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Health Status of Population Living in High Ecological Risk Areas in Poland I. General Negative Health Indicators in the Period 1988-1993

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Abstract

The health status of the population living in high ecological risk areas (HERAs) in Poland is described at the level of general negative health indicators such as infant mortality rates, low birth weight rate, and standardized mortality rates. Analysis of temporal trends over the period 1988-1993 is included. These indicators are compared with analogous quantities for areas outside HERAs. The results suggest that the health status of the population of Poland living in HERAs is worse than that of the population living outside HERAs.

The ranking of HERAs according to the analyzed indicators does not correspond exactly to those proposed previously, based on the so-called "total hazard index". It demonstrates the need to review the definition of HERAs.

Keywords: Negative health indicators, temporal trends, high ecological risk areas

Introduction

There is a growing public awareness of potential adverse health effects of environmental pollution. It has become clear that the benefits of increased overall prosperity due to rapid economic growth over recent decades have not been compensated by proper actions to guarantee the safety of the environment.

Individual persons or populations may be viewed as "detectors" of the state of the environment in which they are immersed. Relying on the continuous flow of energy in metabolic processes, human organisms are tuned into the environment by complex system of adaptive homeostatic mechanisms. The outcome of the "measurement" provided by such "detectors" (the organisms) is reflected in what we call the state of health. Such a broad understanding of health is contained in the WHO definition, which states that *"Health is not merely the absence of disease or infirmity but rather a state of complete physical, mental and social well-being."*

The basic information about health of human populations is provided by *epidemiology*, which is a science studying the occurence and distribution of diseases and other health-related conditions and their determinants in populations [2].

The term *High Ecological Risk Area* (HERA) first appeared in Poland in enclosure No. 4 to the agenda of the Cabinet on March 4th, 1983, concerning the National Socio-Economic Plan. The basis for delimiting HERAs was founded on the following criteria [1]:

– exceeding admissible concentrations of pollutants in, or heavy degradation of at least two elements of the environment,

– recurrent or particularly annoying (toxic) excess of admissible concentrations of pollutants in, or extremely heavy pollution of one element of the environment.

By using a cartographic method of overlaping maps displaying the state of various elements of the environment with the administrative distinction of cities and districts a total of 27 HERAs has been estaslished. In Table 1 urban areas and districts constituing distinct HERAs have been enumerated with an intention to provide a guide for further studies on the health status of populations inhabiting HERAs, utilizing the statistical data available from central or provincial offices. It should be stressed that the definition of HERAs does not coincide with administrative division into voivodeships, which severely complicates the use of statistical data provided by the Central Statistical Office, which routinely uses administrative divisions.

Despite of the fact that potential health hazards associa-

Table 1. High Ecological Risk Areas in Poland

1. Bełchatów HERA:
   cities:
   districts: Kamieńsk, Kleszczów
2. Bydgoszcz-Toruń HERA:
   cities: Bydgoszcz, Solec Kujawski, Toruń, Aleksandrów Kujawski, Ciechocinek,
   districts: Białe Błota, Dąbrowa Chełmińska, Nowa Wieś Wielka, Osielsko, Solec Kujawski, Lubicz, Łysomice, Obrowo, Wielka Nieszawka, Zławieś Wielka, Aleksandrów Kujawski
3. Chełm HERA:
   cities: Chełm, Rejowiec Fabryczny
   districts: Chełm, Dorohusk, Łopiennik Górny, Rejowiec, Ruda Huta, Sawin, Siedliszcze, Wierzbica
4. Częstochowa HERA:
   cities: Blachownia, Częstochowa,
   districts: Blachownia, Konopiska, Poczesna, Rędziny
5. Gdańsk HERA:
   cities: Braniewo, Elbląg, Frombork, Tolkmicko, Gdańsk, Gdynia, Hel, Jastarnia, Pruszcz Gdański, Puck, Reda, Rumia, Sopot, Wejherowo, Władysławowo
   districts: Braniewo, Elbląg, Frombork, Milejewo, Stegna, Sztutowo, Tolkmicko, Cedry Wielkie, Kolbudy Górne, Kosakowo, Krokowa, Pruszcz Gdański, Puck, Wejherowo, Żukowo
6. Upper Silesian HERA:
   cities: Chełmek, Oświęcim, Będzin, Brzeszcze, Bukowno, Bytom, Chorzów, Chrzanów, Czechowice-Dziedzice, Czeladź, Dąbrowa Górnicza, Gliwice, Jaworzno, Katowice, Libiąż, Łaziska Górne, Mikołow, Mysłowice, Olkusz, Orzesze, Piekary Śląskie, Pyskowice, Ruda Śląska, Siemianowice Śląskie, Sosnowiec, Świtochłowice, Tarnowskie Góry, Trzebinia, Tychy, Zabrze
   districts: Chełmek, Oświęcim, Babice, Bobrowniki, Brzeszcze, Bukowno, Chrzanów, Klucze, Libiąż, Miedźna, Olkusz, Psary, Świerklaniec, Trzebinia, Zbrosławice
7. Inowrocław HERA:
   cities: Barcin, Inowrocław, Janikowo, Kruszwica, Pakość,
   districts: Barcin, Inowrocław, Janikowo, Kruszwica, Pakość
8. Jelenia Góra HERA :
   cities: Jelenia Góra, Karpacz, Kowary, Piechowice, Szklarska Poręba,
   districts: Janowice Wielkie, Mysłakowice, Podgórzyn
9. Kielce HERA:
   cities: Chęciny, Kielce,
   districts: Chęciny, Daleszyce, Małogoszcz, Morawica, Piekoszów, Sitkówka-Nowiny, Sobków
10. Konin HERA:
    cities: Kleczew, Konin, Ślesin, Turek,
    districts: Brudzew, Kazimierz Biskupi, Kleczew, Kramsk, Przykona, Ślesin, Turek, Władysławów
11. Kraków HERA:
    cities: Kraków, Krzeszowice, Niepołomice, Proszowice, Skawina, Słomniki, Wieliczka
    districts: Alwernia, Biskupice, Czernichów, Drwinia, Iwanowice, Jerzmanowice-Przeginia, Koniusza, Kocmyrzów-Luborzyca, Kłaj, Krzeszowice, Liszki, Mogilany, Michałowice, Niepołomice, Nowe Brzesko, Proszowice, Radziemice, Skała, Skawina, Słomniki, Sułoszowa, Świtniki Górne, Igłomia-Wawrzeńczyce, Wieliczka, Wielka Wieś, Zabierzów, Zielonki
12. Legnica – Głogów HERA
    cities: Bolesławec, Chocianów, Chojnów, Głogów, Jawor, Legnica, Lubin, Polkowice, Prochowice, Przemków, Ścinawa, Złotoryja
    districts: Bolesławec, Chocianów, Chojnów, Gaworzyca, Głogów, Grębocice, Gromadka, Jerzanowa, Kotla, Krotoszyce, Kunice, Legnickie Pole, Lubin, Mięcinka, Miłkowice, Mściwojów, Pęcław, Polkowice, Prochowice, Przemkow, Radwanice, Rudna, Ruja, Ścinawa, Warta Bolesławicka, Wądroże Wielkie, Zagrodno, Złotoryja Żukowice
13. Łódź HERA:
    cities: Aleksandrów Łódzki, Konstantynów Łódzki, Łódź, Pabianice,
    districts: Aleksandrów Łódzki, Pabianice, Rzgów, Zgierz
14. Myszków – Zawiercie HERA:
    cities: Myszków, Ogrodzieniec, Poręba, Zawiercie,
15. Opole HERA:
    cities: Krapkowice, Kuźnia Raciborska, Gogolin, Kędzierzyn-Koźle, Leśnica, Opole, Strzelce Opolskie, Zdzieszowice
    districts: Bierawa, Gogolin Krapkowice, Leśnica, Strzelce Opolskie, Tarnów Opolski, Zdzieszowice
16. Płock HERA
    cities: Płock
    districts: Stara Biała
17. Poznań HERA:
    cities: Luboń, Mosina, Poznań, Puszczykowo, Stęszew, Swarzędz
    districts: Czerwonak, Komorniki, Mosina, Stęszew, Suchy Las, Swarzędz
18. Puławy HERA:
    cities: Kazimierz Dolny, Nałęczów, Puławy,
    districts: Baranów, Janowiec, Kazimierz Dolny, Końskowola, Puławy, Wąwolnica, Zyrzyn
19. Rybnik HERA:
    cities: Jastrzębie Zdrój, Leszczyny, Rybnik, Wodzisław Śląski, Żory
    districts: Gaszowice, Gierałtowice, Godów, Gorzyce, Leszczyny, Lubomia, Lyski, Mszana, Pawłowice, Świerklany, Zebrzydowice
20. Szczecin HERA:
    cities: Goleniów, Gryfino, Kamień Pomorski, Nowe Warpno, Police, Stargard Szczeciński, Szczecin, Świnoujście, Wolin,
    districts: Dobra Szczecińska, Dziwnów, Goleniów, Gryfino, Kamień Pomorski, Kobylanka, Kołbaskowo, Nowe Warpno, Police, Stare Czarnowo, Stargard Szczeciński, Stepnica, Wolin
21. Tarnobrzeg HERA:
    cities: Mielec, Baranów Sandomierski, Nowa Dęba, Nisko, Połaniec, Stalowa Wola, Staszów, Tarnobrzeg
    districts: Borowo, Czermin, Mielec, Tuszów Narodowy, Baranów, Bojanów, Jarocin, Grębów, Koprzywnica, Nowa Dęba, Osiek, Padew, Połaniec, Pysznica, Rytwiny, Staszów
22. Tarnów HERA:
    cities: Dębica, Pilzno, Tarnów, Żabno
    districts: Czarna, Dębica, Lisia Góra, Pilzno, Radłów, Skrzyszów, Tarnów, Wierzchosławice, Żyraków
23. Tomaszów HERA:
    cities: Tomaszów Mazowiecki,
    districts: Inowłódzm, Lubochnia, Tomaszów Mazowiecki
24. Turoszów HERA:
    cities: Bogatynia, Pieńsk, Zawidów, Zgorzelec
    districts: Bogatynia, Pieńsk, Sulików, Zgorzelec
25. Wałbrzych HERA
    cities: Boguszów-Gorce, Głuszyca, Jedlina Zdrój, Nowa Ruda, Szczawno Zdrój, Świebodzice, Wałbrzych
    districts: Głuszyca, Nowa Ruda, Walim
26. Włocławek HERA:
    cities: Brześć Kujawski, Włocławek
    districts: Brześć Kujawski, Fabianki, Włocławek
27. Wrocław HERA
    cities: Brzeg Dolny, Oborniki Śląskie, Oława, Wrocław
    districts: Brzeg Dolny, Oborniki Śląskie, Oława, Święta Katarzyna

ted with living in HERAs are present in the definition of the HERA [1], the literature adressing these issues is relatively poor [3, 4, 5]. The present paper attempts to describe the health status of the population living in HERAs in comparison with areas outside HERAs. The analysis will be performed at the level of basic negative health indicators like infant mortality rate (IMR), low birth weight rate (LBWR) and standardized mortality rate (SMR), including their temporal trends over the period 1988-1993. For the sake of transparency of the presentation, discussion of specific mortality rates due to chosen diseases is left for a subsequent paper.

Material and Methods

In the present study we have used source records of births and deaths over the period 1988-1993 obtained from the Central Statistical Office. These enabled us to perform analysis of the district statistics both in and outside HERAs. The health status of the population was estimated by using the following negative health indicators:

– infant mortality rate
– low birth weight rate
– total mortality rate standardized according to age and sex (SMR).

Indirect standardization [6] has been performed by using the age and sex demographic structure of Poland in 1991 as a standard. Infant mortality rates were calculated according to the WHO definition, which treats the birth of a newborn unable to live, but shawing signs of life, as alive. A threshold value of weight below which the newborn was classified as low birth weight was taken to equal 2500 g.

In order to assess the temporal trends of the above-mentioned indicators, linear regresion analysis of respective time series has been performed. The resuls are quantified by means of a regression coefficient r and statistical significance of the trend p (estimated by analysis of variance).

It shoud be emphasized that the definition of HERAs makes it possible for both urban and rural regions to fall within this category. It is hence reasonable to introduce the distinction between urban and rural HERAs and, analogously, urban and rural regions outside HERAs.

Results

Infant mortality rates per 1000 live births are presented in Table 2. They were calculated separately for urban and rural areas both inside and outside HERAs during the period 1988-1993. The last column displays the temporal trend of IMRs. It can be seen that IMRs in urban HERAs were higher than in urban areas outside HERAs (19.95 vs. 17.85 infant deaths per 1000 live births). In the rural areas this relationship was reversed (17.97 vs. 18.66 infant deaths per 1000 live births). The temporal trend of IMRs inside HERAs was strongly decreasing both in urban

Table 2. Infant mortality rates during the period 1988-1992 in the regions inside and outside HERAs.

Year	Infant mortality rates per 1000 live births			
	HERAs		Outside HERAs	
	Urban Areas	Rural Areas	Urban Areas	Rural Areas
1988	21.24	19.32	18.95	20.05
1989	20.85	19.73	18.13	19.00
1990	20.25	17.78	18.16	19.93
1991	19.97	18.07	19.18	19.76
1992	18.86	16.55	16.90	17.47

($r = -0.98$, $p < 0.001$) and in rural areas ($r = -0.94$, $p < 0.005$). Outside HERAs this decreasing tendency was weaker, i.e. $r = -0.77$ at $p = 0.07$ in the urban and $r = -0.82$ at $p = 0.047$ in rural areas, respectively.

Table 3 presents the percentage of infant deaths for different age groups of mothers. The results don't show any significant difference between HERAs and outside.

The coefficients of low birth weight rate of newborns (calculated per 1000 live births) are presented in Table 4. It is evident from this table that the low-weight births occurred more frequently in regions inside HERAs (97.1% of alive births in the urban areas and 84.09% in rural areas) than outside HERAs (86.36% of alive births in the urban and 80.10% in rural areas). No significant trend could be noticed during the considered period of time.

Analogously, the percentage of low-weight births for different age groups of mothers was analyzed and did not reveal any difference between HERAs and outside (see Table 5).

Table 6 displays the total mortality rates standardized according to age and sex during the period 1988-1993 in the regions inside and outside HERA. The standardized mortality rate does not show actual mortality. However, it is a starting point for comparisons between populations which may intrinsically be different according to age and sex. As can be seen from Table 6, standardized total mortality rates in urban areas inside HERAs were higher (100.84) than in urban areas outside HERAs (97.11). A similar relation also holds true for rural areas (100.1 vs 99.08, respectively). The temporal analysis did not reveal any significant trend either inside or outside HERAs.

Table 7 ranks HERAs according to three basic negative health indicators discussed in the persent paper.

Discussion and Conclusions

It is generally assumed that mortality is a basic negative index of the health status of the population [5]. Despite some obvious limitations of using morality data, the fundamental advantage of mortality indicators consists of very good coverage of the population by vital registers. Infants clearly constitute the distinguished age group for which the association between mortality and environmental pollution may be of special interest. Advantageously, infant deaths are reported as a part of the vital registration system (mortality component) and, similary, the birth registration system carries information about low birth mass, which is the strongest predictor of infant mortality.

Table 3. Infant mortality rates in relation to mother's age (expressed as a percent of the total mortality rate) inside and outside the HERAs.

Year	HERAs										Outsise HERAs									
	Urban Areas					Rural Areas					Urban Areas					Rural Areas				
	≤ 18	19-23	24-28	≥ 29	mean age	≤ 18	19-23	24-28	≥ 29	mean age	≤ 18	19-23	24-28	≥ 29	mean age	≤ 18	19-23	24-28	≥ 29	mean age
1988	2.95	24.02	28.39	44.64	27.89	1.59	29.82	32.41	36.18	27.20	1.76	23.70	31.25	43.29	27.89	2.23	29.27	32.91	35.59	27.09
1989	2.90	26.31	29.59	41.20	27.55	2.97	31.17	29.68	36.18	27.07	2.57	25.37	28.93	43.13	27.83	1.96	30,46	30.80	36.77	27.18
1990	2.94	27.28	28.93	40.85	27.67	2.95	32.73	29.55	34.77	26.71	2.77	24.88	29.63	42.71	27.89	2.79	30.17	30.42	36.61	27.12
1991	3.71	26.65	27.09	42.55	27.81	2.32	32.47	26.29	38.92	27.37	3.57	25.14	28.05	43.24	27.95	2.57	30.15	29.32	37.96	27.31
1992	3.43	27.53	27.89	41.14	27.78	4.58	31.27	27.49	36.66	27.17	2.97	24.17	28.35	44.52	28.20	2.50	30.50	29.05	37.95	27.37

Table 4. Coefficients of low birth weight of newborns per 1000 live birth in regions inside and outside HERAs. According to the WHO convention, the birth of a newborn unable to live, but showing signs of life, was treated as alive.

Year	HERAs		Outside HERAs	
	Urban Areas	Rural Areas	Urban Areas	Rural Areas
1988	95.81	84.42	84.99	77.59
1989	95.39	85.21	83.37	77.89
1990	99.24	86.49	89.21	82.98
1991	97.53	84.12	88.45	82.61
1992	97.21	81.07	85.79	81.02

The results of analysis presented in this paper indicate that the health status of the population of Poland living in high ecological risk areas (as assessed by general health indicators) is worse than that of the population living outside HERAs. In urban areas inside HERAs the level of infant mortality is higher than outside, and newborns with low birth weight are born more frequently. The lack of any significant influence of mother's age (one possible confounder) is another argument in favour of the importance of environmental factors for the health status of human populations. The decreasing tendency in infant mortality rate is a national one affecting regions both inside and outside HERAs.

The performed ranking of HERAs according to three basic negative health indicators (Table 7) doesn't correspond to the ranking according to the total hazard index performed in [7]. It reflects the complexity of factors and processes which manifest themselves in negative health indicators. This should be considered as a caution against oversimplifying the complex reality, and points toward the necessity of putting the definition of the high ecological risk areas on a more firm basis, closely related to the potential adverse health effects of living in such regions.

Table 5. Low birth weight rates in relation to mother's age (expressed as a percent of total births with low weight) inside and outside HERAs.

Year	HERAs										Outsise HERAs									
	Urban Areas					Rural Areas					Urban Areas					Rural Areas				
	≤ 18	19-23	24-28	≥ 29	mean age	≤ 18	19-23	24-28	≥ 29	mean age	≤ 18	19-23	24-28	≥ 29	mean age	≤ 18	19-23	24-28	≥ 29	mean age
1988	4.22	27.55	28.10	40.13	27.16	3.67	35.00	30.01	31.33	26.14	3.66	26.74	29.19	40.41	27.26	4.47	33.71	29.38	32.43	26.25
1989	4.79	28.14	26.80	40.28	27.17	4.50	33.25	29.34	32.91	26.40	4.16	27.79	27.67	40.37	27.23	4.30	34.28	28.96	32.46	26.28
1990	5.20	27.91	27.13	39.75	27.15	5.01	33.57	27.43	33.99	26.36	4.84	27.23	27.71	40.23	27.24	4.97	34.33	28.22	32.48	26.26
1991	5.53	28.45	26.45	39.58	27.18	5.34	33.30	26.81	34.54	26.47	5.06	28.25	26.21	40.48	27.31	5.31	33.93	26.66	34.10	26.37
1992	5.48	28.05	25.75	40.72	27.33	5.42	30.78	27.92	35.89	26.72	5.05	26.64	25.97	42.33	27.59	5.09	33.03	26.88	34.99	26.59

Table 6. Total mortality rate standardized according to age and sex inside and outside HERAs during the period 1988-1992.

Year	HERA			Outside HERA		
	Urban Areas	Rural Areas	Total	Urban Areas	Rural Areas	Total
1988	100.22	98.52	101.31	95.35	97.26	95.73
1989	103.94	106.30	105.73	97.20	98.29	97.14
1990	101.58	100.50	102.83	96.63	99.35	97.51
1991	103.58	102.07	104.84	101.74	102.65	101.61
1992	100.85	100.06	102.21	96.84	98.68	97.28

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Table 7. Ranking of HERAs according to infant mortality rates (IMR), low birth weight rates (LBWR) and standardized mortality rates (SMR).

High Ecological Risk Area	IMR*		LBWR*		SMR	
	place	mean	place	mean	place	mean
Wałbrzych HERA	3	23.99	1	122.73	4	110.76
Włocławek HERA	2	24.13	2	120.35	7	109.02
Łódź HERA	7	22.04	3	119.51	3	110.99
Upper Silesian HERA	10	21.42	6	105.74	5	110.68
Inowrocław HERA	4	23.02	5	110.68	12	105.58
Myszków-Zawiercie HERA	8	22.02	4	115.88	9	107.23
Turoszów HERA	6	22.36	9	98.00	6	109.63
Tomaszów HERA	12	21.08	10	97.87	2	115.24
Legnica-Głogów HERA	14	19.87	12	92.48	1	120.38
Częstochowa HERA	13	21.01	8	100.96	11	105.82
Chełm HERA	1	24.44	15	89.33	18	98.05
Bydgoszcz-Toruń HERA	5	22.97	11	96.06	21	95.73
Opole HERA	9	21.47	21	82.02	8	108.45
Szczecin HERA	17	18.79	7	105.20	16	99.63
Płock HERA	15	19.23	16	88.10	13	104.69
Jelenia Góra HERA	23	16.77	13	89.90	10	106.02
Poznań HERA	16	18.89	18	87.07	14	102.36
Rybnik HERA	19	18.42	14	89.65	15	102.13
Wrocław HERA	11	21.28	19	86.91	20	97.04
Gdańsk HERA	20	18.23	17	87.92	19	97.66
Kielce HERA	18	18.76	23	80.93	24	94.21
Konin HERA	22	17.38	27	72.54	17	98.12
Puławy HERA	26	15.17	20	83.99	25	90.44
Tarnów HERA	21	17.59	24	78.84	26	89.91
Bełchatów HERA	27	9.89	22	81.20	23	94.66
Kraków HERA	25	16.17	26	74.42	22	95.27
Tarnobrzeg HERA	24	16.61	25	78.16	27	86.52

* – index calculated per 1000 alive births.

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