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Analiza występowania zespołu nagłej śmierci niemowląt w Polsce

The analysis of Sudden Infant Death Syndrome in Poland

Anna Lewandowska¹, Anna Stokłosa¹, Tomasz Lewandowski², Barbara Laskowska¹

¹Institut Ochrony Zdrowia, Państwowa Wyższa Szkoła Techniczno-Ekonomiczna w Jarosławiu, ul. Czarnieckiego 16, 37-500 Jarosław

²Institut Inżynierii Technicznej Państwowa Wyższa Szkoła Techniczno-Ekonomiczna w Jarosławiu, ul. Czarnieckiego 16, 37-500 Jarosław

¹Institute of Healthcare, State School of Technology and Economics in Jarosław, address: Czarnieckiego Street 16, 37-500 Jarosław

²Institute of Technical Engineering State School of Technology and Economics in Jarosław, address: Czarnieckiego Street 16, 37-500 Jarosław

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Key words: sudden death, epidemiology, neonatology, statistics

Contact address:

dr n. med. Anna Lewandowska

ul. Czarnieckiego 16, 37-500 Jarosław

phone: 698757926; e-mail: am.lewandowska@poczta.fm

Streszczenie

Wprowadzenie: Zespół nagłej śmierci niemowlęcej to nagły i nieoczekiwany zgon dziecka w wieku poniżej 1 roku życia, którego przyczyny nie można wyjaśnić badaniami autopsyjnymi, badaniami miejsca śmierci ani na podstawie analizy wywiadu klinicznego. Zespół nagłej śmierci niemowlęcej uważa się za najczęstszą przyczynę zgonu wśród niemowląt, w krajach wysoko rozwiniętych. Częstość występowania SIDS na całym świecie waha się od 0,1 do 6/1000 żywych urodzeń. Aż 90% z nich dotyczy zgonów w 1 roku życia

dziecka, przy czym 70 % stanowią zgony o nieznanym przyczynie. W przypadku SIDS około 90% przypadków dotyczy dzieci poniżej 1 roku życia a w szczególności znajdujących się pomiędzy 2 a 4 miesiącem życia

Celem pracy było przedstawienie najistotniejszych zagadnień związanych z SIDS oraz opis i analiza czynników występowania zespołu nagłej śmierci niemowlęcia w oparciu o dane statystyczne.

Materiał i metoda: Zastosowano metodę analizy danych zastanych oraz technikę desk research. Analizie poddano dane statystyczne z lat 2009-2014 udostępnione przez Główny Urząd Statystyczny. Narzędziem zastosowanym w metodzie analizy danych zastanych był wykaz szukanych informacji wynikających z problematyki badawczej.

Wyniki: W latach 2009-2014 największą liczbę zgonów niemowląt i noworodków odnotowano w 2009 roku, bo aż 2327. W kolejnych latach liczba zgonów noworodków i niemowląt systematycznie spadała. W roku 2010 było to 2057 zgonów w 2011 - 1836 zgonów, w 2012 - 1791 zgonów, w 2013 - 1684 zgonów a w 2014 - 1583 zgony. Największą liczbę zgonów chłopców odnotowano w roku 2009 – 1298, przy czym liczba zgonów dziewczynek w tym okresie, choć najwyższa dla analizowanych lat, była niższa i wynosiła 1029.

Wnioski: zgony dotyczyły częściej chłopców niż dziewczęta, największą liczbę zgonów stwierdzono wśród niemowląt, które nie ukończyły 1 miesiąca życia a wraz z wiekiem osiąganym przez dziecko ilość zgonów z powodu SIDS spadała, więcej zgonów odnotowano w miastach aniżeli na wsi, najwięcej zgonów odnotowano w szpitalach, a najmniej w domu i innych zakładach opieki zdrowotnej oraz w innych miejscach.

Summary

Introduction: Sudden Infant Death Syndrome is defined in literature similarly as a sudden and unexpected death of an infant occurring during sleep and, at the same time, causes of which cannot be explained based on anamnesis, circumstances of death or comprehensive post-mortem examinations. Sudden Infant Death Syndrome is considered to be the most frequent cause of death among infants in the developed countries. Incidence of SIDS in the whole world ranges from about 0.1 to 6.0/1,000 live births. As much as 90% concerns deaths in the first year of life of a child, whereas 70% stands for deaths for which the cause remains unknown. In SIDS, about 90% of cases concern children under 1 year old and, in particular, at the age of between 2 and 4 months.

The aim: The aim of the study was to present the most significant aspects of SIDS as well as description and analysis of risk factors for occurrence of sudden infant death syndrome based on statistical data.

Materials and methods: For the purpose of the study, the secondary data analysis and desk research technique have been applied. The analysis is based on statistical data from the time period 2009-2014 released by the Central Statistical Office of Poland.

Results: In 2009-2014, the highest number of deaths of infants and new-borns was reported in 2009 with the number being as high as 2,327. In the following years, the number of deaths of new-borns and infants systematically decreased. In 2010 it was 2,057 and in 2011 – 1,836, in 2012 – 1,791, in 2013 – 1,684, and in 2014 – 1,583. The highest number of deaths of boys was reported in 2009 – 1,298, while the number of deaths of girls in that year, although it was the highest in the analysed period, was lower – 1,029.

Conclusions: cases of death were more frequent among boys rather than girls. The highest number of deaths was reported among infants under the age of one month and the number decreased with an increasing infants' age. More cases of death were reported in the city area rather than in a village.

Introduction

In the first half of the 20th century an unexpected death of infants was not an issue that drew special attention. It was not until the quality of healthcare improved that it became a subject of research. In the second half of the 20th century, this phenomenon was determined as a cot death and was believed to occur in post neonatal period. Sudden Infant Death Syndrome (SIDS) was also frequently described as a cot death, silent death or death without pathological findings [1]. It was only after many years of epidemiological studies that cot death received a unified name of Sudden Infant Death Syndrome and was added to the International Statistical Classification of Diseases and Related Health Problems. In the 10th revision of the classification mentioned above, SIDS was coded as R 95 [2,3]. However, SIDS is not a literal term defining a disease or a syndrome but it is a type of a natural and unexpected death, causes of which cannot be explained based on results of post-mortem examination or medical history [4,5,6]. Nowadays, sudden cot death syndrome is defined in literature similarly as a sudden and unexpected death of an infant occurring during sleep and, at the same time, causes of which cannot be explained based on anamnesis, circumstances of death or comprehensive post-mortem examinations [7,8]. A little wider concept than SIDS is a concept of not classified sudden deaths of infants (SUID). This category includes deaths for which cause has been identified based on detailed circumstantial analysis, as well as cases for which cause has not been identified despite detailed autopsy and numerous additional examinations [9].

Aim of the study

The general aim of the study was to describe and analyse risk factors for the occurrence of sudden infant death syndrome based on statistical data.

The study also defines specific objectives that are aimed at indicating:

1. The general number of deaths of infants and new-borns, as well as number of deaths of infants and new-borns in 2009-2014 in terms of sex, region, place of residence, place of death, based on statistical data.
2. The general number of deaths of infants and new-borns caused by SIDS, as well as number of deaths of infants and new-borns caused by SIDS in terms of age, sex, place of residence, region, as well as place of death in 2009-2014, based on statistical data.

3. Comparison of the number of deaths of infants in general to the number of deaths caused by SIDS in total, as well as in terms of sex, place of residence, and region in 2009-2014, based on statistical data.

Materials and methods

In the study, the secondary data analysis method has been applied. The applied desk research technique consists in analysis of the secondary data, already existing, already collected and processed by research agencies and public institutions. The analysis is based on statistical data from the time period 2009-2014 released by the Central Statistical Office of Poland. The tool applied in secondary data analysis method was an index of terms sought, resulting from the research aspects. It was prepared in a form of a list of information sought including description of objectives set and research aspects.

Results

In 2009-2014, the highest number of deaths of infants and new-borns was reported in 2009 with the number being as high as 2,327. In the following years, the number of deaths of new-borns and infants systematically decreased. In 2010 it was 2,057 and in 2011 – 1,836, in 2012 – 1,791, in 2013 – 1,684, and in 2014 – 1,583 (Table 1).

Table 1. Live births and deaths of babies and infants in total in 2009-2014

Year	2009	2010	2011	2012	2013	2014
live births	417589	413300	388416	386257	369576	375160
deaths	2327	2057	1836	1791	1684	1583

Source: Own calculations based on demografia.stat.gov.pl

In each of the analysed years, deaths of infants and new-borns were more frequent in boys rather than girls. As the general tendency shows, with years the number of deaths for both sexes decreased regularly. The highest number of deaths of boys was reported in 2009 – 1,298, while the number of deaths of girls in that year, although it was the highest in the analysed period, was lower – 1,029 (Table 2).

Table 2. Live births and deaths of babies and infants by gender for the period 2009-2014

Categories		Year					
		2009	2010	2011	2012	2013	2014
Boys	live births	214908	214428	199921	198696	189917	193091
	deaths	1298	1155	1027	995	927	870
Girls	live births	202681	198872	188495	187561	179659	182069
	deaths	1029	902	809	796	747	713

Source: Own calculations based on demografia.stat.gov.pl

Provinces in which the highest number of deaths of infants and new-borns in the analysed period was reported are as follows: Silesia, Mazovia, Wielkopolska, and Lower Silesia. In 2000-2014, for each of these provinces the number of deaths of infants and new-borns in total was: Silesia – 1,257, Wielkopolska – 927, Lower Silesia – 829, Mazovia – 807 deaths. In these provinces, the highest number of deaths of children and new-borns was also identified in the following years of the analysed period. In 2009, the highest number of deaths was reported in Wielkopolska Province – 115, in 2010, 2011, and 2013 in Silesia Province (274, 270, 218, respectively), and in 2012 and 2014 in Mazovia Province (248 and 214 respectively). These provinces are characterised by the highest population density and they are most urbanised. The lowest number of deaths in the analysed group of infants and in the same time period was reported in smaller provinces, much less populated and poorly urbanised: Opole Province, Lubuskie Province, and Świętokrzyskie Province (Table 3).

Table 3. Live births and deaths of babies and infants in particular provinces in the period 2009-2014

Categories		Year					
		2009	2010	2011	2012	2013	2014
Dolnośląskie	live births	29826	29549	27660	27239	25805	27174
	deaths	66	181	155	171	132	124
Kujawsko-pomorskie	live births	23059	22596	20971	20764	19853	20031
	deaths	55	131	126	100	88	93
Lubelskie	live births	22964	22635	21363	21214	19738	19828
	deaths	67	106	95	91	90	83
Lubuskie	live births	11499	10939	10421	10367	9737	9716
	deaths	21	59	58	62	55	37
Łódzkie	live births	26052	25526	23952	23851	22420	22704
	deaths	46	101	107	101	105	99
Małopolskie	live births	37286	37049	35524	35117	34307	34419
	deaths	113	168	152	134	131	109
Mazowieckie	live births	59841	60756	57258	57281	55400	57139
	deaths	98	274	195	248	214	214
Opolskie	live births	9280	9163	8686	8939	8227	8593
	deaths	15	48	33	55	35	40
Podkarpackie	live births	22368	21990	21130	21064	20373	19953
	deaths	82	115	112	107	92	99
Podlaskie	live births	12202	11928	11155	11161	10619	11029
	deaths	22	54	54	46	49	50
Pomorskie	live births	27343	26890	25059	25052	23938	24610
	deaths	65	122	103	109	103	82
Śląskie	live births	47860	47814	44803	44565	42829	42720
	deaths	71	274	270	214	218	210
Świętokrzyski e	live births	12741	12445	11600	11510	10720	10756
	deaths	28	78	70	41	52	33
Warmińsko-mazurskie	live births	16538	15771	14750	14330	13624	13958
	deaths	42	75	70	59	80	67
Wielkopolskie	live births	40882	40909	38082	37833	36561	37000
	deaths	115	180	139	170	163	160
Zachodniopomorskie	live births	17848	17340	16002	15970	15425	15530
	deaths	36	91	97	83	77	83

Source: Own calculations based on demografia.stat.gov.pl

Significantly higher number of deaths of infants and new-borns was reported in cities rather than in villages. Both in a village and in a city the number of deaths decreased every year, which was consistent with the general tendency in 2009-2014. In 2009 the number of deaths of infants and new-borns in a city was as high as 1,385, while in a village it did not exceed 1,000 and was 942. In 2010-2014, in a city, the following numbers were reported: 1,198,

1,059, 1,006, 928, and 885 of deaths, respectively. In the same period, in a village, the following numbers were reported: 859, 777, 785, 756, and 698 of deaths of infants and newborns. This means that in a city the decrease of the number of deaths was higher in the analysed period (Table 4).

Table 4. Live births and deaths of infants and newborns with distinction town-village in the period 2009-2014

Categories		Year					
		2009	2010	2011	2012	2013	2014
City	live births	246429	241920	225701	223712	213749	217699
	deaths	1385	1198	1059	1006	928	885
Village	live births	171160	171380	162715	162545	155827	157461
	deaths	942	859	777	785	756	698

Source: Own calculations based on demografia.stat.gov.pl

The highest number of deaths caused by SIDS in 2009-2013 was reported in 2009 (89), while in 2010 the decrease was reported (39 deaths). The decreasing tendency was not continued in 2011 (57 deaths) and the increase was reported. Since 2012, the decreasing tendency has been reported (51 deaths) and continued in 2013 (41 deaths). It has also turned out that after the increase of number of deaths in 2011, the rate from 2010 was not possible to be achieved until 2013. However, it is difficult to determine if the tendency continues.

In the analysed period, the highest number of deaths caused by SIDS was reported among infants under the age of one month (in 2009-2014 – 71 deaths in total). The number of deaths caused by SIDS decreased with an increasing infants' age and deaths in infants over 8 months old were sporadically caused by SIDS (in 2009-2014 for infants over 8 months old – 15 deaths in total). In 2009-2011 and in 2013 the highest number of deaths concerned infants under 1 year old (21, 12, 13, and 13, respectively), while only in 2012 in infants at the age of 1 month – 13 deaths were reported. In 2009 deaths of infants caused by SIDS were not reported in infants over 9 months old (0 deaths), in 2010 in infants at the age of 8 months, in 2011 in infants at the age of 9 and 11 months, in 2012 in infants at the age of 6, 8, 10, and 11 months, while in 2013 in infants at the age of 7, 9, and 11 months. The number of deaths caused by SIDS varied depending on a sex of an infant. In 2009-2014, significantly higher number of deaths was reported among boys in comparison to girls (160 deaths of boys in comparison to 117 deaths of girls). In 2009-2010 and 2012-2013, the number of deaths of boys was higher than of girls and was as follows: in 2009, 57 deaths of boys compared to 32 deaths of girls, in 2010, 24 deaths of boys compared to 15 deaths of girls, in 2012, 30 deaths

of boys compared to 21 deaths of girls, while in 2013, 21 deaths of boys compared to 20 deaths of girls. The highest difference between the number of deaths of boys and girls was reported in 2009 (25 deaths more reported in boys), while the lowest difference in 2013 (1 death more reported in boys than in girls). However, in 2011, the higher number of deaths caused by SIDS was reported in girls (29) rather than in boys (28 deaths). Another factor in the mortality rate in cases caused by SIDS was distinction between city and village. More cases of death were reported in the city area rather than in a village (in 2009-2013, 181 deaths in a city in comparison to 96 deaths in a village). One of the factors responsible for this tendency is a higher population density. The highest number of deaths in a city and in a village was reported in 2009 and the numbers were 55 and 34 deaths, respectively. The lowest number of deaths in a city was reported in 2013 (25 deaths) and in a village in 2010 (10 deaths). The lowest difference between the number of deaths of infants caused by SIDS was reported in 2013 (9 deaths).

The difference in the number of deaths from SIDS is also visible in terms of provinces.

The highest number of deaths caused by SIDS was reported in the analysed period in Lower Silesia Province (in 2009-2013 – 45 deaths in total). The number concerns in particular the time period 2009-2011 (13 deaths in 2009, 9 deaths in 2010, and 17 deaths in 2011). In 2012, the highest number of deaths caused by SIDS was reported in Łódź Province (9 deaths) and in 2013 in Warmia-Masuria Province (8 deaths). In 2012, the lowest number of deaths was reported in Lubuskie, Podkarpacie, Pomerania, Świętokrzyskie, and Warmia-Masuria Provinces, while in 2013 in Kujawy-Pomerania, Lubuskie, Lublin, Podlasie and Świętokrzyskie Provinces (1 death caused by SIDS in each province).

Every year, the highest number of deaths was reported in winter and autumn months with an exception of the year 2012. In 2010, November was the month with the highest number of deaths (6 deaths caused by SIDS), in 2011 – January and February (9 deaths caused by SIDS in each month), in 2012 – July (8 deaths caused by SIDS), and in 2013 – January (6 deaths caused by SIDS). The months with the lowest number of deaths caused by SIDS in the following years were: in 2010 – June and August (1 death caused by SIDS in each of the months), in 2011 – May and November (2 deaths caused by SIDS in each of the months), in 2012 no infant death caused by SIDS was reported in August and in 2013 1 death caused by SIDS was reported in December (Figure 1,2).

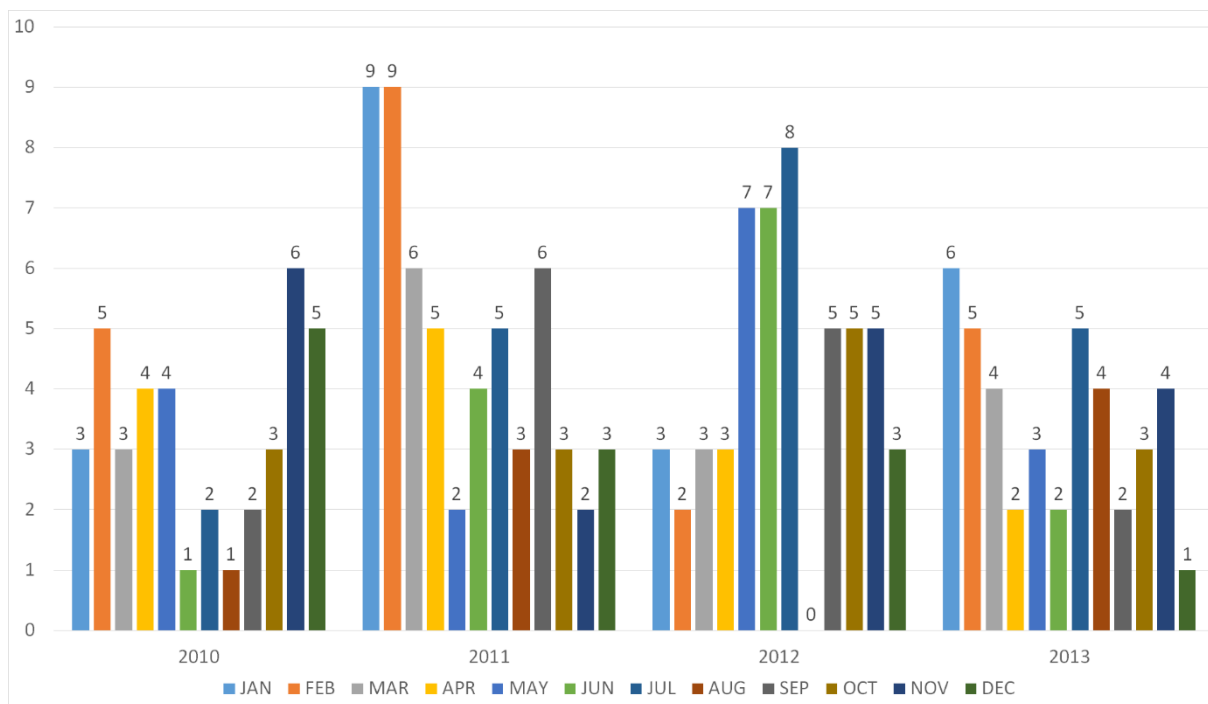


Figure 1. Deaths of infants and newborns because of SIDS, due to the month of death in 2009-2013, grouped by years. Source: Own calculations based on demografia.stat.gov.pl

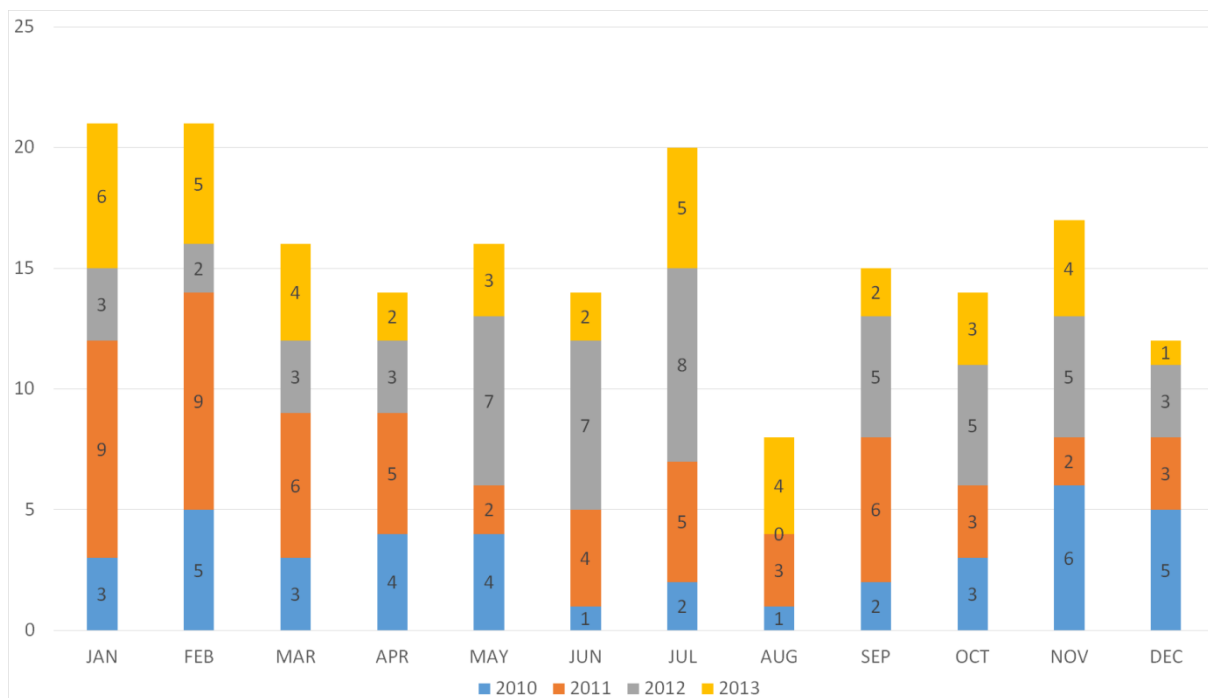


Figure 2. Deaths of infants and newborns because of SIDS in 2009-2013, accumulated by month. Source: Own calculations based on demografia.stat.gov.pl

The next section of the study presents the analysis and the comparison of the number of infant deaths in total and those caused by SIDS, as well as for the selected parameters.

In the analysed period, the highest percentage of deaths caused by SIDS in the total number of infants deaths was reported in 2009 (3.82%). The following year the percentage was significantly lower (1.89%) but the year after that it increased again (3.10%). In 2012 and 2013 the decreasing tendency was observed with the percentage being at 2.84% and 2.43%, respectively). The paragraph below presents the comparison between the number of deaths of infants and new-borns in total and the cases caused by SIDS, in terms of sex.

The percentage of deaths caused by SIDS among boys in comparison to the general number of deaths among boys is usually higher than in case of girls. The tendency was not confirmed in 2011 and in 2013. The highest percentage of deaths in boys caused by SIDS in the total number of deaths was reported in 2009 (4.39%), and the lowest percentage the following year (2.07%). In 2011, the percentage was 2.72%, in 2012 3.01%, and in 2013 2.26%. Among girls, the highest percentage of deaths caused by SIDS in the total number of deaths was reported in 2011 (3.58%) and the lowest in 2010 (1.66%). In 2009 the percentage for girls was 3.1%, in 2012 2.63%, and in 2013 2.67%.

The next section includes comparison of number of deaths of infants and new-borns in total and the cases caused by SIDS in terms of place of residence (city-village).

The percentage of deaths of infants caused by SIDS in cities in the analysed period was higher each year than in a village. Also, neither in case of a city, nor in case of a village, a decreasing or an increasing tendency for percentage of deaths of infants caused by SIDS in the total number of deaths was observed. The highest percentage of deaths of infants and new-borns in cities caused by SIDS in the total number of deaths was reported in 2009 (3.97%) and the lowest in 2010 (2.42%). In 2011, the percentage was 3.30%, in 2012 3.67%, and in 2013 2.69%. When it comes to the percentage of deaths of infants and new-borns caused by SIDS in the total number of deaths in a village, the highest number was reported, similarly to city, in 2009 (3.60%), and the lowest in 2010 (1.16%). The higher percentage was reported for deaths in a village caused by SIDS in 2011-2013 (2.83%, 1.78%, and 2.11%, respectively). In each province, except for Podlasie and Opole Provinces, in the analysed period, the highest percentage of deaths caused by SIDS occurred in 2009, reaching the following values: Lower Silesia Province. In Opole and Podlasie Provinces, the highest number of deaths caused by SIDS occurred in 2012 and was 15.54% and 4.34%, respectively. The highest percentage of infants deaths caused by SIDS in the total number of infants deaths in the analysed period was

reported in the provinces of Lower Silesia and Opole and the lowest in Warmia-Masuria and Wielkopolska Provinces.

Discussion

SIDS occurs in the whole world, however, in some of the regions its incidence is difficult to estimate due to lack of autopsy studies. This issue concerns, in particular, the poor regions [5]. Sudden Infant Death Syndrome is considered to be the most frequent cause of death among infants in the developed countries. Incidence of SIDS in the whole world ranges from about 0.1 to 6.0/1,000 live births [1]. The highest incidence rate was observed in Australia and New Zealand, about 6/1,000 live births, in Europe and in the USA 1.2-2/1,000, while in Poland in 2002-2007 0.12-0.18/1,000 live births [9, 10, 11, 12]. So far, the age of an infant has been a constant and unexplained characteristic feature for SIDS. Based on the available epidemiological data, it was established that SIDS rarely occurs in the second mid-year of the first year of life of a child. According to the statistical data referring to the structure of sudden human deaths, deaths of infants stand for 3% of cases in this group. As much as 90% concerns deaths in the first year of life of a child, whereas 70% stands for deaths for which the cause remains unknown. In SIDS, about 90% of cases concern children under 1 year old and, in particular, at the age of between 2 and 4 months [9, 13]. In the United States, every year, about 6,000 children aged between 4 and 6 month die, whereas almost 98% of cases concern children under 6 months [10]. Also, it has been established that the number of cases of SIDS varied depending on a race. SIDS occurs much more frequently in North-American Indians and in Afro-American population, whereas it is much less common among mongoloid race [5].

The causes of SIDS remain unknown, however, nowadays, many actions are taken to allow to indicate risk factors and circumstances of a child's death, which has enabled people to take preventive actions. Based on the epidemiological studies, it was established that SIDS occurs as a result of numerous genetic and environmental factors and probability of occurrence of this syndrome increases with the number of the factors influencing an infant [8]. The epidemiological studies conducted by the Great Ormond Street Hospital in London in 1996-2005 for 10 years, based on 546 autopsies, proved that 81% of SUID are deaths during sleep. In SIDS, the death of an infant occurs during sleep when an infant is placed to sleep on their stomach, which is the primary risk factor. Based on the studies, it has been established that the age of infants when most frequently unexplained death of an infant occurs corresponds to the time of decrease of immunoglobulins concentration in blood serum, which causes difficulties

in fighting infection and bacterial toxins [13]. Based on the epidemiological studies, it has been proved that there is a connection between SIDS and non-specific disease process that occurred in an infant during last two weeks of life. What was also identified was a higher incidence of digestive diseases. The appearing symptoms preceding death are getting tired during feeding in a week before death and excessive sweating during sleep. It has been also stated that in numerous cases during last 24 hours before death, an infant suffered from sleepiness and upper respiratory tract infection [14]. The greatest danger is connected to bacteria *Staphylococcus Aurele* and *Escherichia coli*, which was confirmed by the studies conducted by use of retrospective analysis method on material collected by the Great Ormond Street Hospital in London in 1996-2005. As the epidemiological studies conducted in infants in whom death occurred show, bacteria *Staphylococcus Aurele* and *Escherichia coli* are more frequent in the above cases than in healthy infants. In the cited epidemiological studies, viral causes of death were found in 2% of cases. Hidden and unrecognized malformations are a cause of 2% of deaths. The issue concerns, in particular, malformations of cardiovascular and respiratory system that were not diagnosed in prenatal period and in first months of infant's life. Tobacco smoke is a very significant risk factor that increases risk of respiratory system diseases and respiratory disorders [13]. High risk group includes also infants that have been diagnosed to have life threatening symptoms (ALTE) that usually are a sign of apnoea [8, 15, 16,17].

Conclusions

The theoretical considerations conducted in the study and statistical data analysis for the period 2009-2014 have led to the following conclusions that constitute an answer for research objectives:

1. In the analysed period the highest number of deaths of infants and new-borns was reported in 2009 and in the following years the number systematically decreased. With regard to the analysed variables it has been also established:
 - deaths were more frequent in boys rather than in girls,
 - the highest number of deaths was reported in the following provinces: Opole, Lubuskie, and Świętokrzyskie,
 - more deaths were reported in cities rather than in villages,
 - the highest number of deaths was reported in hospitals and the lowest at home and other healthcare centres, as well as other places.

2. The highest number of deaths caused by SIDS in 2009-2013 was reported in 2009, in 2010 the number decreased, however, the decreasing tendency did not continue and in the following years both increase and decrease were reported. Moreover, with regard to the analysed variables, it has been proved that:
 - the highest number of deaths was reported in infants under the age of one month and the number of deaths caused by SIDS decreased with an increasing infants' age,
 - significantly more deaths were reported in boys in comparison to girls,
 - deaths were more frequent in cities than in villages,
 - the highest number of deaths was reported in Lower Silesia Province and the lowest number in Lubuskie Province,
 - the highest number of deaths was reported in winter and autumn months.
3. In the analysed period the highest percentage of deaths caused by SIDS in the total number of deaths among infants was reported in 2009 and the lowest in 2010. Moreover:
 - percentage of deaths in boys in comparison to the total number of deaths in boys is usually higher than in case of girls,
 - percentage of deaths of infants in cities was higher than in villages,
 - the highest percentage of deaths in each of the provinces, except for Podlasie and Opole Provinces, occurred in 2009 and the highest percentage of infants deaths caused by SIDS in the total number of infants deaths was reported in the provinces of Lower Silesia and Opole, while the lowest in Warmia-Masuria and Wielkopolska Provinces.

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