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OCCUPATIONAL DISEASES AMONG WORKERS EMPLOYED IN VARIOUS BRANCHES OF THE NATIONAL ECONOMY

CHOROBY ZAWODOWE WŚRÓD PRACUJĄCYCH
W RÓŻNYCH GAŁĘZIACH GOSPODARKI NARODOWEJ

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ABSTRACT

Introduction: The purpose is to present the incidence of occupational diseases and their causal factors in the sections and divisions of the national economy in Poland. **Material and Methods:** The analysis is based on the cases of occupational diseases obligatorily reported in 2009–2011 from all over the country to the Central Register of Occupational Diseases. Data is presented as absolute numbers and average annual incidence rates per 100 000 persons employed in NACE-classified sections and divisions. **Results:** The average annual incidence of occupational diseases was 20.6 cases per 100 000 of employed people. The highest rates were recorded in mining and quarrying (337.8), the production of metals (169.8), non-metallic mineral products (81.6), motor vehicles and transport equipment (59.7), chemicals (30.1). Specific situation in which high incidence rate is due to a single disease prevails in forestry, where tick-borne diseases represent 96.3% of all recorded cases, in education, where chronic voice disorders account for 96.5% of cases, and in human health and social work activities, where infectious diseases with the dominant hepatitis C represent 68.2% of the cases. The most common causes of occupational diseases in sections and industrial divisions with the highest incidence included: industrial dust, noise and vibration. In the manufacturing industry asbestos was the cause of 20.5% of occupational diseases and 55% of occupational cancers. **Conclusions:** Careful monitoring of working conditions and implementing health prevention programs should be exercised in sections and divisions of the national economy where a high risk of occupational diseases has been found. *Med Pr* 2013;64(2):161–174

Key words: occupational diseases, incidence, mining, manufacturing, construction, agriculture and forestry, education, health care

STRESZCZENIE

Cel: Celem analizy jest przedstawienie częstości występowania chorób zawodowych i czynników je wywołujących w poszczególnych sekcjach i działach gospodarki narodowej w Polsce. **Materiał i metody:** Analizę przeprowadzono na podstawie przypadków chorób zawodowych zgłoszonych obligatoryjnie z terenu całego kraju do Centralnego Rejestru Chorób Zawodowych w latach 2009–2011. Dane przedstawiono w postaci liczb bezwzględnych i średnich rocznych współczynników zapadalności na 100 tys. pracujących w sekcjach i działach gospodarki narodowej według Polskiej Klasyfikacji Działalności (PKD). **Wyniki:** W analizowanych latach średni roczny współczynnik zapadalności na choroby zawodowe wynosił 20,6 przypadków na 100 tys. pracujących. Najwyższe współczynniki odnotowano wśród pracujących w górnictwie i kopalnictwie (337,8), przy produkcji metali (169,8), wyrobów z mineralnych surowców niemetalicznych (81,6), pojazdów samochodowych i sprzętu transportowego (59,7), chemikaliów i wyrobów chemicznych (30,1). Specyficzne sytuacje, w których o stosunkowo wysokim współczynniku zapadalności decyduje jedna patologia występują w: leśnictwie, gdzie choroby odkleszczowe stanowią 96,3%, edukacji, w której dominują przewlekłe choroby narządu głosu stanowiące 96,5% oraz opiece zdrowotnej i pomocy społecznej, gdzie choroby zakaźne z przewagą WZW typu C stanowią 68,2% przypadków. Najczęstszymi przyczynami chorób zawodowych w sekcjach i działach przemysłowych o najwyższej zapadalności były: pyły przemysłowe, hałas i wibracja. W przetwórstwie przemysłowym azbest był przyczyną 20,5% przypadków chorób zawodowych oraz 55% nowotworów zawodowych. **Wnioski:** Wskazane w artykule sekcje i działy gospodarki narodowej o wysokim ryzyku zagrożenia chorobami zawodowymi powinny być objęte wnikliwym nadzorem nad warunkami pracy i wdrażaniem medycznych programów profilaktycznych. *Med. Pr.* 2013;64(2):161–174

Słowa kluczowe: choroby zawodowe, zapadalność, górnictwo, przetwórstwo przemysłowe, budownictwo, rolnictwo i leśnictwo, edukacja, ochrona zdrowia

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INTRODUCTION

This paper examines the incidence of occupational diseases in Poland in order to identify the sections and divisions of the national economy with the highest risk of adverse factors responsible for the development of diseases recognized according to the current criteria as occupational.

MATERIAL AND METHODS

The analysis of the incidence of occupational diseases was based on occupational disease reporting forms that had been sent from all of the territory of Poland to the Central Register of Occupational Diseases during 2009–2011. The analysis takes into account the diseases specified in the currently valid list of occupational diseases published in 2009 (1). The content of that is in line with the European Schedule of Occupational Diseases (Commission Recommendation, September, 2003). The Polish list, in addition to the diseases listed in Annex I of the European Schedule, includes also voice disorders caused by excessive vocal effort specified in Annex II. The number of cases of occupational diseases were analyzed by sections and divisions of the national economy specified in the Polish Classification of Activities (2). In order to avoid random fluctuations in the number of the diseases in different years, average annual incidence rates per 100 thousand of people employed in sections and divisions of the national economy were used. The coefficients were calculated from data published in the Central Statistical Office (Główny Urząd Statystyczny – GUS) year books (3–5).

RESULTS

In the period 2009–2011 in Poland, 8,641 cases of occupational diseases were recorded, which corresponds to the average annual number of new cases slightly above 2880, and to the average annual incidence rate of 20.6 per 100 thousand employed people. The number of cases in 2011 compared to 2009 decreased by 18.6%.

The most frequently recognized diseases included contagious and parasitic diseases (26.2%), pneumoconioses (24.6%), chronic voice disorders (13.6%), and hearing loss (9.8%). In total, they accounted for 74.2% of all occupational diseases. Occupational diseases were observed in all, without any exception, activities, but 89% of the cases were recorded in employees of the following six sections of the national economy: manu-

facturing (25.9%), mining and quarrying (21.2%), agriculture, forestry, hunting and fishing (20.5%), education (13.7%), human health and social work activities (7.7%) and construction (4%) (Table 1).

The average number of persons employed in mining and quarrying (Section B) was 180.4 thousand; the largest group in that category (73.8%) were the miners of coal and lignite. In this section of the economy in the period under analysis, there were 1828 cases of occupational diseases, including only 6 women. This was the section with the highest average annual incidence rate (337.8), which exceeded over 16-fold the nation-wide average incidence rate (Table 2).

Predominant diseases among miners included pneumoconioses (79.8%), hearing loss (10.2%), vibration syndrome (5.8%), cancer (1.7%) and musculoskeletal disorders (1.3%). In the case of pneumoconioses, was coal miners pneumoconiosis most frequent (94%), while the numbers of the other types were much lower: silicosis (3.6%) and pneumoconiosis with tuberculosis (2%); single cases of welder's pneumoconiosis and asbestosis were also reported.

Occasionally, there were also single cases of obstructive bronchitis, diseases of the peripheral nervous system in the form of carpal tunnel syndrome, skin diseases including allergic contact dermatitis, pleural disease caused by asbestos dust, asthma and Lyme disease.

The mean age of the pneumoconiotic subjects was 56.5 years. Every fourth case of silicosis (27.4%) was recognized at the retirement age; in three cases, pneumoconiosis was recognized posthumously. The period of employment of persons with recognized silicosis was approximately 24 years; in 86% of the subjects the period of employment was longer than 20 years.

In the analyzed period, there were 31 cases of malignant tumors, including 29 lung cancers and 2 cases of pleural mesothelioma. The average age of people with recognized occupational cancer was almost 62 years. In 11 cases, the tumors were recognized at the retirement age, and in 11 cases were recognized post-mortem. The average period of employment of people with recognized occupational cancer was almost 23 years; for 74.2% of those people, the period of employment was over 20 years. Occupational diseases in the mining and quarrying industry were recorded after a relatively long period of service; in approximately 86% of cases it was 20 years and longer (Table 3).

The incidence of occupational diseases in mining was characterized by a very advanced age of people in whom the occupational disease had been recognized.

Table 1. Occupational diseases and employment according to NACE sections, 2009–2011
Tabela 1. Choroby zawodowe i pracujący zatrudnieni w poszczególnych sekcjach gospodarki według PKD, 2009–2011

Sections Sekcje	Cases during 2009–2011 Przypadki w latach 2009–2011		Rate per 100 000 employed persons, average per year Średni roczny współczynnik na 100 000 pracujących	Employed persons (per year) Pracujący (rocznie)	
	n	%		total (in thous.) ogółem (w tys.) [n]	women kobiety [%]
Total / Ogółem	8 641	100.0	20.6	13 975.5	45.7
A Agriculture, hunting, forestry and fishing / Rolnictwo, łowiectwo, leśnictwo, rybactwo	1 774	20.5	26.7	2 209.8	45.1
B Mining and quarrying / Górnictwo i wydobywanie	1 828	21.2	337.8	180.4	10.6
C Manufacturing / Przetwórstwo przemysłowe	2 237	25.9	30.0	2 483.0	35.0
D Electricity, gas, steam and air conditioning supply / Wytwarzanie i zaopatrywanie w energię elektryczną, gaz, parę wodną, gorącą wodę i powietrze do układów klimatyzacyjnych	38	0.4	8.2	154.4	21.6
E Water supply; sewerage, waste management and remediation activities / Dostawa wody; gospodarowanie ściekami i odpadami oraz działalność związana z rekultywacją	15	0.2	3.7	136.5	18.9
F Construction / Budownictwo	347	4.0	13.1	875.1	10.4
G Trade; repair of motor vehicles / Handel hurtowy i detaliczny; naprawa pojazdów samochodowych, włączając motocykle	122	1.4	1.8	2 218.6	51.4
H Transportation and storage / Transport i gospodarka magazynowa	89	1.0	4.2	709.4	25.9
I Accommodation and catering / Działalność związana z zakwaterowaniem i usługami gastronomicznymi	19	0.2	2.5	254.9	61.9
J Information and communication / Informacja i komunikacja	7	0.1	1.0	236.8	36.5
K Financial and insurance activities / Działalność finansowa i ubezpieczeniowa	19	0.2	1.9	339.9	66.4
L Real estate activities / Działalność związana z obsługą rynku nieruchomości	8	0.1	1.4	193.9	47.7
M Professional, scientific and technical activities / Działalność profesjonalna, naukowa i techniczna	53	0.6	3.7	478.0	51.0
N Administrative and support service activities / Działalność w zakresie usług administrowania i działalność wspierająca	26	0.3	2.2	387.3	43.2
O Public administration and defence; compulsory social security / Administracja publiczna i obrona narodowa; obowiązkowe zabezpieczenia społeczne	82	0.9	2.9	951.2	47.5
P Education / Edukacja	1 182	13.7	36.8	1 070.0	75.9
Q Human health and social work activities / Opieka zdrowotna i pomoc społeczna	663	7.7	29.6	747.0	81.2
R Arts, entertainment and recreation / Działalność związana z kulturą, rozrywką i rekreacją	59	0.7	13.4	146.8	59.3
S Other service activities / Pozostała działalność usługowa	68	0.8	11.2	202.5	56.0
Enterprise division abroad / Zakład poza granicami kraju	5	0.1	×	×	×

NACE – Statistical Classification of Economic Activities in the European Community (Nomenclature statistique des Activités économiques dans la Communauté Européenne) / PKD – Polska Klasyfikacja Działalności.

Table 2. Most frequent occupational diseases among persons employed in mining and quarrying (section B, NACE), 2009–2011
Tabela 2. Najczęściej występujące choroby zawodowe wśród pracujących w górnictwie i kopalnictwie (sekcja B, PKD), 2009–2011

Occupational diseases Choroby zawodowe	Rate per 100 000 employed persons, average per year Średni roczny współczynnik na 100 000 pracujących	Cases during 2009–2011 Przypadki w latach 2009–2011 [n]	
		total ogółem	of which recognised at pension age stwierdzenie choroby w wieku emerytalnym
Total / Ogółem	337.76	1 828	414
Pneumoconioses / Pylice płuc	269.40	1 458	399
coal workers / górników kopalń węgla	253.51	1 372	363
silicosis / krzemowa	9.61	52	20
pneumoconiosis with tuberculosis / pylico-gruźlica	5.54	30	12
Hearing loss / Ubytek słuchu	34.55	187	3
Vibration syndrome / Zespół wibracyjny	19.40	105	–
Malignant neoplasms / Nowotwory złośliwe	5.73	31	11
lung cancer / rak płuca	5.36	29	9
pleural mesothelioma / międzybłoniak opłucnej	0.37	2	2
Diseases of locomotor system / Choroby układu ruchu	4.24	23	–

Abbreviations as in Table 1 / objaśnienia jak w tabeli 1.

Every fifth case (more precisely 22.6%) of the occupational disease was found in people at retirement age; for silicosis, this proportion exceeded 27%, and for malig-

nant tumors it was 35% (Table 2). It is also noteworthy that one third of lung cancers recognized as occupational disease were recognized posthumously.

Table 3. Period of employment and age at the recognition of occupational disease of persons employed in mining and quarrying (section B, NACE), 2009–2011

Tabela 3. Staż pracy i wiek w chwili stwierdzenia choroby zawodowej u pracujących w górnictwie i kopalnictwie (sekcja B, PKD), 2009–2011

Occupational diseases Choroby zawodowe	Cases Przypadki [n]	Period of employment* Staż pracy*		Age [years] Wiek [w latach] $\bar{X} \pm SD$
		≥ 20 years / lat [%]	$\bar{X} \pm SD$ [w latach / years]	
Total / Ogółem	1 828	85.9	23.7±3.6	55.7±8.1
Pneumoconioses / Pylice płuc	1 458	86.0	23.6±3.6	56.5±8.2
Hearing loss / Ubytek słuchu	187	92.0	24.3±2.4	53.6±6.0
Vibration syndrome / Zespół wibracyjny	105	81.9	23.3±3.8	48.7±4.8
Malignant neoplasms / Nowotwory złośliwe	31	74.2	22.9±3.7	61.8±4.7
Diseases of locomotor system / Choroby układu ruchu	23	78.3	22.5±5.3	48.9±7.1

* Excluding diseases for which duration of exposure is not applicable, i.e. infectious and allergic diseases / Z pominięciem chorób, dla których okres narażenia nie ma znaczenia, tj. zakaźnych i alergicznych.

\bar{X} – mean / średnia, SD – standard deviation / odchylenie standardowe.

Other abbreviations as in Table 1 / Inne objaśnienia jak w tabeli 1.

The causes of occupational diseases in mining and quarrying were classic factors in the industry: coal dust and industrial dust containing free crystalline silica (80.2%), noise (10.2%), vibration (5.7%), ionizing radiation i.e. radon decay products (1.4%), forced working posture (1.6%). The contribution from other agents was 0.9%.

In Section C, manufacturing industry, the average number of employed people during 2009–2011 was 2483 thousand, and the incidence rate was 30.3/100 thousand. The highest values of the incidence rates were recorded among people working in the production of metals (169.8), non-metallic mineral products (81.6), motor vehicles and transport equipment (59.7), and chemicals (30.1) (Table 4).

Predominant diseases in the manufacturing sector as a whole included hearing loss (22.6%), pneumoconioses (22%), diseases of the peripheral nervous system (15.7%), cancer (9.1%), musculoskeletal disorders (8%). Other diseases, such as thickening of the pleura caused by asbestos dust, dermal diseases, asthma, allergic rhinitis, vibration syndrome, poisonings, eye diseases and chronic obstructive bronchitis were also noted at incidences ranging from 1.1% to 4.3%.

This section is observed to represent the most diverse picture of morbidity as a consequence of the very wide range of activities classified into this group. In these industries, as many as 74.1% of all manufacturing workers were employed and as many as 87.1% of all

Table 4. Occupational diseases and employment in manufacturing by divisions (section C, NACE), 2009–2011

Tabela 4. Choroby zawodowe i pracujący w przetwórstwie przemysłowym (sekcja C, PKD) według działów, 2009–2011

Division Dział	Manufacturing Przetwórstwo przemysłowe	Cases during 2009–2011 Przypadki w latach 2009–2011		Rate per 100 000 employed persons Współczynnik na 100 000 pracujących	Employed persons (per year) Pracujący (rocznie)	
		n	%		total ogółem [n]	women kobiety [%]
Total / Ogółem		2 237	100.0	30.30	2 483.0	33.6
24	Manufacture of basic metals / Produkcja metali	322	14.4	169.83	63.2	15.3
23	Manufacture of non-metallic mineral products / / Produkcja wyrobów z pozostałych mineralnych surowców niemetalicznych	335	15.0	81.57	136.9	21.8
29+30	Manufacture of motor vehicles and other transport equipment / Produkcja pojazdów samochodowych i sprzętu transportowego	348	15.5	59.73	194.2	28.7
20	Manufacture of chemicals and chemical products / / Produkcja chemikaliów i wyrobów chemicznych	77	3.4	30.09	85.3	32.0
28	Manufacture of machinery and equipment / Produkcja maszyn i urządzeń	141	6.3	28.26	166.3	13.2
22	Manufacture of rubber and plastic products / Produkcja wyrobów z gumy i tworzyw sztucznych	138	6.2	27.28	168.6	31.4
27	Manufacture of electrical equipment / Produkcja urządzeń elektrycznych	80	3.6	26.91	99.1	36.8
13+14	Manufacture of textiles and wearing apparel / / Produkcja wyrobów tekstylnych i odzieży	110	4.9	19.13	191.7	72.8
25	Manufacture of fabricated metal products, except for machinery and equipment / Produkcja metalowych wyrobów gotowych, z wyłączeniem maszyn i urządzeń	161	7.2	19.00	282.4	15.7
10+11	Manufacture of food products and beverages / / Produkcja artykułów spożywczych i napojów	237	10.6	17.52	451.0	46.8
	Other / Pozostałe	288	12.9	14.90	644.3	32.0

Abbreviations as in Table 1 / Objasnienia jak w tabeli 1.

occupational diseases were recognized. Occupational diseases prevailing in the manufacturing industry at highest incidence rates are shown in Table 5.

Manufacture of basic metals is the industry with the highest incidence of occupational diseases, exceeding more than 5-fold the incidence in the entire section (Table 5). Among workers employed in the production of metals, the dominant diseases included pneumoconiosis (40.4%), followed by hearing loss (27.1%) and cancer (13.7%). The individual types of pneumoconio-

sis included silicosis (83.8%), and asbestosis (10.8%), pneumoconiosis with tuberculosis (3.8%), and isolated cases of welders' pneumoconiosis and anthracosis. Factors responsible for the occupational diseases in the production of metals included primarily industrial dusts containing free crystalline silica, noise, asbestos dust, and polycyclic aromatic hydrocarbons.

Manufacture of non-metallic mineral products with the incidence rate of 81.57 per 100 employed people occupied the second place among the industries with

Table 5. Most frequent occupational diseases among persons employed in manufacturing in selected divisions (section C, NACE), 2009–2011
Tabela 5. Najczęściej występujące choroby zawodowe wśród pracujących w przetwórstwie przemysłowym i jego wybranych działach (sekcja C, PKD), 2009–2011

Section, division Sekcja, dział	Occupational diseases Choroby zawodowe	Rate per 100 000 employed persons, average per year Średni roczny współczynnik na 100 000 pracujących	Cases during 2009–2011 Przypadki w latach 2009–2011 [n]
Manufacturing / Przetwórstwo przemysłowe (section / sekcja C)	total / ogółem	30.0	2 237
	hearing loss / ubytek słuchu	6.7	504
	pneumoconioses / pylice płuc	6.5	491
	diseases of peripheral nervous system / choroby obwodowego układu nerwowego	4.7	352
	malignant neoplasms / nowotwory złośliwe	2.7	205
	diseases of locomotor system / choroby układu ruchu	2.3	178
	thickening of pleura induced by asbestos dust / zgrubienia opłucnej wywołane pyłem azbestu	1.3	96
	skin diseases / choroby skóry	1.3	97
Manufacture of basic metals / / Produkcja metali (division / dział 24)	total / ogółem	169.83	322
	pneumoconioses / pylice płuc	68.57	130
	– silicosis / krzemowa	57.49	109
	– asbestosis / azbestowa	7.38	14
	hearing loss / ubytek słuchu	45.89	87
	malignant neoplasms / nowotwory złośliwe	23.21	44
	– lung cancer / rak płuca	13.19	25
	– larynx / rak krtani	4.75	9
	– mesothelioma / międzybłoniak	2.11	4
	diseases of peripheral nervous system / choroby obwodowego układu nerwowego	7.38	14
Manufacture of non-metallic mineral products / Produkcja wyrobów z mineralnych surowców niemetalicznych (division / dział 23)	total / ogółem	81.57	335
	pneumoconioses / pylice płuc	34.09	140
	– asbestosis / azbestowa	22.40	92
	– silicosis / krzemowa	11.69	48
	thickening of pleura induced by asbestos dust / zgrubienia opłucnej wywołane pyłem azbestu	13.88	57
	malignant neoplasms / nowotwory	11.44	47
	– lung cancer / rak płuca	7.06	29
	– mesothelioma / międzybłoniak	4.14	17

Table 5. Most frequent occupational diseases among persons employed in manufacturing in selected divisions (section C, NACE), 2009–2011 – cd.

Tabela 5. Najczęściej występujące choroby zawodowe wśród pracujących w przetwórstwie przemysłowym i jego wybranych działach (sekcja C, PKD), 2009–2011 – cont.

Section, division Sekcja, dział	Occupational diseases Choroby zawodowe	Rate per 100 000 employed persons, average per year Średni roczny współczynnik na 100 000 pracujących	Cases during 2009–2011 Przypadki w latach 2009–2011 [n]
Manufacture of motor vehicles and other transport equipment / / Produkcja pojazdów samochodowych i sprzętu transportowego (division / dział 29, 30)	diseases of peripheral nervous system / choroby obwodowego układu nerwowego	7.06	29
	diseases of locomotor system / choroby układu ruchu	6.09	25
	total / ogółem	59.73	348
	hearing loss / ubytek słuchu	32.96	192
	diseases of peripheral nervous system / choroby obwodowego układu nerwowego	11.33	66
	diseases of locomotor system / choroby układu ruchu	5.15	30
	malignant neoplasms / nowotwory złośliwe	2.57	15
	– lung cancer / rak płuca	1.37	8
	– mesothelioma / międzybłoniak	1.20	7
	pneumoconioses / pylice płuc	2.06	12
	– asbestosis / azbestowa	1.03	6
– silicosis / krzemowa	0.69	4	
thickening of pleura induced by asbestos dust / zgrubienia opłucnej wywołane pyłem azbestu	1.89	11	
Manufacture of chemicals and chemical products / Produkcja chemikaliów i wyrobów chemicznych (division / dział 20)	total / ogółem	30.09	77
	malignant neoplasms / nowotwory złośliwe	8.99	23
	– lung cancer / rak płuca	5.47	14
	– bladder cancer / rak pęcherza moczowego	1.56	4
	– mesothelioma / międzybłoniak	1.17	3
	asbestosis / pylica azbestowa	7.03	18
	hearing loss / ubytek słuchu	3.13	8
	intoxications / zatrucia (lead / ołów, fluorine / fluor, manganese / mangan)	2.74	7
	diseases of peripheral nervous system / choroby obwodowego układu nerwowego	2.74	7
	total / ogółem	28.26	141
Manufacture of machinery and equipment / Produkcja maszyn i urządzeń (division / dział 28)	hearing loss / ubytek słuchu	9.02	45
	pneumoconioses / pylice płuc	7.42	37
	– silicosis / krzemowa	4.21	21
	– welders' / spawaczy	1.60	8
	carpal tunnel syndrome / zespół cieśni nadgarstka	2.81	14
	diseases of locomotor system / choroby układu ruchu	2.61	13
	allergic and contact dermatitis / alergiczne i kontaktowe zapalenie skóry	2.00	10
	vibration syndrome / zespół wibracyjny	2.00	10
	malignant neoplasms / nowotwory złośliwe	1.00	5

Abbreviations as in Table 1 / Objasnienia jak w tabeli 1.

the highest rate of incidence of occupational diseases. Asbestos-related diseases (asbestosis, pleural thickening, mesothelioma and lung cancers) accounted for 58% of all occupational diseases reported in that industry, as a consequence of occupational exposure to asbestos in several former asbestos processing plants classified in this group. The next most frequent diseases recorded in that industry included diseases of the peripheral nervous (8.6%) and the musculoskeletal (7.4%) systems, and hearing loss (5.1%).

The main causative agents of occupational diseases was asbestos, followed by industrial dusts containing free crystalline silica, forced working posture, and noise.

Among workers employed in the production of motor vehicles and transport equipment (including shipbuilding), the incidence rate of occupational diseases was 59.73 per 100 thousand employed people. The dominant disease in that group was hearing loss, which accounted for 55% of all identified diseases, followed by carpal tunnel syndrome (18.4%), musculoskeletal diseases (8.6%), cancer caused by asbestos dust (4.3%). Noise, forced working posture and asbestos dust were the main causes of the occupational diseases in this group of workers.

Manufacture of machinery and equipment with the incidence rate of 28.3/100 thousand employed, which was slightly lower than the average rate in the entire section, occupied the fifth place in terms of the frequency of occupational diseases. The major occupational diseases in this group were hearing loss (32%), silicosis (14.9%), carpal tunnel syndrome (9.9%), musculoskeletal disorders (9.2%), vibration syndrome (7%) and skin diseases (7%). The main causal factors of diseases reported in this section were: noise, industrial dust containing crystalline silica and forced working posture.

In the manufacture of chemicals and chemical products, where the average annual incidence rate was 30.09/100 thousand employed people, dominant diseases were: cancer accounting for 29% of diseases in this section (including cancer of lung 61%, bladder 17%, mesothelioma 12%, and cancer of larynx and skin), followed by asbestosis (3.4%), hearing loss (10.4%), poisoning with lead, fluoride, and manganese (9.1%), carpal tunnel syndrome (7.8%) and isolated cases of pleural thickening caused by asbestos dust, allergic rhinitis, skin diseases, musculoskeletal disorders, and cataracts.

Asbestos dust was the dominant factor responsible for the development of occupational diseases and the contribution of asbestos-related occupational diseases in that sector of production was 45%.

Among people employed in the manufacture of rubber and plastics, the incidence rate of occupational diseases was 27.28 per 100 thousand of employed people. The most common disease was asbestosis, representing 55% of all identified diseases, followed by cancer (13.8%), carpal tunnel syndrome (11.6%), musculoskeletal diseases (7.2%). The less frequent diseases included diffuse thickening of the pleura caused by asbestos dust, hearing loss, allergic contact dermatitis and vibration syndrome. Asbestos was the cause of 73.2% of occupational diseases in the industry. Another group comprised work demanding repetitive movements and forced working postures.

In the two following sections, i.e. the production of electrical equipment and the production of textiles and wearing apparel, the predominant diseases included carpal tunnel syndrome (47.5% and 54.5%, respectively) and musculoskeletal disorders (18.7% and 21.8%, respectively). In addition, people employed in the production of electrical equipment were affected by silicosis (16.2%), hearing loss (8.7%), allergic contact dermatitis (6.2%), while those employed in the manufacture of textiles and wearing apparel developed hearing loss (9.1%), allergic contact dermatitis (5.5%), cancer (mesothelioma, laryngeal and bladder cancer) and asthma. Major causative factors of the occupational diseases in both groups included jobs requiring repetitive movements, forced working posture, and noise.

In the industry of food and beverages, dominant occupational diseases were those caused by allergenic agents: asthma (32.5%), allergic rhinitis (25.3%), allergic contact dermatitis (7.1%); other occupational diseases in that industry included carpal tunnel syndrome (17.7%), musculoskeletal disorders (5.5%), and single cases of brucellosis, Lyme disease, erysipelas, and toxoplasmosis. The most common causes of the diseases prevailing in that industry were sensitizing agents, including flour dust, forced working posture, jobs requiring repetitive movements.

The construction industry (section F), consisting of three segments, employed 875.1 thousand persons. Most of them were workers performing specialized construction jobs – 43.2%, as much as 37.3% of those workers were employed in the construction of buildings, while 19.5% performed civil engineering jobs. In the three years, in the construction industry there were 347 cases of occupational diseases, of which 5 cases were recorded in women. The incidence rate of occupational diseases was 13.1 per 100 thousand of the employed (Table 6).

Table 6. Occupational diseases and employment in construction by divisions (section F, NACE), 2009–2011
Tabela 6. Choroby zawodowe i pracujący w budownictwie i jego działach (sekcja F, PKD), 2009–2011

Section F Sekcja F	Cases during 2009–2011 Przypadki w latach 2009–2011		Rate per 100 000 employed persons Współczynnik na 100 000. pracujących	Employed persons (per year) Pracujący (rocznie)	
	n	%		total (in thous.) ogółem (w tys.) [n]	women kobiety [%]
Construction / Budownictwo	347	100.0	13.22	875.1	10.4
Construction of buildings / Budowa budynków	62	17.9	6.33	326.6	11.6
Civil engineering / Budowa obiektów inżynierii lądowej i wodnej	113	32.5	22.05	170.8	11.7
Specialised construction activities / Roboty budowlane specjalistyczne	172	49.6	15.18	377.7	9.2

Abbreviations as in Table 1 / Objasnienia jak w tabeli 1.

The most common diseases among the construction workers were pneumoconioses (44.9%). A much smaller number of those workers developed hearing loss (15.8%), cancer (10.1%), skin diseases (7.8%), musculoskeletal disorders (5.4%), vibration syndrome (5.2%). There were also a few cases of diseases of the peripheral nervous system, poisoning, diseases of the pleura caused by asbestos dust, chronic obstructive bronchitis, eye diseases and infectious diseases.

The average age of the employees at the time of recognizing of the occupational disease was almost 57 years, and the average period of occupational exposure was 25 years. As much as 72% of the cases developed the disease after at least 20 years of employment.

The intensity of the incidence and its structure varied depending on specific division of the construction industry. The highest incidence rate of 22 cases per 100 thousand of employed people was recorded among the workers employed in the construction of buildings and civil engineering. Slightly lower incidence (15.2 per 100 thousand) was noted among specialized construction workers. Pneumoconiosis was the most frequent occupational disease in both groups, accounting for over 50% of the cases. Anthracosis, followed by silicosis and pneumoconiosis with tuberculosis were the most frequent types of pneumoconiosis. Hearing loss and cancer were the next most common diseases in both groups (Table 7).

Table 7. Most frequent occupational diseases among persons employed in construction and its divisions (section F, NACE), 2009–2011
Tabela 7. Najczęściej występujące choroby zawodowe wśród pracujących w budownictwie i jego działach (sekcja F, PKD), 2009–2011

Section, division Sekcja, dział	Occupational diseases Choroby zawodowe	Rate per 100 000 employed persons, average per year Średni roczny współczynnik na 100 000 pracujących	Cases during 2009–2011 Przypadki w latach 2009–2011 [n]
Construction (section F) / / Budownictwo (sekcja F)	total / ogółem	13.1	347
	pneumoconioses / pylice płuc	5.9	156
	– coal workers / górników	4.1	108
	– silicosis / krzemowa	1.1	30
	hearing loss / ubytek słuchu	2.1	55
	malignant neoplasms / nowotwory złośliwe	1.4	35
	skin diseases / choroby skóry	1.0	27

Table 7. Most frequent occupational diseases among persons employed in construction and its divisions (section F, NACE), 2009–2011 – cd.
Tabela 7. Najczęściej występujące choroby zawodowe wśród pracujących w budownictwie i jego działach (sekcja F, PKD), 2009–2011 – cont.

Section, division Sekcja, dział	Occupational diseases Choroby zawodowe	Rate per 100 000 employed persons, average per year Średni roczny współczynnik na 100 000 pracujących	Cases during 2009–2011 Przypadki w latach 2009–2011 [n]
Construction of buildings (division 41) / / Budowa budynków (dział 41)	total / ogółem	6.3	62
	hearing loss / ubytek słuchu	1.7	17
	skin diseases / choroby skóry	1.1	11
Civil engineering (division 42) / / Budowa obiektów inżynierii lądowej i wodnej (dział 42)	total / ogółem	22.0	113
	pneumoconioses / pylice płuc	11.9	61
	– coal workers' / górników	9.2	47
	hearing loss / ubytek słuchu	3.1	16
	malignant neoplasms / nowotwory złośliwe	1.6	8
	– lung cancer / rak płuca	1.2	6
	vibration syndrome / zespół wibracyjny	1.6	8
	diseases of locomotor system / choroby układu ruchu	1.4	7
Specialised construction activities (division 43) / Specjalistyczne roboty budowlane (dział 43)	total / ogółem	15.2	172
	pneumoconioses / pylice płuc	7.8	88
	– coal workers' / górników	5.4	61
	– silicosis / krzemowa	1.2	14
	hearing loss / ubytek słuchu	1.9	22
	malignant neoplasms / nowotwory złośliwe	1.8	21
	– lung cancer / rak płuca	1.1	13

Abbreviations as in Table 1 / Objasnienia jak w tabeli 1.

The dominant causal agents of occupational diseases in the two groups were dust containing coal or free crystalline silica, noise, forced working posture. The lowest incidence rate of the occupational diseases was recorded in the people employed in the construction of buildings – 6.3 per 100 thousand, and the most common disease in that group was hearing loss, representing 27.4% of cases. Other reported occupational diseases in that category included allergic contact dermatitis (17.7%), pneumoconioses (11.3%) and musculoskeletal disorders (11.3%), cancer (9.7%), carpal tunnel syndrome (4.8%), pleural diseases caused by asbestos dust (3.2%) and lead poisoning (3.2%). Isolated cases of extrinsic alveolitis, asthma, acute generalized allergic reactions, cataract, vibration syndrome were also reported. The main causal factors of occupational disease

occurring among construction workers were noise and cement-borne chromium.

In agriculture, forestry, hunting and fishing (Section A), the two major branches differed significantly in terms of both number of employees and the incidence of occupational diseases (Table 8).

Among the people employed in agriculture and hunting, who constituted 97.7% of the workers in this section, 692 cases of occupational diseases were recorded, and the incidence rate was 10.67/100 thousand of the employed people, which was twice lower than the average rate in Poland. The most frequent were infectious and parasitic diseases, which constituted 82.1% of all diseases in this group, with the incidence of 8.09/100 thousand. The most numerous were the cases of Lyme disease (75.9%) and tick-borne encephala-

Table 8. Occupational diseases and employment in agriculture, hunting, forestry and fishing by divisions (section A, NACE), 2009–2011
Tabela 8. Choroby zawodowe i liczba pracujących w rolnictwie, leśnictwie, łowiectwie i rybactwie (sekcja A, PKD), 2009–2011

Section A Sekcja A	Cases during 2009–2011 Przypadki w latach 2009–2011		Rate per 100 000 employed persons Współczynnik na 100 000 pracujących	Employed persons (per year) Pracujący (rocznie)	
	n	%		total (in thous.) ogółem (w tys.) [n]	women kobiety [%]
Agriculture, hunting, forestry and fishing / Rolnictwo, leśnictwo, łowiectwo i rybactwo	1 774	100.0	26.76	2 209.8	24.4
Agriculture and hunting / Rolnictwo i łowiectwo	692	39.0	10.67	2 158.1	54.0
Forestry / Leśnictwo	1 081	60.9	747.58	48.2	22.4
Fishing / Rybactwo	1	0.1	9.52	3.5	10.9

Abbreviations as in Table 1 / Objasnienia jak w tabeli 1.

litis (8.1%). Cases of infectious and parasitic diseases also included tuberculosis, brucellosis, aspergillosis, liver and brain echinococcosis, ocular toxoplasmosis and toxocariasis.

In addition to infectious and parasitic diseases, farmers also suffered from extrinsic alveolitis, asthma, allergic contact dermatitis, allergic rhinitis, and carpal tunnel syndrome.

Major factors causing occupational diseases in agriculture and farming were the borrelia spirochetes, vegetable dust, tick-borne encephalitis virus and dust of animal origin. The average age of the people with recognized occupational disease was almost 50 years.

In the relatively small group of forestry workers representing 2.2% of the total number of people employed in this section, there were 1081 cases of occupational diseases. The average annual incidence rate exceeded over 36-fold the incidence rate of occupational diseases in Poland. Among forestry workers, tick-borne diseases (525 cases of Lyme disease and 9 cases of tick-borne encephalitis) accounted for 96.3% of the reported cases of occupational diseases. The analysis of the incidence of Lyme disease by territory showed statistically significant correlation with the overall province's forest/agricultural land area ratio (rank correlation coefficient = 0.55, $p < 0.05$). In addition, this group had 35 cases of vibration disease, which accounted for 3.2% of the incidence of occupational diseases (Table 9).

The average age of forestry workers at the date of recognizing the occupational disease was slightly over 50 years.

Hearing loss was the only case of occupational disease recognized in the fishing division.

In education (Section P) the average annual number of employees was 1070 thousand people, of whom about 75% were women. During that period, there were 1182 cases of occupational diseases, and the incidence rate was 36.82 per 100 thousand employed people. Voice organ dysfunction caused by excessive vocal effort accounted for 95.7% of all occupational disease in that professional group. Occupational diseases in education employees were dominated by voice disorders, which most often occurred in the form of the paralysis of inner laryngeal muscles (61.2%) and secondary hypertrophic changes (33.4%).

In addition to the voice organ diseases, the very few cases of other diseases included infections, carpal tunnel syndrome, musculoskeletal disorders, skin lesions, hearing loss and pneumoconiosis was found in vocation teachers and other education section employees. The average period of service as teachers of the people with recognized chronic voice organ disease was about 30 years. The disease was recognized in people at the age of about 56, in over 23% of the cases it was recognized at the retirement age.

The average number of people employed in human health and social work activities (Section Q) in 2009–2011 was 747 thousand people per year, including 81% of women. During that period, there were 663 cases of occupational diseases, the incidence rate was 29.6 per 100 thousand employed people. Infectious diseases (68.3%) were most frequent, among which the most numerous were cases of viral hepatitis. In total, 284 cases of viral hepatitis were reported, including 213 cases of hepatitis C (incidence rate 9.5/100 thousand) and 71 cases of hepatitis B (3.2/100 thousand employed persons). The second-in-frequency infectious

Table 9. Most frequent occupational diseases among persons employed in agriculture, hunting, forestry and fishing and its divisions (section F, NACE), 2009–2011**Tabela 9.** Najczęściej występujące choroby zawodowe u pracujących w rolnictwie, leśnictwie, łowiectwie i rybactwie i jego wybranych działach (sekcja A, PKD), 2009–2011

Section, division Sekcja, dział	Occupational diseases Choroby zawodowe	Rate per 100 000 employed persons, average per year Średni roczny współczynnik na 100 000 pracujących	Cases during 2009–2011 Przypadki w latach 2009–2011 [n]
Agriculture, hunting, forestry and fishing (section A) / / Rolnictwo, leśnictwo, łowiectwo i rybactwo (sekcja A)	total / ogółem	26.76	1774
	infectious and parasitic diseases / choroby zakaźne lub pasożytnicze	24.5	1623
	vibration syndrome / zespół wibracyjny	0.5	35
	extrinsic allergic alveolitis / zewnątrzpoходne alergiczne zapalenie pęcherzyków płucnych	0.4	30
	bronchial asthma / astma	0.4	24
	skin diseases / choroby skóry	0.4	23
	allergic rhinitis / alergiczny nieżyt nosa	0.2	13
	diseases of peripheral nervous system / choroby obwodowego układu nerwowego	0.2	12
	Agriculture and hunting (division 01) / Rolnictwo i łowiectwo (dział 01)	total / ogółem	10.67
infectious and parasitic diseases / choroby zakaźne lub pasożytnicze		8.97	582
– borreliosis / borelioza		8.09	525
– tick-borne encephalitis / odkleszczowe zapalenie mózgu		0.72	47
– brucellosis / bruceloza		0.05	3
– other / inne		0.11	7
extrinsic allergic alveolitis / zewnątrzpoходne alergiczne zapalenie pęcherzyków płucnych		0.46	30
bronchial asthma / astma		0.37	24
skin diseases / choroby skóry		0.35	23
– allergic and contact dermatitis / alergiczne i kontaktowe zapalenie skóry		0.29	19
allergic rhinitis / alergiczny nieżyt nosa	0.20	13	
Forestry (division 02) / Leśnictwo (dział 02)	total / ogółem	747.58	1081
	infectious and parasitic diseases / choroby zakaźne lub pasożytnicze	719.92	1041
	– borreliosis / borelioza	713.69	1032
	– tick-borne encephalitis / odkleszczowe zapalenie mózgu	6.22	9
	vibration syndrome / zespół wibracyjny	24.20	35

disease was tuberculosis (34.3%) with an incidence rate of 6.9/100 thousand.

Other occupational diseases in that group were: skin diseases (8.9%), carpal tunnel syndrome (8.1%), musculoskeletal disorders (6%). Besides, there were few cases of ocular diseases, bronchial asthma, allergic rhinitis,

generalized allergic reaction, post-radiation cataract, cancer, hearing loss, vibration syndrome.

The most frequent causal factors of the diseases among workers in health care (division 86) were, in the order of frequency: HCV, Mycobacterium tuberculosis, HBV, forced working posture, repetitive move-

ments, allergenic agents. The territorial analysis of the incidence of occupational hepatitis and tuberculosis among the employees of human health and social activities did not show correlation with the incidence of these diseases among the general population of each province (rank correlation coefficient was 0.058 and 0.007, respectively, $p > 0.05$).

DISCUSSION

The use of different diagnostic criteria, recognizing procedures and administrative practices in the process of recognizing a disease as occupational, as well as different social security and compensation systems prevailing in different countries cause that it is not possible to assess the incidence of occupational diseases in different countries by analyzing data from individual national registers; a conclusion like that has been confirmed by a recent analysis based on EU countries case records (6). Causes of data-related imperfections in the records of occupational diseases are presented in the publication by Spreeuwers et al. (7), who highlight the impact of training of physicians on the recognizing of occupational diseases.

Our present publication, based on the analysis of data from the registry, shows the incidence of occupational diseases in selected NACE-classified sections and divisions in Poland.

The analysis showed that, in the sections with a broad spectrum of activities, there is a significant variation in the extent and distribution of the incidence. This refers to three sections: manufacturing, construction and agriculture, forestry, hunting and fishing, for which the incidence of occupational diseases among employees was examined with reference to selected divisions. The highest incidence of the diseases caused by exposure to harmful agents in the work environment was found in heavy industries (mining, metallurgical, automotive and transport equipment manufacturing), and it was associated with exposure to traditional agents: industrial dust containing free crystalline silica, asbestos dust, noise, vibration and forced working posture. Asbestos, that has not been used in commercial production since 1998, in the manufacturing sector in 2009–2011 accounted for every fifth cause of occupational diseases (20.5%), of which over half (55%) were occupational cancers. The particularly low rates of incidence observed among farmers and workers of housing construction industry (about 2-fold and over 3-fold lower, respectively, than the national average) were undeniably

due to social policy and the system of insurance and occupational disease compensation.

Specific situations, in which relatively high incidence rates were due to a single class of diseases, prevailed in forestry, where tick-borne diseases represented 96.3%, in education, which was dominated by chronic voice disorders constituting 96.5%, and human health and social work activities, where infectious disease with the predominance of hepatitis C accounted for 68.2% of the cases. It is worth to note the relatively low incidence of musculoskeletal disorders and peripheral nervous system diseases, which today are predominant diseases in the developed countries.

When looking at the incidence of occupational diseases with reference to the data from the registry, both underestimation and overestimation of the number of cases can be observed. Epidemiological analyses indicate that, in Poland, this is true about different diseases (8). The causes responsible for the underestimation or overestimation include factors related to the diagnostic process (under- or over-recognition), in which the main role is played by the physician and employee's motivation based on the assessment of gains and losses arising from the status of formal recognition of the disease as occupational. Spreeuwers et al. (9) point to the importance of the quality of the data in the registry, qualifications of the occupational physicians deciding about the occupational character of the disease and, in particular, it is stressed that physicians of other specialties need to improve their qualifications in that respect. Underestimation of the cases may also be due to non-reporting of cases to the registry (under registration). McDonald (10) examines the availability of doctors and its relationship with considerable non-reporting (underreporting) of the cases of occupational diseases in various sectors of the economy. The data presented in this article is comprehensive as the result of the mandatory procedures for reporting all the cases of occupational diseases to the Central Register of Occupational Diseases.

CONCLUSIONS

The sections and divisions of the national economy characterized by the high risk of occupational disease indicated in this paper should be subject to careful supervision of working conditions. The high risk of developing specific diseases points to the necessity to develop and implement prevention and health conservation programs for people belonging to those occupational groups.

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