

Michalina Krzyżak<sup>1</sup>, Dominik Maślach<sup>1</sup>, Katarzyna Piotrowska<sup>2</sup>,  
Angelika E. Charkiweicz<sup>1</sup>, Andrzej Szpak<sup>1</sup>, Jan Karczewski<sup>2</sup>

## PERINATAL MORTALITY IN URBAN AND RURAL AREAS IN POLAND IN 2002-2012

<sup>1</sup> Department of Public Health, Medical University of Białystok

<sup>2</sup> Department of Hygiene and Epidemiology, Medical University of Białystok

### ABSTRACT

**AIM.** The aim of this study was to analyze the level and trends of perinatal mortality by mother's place of residence (urban vs rural area) in Poland in 2002–2012.

**MATERIAL AND METHOD.** This study was based on the data of the Central Statistical Office on the number of live births, infant deaths (0-6 days) and stillbirths by mother's place of residence (urban vs rural area), reported in 2002–2012 in 16 provinces and Poland in general. *Joinpoint* model was used to analyze perinatal mortality rate trends over time and average annual percent change (APC). Urban/rural ratio was employed to demonstrate the differences in perinatal mortality between urban and rural areas.

**RESULTS.** In the period analyzed, perinatal mortality in Poland decreased by 3.4% ( $p < 0.05$ ) and 2.7% ( $p < 0.05$ ) per year in urban and rural areas, respectively. Having considered urban areas, perinatal mortality rate was decreasing at the fastest pace in the following provinces: Pomorskie (APC) = -6.6%,  $p < 0.05$ , Warmińsko-Mazurskie (APC) = -5.4%,  $p < 0.05$ , Lubuskie i Świętokrzyskie (APC) = -4.5%,  $p < 0.05$ ) while for rural areas – Dolnośląskie (APC = -4.3%,  $p < 0.05$ ), Wielkopolskie, Zachodniopomorskie (APC = -3.7%,  $p < 0.05$ ) and Śląskie (APC = -3.2%,  $p < 0.05$ ).

**CONCLUSIONS.** In the study period, a decrease in perinatal mortality was reported in Poland, both in urban and rural areas. The level of perinatal mortality rate as well as the pace of these changes differed between provinces.

**Key words.** *perinatal mortality, urban-rural differences, joinpoint analysis*

### INTRODUCTION

Perinatal mortality is an important indicator used for evaluating the health care quality for mothers and their newborns. It serves as a reflection of living conditions and general health of mothers and their children. It allows policy makers for identification of major problems associated with perinatal care. Furthermore, it enables to monitor time and territorial trends in mortality and consequently to plan and introduce organizational changes to the health care system (1).

Perinatal care requires interdisciplinary interventions, involving the cooperation of obstetricians, neonatologists and other professionals (pediatricians, surgeons, dieticians, social workers). It should cover such components as health care, health promotion and therapeutic activities undertaken in preconceptional period, pregnancy, at childbirth and postpartum with regard to mother, fetus and newborn (2, 3, 4, 5).

### AIM

This paper aimed at analyzing the level and trends of perinatal mortality by mother's place of residence (urban vs rural area) in Poland in 2002–2012.

### MATERIAL AND METHODS

Analysis was based on the data of the Central Statistical Office (CSO) on the number of live births, infant deaths (0-6 days) and stillbirths reported in Poland in 2002–2012 (6).

Perinatal mortality rate was calculated as a quotient of the total of infant deaths within the first seven days of life (0-6 days) and stillbirths (death preceding the complete expulsion or extraction from mother's organism; provided it occurred at week 22 of gestation or later) to the total of births per 1000 births. Rates were calculated

separately for each of 16 provinces by mother's place of residence (urban vs rural area).

Mother's place of residence was defined by the CSO pursuant to the *Act of 29 August 2003 on official names of localities and physiographic objects (Journal of Laws of 2003, No. 166, item 1612)*.

**Statistical analysis.** *Urban/rural ratio* was used to demonstrate the differences in perinatal mortality between urban and rural areas. It was calculated as a quotient of perinatal mortality rate in urban and rural areas. The values of *urban/rural ratio* and 95% confidence interval were determined, using *Health Disparities Calculator (Version 1.2.4. – October 2013)* (7).

Analysis of trends in perinatal mortality over time, i.e. in 2002-2012 was performed. Time trends were investigated for Poland in general and each province by mother's place of residence (urban vs rural area).

*Joinpoint* model was used to determine the changes in perinatal mortality rate. Such method is an extension of linear regression, in which time trends are expressed by lines connected together at the joinpoints where there is a statistically significant change in trend direction ( $p < 0.05$ ) (8).

Based on linear regression model, where natural logarithm of perinatal mortality rate was a dependent variable while calendar year was an independent variable ( $y = a + bx$ , where  $y = \ln(\text{perinatal mortality rate})$ ,  $x = \text{calendar year}$ ), annual percent change (APC) of perinatal mortality rates for each trends, was calculated as follows:

$$APC = 100 * (\exp^b - 1).$$

To determine the statistical significance of APC, 95% confidence interval was adopted in analyzed period. As the border of statistical significance,  $p < 0.05$  was established. *Joinpoint Regression Program (Version 4.0.1 – January 2013)* was used to analyze trends and APC values (9).

## RESULTS

Table I presents the trends of perinatal mortality rate in 2002-2012 in Poland in general and provinces, in urban and rural areas.

In Poland, perinatal mortality was decreasing systematically by 3.4% in urban areas ( $p < 0.05$ ), and

Table I. Trends in perinatal mortality rate in urban and rural areas in 2002 – 2012.

	Urban area						Rural area					
	Perinatal mortality rate			Trend			Perinatal mortality rate			Trend		
	2002	2012	Difference <sup>a</sup> (%)	Period	APC (%)	95% CI	2002	2012	Difference <sup>a</sup> (%)	Period	APC (%)	95% CI
<b>Poland</b>	8.7	6.2	-28.7	2002-2012	<b>-3.4*</b>	<b>(-3.9; -2.8)</b>	8.7	6.9	-21.3	2002-2012	<b>-2.7*</b>	<b>(-3.3; -2.1)</b>
Dolnośląskie	11.3	7.0	-37.8	2002-2012	<b>-4.3*</b>	<b>(-5.4; -3.1)</b>	11.0	7.5	-31.7	2002-2012	<b>-4.3*</b>	<b>(-6.2; -2.3)</b>
Kujawsko - pomorskie	8.6	7.2	-17.0	2002-2012	-0.8	(-3.2; 1.7)	9.9	7.2	-27.0	2002-2007	<b>-10.1*</b>	<b>(-16.2; -3.6)</b>
Lubelskie	7.3	6.1	-16.1	2002-2012	<b>-3.0*</b>	<b>(-4.6; -1.3)</b>	8.0	6.2	-22.8	2007-2012	+4.5	(-2.5; 12.0)
Lubuskie	9.1	7.7	-15.8	2002-2012	<b>-4.5*</b>	<b>(-7.2; -1.8)</b>	6.4	6.2	-3.7	2002-2012	-0.5	(-4.2; 3.3)
Łódzkie	8.0	6.2	-22.4	2002-2012	<b>-2.8*</b>	<b>(-4.5; -1.0)</b>	9.6	6.7	-30.2	2002-2012	<b>-2.6*</b>	<b>(-5.1; -0.1)</b>
Małopolskie	7.7	6.0	-21.8	2002-2012	<b>-2.5*</b>	<b>(-4.6; -0.4)</b>	8.3	6.7	-19.4	2002-2012	<b>-3.1*</b>	<b>(-4.9; -1.2)</b>
Mazowieckie	7.7	5.8	-25.0	2002-2012	<b>-2.1*</b>	<b>(-3.6; -0.7)</b>	8.4	7.1	-15.6	2002-2012	<b>-2.3*</b>	<b>(-3.6; -1.0)</b>
Opolskie	9.3	8.5	-8.9	2002-2012	-2.2	(-6.7; 2.7)	9.2	6.1	-33.4	2002-2012	-2.5	(-5.2; 0.3)
Podkarpackie	8.2	6.1	-25.7	2002-2012	<b>-4.1*</b>	<b>(-7.9; -0.2)</b>	8.7	7.0	-19.4	2002-2012	-2.1	(-4.6; 0.5)
Podlaskie	8.2	5.8	-29.4	2002-2012	<b>-3.5*</b>	<b>(-5.5; -1.4)</b>	8.2	6.7	-18.4	2002-2012	<b>-2.6*</b>	<b>(-4.6; -0.6)</b>
Pomorskie	10.0	5.2	-47.7	2002-2012	<b>-6.6*</b>	<b>(-8.5; -4.6)</b>	8.1	7.0	-14.6	2002-2012	-1.4	(-5.0; 2.3)
Śląskie	10.0	6.6	-33.7	2002-2007	-1.2	(-5.7; 3.6)	8.3	6.2	-25.0	2007-2012	<b>-6.8*</b>	<b>(-11.0; -2.3)</b>
Świętokrzyskie	9.7	5.1	-47.3	2002-2012	<b>-4.5*</b>	<b>(-7.2; -1.7)</b>	9.1	7.2	-21.4	2002-2012	-1.8	(-5.2; 1.6)
Warmińsko - mazurskie	9.0	4.1	-55.2	2002-2012	<b>-5.4*</b>	<b>(-8.2; -2.5)</b>	9.5	10.3	+8.5	2002-2012	-1.3	(-4.9; 2.4)
Wielkopolskie	7.4	6.2	-17.3	2002-2012	<b>-3.5*</b>	<b>(-5.5; -1.4)</b>	8.5	5.9	-30.3	2002-2012	<b>-3.7*</b>	<b>(-6.1; -1.2)</b>
Zachodniopomorskie	7.5	6.8	-9.5	2002-2012	-0.1	(-1.8; 1.7)	8.2	7.1	-13.5	2002-2012	<b>-3.7*</b>	<b>(-5.9; -1.4)</b>

\* APC is statistically significantly different from zero ( $p < 0.05$ )

a – change in perinatal mortality rate between 2002 and 2012 (%) (based on data observed)

slightly more slowly in rural areas, i.e. by 2.7% on annual basis ( $p < 0.05$ ).

In analyzed period, statistically significant decrease of perinatal mortality in urban areas was noted in the following provinces: Dolnośląskie (APC = -4.3%,  $p < 0.05$ ), Lubelskie (APC = -3.0%,  $p < 0.05$ ), Lubuskie (APC = -4.5%,  $p < 0.05$ ), Łódzkie (APC = -2.8%,  $p < 0.05$ ), Małopolskie (APC = -2.5%,  $p < 0.05$ ), Mazowieckie (APC = -2.1%,  $p < 0.05$ ), Podkarpackie (APC = -4.1%,  $p < 0.05$ ), Podlaskie (APC = -3.5%,  $p < 0.05$ ), Pomorskie (APC = -6.6%,  $p < 0.05$ ), Świętokrzyskie (APC = -4.5%,  $p < 0.05$ ), Warmińsko-mazurskie (APC = -5.4,  $p < 0.05$ ) and Wielkopolskie (APC = -3.5,  $p < 0.05$ ). Since 2007, a significant acceleration of the pace of changes was noted in Śląskie province, which in 2007–2012 was 6.8% annually ( $p < 0.05$ ).

In rural areas, perinatal mortality rate decreased considerably in 2002–2012 in the following provinces: Dolnośląskie (APC = -4.3%,  $p < 0.05$ ), Lubelskie (APC = -2.8%,  $p < 0.05$ ), Łódzkie (APC = -2.6%,  $p < 0.05$ ), Małopolskie (APC = -3.1%,  $p < 0.05$ ), Mazowieckie (APC = -2.3%,  $p < 0.05$ ), Podlaskie (APC = -2.6%,  $p < 0.05$ ), Śląskie (APC = -3.2%,  $p < 0.05$ ), Wielkopolskie (APC = -3.7%,  $p < 0.05$ ) and Zachodniopomorskie (APC = -3.7%,  $p < 0.05$ ). In Kujawsko-pomorskie province, perinatal mortality was decreasing by 10.1% annually to 2007 ( $p < 0.05$ ). Subsequently, trend changed and perinatal mortality rate increased by 4.5% annually. Following 2007, the increase of perinatal rate was not of statistical significance.

Table II demonstrates the differences in perinatal mortality rate between urban and rural areas. Average perinatal mortality rate in a year in Poland was higher by 6% ( $p < 0.05$ ) in rural compared to urban areas. Sta-

tistically significantly increased perinatal mortality rate in rural areas was reported in the following provinces: Dolnośląskie (by 9%,  $p < 0.05$ ), Małopolskie (by 11%,  $p < 0.05$ ), Mazowieckie (by 17%,  $p < 0.05$ ), Warmińsko-mazurskie (by 13%,  $p < 0.05$ ), Wielkopolskie (by 7%,  $p < 0.05$ ) and Zachodniopomorskie (by 17%,  $p < 0.05$ ). In Śląskie province, perinatal mortality was higher by 11% ( $p < 0.05$ ) on average in urban areas. In the remaining provinces, no statistically significant differences between urban and rural areas were reported.

## DISCUSSION

Since the post-war period, perinatal mortality in Poland was a reason of substantial decline in the population aged up to one year old. In 1952, it was 80/1000 births (10). Currently, perinatal mortality rates show a decreasing tendency. In the 90s of the last century, it amounted to 20/1000 births while at the beginning of this century, it is 10/1000 births. In 2012, it was 6.5/1000 births (11).

In the European countries, the decrease in perinatal mortality is also reported, i.e. from 42.8–19.7/1000 births in 1960 to 2.6–11.0/1000 births in 2012 (12, 13).

Our studies also confirm the decrease of perinatal mortality in Poland in 2002–2012. Perinatal mortality rate decreased by nearly 28.7% and 21.3% in urban and rural areas, respectively. According to Troszyński's report, perinatal mortality rate in 1999 was 10.8/1000 births while in 2010–6.9/1000 births. It suggests 38% decrease within 12 years, i.e. about 3% annually (14). The pace of perinatal mortality rate, however, is lower compared to 1950–1995 (4, 15).

Table II. Urban/rural ratio of perinatal mortality in Poland in 2002–2012.

	2002		2012		2002–2012 <sup>a</sup>	
	U/R	95% CI	U/R	95% CI	U/R	95% CI
<b>Poland</b>	1.00	(0.93;1.07)	<b>0.91*</b>	<b>(0.84;0.98)</b>	<b>0.94*</b>	<b>(0.92;0.96)</b>
Dolnośląskie	1.03	(0.80;1.32)	0.94	(0.70;1.26)	<b>0.91*</b>	<b>(0.84;0.98)</b>
Kujawsko - pomorskie	0.87	(0.65;1.16)	0.99	(0.72;1.36)	0.93	(0.85;1.02)
Lubelskie	0.90	(0.66;1.24)	0.98	(0.70;1.39)	0.93	(0.84;1.02)
Lubuskie	1.42	(0.88;2.29)	1.24	(0.77;2.01)	1.03	(0.90;1.19)
Łódzkie	0.84	(0.63;1.11)	0.93	(0.67;1.28)	0.91	(0.83;1.00)
Małopolskie	0.93	(0.73;1.19)	0.90	(0.69;1.17)	<b>0.89*</b>	<b>(0.83;0.96)</b>
Mazowieckie	0.92	(0.75;1.13)	0.81	(0.66;1.01)	<b>0.83*</b>	<b>(0.78;0.89)</b>
Opolskie	1.01	(0.65;1.57)	1.38	(0.85;2.26)	1.02	(0.88;1.18)
Podkarpackie	0.94	(0.69;1.27)	0.86	(0.61;1.22)	0.93	(0.84;1.02)
Podlaskie	1.00	(0.67;1.51)	0.87	(0.54;1.40)	0.93	(0.81;1.06)
Pomorskie	1.23	(0.92;1.63)	0.75	(0.54;1.04)	1.02	(0.94;1.12)
Śląskie	1.20	(0.94;1.55)	1.06	(0.81;1.40)	<b>1.11*</b>	<b>(1.03;1.20)</b>
Świętokrzyskie	1.07	(0.73;1.56)	0.72	(0.44;1.16)	0.90	(0.79;1.01)
Warmińsko - mazurskie	0.95	(0.68;1.33)	<b>0.39*</b>	<b>(0.26;0.60)</b>	<b>0.87*</b>	<b>(0.78;0.97)</b>
Wielkopolskie	0.87	(0.69;1.11)	1.04	(0.80;1.34)	<b>0.93*</b>	<b>(0.86;0.99)</b>
Zachodniopomorskie	0.91	(0.64;1.31)	0.95	(0.65;1.40)	<b>0.83*</b>	<b>(0.75;0.92)</b>

a – average urban/rural ratio in a year as of 2002–2012; \* $p \leq 0.05$

From the study transpires that there are disparities between the level and pace of perinatal mortality between provinces. Differences are also reported with regard to mother's place of residence (urban vs rural area). It is also confirmed by the results of Troszyński's report which demonstrates that in 1999-2010 the highest perinatal mortality rates were reported in Dolnośląskie province (from 13.7/1000 births in 1999 to 8.2/1000 births in 2009), while the lowest in Lubelskie province (from 7.6/1000 births in 2001, 7.7/1000 births in 2002 to 6.9/1000 births in 2007). In 2009-2010, the highest increase of perinatal mortality rates was noted in the following provinces: Podkarpackie, Świętokrzyskie and Podlaskie, while the lowest in Łódzkie and Śląskie provinces (14). It may be presumed that it partially results from health-related disparities in population living in different areas which are observed in Poland since many years (16, 10, 15), including women during pregnancy as well as throughout reproductive life.

From the National Health Programme (NHP) for the years 2007—2015 transpires that the primary objectives of care for pregnant women should be ensuring a normal course of pregnancy and possibly the quickest identification of risk factors. Consequently, women would receive a care which is tailored to their health needs (17). It would ensure the continuation of positive trends in perinatal mortality presented in the analysis. An indispensable element for meeting the aforesaid rights of women and sustaining a decreasing tendency of perinatal mortality rates is a properly functioning 3-tier perinatal care system, which grants highly-specialist medical care, consistent with current knowledge (3).

The authors of NHP 2007-2015 put an emphasis on the fact that the care for pregnant women and access to specialist testing in many areas is not satisfactory. Consequently, it leads to the situation in which not all women have a possibility of early visit to the physician. It is also confirmed by our own observations. In analyzed period, in Poland in general and six provinces, i.e.: Dolnośląskie, Małopolskie, Mazowieckie, Warmińsko-mazurskie, Wielkopolskie and Zachodniopomorskie, perinatal mortality rate was considerably higher in rural areas. This 3-tier perinatal care system does not function comprehensively throughout Poland. Furthermore, the lifestyle of pregnant women does not correspond to health requirements (17, 2). It may be concluded that there is no comprehensive approach to perinatal care in Poland which would cover community studies, social and health care, especially in neglected environments. It indicates a necessity of proper systemic solutions, especially those referring to organization (5, 3). In Poland, there are still areas, where there is limited or the lack of obstetric care. Such statement is confirmed by the findings of the Supreme Audit Office control regarding the midwifery activities

within primary care system. Based on the analysis of the access to midwives in communes located in provinces subject to control, it was confirmed that the inhabitants of large cities and urban-rural communes, in which there are health care centers, have the most optimal access to obstetric care. In some rural communes, the services rendered by midwives in primary care system are not contracted. Consequently, women have to benefit from the midwifery services in neighbouring communes. It may result in disparities in perinatal mortality rates by mother's place of residence, which was demonstrated in this study, to the disadvantage of rural areas (18). Therefore, it is necessary to draw policy makers attention to the essential role of midwives, especially in rural areas with regard to medical, social and psychological aspects, including monitoring women and their children throughout the pregnancy, at childbirth and postpartum, taking care of newborns and preparing the women to childbirth and parenthood. Such activities would ensure equal access to medical services and elimination of health disparities in different areas. Furthermore, such system would ensure more optimal access to medical services rendered with concomitant safety provision and effective management of funds (3).

A special attention should be paid to the necessity of constant improvement of 3-tier perinatal care system by focusing on early identification of high-risk pregnancies and referring such women to specialist centers. It should not be forgotten that for a properly functioning perinatal care system, out-patient clinics and obstetric wards as well as neonatal intensive care units and neonatal pathology units need to be equipped with the most optimal devices. Furthermore, medical personnel working in these units should be adequately educated and trained (5, 15). An important issue is also to raise the awareness on health culture in society with regard healthy diet, non-smoking and healthy lifestyle (15). All of these recommendations are required for sustaining a decreasing tendency of perinatal mortality in Poland.

For evaluation and monitoring of perinatal health, adequate reporting forms and meticulous documentation of data on births and neonatal deaths are required. These data should correspond to indicators recommended by EURO-PERISTAT (19). It is also necessary to conduct systemic epidemiological studies on pregnant women and newborns from high-risk groups as well as those regarding the quality of medical services. Furthermore, Poland should be involved in specialist European registers with the objective to ensure constant, multifaceted analysis of perinatal mortality which is essential for establishing the direction of activities aiming at improving perinatal care in Poland.

## CONCLUSIONS

1. In analyzed period, perinatal mortality was subject to improvement in Poland, both in urban and rural areas.
2. Perinatal mortality rate and the pace of changes differed between provinces.
3. The highest decrease of perinatal mortality in urban areas was reported in Pomorskie, Warmińsko-mazurskie, Lubuskie and Świętokrzyskie provinces while in urban areas - Dolnośląskie, Wielkopolskie, Zachodniopomorskie and Śląskie provinces.
4. A negative change in perinatal mortality trend was reported in rural areas in Kujawsko-pomorskie province.
5. Analysis of perinatal mortality suggests a necessity of undertaking reproductive and perinatal health-related activities, aiming at reducing regional health disparities regarding the health of mothers, fetus and newborns in Poland.

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Received: 11.06.2014

Accepted for publication: 20.10.2014

### Address for correspondence:

Dr Michalina Krzyżak

Department of Public Health, Medical University of Białystok

Szpitalna 37, 15 – 295 Białystok

tel. /fax (85) 686 50 55

e – mail: [michalina.krzyzak@umb.edu.pl](mailto:michalina.krzyzak@umb.edu.pl)

