RESEARCH PAPER

Occupational Diseases Due To Occupational Risk Factors In Mining In Peru, 2013-2022

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Abstract
This retrospective, observational study aimed to determine the prevalence of occupational diseases caused by risk factors in the mining sector in Peru between 2013 and 2022. To this end, statistical data from the Ministry of Energy and Mines were analyzed using SPSS v.23 software, considering variables such as mining activity, causal agent, age, gender, occupation, and length of service. During the period analyzed, a total of 30,465 cases of occupational diseases were recorded, with noise-induced hearing loss (physical risk factor) identified as the most prevalent pathology with 97.73% of cases (n = 29,163), followed by pneumoconiosis caused by dust (chemical risk factor) with 3.94% (n = 1,202). The results revealed that the most affected population was male, workers over 60 years of age, those with more than 30 years of service, and personnel working as drillers. It was also determined that the highest incidence of these diseases originated in mining companies and open-pit operations. It is concluded that, although hearing loss and pneumoconiosis are the main conditions in Peruvian mining, there is a downward trend in cases towards the end of the study period, possibly associated with the implementation of occupational health and safety regulations.
Keywords: Sport, physical activity, recreation, reconstruction, social fabric

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1. Introduction

Mining in Peru has been important throughout history. Metals and their related activities have played a key role in the economic development of the ancient world since pre-Columbian times. It is the most at risk for accidents and/or occupational diseases. Despite the efforts of many countries, death, injury and prevalence rates among miners around the world show that in most countries mining remains the most dangerous occupation in terms of the number of people at risk. Although it represents only 1 percent of the global workforce, mining accounts for around 8 percent of fatal workplace accidents. There is no reliable data on the number of injuries, but they are considerable, as is the number of workers affected by disabling occupational diseases such as pneumoconiosis, hearing loss and the effects of vibrations (ILO, 2015).

The participation of the mining subsector in the Gross Domestic Product (GDP) in 2023 was 10.4% (58,807 million soles), in the internal tax revenue collected by SUNAT in the month of January 2024 was 10.9%, managing to generate 1,409 million soles, a figure 43.2% higher than what was collected in January 2023 (MINEM, 2024). Between January and November 2023, mining exports totaled US$38,673 million, 12% more than in the similar period of 2022 (SNMPE, 2023). Therefore, the withdrawal of this sector is unacceptable and, in addition to the high employment it generates, it also has negative consequences, one of them being the occupational diseases that affect workers, causing them to have less vitality and, consequently, a poor quality of life.

The National Center for Occupational Health and Environmental Protection for Health (SENSOPAS) is a deconcentrated body in Peru responsible for developing research, innovation, technologies and specialized services for the prevention and control of risks and damages related to occupational health and

protection of the environment for health (INS, 2024). However, in the country, the safety conditions in mining companies are risky due to the occupational risk factors (ORF) present in the different stages of the mining process, which cause various types of accidents, including fatalities and occupational diseases. It should be noted that there are also few publications around us that mention occupational diseases due to occupational risk factors in mining in Peru.

It is expected that this study contributes to the statistical investigation of occupational diseases caused by occupational risk factors in the mining industry and to the awareness and commitment of employees of companies in the mining sector from top management to the last worker, since they have a significant impact on the quality of life, family and most importantly, because it is tangible in the improvement of the controls of occupational risk factors in order to have adequate and healthy work environments for the protection of the health of hundreds of millions of employees who in Every day they face occupational risks. The objective of this study is to determine the prevalence of occupational diseases due to occupational risk factors in mining in Peru between the years 2013 and 2022.

Table 1. Occupational Diseases in Mining in Peru During the years 2013 to 2022, according to the International Classification of Diseases - ICD 10

CIE 10	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	Total	
	Amou	Amou	Amou	Amou	Amou	Amou	Amou	Amou	Amou	Amou	Amou	%
H90.0 - BILATERAL CONDUCTIVE HEARING HEARING	28	23	12	7	8	26	0	10	0	0	114	0.37
H90.1 - CONDUCTIVE HEARING HEARING, UNILATERAL WITH CONTRALATERAL UNRESTRICTED HEARING	127	14	16	5	0	0	0	0	0	0	162	0.53
H90.3 - NEUROSENSORIAL HEARING HEARING, BILATERAL	3670	4021	5651	2337	3363	3365	3034	83	72	8	25604	84.04
H90.4 - NEUROSENSORIAL HEARING HEARING, UNILATERAL WITH CONTRALATERAL UNRESTRICTED HEARINGCON	131	137	122	50	12	14	11	0	0	0	477	1.57
H90.5 - NEUROSENSORY HEARING HEARING, WITHOUT	544	463	400	170	1	0	0	0	0	0	1578	5.18
H90.6 - MIXED CONDUCTIVE AND NEUROSENSORIAL HEARING HEARING, BILATERAL	68	105	86	35	84	78	48	0	1	0	505	1.66
H90.7 - MIXED CONDUCTIVE AND NEUROSENSORIAL HEARING HEARING, UNILATERAL WITH CONTRALATERAL	23	31	24	10	12	12	0	0	0	0	112	0.37
H90.8 - MIXED CONDUCTIVE AND NEUROSENSORY HEARING	2	7	1	0	0	0	0	0	0	0	10	0.03
H91 - OTHER HEARING HEARINGS	149	85	54	20	9	18	5	1	2	0	343	1.13
H91.8 - OTHER SPECIFIED HEARING HEARINGS	24	24	6	0	3	3	0	2	3	0	65	0.21
H91.9 - HYPOAUSIA, UNSPECIFIED	24	30	42	5	13	56	0	23	0	0	193	0.63
J62 - PNEUMOCONIOSIS DUE TO SILICA DUST	214	237	157	45	123	74	63	0	2	0	915	3.00
J62.8 - PNEUMOCONIOSIS DUE TO OTHER DUSTS CONTAINING SILICA	1	0	4	0	2	0	1	0	3	0	11	0.04
J63 - PNEUMOCONIOSIS DUE TO OTHER INORGANIC DUSTS	17	12	3	0	0	3	1	0	0	0	36	0.12
J63.8 - PNEUMOCONIOSIS DUE TO OTHER SPECIFIED INORGANIC DUSTS	6	0	7	2	2	1	0	0	0	0	18	0.06
J64 - UNSPECIFIED PNEUMOCONIOSIS	74	18	106	8	8	0	8	0	0	0	222	0.73
L23.5 - ALLERGIC CONTACT DERMATITIS DUE TO OTHER CHEMICALS	3	0	0	0	0	0	0	0	0	0	3	0.01
M70 - USE, OVERUSE, AND PRESSURE-RELATED SOFT TISSUE DISORDERS	1	2	3	0	0	0	1	0	0	1	8	0.03
T75 - EFFECTS OF OTHER EXTERNAL CAUSES	31	0	0	0	3	0	2	1	8	2	47	0.15
T75.2 - EFFECTS OF VIBRATION	7	7	14	0	6	4	2	0	0	2	42	0.14
TOTAL	5144	5216	6708	2694	3649	3654	3176	120	91	13	30465	100.00

Note: Data taken from the statistics of occupational diseases of the Ministry of Energy and Mines (MINEM) (2023).

2. Method

It is an observational, retrospective study of statistical analysis of occupational diseases due to risk factors in mining in Peru during the years 2013-2022, registered and obtained on the website of the Ministry of Energy and Mines (https://www.gob.pe/institucion/minem/informes-publicaciones/4646253-estadistica-de-mujeres-ocupaciones-en-minería). The date of data collection was from October 1 to November 15, 2024.

This study was carried out taking into account the observed variables: Occupational diseases by occupational risk factor in mining in Peru, according to mining activity, causal agent, international classification of disease, age, gender, occupation, length of service and type of company.

The author carefully reviewed each annual record, verifying suitability, then aggregated the variables of importance.

As annual reports are publicly available, the study plan did not need approval from the ethics committee. The chosen data were entered into Microsoft Excel® 2016 and then statistically quantified using SPSS v 23. With tables and figures of frequencies and percentages.

3. Results

According to the analysis of the statistics of occupational diseases taken from the registry of the Ministry of Energy and Mines website (https://www.gob.pe/institucion/minem/informes-publicaciones/4646253-estadistica-de-ciudades-trabajocionales-en-minería), the results described below were obtained.

Table 2. Synthesis of Occupational Diseases in Mining in Peru During the years 2013 to 2022, according to the International Classification of Diseases - ICD 10

CIE	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	Total	%
H90 Hearing loss	4790	4940	6414	2639	3505	3572	3098	119	78	8	29163	95.73
J62 Pneumoconiosis	312	267	277	55	135	78	73	0	5	0	1202	3.95
L23.5 - Dermatitis	3	0	0	0	0	0	0	0	0	0	3	0.01
M70 - Soft tissue disorders	1	2	3	0	0	0	1	0	0	1	8	0.03
T75 - Effects of other causes	31	0	0	0	3	0	2	1	8	2	47	0.15
T75.2 - Effects of vibration	7	7	14	0	6	4	2	0	0	2	42	0.14
Total	5144	5216	6708	2694	3649	3654	3176	120	91	13	30465	100

Note: Data taken from the statistics of occupational diseases of the Ministry of Energy and Mines (MINEM) (2023).

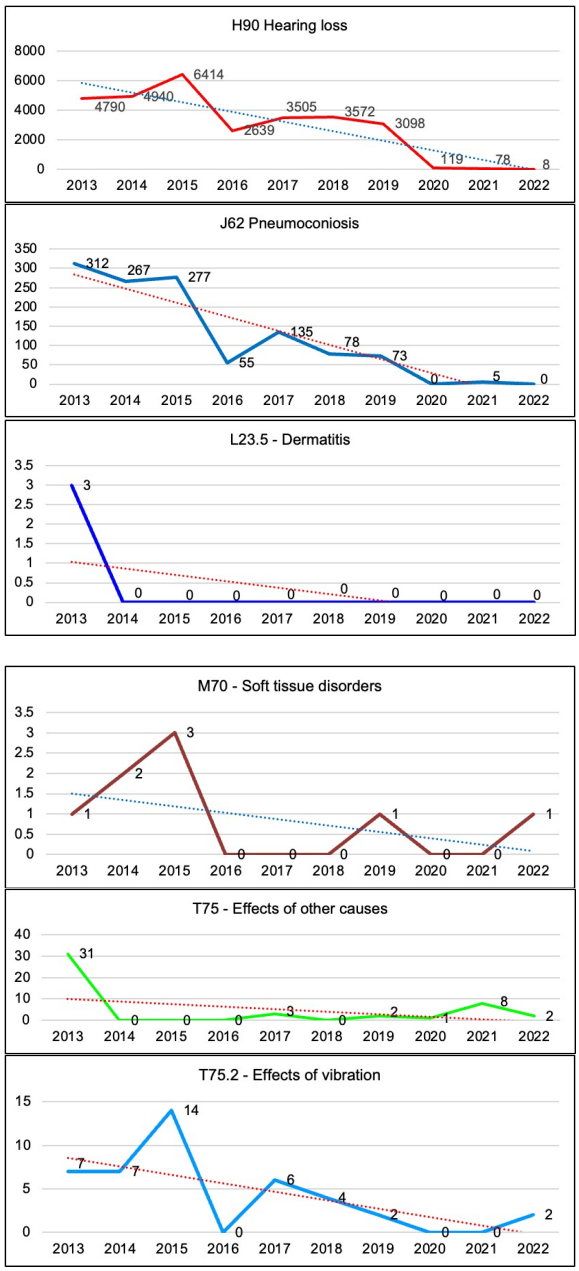


Figure 1. Synthesis of Occupational Diseases according to Type of Causal Agent in Mining in Peru during the years 2013 - 2022
Note: Own elaboration.

During the period 2013-2022, 30,465 occupational diseases were recorded in mining in Peru, of which hearing loss was the most representative with 97.73% (n = 29,163), followed by pneumoconiosis with 3.94% (n = 1,202) and the effect of other external causes 0.15% (n = 47), among the most frequent (Tables 1 – 2 and Figure 1).
The other tables and figures of the results obtained from the study are shown below.

Table 3. Occupational Diseases according to Type of Causal Agent in Mining in Peru during the years 2013 – 2022.

Causal Agent	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	Total	%
OD Physical Agents	4786	4941	6396	2628	3505	3573	3100	96	78	9	29112	95.56
OD Chemical Agents	322	267	289	61	141	81	74	23	7	1	1266	4.16
OD Biological Agents	1	0	6	5	0	0	0	1	3	0	16	0.05
OD Ergonomic	35	8	17	0	3	0	3	0	3	2	71	0.23
Total	5144	5216	6708	2694	3649	3654	3177	120	91	12	30465	100.00

Note: Data taken from the statistics of occupational diseases of the Ministry of Energy and Mines (MINEM) (2023).

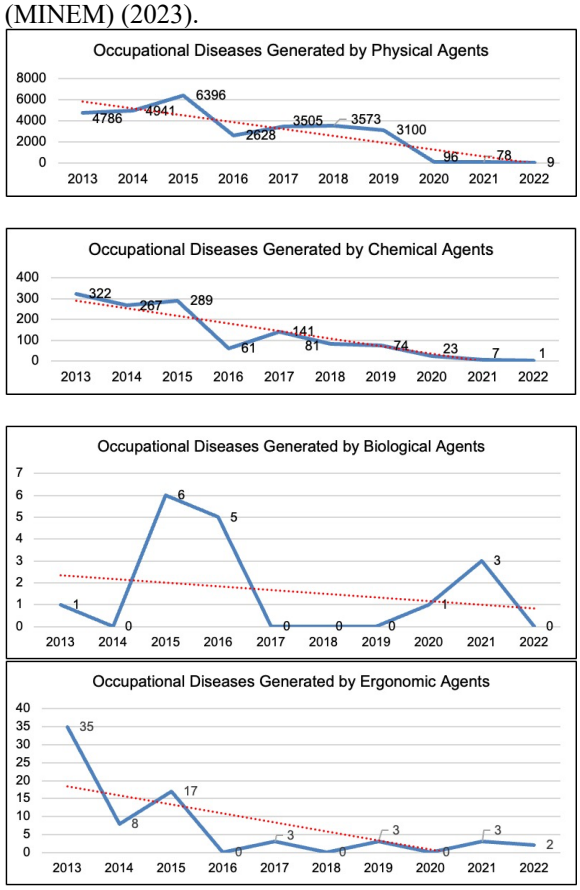


Figure 2. Occupational Diseases according to Type of Causal Agent in Mining in Peru During the years 2013 – 2022.

Note: Own elaboration.

In Table 3 and Figure 2, it can be seen that the highest frequency of occupational diseases was affected by the occupational risk factor of physical agents (95.56%), followed by the occupational risk factors of chemical agents (4.16%), this during the period 2013-2022.

Table 4. Occupational Diseases by Age Range in Mining in Peru during the years 2013 – 2022

AGE RANGE	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	Total	%
	Amount	Amount	Amount	Amount	Amount	Amount	Amount	Amount	Amount	Amount		
21 - 25	25	26	24	10	1	0	2	0	0	1	89	0.29
26 - 30	131	93	124	50	61	66	55	0	3	0	583	1.91
31 - 35	388	324	474	195	220	224	200	0	4	2	2031	6.67
36 - 40	650	604	787	313	307	320	278	2	4	0	3265	10.72
41 - 45	761	755	992	383	409	410	358	5	3	3	4079	13.39
46 - 50	876	875	1025	412	448	432	359	16	12	0	4455	14.62
51 - 55	786	754	922	369	451	437	373	1	2	1	4096	13.44
56 - 60	728	771	949	387	584	590	516	47	21	3	4596	15.09
60 - +	799	1014	1411	575	1168	1175	1036	49	42	2	7271	23.87
TOTAL	5144	5216	6708	2694	3649	3654	3177	120	91	12	30465	100

Note: Data taken from the statistics of occupational diseases of the Ministry of Energy and Mines (MINEM) (2023).

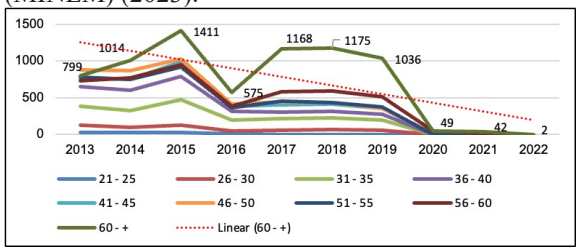


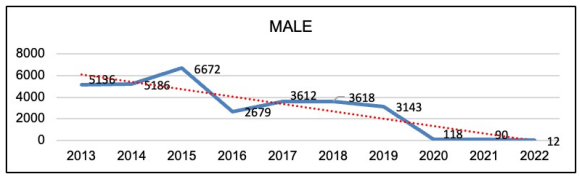
Figure 3. Occupational Diseases by Age Range in Mining in Peru during the years 2013 – 2022
Note: Own elaboration

In Table 4 and Figure 3, a higher frequency of occupational diseases is evident in collaborators over 60 years of age (n = 7,271; 23.87%), followed by collaborators between 56 and 60 years of age (n = 4,596; 15.09%), in the period 2013-2022.

Table 5. Occupational Diseases by Gender in Mining in Peru During the years 2013 - 2022

Género	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	Total	%
	Amount	Amount	Amount	Amount	Amount	Amount	Amount	Amount	Amount	Amount		
FEMALE	8	30	36	15	37	36	34	2	1	0	199	0.65
MALE	5136	5186	6672	2679	3612	3618	3143	118	90	12	30266	99.35
TOTAL	5144	5216	6708	2694	3649	3654	3177	120	91	12	30465	100.00

Note: Data taken from the statistics of occupational diseases of the Ministry of Energy and Mines (MINEM) (2023).



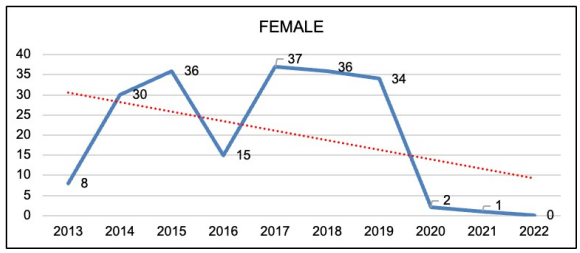


Figure 4. Occupational Diseases by Gender in Mining in Peru During the years 2013 – 2022
Note: Own elaboration

In Table 5 and Figure 4, it is observed that the most frequent occupational diseases occur in males (n = 30,266: 99.35%), compared to women (n = 199; 0.65%).

Table 6. Occupational Diseases by Occupation in Mining in Peru During the years 2013 – 2022.

Ocupation	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	Cant.	%
	Cant.	Cant.	Cant.	Cant.	Cant.	Cant.	Cant.	Cant.	Cant.	Cant.		
CONSTRUCTION WORKER	10	21	24	10	24	24	22	0	0	0	135	0.44
WAREHOUSE/WAREHOUSE MANAGER	16	15	22	5	12	13	11	0	0	0	94	0.31
AUX. LIMPIEZA	12	11	7	0	0	1	0	0	0	0	31	0.10
ASSISTANT	140	106	272	110	253	257	231	0	0	0	1369	4.49
ASSISTANT I	12	11	0	0	0	1	0	2	0	0	26	0.09
MOTORCYCLE ASSISTANT	24	24	24	10	0	1	0	0	0	0	83	0.27
DRILLING ASSISTANT	100	96	86	36	6	3	1	0	0	0	328	1.08
HELPERS-OTHER	36	27	24	10	0	12	0	0	2	0	111	0.36
ASSISTANT - ELECTRICIAN	3	0	0	0	12	0	0	0	0	0	15	0.05
FIREFIGHTER	0	0	0	0	1	0	0	0	0		1	0.00
GROCER	3	2	0	0	0	0	1	0	0	0	6	0.02
SURFACE FOREMAN	1	1	9	0	0	1	0	0	0	0	12	0.04
MINE FOREMAN	224	201	196	71	1	1	0	0	2	0	696	2.28
CARPENTER	7	9	12	5	12	15	11	0	0	0	71	0.23
CARRILANO	12	14	12	5	0	0	0	0	0	0	43	0.14
CRUSHER	22	24	32	10	24	24	12	6	0	0	154	0.51
DRIVER	60	84	132	50	108	115	99	0	0	0	648	2.13
COMPRESSORIST	8	13	12	5	12	13	0	0	0	0	63	0.21
EQUIPMENT-MACHINERY DRIVER	1	11	0	0	0	18	0	0	0	0	30	0.10
CONTROLLER	2	4	0	0	1	7	0	0	0	0	14	0.05
SQUALER	3	0	0	0	36	2	0	0	0	0	41	0.13
TRIGGER	17	31	36	15	264	36	35	12	11	0	457	1.50
ELECTRICIAN	136	103	260	110	1	267	243	12	7	0	1139	3.74
SURFACE EMPLOYEE	42	98	178	75	180	181	166	0	0	0	920	3.02
WOODWORKER	90	89	93	35	1	4	0	0	0	0	312	1.02
OFFICIAL	0	0	0	0	2	0	0	0	0	0	2	0.01
ING. MINE SERVICES	16	12	12	5	0	0	0	0	0	0	45	0.15
ING. ON THE SURFACE	16	35	60	25	61	60	55	0	0	0	312	1.02
ING. GEOLOGIST	0	0	0	0	0	2	0	0	0	0	2	0.01
MINE CHIEF ENGINEER	22	25	15	5	0	0	0	0	0	0	67	0.22
PLANT HEAD ENGINEER	1	0	0	10	0	1	1	0	0	0	13	0.04
ENG.CHIEF PROG.SEG.E.HIG	24	25	24	0	0	0	0	0	0	0	73	0.24
ING. HEAD OF SERVICES	0	0	8	0	0	0	0	0	0	0	8	0.03
MINE SUPERINTENDENT	3	0	3	0	0	0	0	0	0	0	6	0.02
MINING ENGINEER	1	9	12	6	12	12	11	0	3	0	66	0.22
MECHANICAL ENGINEER	7	0	0	0	0	0	0	0	0	0	7	0.02
INVENTORY HEAD	2	0	0	0	0	0	0	0	0	0	2	0.01
LABORATORY	13	12	12	5	0	0	0	0	0	0	42	0.14
TEACHER	13	12	24	6	4	4	4	12	11	0	90	0.30
MASTER I	20	28	0	0	0	0	0	0	0	0	48	0.16

MASTER II	42	56	36	15	0	0	0	0	0	0	149	0.49
MASTER III	48	48	48	20	0	0	0	0	0	0	164	0.54
MECHANIC	274	378	701	290	698	686	629	0	0	0	3656	12.00
SURFACE MECHANICAL	14	12	12	5	0	0	0	0	0	0	43	0.14
MECHANIC-WELDER	3	0	1	0	0	1	1	0	0	1	7	0.02
MINER	12	12	12	5	0	0	0	0	0	0	41	0.13
MILLER	0	7	12	5	12	12	11	0	0	0	59	0.19
BIKER	175	148	138	56	24	32	0	0	0	0	573	1.88
SAMPLER	55	52	76	31	24	26	24	0	0	1	289	0.95
WORKER	70	82	144	60	132	130	110	0	0	1	729	2.39
SURFACE WORKER	3	0	11	5	0	1	0	0	0	0	20	0.07
OF. MINER	12	12	12	5	0	0	0	0	0	0	41	0.13
MINE OFFICER	1	0	0	0	1	0	0	0	0	0	2	0.01
FILLING OPERATOR	13	24	21	5	13	12	11	0	0	0	99	0.32
WINCH OPERATOR (WINCHERO)	25	24	24	10	0	0	0	0	0	0	83	0.27
STATIONARY EQUIPMENT OPERATOR (FORCE C.)	32	36	36	15	12	12	0	0	0	0	143	0.47
HEAVY EQUIPMENT OPERATOR (SCOOP, JUMBO)	215	175	149	51	116	86	63	0	0	2	857	2.81
OPERATOR	500	420	797	333	665	663	633	14	14	1	4040	13.26
OTHERS	0	0	0	0	0	15	6	48	27	3	99	0.32
PALERO	14	7	12	5	12	12	11	0	0	0	73	0.24
PAWN	30	24	26	10	1	1	0	0	0	0	92	0.30
MINE PAWN	12	12	12	5	0	0	0	0	0	0	41	0.13
DRILLER	1702	1608	1589	634	102	73	47	1	2	0	5758	18.90
MINE SERVICES PERSONNEL	2	0	0	0	0	0	0	0	0	0	2	0.01
SECRETARY	20	105	131	55	132	132	110	2	2	2	691	2.27
MINE GENERAL SERVICE	0	1	0	0	0	0	0	0	0	0	1	0.00
OVERSHELF	38	36	36	15	0	0	0	0	0	0	125	0.41
WELDER	159	166	263	110	204	208	189	12	12	1	1324	4.35
SUPERVISOR	236	312	481	187	354	352	319	1	0	0	2242	7.36
FOREMAN SUPERVISOR	14	15	12	5	0	0	0	0	0	0	46	0.15
ENGINEER SUPERVISOR	48	57	72	30	36	36	33	0	0	0	312	1.02
MULTIFUNCTIONAL TECHNICIAN	40	14	12	8	0	0	0	0	0	0	74	0.24
BLASTING TECHNICIAN	12	12	12	5	0	0	0	0	0	0	41	0.13
TECHNICIAN II	91	91	97	40	12	13	11	0	0	1	356	1.17
TECNICO III	14	14	12	5	0	0	0	0	0	0	45	0.15
TECHNICIAN IV	7	14	12	5	12	12	11	0	0	1	74	0.24
SURVEYOR	34	37	2	15	12	12	11	0	0	0	123	0.40
TURNER	27	36	36	20	48	49	44	0	0	0	260	0.85
TUBE	12	0	48	0	0	0	0	0	0	0	60	0.20
VIGILANT	18	13	12	5	0	1	0	0	0	0	49	0.16
TOTAL	5143	5213	6708	2694	3649	3652	3177	120	91	12	30465	100

Note: Data taken from the statistics of occupational diseases of the Ministry of Energy and Mines (MINEM) (2023).

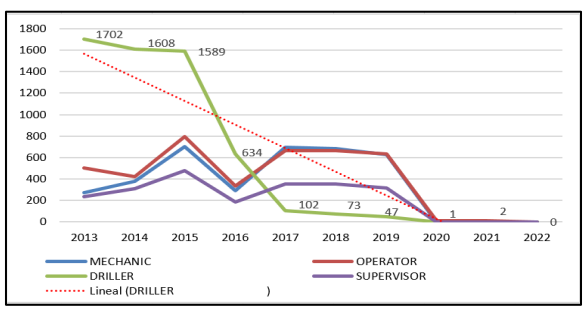


Figure 5. Occupational Diseases by Occupation in Mining in Peru During the years 2013 – 2022.
Note: Own elaboration

Table 6 and Figure 5 show that the relevant occupational disease occurs in the driller occupation (n = 5,758; 18.90%), followed by the operator occupation (n = 4,040; 13.26%).

Table 7. Occupational Diseases by Length of Service in Mining in Peru during the years 2013 – 2022

Service Time	2013 Amount	2014 Amount	2015 Amount	2016 Amount	2017 Amount	2018 Amount	2019 Amount	2020 Amount	2021 Amount	2022 Amount	Amount	%
0 - 1	103	27	39	11	12	13	11	0	5	1	222	0.73
1 - 2	60	42	65	25	37	36	33	0	0	1	299	0.98
2 - 3	50	56	95	40	73	75	66	0	1	0	456	1.50
3 - 4	97	70	94	40	63	67	56	1	1	0	489	1.61
4 - 5	233	203	225	93	96	99	90	0	1	0	1040	3.41
5 - 10	877	938	1499	621	966	1016	882	2	1	2	6804	22.33
10 - 15	950	967	1073	427	250	253	205	32	21	3	4181	13.72
15 - 20	1036	1029	1052	410	183	170	148	2	1	0	4031	13.23
20 - 25	594	604	710	266	263	229	183	3	4	0	2856	9.37
25 - 30	316	396	474	192	367	361	315	2	2	3	2428	7.97
30 +	828	884	1382	569	1339	1335	1188	78	54	2	7659	25.14
TOTAL	5144	5216	6708	2694	3649	3654	3177	120	91	12	30465	100

Note: Data taken from the statistics of occupational diseases of the Ministry of Energy and Mines (MINEM) (2023).

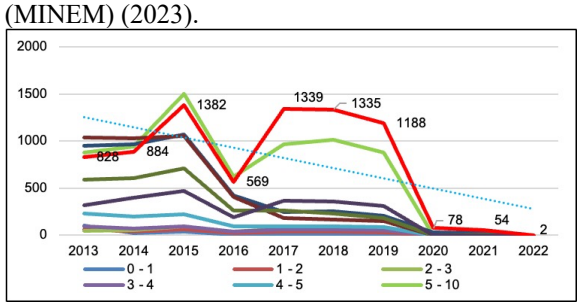


Figure 6. Occupational Diseases by Length of Service in Mining in Peru during the years 2013 – 2022
Note: Own elaboration

According to table 7 and figure 6, it is observed that the predominant occupational disease occurs in employees with more than 30 years of service (n = 7,659; 25.14%), seconded by employees with service time between 5 and 10 years (n = 6,804; 22.33%).

Table 8. Occupational Diseases by Type of Company in the Mining of Peru During the years 2013 – 2022

Company Type	2013 Amount	2014 Amount	2015 Amount	2016 Amount	2017 Amount	2018 Amount	2019 Amount	2020 Amount	2021 Amount	2022 Amount	Amount	%
Holder	1863	2172	3792	1525	3544	3631	3152	119	78	8	19884	65.27
Mining Contractor	3002	2833	2737	1099	98	15	18	1	13	4	9820	32.23
Related Company	279	211	179	70	7	8	7	0	0	0	761	2.50
TOTAL	5144	5216	6708	2694	3649	3654	3177	120	91	12	30465	100.00

Note: Data taken from the statistics of occupational diseases of the Ministry of Energy and Mines (MINEM) (2023).

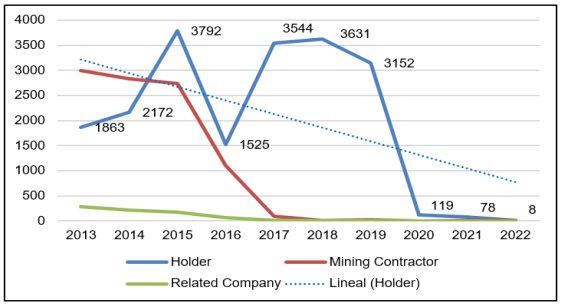


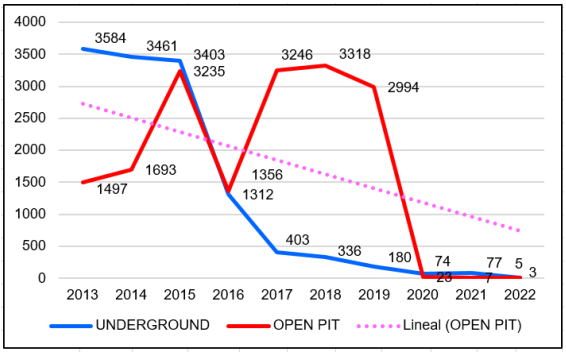
Figure 7. Occupational Diseases by Type of Company in the Mining of Peru During the years 2013 – 2022
Note: Own elaboration

From Table 8 and Figure 7, it is determined that the most frequent occupational disease occurs in the mining owner's companies (n = 19,884; 65.27%), followed by mining contractor companies (n = 9,820; 32.23%).

Table 9. Occupational Diseases due to Mining Activity in Mining in Peru during the years 2013 – 2022

Actividad Minera	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	Total	%
DEPOSIT	24	25	24	10	0	0	1	3	6	3	96	0.32
PROFIT PLANTS	39	37	46	16	0	0	2	20	1	1	162	0.53
UNDERGROUND	3584	3461	3403	1312	403	336	180	74	77	5	12835	42.13
OPEN PIT	1497	1693	3235	1356	3246	3318	2994	23	7	3	17372	57.02
TOTAL	5144	5216	6708	2694	3649	3654	3177	120	91	12	30465	100

Note: Data taken from the statistics of occupational diseases of the Ministry of Energy and Mines (MINEM) (2023).



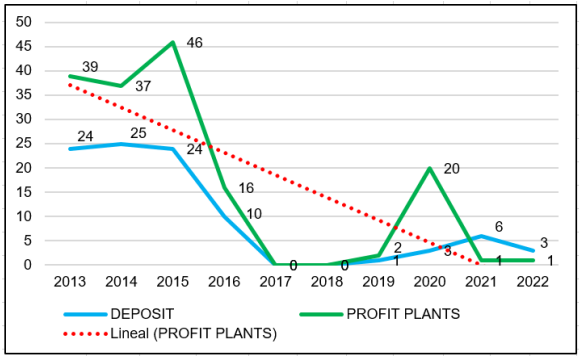


Figure 8. Occupational Diseases due to Mining Activity in Mining in Peru during the years 2013 – 2022
Note: Own elaboration

From Table 9 and Figure 8, it is concluded that the most frequent occupational disease originates in open pit mining (n = 17,372; 57.02%), followed by underground operations (n = 12,835; 42.13%).

4. Discussion

Safety and health at work are the fundamental pillars of any work environment work, while generating the added value of improving safety and health, preventing accidents, occupational diseases and ensuring the well-being of collaborators.

The onset of occupational diseases is slow and overlapping. They arise as a result of repeated occupational exposures or even by mere presence in the workplace, but they may have a long latency period. Many of these diseases are progressive, even after the worker has been removed from exposure to the causal agent, irreversible and serious; however, many are foreseeable, which is why all the accumulated knowledge should be used for their prevention (DIGESA, 2005).

Hearing loss is an occupational disease, one of the most frequent occupational diseases according to the WHO worldwide (OMS, 2019). This pathology produces great deterioration in the quality of life in the working population, as well as considerable economic losses for companies (Neitzel et al., 2017; Rabinowitz, cited in Le Prell et al., 2012). In addition to the inability it causes for interpersonal communication, it reduces the worker's quality of life and work options (Kuhn et al., 2011).

4.1 Prevalent Occupational Diseases

According to the study carried out, it was determined that the occupational disease of hearing loss caused by the physical occupational risk factor of noise is the most frequent 97.73% (n = 29,163) (See Table No. 3), agreeing with the publication of other similar studies. Cerro and Valladares, who found that approximately 1 in 10 workers had hearing loss due to noise according to the occupational evaluation carried out (Cerro et al., 2020). In 2015, 25% of the world's population had hearing loss due to excessive noise in their workplace (Wolf et al., 2018) and according to data from the CDC, within the industry, mining occupies the sector with the highest prevalence of hearing damage (Masterson et al., 2003).

In this study, it was determined that hearing loss caused by the physical occupational risk factor noise has a downward trend from 2013 to 2022, reaching 0 (zero) in this last year, which contradicts what was determined by Tulcán and Tutillo (2011), who declare that the vast majority of workers, 60%, have suffered blows and cuts, 24% from falling tools and 7% from entrapments, taking into account that This work is high risk, making it the first cause of occupational diseases due to physical agents.

In the study carried out, it was determined that the occupational disease of pneumoconiosis caused by the chemical occupational risk factor, dust, is the second most frequent 4.16% (n = 1,266) (See table No. 3), a quantity greater than the prevalence of pneumoconiosis reported in the study by Garces et al. (2005), which was 0.54%, in the same way as that reported in the period 1996-2002 by Weekly in the USA where the prevalence among coal miners found a prevalence of 2.8% (CDC, 2003), likewise, in the study by Montes in Spain, who in a 20-year follow-up of coal miners determined a prevalence of 3.8% % (Montes et al., 2003).

According to the study carried out during the period 2013-2022, the decrease in the occupational disease of pneumoconiosis caused by the chemical occupational risk factor, dust, was evident. This decreasing trend was corroborated by the study by Tulcán and Tutillo (2011), who mention that 36% of the personnel working in the Rocafuerte mining area have a greater number of respiratory problems, especially the flu, due to the inhalation of dust particles, placing it in second place with respect to those produced by physical agents. Furthermore, Medina and Rodas (2016), according to the results of their research, determined that 2% of workers mention having suffered serious illnesses due to the chemical mining process such as: cancer, silicosis, bronchitis; while 98% of workers say they have not suffered serious illnesses due to the same process.

Regarding occupational diseases due to ergonomic risk factors, the study concluded that it is the third most frequent occupational disease 0.23% (n = 71) (Table 3). This contrasts with the study carried out by Caro (2014), who determined that as a consequence of the anti-ergonomic design of the 41 jobs evaluated, it is confirmed that the most persistent health problems that require medical attention periodically are musculoskeletal (lower back) 82.85% and (wrist, shoulder and eye pain) with an incidence of 17.15 among the population studied. Likewise, in the study by Rafael (2020), he concluded that ergonomic risk factors significantly affect the work performance of the workers of the Mining Company Shougang Hierro Perú S.A.A., in 2020; thus corroborating the general hypothesis, that, Ergonomic risk factors significantly affect the work performance of workers in the company in question, in the year 2020, obtaining a Zc=46.67.

According to Table 3, it is observed that occupational diseases due to the biological risk factor were very few, 0.05% (n = 16), occupying the fourth place of the most frequent occupational diseases. Which is in contrast to what was reported by the Survey on Working Conditions in Europe 2015 (Eurofound, 2015), which concludes that an increasing percentage of European workers (13%, 1.5 times more than 10 years ago) are exposed to infectious agents at work. Biological agents include viruses, bacteria, fungi and parasites, and can cause health problems, either directly or through exposure to allergens or toxins related to them. The Organization International Labor (OIT, 2022), maintains that many agents and substances used or generated at work can be harmful to health. These include chemicals in all their forms: solid, liquid, gaseous, including nanoparticles, and biological agents such as bacteria, viruses or other microorganisms that can cause infections, allergic reactions or be toxic in nature. Biological risks also include the transmission of diseases between humans

(HIV, hepatitis, influenza, etc.), or between animals and humans (malaria, dengue fever, Weil's disease, etc.).

This study showed that miners' illnesses in Peru have decreased in the period 2013 - 2022. This could be due to the implementation of the Occupational Health and Safety Regulation in Mining DS 024-2016-EM and its amendment DS 023-2017-EM, which emphasize the prevention of occupational diseases (MINEM, 2020), and another due to the reduction in the workforce due to the COVID-19 Pandemic (Galas et al., 2021).

4.2 Limitation

For the present study, the records of occupational diseases of the Ministry of Energy and Mines were used, so it was evident that in the years: 2016 there are only the reports from January to May, 2021 the report for the month of December is missing, 2022 the reports for the months of January, June, August and September were not recorded, which may be that the statistics shown do not reflect the reality of occupational diseases due to the occupational risk factors in the mining of Peru..

5. Conclusions

Of 30,465 occupational diseases caused by occupational risk factors in mining in Peru during the period 2013 – 2022, the most frequent was hearing loss 97.73% (n = 29,163) caused by the physical occupational risk factor noise, followed by pneumoconiosis 3.94% (n = 1,202) generated by the chemical occupational risk factor dust.

Noise, considered as the physical occupational risk factor, was the cause of the greatest number of occupational diseases compared to occupational, chemical, biological and ergonomic risk factors.

In the study period 2023 - 2022, the most frequent occupational disease is registered in people over 60 years of age 23.87% (n = 7,271), followed by people between 56 and 60 years of age 15.09% (n = 4,596). Likewise, considering gender, the relevant occupational disease was male 23.87% (n = 7,271), then female 15.09% (n = 4596). In the last decade in Peruvian mining, the most relevant occupational disease considering the occupation is recorded in the driller 18.90% (n = 5,758), followed by the operator 13.26% (n = 4,040). Considering the length of service, the most relevant is evident in collaborators with more than 30 years of service with 25.14% (n = 7,659), followed by workers who are between 5 to 10 years of service, which represents 22.33% (n = 6,804).

Considering the type of company where Peruvian mining employees work, it was determined that relevant occupational diseases are observed in workers who work in the mining company owner 65.27% (n = 19,884), followed by Mining Contractor 32.23% (n = 9,820).

The mining activity that registers the highest number of occupational diseases is the open pit (n = 17,372; 57.02%), and in second place are underground operations (n = 12,835; 42.13%)..

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