss of up to 40 dB is categorized as mild. Such loss usually doesn't require providing a patient with a hearing aid. Whereas an increase of the threshold of hearing up to above 45 dB has a significant impact on patient's communication with environment and requires the use of a hearing aid. The dynamics of the hearing loss is relatively fast during the first 10 years of exposure, later it slows down. The period during which a documented hearing impairment caused by an occupational exposure to noise occurred cannot exceed 2 years after the cessation of work under exposure. After cessation of exposure to noise hearing impairment doesn't deteriorate, but around the age of 65 a dynamic hearing impairment is observed which is caused by the process of aging of the hearing organ. [1]

A susceptibility to hearing impairment is individually variable and depends on many factors. The internal factors dependent on a patient are: smoking, hypertension, hypercholesterolemia and drugs that patient takes. External factors are: type of noise to which a patient is exposed, length of exposure, intensity of noise and whether a patient used hearing protectors. Additionally, a patient during his work might be exposed to hyperthermia, vibrations or chemical substances. Genetic factors have an influence on individual variation and susceptibility to hearing impairment.

A pulse noise (a noise which lasts less than 1 second) is especially dangerous for the hearing organ. Other external factors which impair the sense of hearing are: ototoxic substances such as chemical solvents, substances which cause anoxia of the tissues, heavy metals, drugs taken by the patients (aminoglycosides and certain painkillers). Hyperthermia has a significant influence on the deterioration of hearing in combination with exposure to noise.

Among internal factors connected with an exposure to noise which are significant in the development of hearing impairment, there are: metabolic diseases such as hyperlipidemia and diabetes as well as hypertension and smoking. These factors foster disturbances of blood supply and oxygenation of the cochlear auditory cells.

Tonal audiometry is a basic audiometric test used for an assessment of the state of hearing. An increase of hearing threshold in this test indicates a deterioration of hearing. A choice of frequency and depth of damage in order to diagnose the disease is conditioned by physiological properties of the human's hearing organ. The frequency range from 0,5 to 4 kHz is important for the understanding of speech, so the frequencies from the middle of this range (1-3 kHz) are established to be corresponding with everyday interpersonal communication.

Otosopic examination is another method of the hearing organ examination which might be performed by a doctor. Its aim is to examine the external ear and tympanic membrane. Accumetric test is another type of examination – hearing of whisper from a distance of 6 m. Pure tone audiometry is an assessment whether a patient hears through air transmission and impedance audiometry assesses a total resistance that a sound has to overcome in order to reach an internal ear. One can also examine auditory evoked potentials from brainstem which is an analysis of a neural pathway of sound from ear to brainstem where a final analysis of sound takes place. [1]

According to a list of occupational diseases included in attachment to a Decree of Council of Ministers from 30th June 2009, hearing occupational diseases are defined as “bilateral, permanent receiving hearing loss of cochlear or sensoneurinal type caused by noise, which is manifested as an increase of hearing threshold of at least 45 dB in a better hearing ear calculated as an arithmetic mean for audiometric frequencies of 1.2 and 3 kHz”. A period of time during which the documented symptoms of disease occurred that enable to diagnose the disease, despite former cessation of work under exposure, lasts 2 years. [2]

Long-term exposure to noise in the work place causes deterioration of hearing. As a result of the fact that the noise affects simultaneously both ears, a hearing loss is bilateral. One-sided hearing loss is not of occupational origin and is not included in the competences of occupational medicine. Hearing impairment is permanent, because the processes of damage of the sensory elements which are caused by the noise are irreversible. 80dB is a threshold established as an exposure to the noise and permissible exposure limit is 85 dB. A noise below 80 dB doesn't have an influence on the hearing organ and risk of damage is minimal. [1]

Purpose

The aim of the work was to analyse the structure of medical reports concerning hearing loss as an occupational disease in the years 2017-2018.

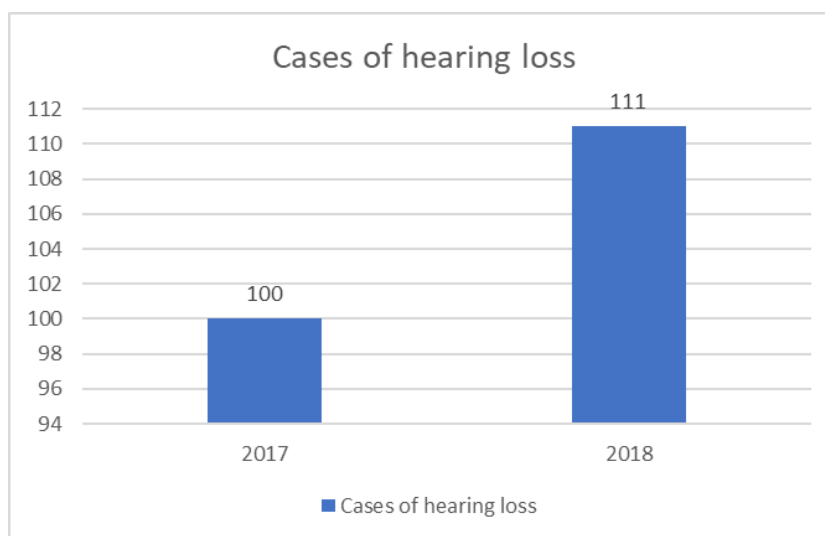
Material and method

An analysis concerned cases of diagnosis of hearing loss diagnosed as an occupational disease based on Centralny Rejestr Chorób Zawodowych Instytutu Medycyny Pracy. [3]

Results

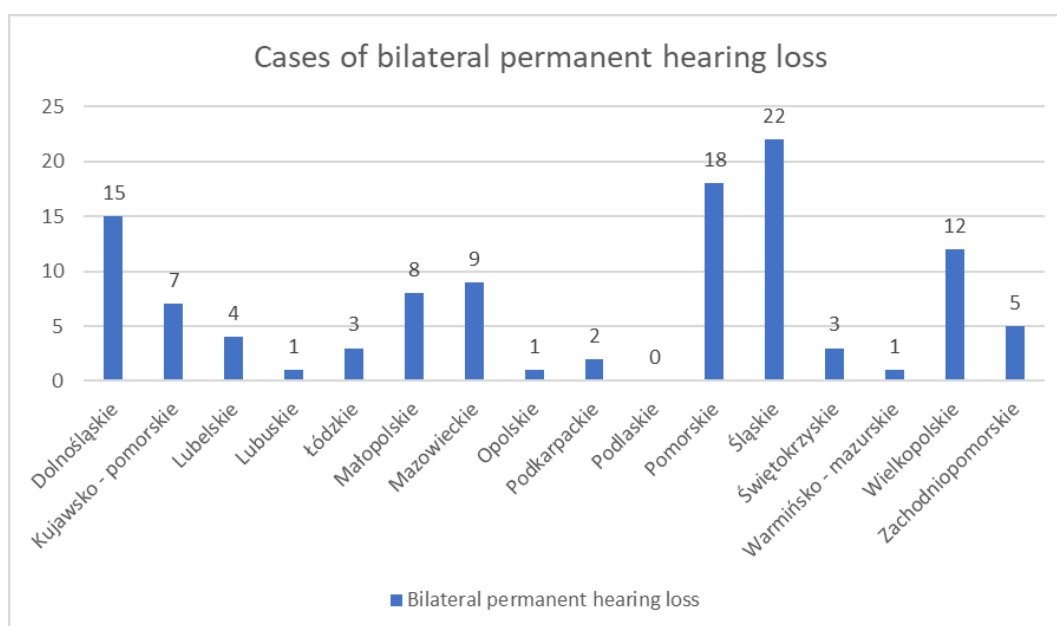
Medical condition	Number of cases		Increase (n)	Increase (%)
	2017	2018		
Hearing loss	100	111	+11	+11,0

Table 1. Number of cases of hearing loss diagnosed as an occupational disease in 2018 compared to 2017. Based on: *Centralny Rejestr Chorób Zawodowych Instytutu Medycyny Pracy*. [3]



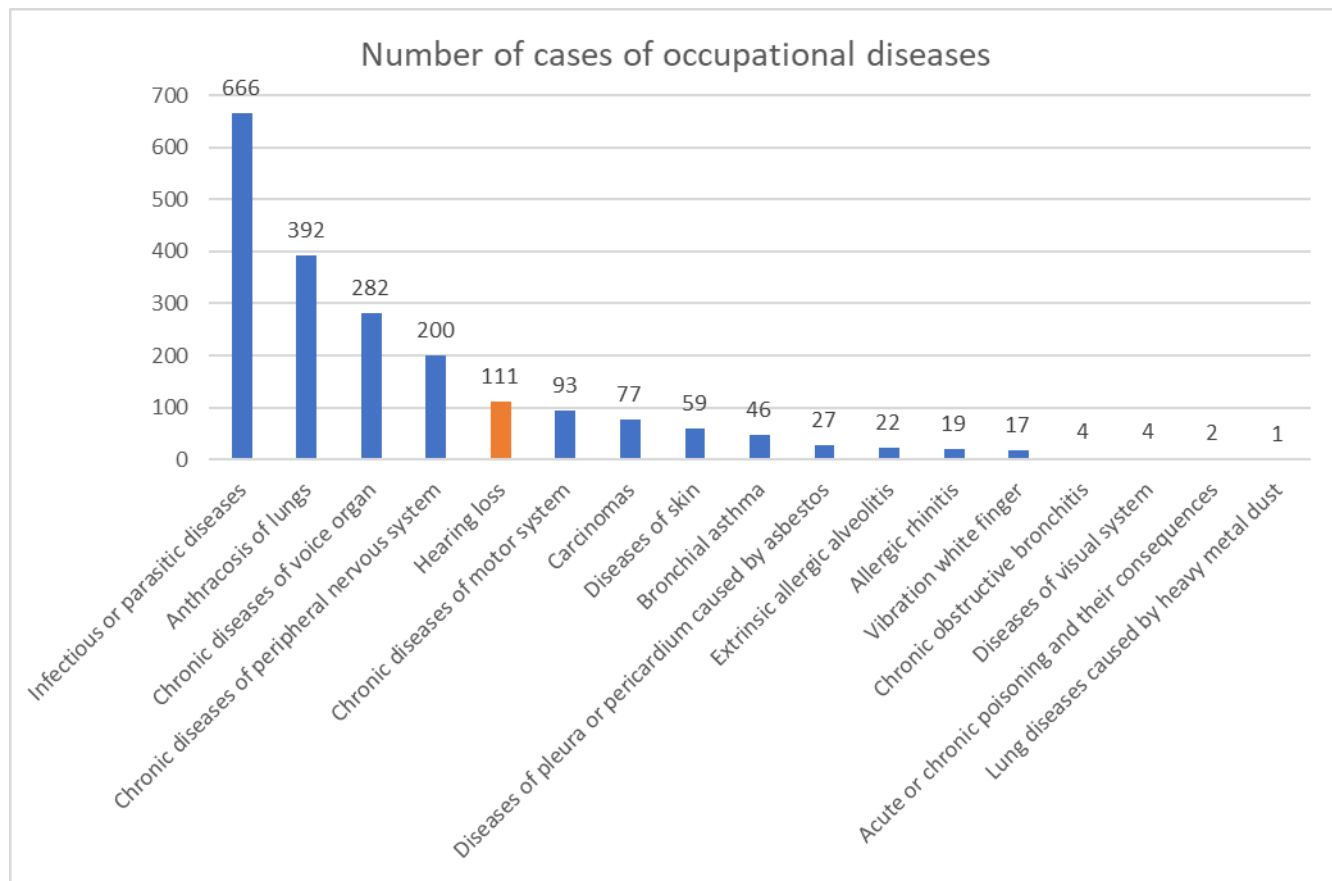
Graph 1. Number of cases of hearing loss diagnosed as an occupational disease in 2018 compared to 2017. Based on: *Centralny Rejestr Chorób Zawodowych Instytutu Medycyny Pracy*. [3]

In 2017 100 reports of hearing loss as an occupational disease were issued, whereas in the next year (2018) a rise of 10% was noted – 111 cases. (Table 1., Graph 1.)



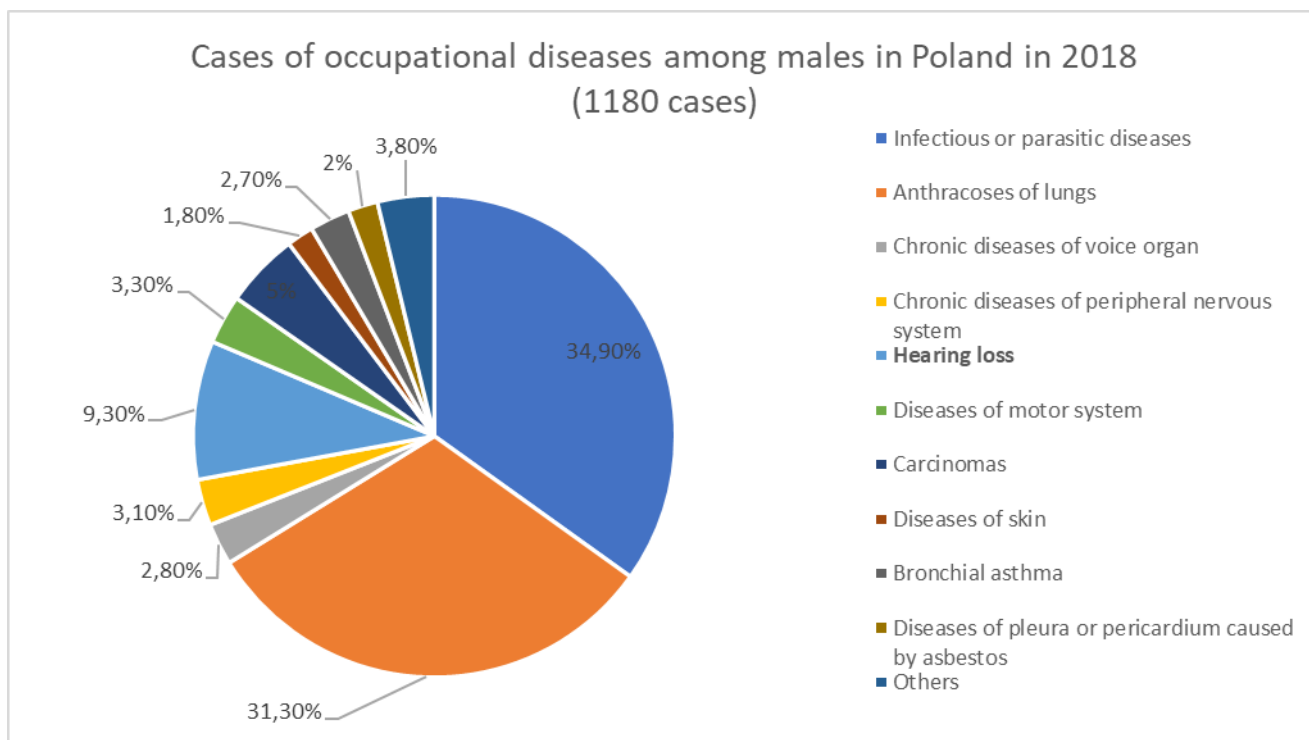
Graph 2. Cases of bilateral permanent hearing loss classified as an occupational disease according to voivodeship in 2018. Based on: *Centralny Rejestr Chorób Zawodowych Instytutu Medycyny Pracy*. [3]

In 2018 the highest number of reports of occupational disease due to permanent hearing loss was noted in śląskie and dolnośląskie voivodeship (mining, metallurgy) and also in pomorskie voivodeship (shipbuilding industry). The lowest number of reports was noted in podlaskie, lubuskie, opolskie and warmińsko-mazurskie voivodeship – due to almost lack of heavy industry in those voivodeships. (Graph 2.)



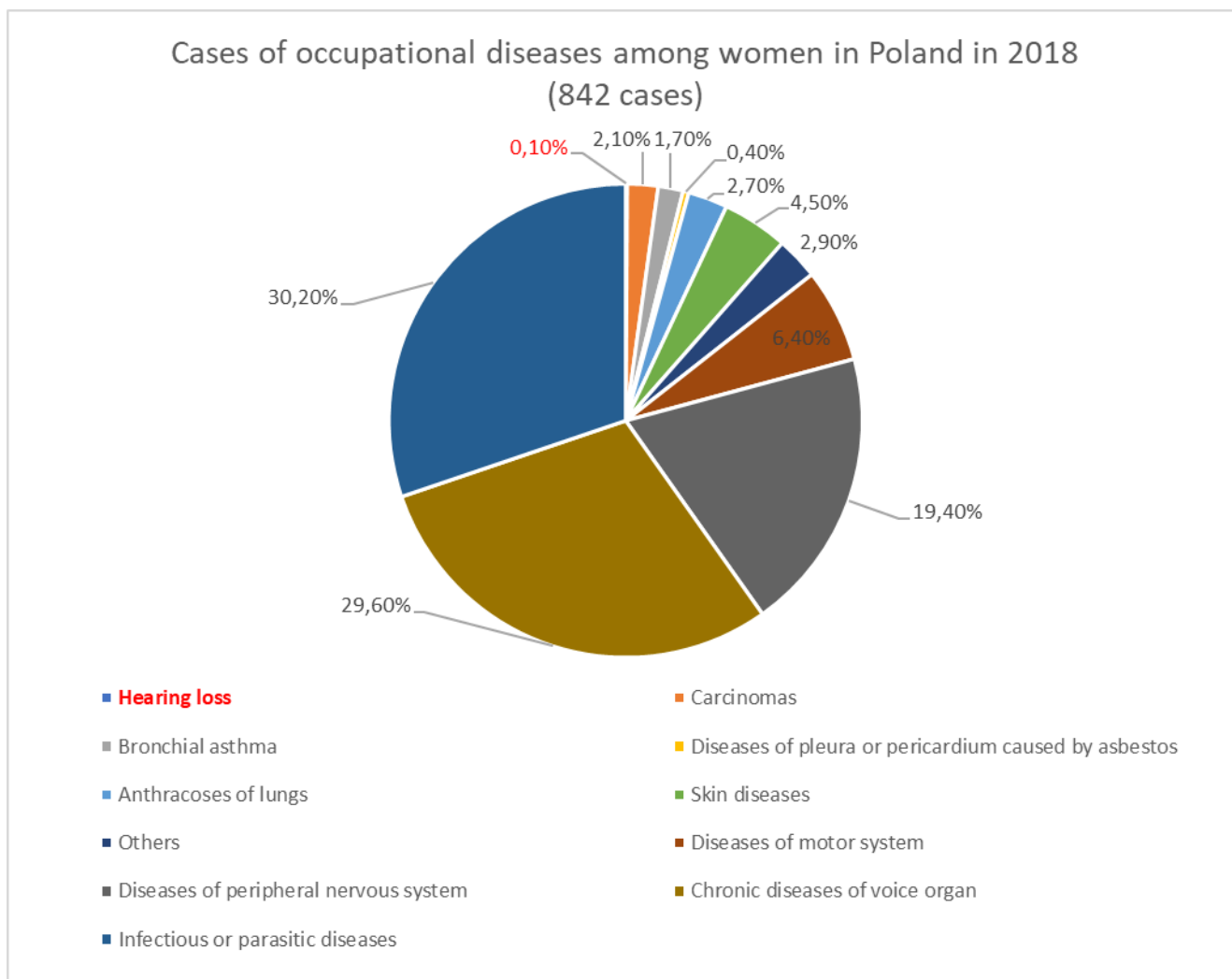
Graph 3. Occurrence of cases of hearing loss as an occupational disease compared to the occurrence of cases of another occupational diseases in Poland in 2018. *Based on: Centralny Rejestr Chorób Zawodowych Instytutu Medycyny Pracy. [3]*

In 2018 a permanent loss of hearing as an occupational disease was the fifth most common cause of reporting an occupational disease. (Graph 3.)



Graph 4. Percentage of hearing loss as an occupational disease in males among other occupational diseases diagnosed in males in Poland in 2018. *Based on: Centralny Rejestr Chorób Zawodowych Instytutu Medycyny Pracy. [3]*

A diagnosis of permanent hearing loss significantly more often affected males. It was the third most common cause of a diagnosis of an occupational disease among males and made up 9.3% of all reports of occupational diseases. (Graph 4.)



Graph 5. Occupational diseases among women in Poland in 2018. Based on: *Centralny Rejestr Chorób Zawodowych Instytutu Medycyny Pracy*. [3]

Permanent hearing loss significantly more often affects males than females . Among females it was a cause of 0,1% of reports of an occupational disease. (Graph 5.)

Medical condition	Total number of cases	Cases among males	
		n	%
Hearing loss	111	110	99,1

Table 2. Cases of hearing loss as an occupational disease among males in Poland in 2018 compared to cases among both genders. Based on: *Centralny Rejestr Chorób Zawodowych Instytutu Medycyny Pracy*. [3]

Occupational disease	Number of cases	% among all cases of occupational diseases	Rate per 100 000 employed persons	Rate per 100 000 paid employees
Hearing loss	110	9,3	1,3	1,8

Table 3. Cases of hearing loss as an occupational disease among males in Poland in 2018. *Based on: Centralny Rejestr Chorób Zawodowych Instytutu Medycyny Pracy. [3]*

Occupational diseases	Number of cases	% among all cases of occupational diseases	Rate per 100 000 employed persons	Rate per 100 000 paid employees
Hearing loss	1	0,1	0,0	0,0

Table 4. Cases of hearing loss as an occupational disease among females in Poland in 2018. *Based on: Centralny Rejestr Chorób Zawodowych Instytutu Medycyny Pracy. [3]*

In 2018 a report of permanent hearing loss as an occupational disease concerned almost exclusively males (110 cases in the whole country). Whereas among women there was only 1 such case that year in Poland. (Table 2., 3., 4.)

Medical condition	Rate per 100 000 employed people		
	Total	Males	Females
Hearing loss	0,7	1,3	0,0

Table 5. The incidence rate of hearing loss per 100 000 employed people in Poland in 2018. *Based on: Centralny Rejestr Chorób Zawodowych Instytutu Medycyny Pracy. [3]*

Hearing loss as an occupational disease in Poland is characteristic for males. Among workers in general this problem is not very common. Only 0,7 people per 100 000 cases were affected by hearing loss with subsequent report of occupational disease. (Table 5.)

Medical condition	Incidence rate per 100 000 employed people		Decrease/increase in relations to 2017 (%)
	2017	2018	
Hearing loss	0,7	0,7	-

Table 6. Incidence of hearing loss in Poland in 2018 compared to 2017. *Based on: Centralny Rejestr Chorób Zawodowych Instytutu Medycyny Pracy. [3]*

Despite the increase by 11 cases of hearing loss as an occupational disease in 2018 compared to 2017, the incidence rate per 100 000 persons is constant and equals 0.7 per 100 000 employed people. (Table 6.)

Year	Number of cases		
	Total	Males	Females
1994	11156	6976	4280
1995	11320	6791	4529
1996	11318	6751	4567
1997	11685	6638	5047
1998	12017	6876	5141
1999	9982	5296	4686
2000	7339	3965	3374
2001	6007	3516	2491
2002	4915	2872	1943
2003	4365	2654	1711
2004	3790	2306	1484
2005	3249	2021	1228
2006	3129	1855	1274
2007	3285	1889	1396
2008	3546	2075	1471
2009	3146	1906	1240
2010	2933	1990	943
2011	2562	1791	771
2012	2402	1601	801
2013	2214	1458	756
2014	2351	1549	802
2015	2094	1297	797
2016	2119	1409	710
2017	1942	1157	785
2018	2022	1180	842

Table 9. Number of cases of occupational diseases in Poland in years 1994-2018 by gender. *Based on: Centralny Rejestr Chorób Zawodowych Instytutu Medycyny Pracy. [3]*

Medical condition	Number of cases			Rate per 100 000 employed people			Rate per 100 000 paid employees		
	2016	2017	2018	2016	2017	2018	2016	2017	2018
Hearing loss	133	100	111	0,9	0,7	0,7	1,2	0,9	1,0

Table 10. Number of cases of hearing loss as an occupational disease in the years 2016-2018 per 100 000 employed persons. *Based on: Centralny Rejestr Chorób Zawodowych Instytutu Medycyny Pracy. [3]*

However, taking into account the 3-year period (including the year 2016) a decrease of cases of hearing loss can be noticed in relation to the year 2018. (Table 10.)

Occupational disease	Total	Age groups						
		≤ 24	25 – 34	35 – 44	45 – 54	55 – 59	60 – 64	≥ 65
Hearing loss	111	-	-	-	8	15	65	23

Table 11. Cases of hearing loss as an occupational disease according to age in Poland in 2018. *Based on: Centralny Rejestr Chorób Zawodowych Instytutu Medycyny Pracy. [3]*

Occupational disease	Total	Age groups						
		≤ 24	25 – 34	35 – 44	45 – 54	55 – 59	60 – 64	≥ 65
Hearing loss	110	-	-	-	8	14	65	23

Table 12. Hearing loss as an occupational disease among males in Poland in 2018 according to age. *Based on: Centralny Rejestr Chorób Zawodowych Instytutu Medycyny Pracy. [3]*

A problem of hearing loss as an occupational disease increases with employees' age. Among people younger than 45 there were no cases of hearing loss, whereas the highest risk of hearing loss is noted among employees in pre-retirement age. The highest number of cases was observed among people aged 60-64 which is a result of both changes caused by the aging of an organism and simultaneous exposure to noise. (Table 11., 12.)

Occupational disease	Total	Age groups						
		≤ 24	25 – 34	35 – 44	45 – 54	55 – 59	60 – 64	≥ 65
Hearing loss	1	-	-	-	-	1	-	-

Table 13. Hearing loss as an occupational disease among women in Poland in 2018 according to age. *Based on: Centralny Rejestr Chorób Zawodowych Instytutu Medycyny Pracy. [3]*

Among women 1 case of hearing loss as an occupational disease was noted and it also concerned a person of pre-retirement age (55-59 years). (Table 13.)

Occupational disease	Duration of exposure									
	Total	One shift	2 days – 1 month	12 months	Years					Not significant
					1 - 4	5 - 9	10 – 14	15 – 19	≥ 20	
Hearing loss	111	-	-	-	-	-	2	-	109	-

Table 14. Incidence of hearing loss as an occupational disease in Poland in 2018 according to the duration of exposure to a harming factor. *Based on: Centralny Rejestr Chorób Zawodowych Instytutu Medycyny Pracy. [3]*

Despite an exposure to noise of up to 10 years, no cases of permanent hearing loss were noted among this group. Almost all cases concerned employees with above 20 years of exposure.

Discussion

In 2018 and 2017 a decrease in medical reports concerning occupational disease due to hearing loss was noted compared to 2016. The reason for this may be a rise of awareness of the problem among workers employed on posts exposed to noise and also an awareness that sense of hearing does not regenerate itself and cannot be rehabilitated after a damage. Also, a pressure from Occupational Health and Safety specialists in order to create programs of optimal hearing protection for workers plays a huge role. Early protection (below 80 dB) and encouraging workers to use that protection is highly significant. A role of occupational medicine doctors and their education of workers during health surveillance is very important. A system of periodic examination of 1 examination per year during the first three years of employment with doctor's appointment and a reminder of hearing protection works very well.

A proper downward trend of incidence of hearing loss and proper actions taken by all services responsible for workers' protection is a well-documented fact. (Table 10.)

In the analysis concerning patients' age at which a permanent hearing loss occurred, a threshold of safe duration of work under exposure to noise can be distinguished which lasts 20 years of work. After this period of time a percentage of people with a hearing loss qualified as an occupational disease rises dramatically.

A downward trend of amount of reports of permanent hearing loss proves proper actions made by services responsible for safety of workers: occupational medicine doctors and nurses, Occupational Health and Safety departments.

These actions raise workers' awareness of the problem and show that after a permanent hearing impairment a return to a primary state is impossible.

A crucial point is also guidelines of periodic examination published in Attachment 1 to the Decree of Minister of Health and Social Services from 30.05.1996 and maintained in the Decree of Minister of Health from 12.11.2020. in which a requirement of audiometric examination each year during first 3 years of work under exposure to noise was included. During those 3 appointments patients with signs of beginning of hearing loss might be distinguished, but they also can be educated on preventive and protective actions that might be taken during work in exposure to noise.

Conclusions

1. A diagnosis of permanent hearing loss as an occupational disease concerns in 99,1% males employed in heavy industry. This problem practically doesn't concern females.
2. Workers at pre-retirement age and those who worked in exposure to noise for over 20 years are at a highest risk of hearing loss.
3. A percentage of medical reports concerning hearing loss as an occupational disease is at a relatively low level in relation to all employees in Poland and has a tendency to decrease in frequency.
4. A system of periodic examination which is 1 examination each year during first 3 years of employment with medical appointment and a reminder of hearing protection works very well.
5. Actions taken by all services (doctors, nurses, Occupational Health and Safety inspectors and employers) responsible for the protection of worker cause a proper downward trend of diagnoses of hearing loss as an occupational disease among employees in Poland.

References

- [1] Śliwińska-Kowalska M i wsp. Zasady orzekania o predyspozycjach do pracy w narażeniu na hałas lub nadmierny wysiłek głosowy oraz diagnostyka i profilaktyka chorób narządu słuchu i głosu. Warszawa 2011.
- [2] Załącznik do rozporządzenia Rady Ministrów z dnia 30 czerwca 2009 r. (poz. 869) Stan prawny 2009-07-03 Dz.U.2009.105.869 - Wykaz chorób zawodowych wraz z okresem, w którym wystąpienie udokumentowanych objawów chorobowych upoważnia do rozpoznania choroby zawodowej pomimo wcześniejszego zakończenia pracy w narażeniu zawodowym.
- [3] Świątkowska B, Hanke W. Szeszenia – Dąbrowska N. „Choroby zawodowe w Polsce w 2018” Instytut Medycyny Pracy, Centralny Rejestr Chorób Zawodowych Łódź 2019.