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SOCIO-ECONOMIC ANALYSIS OF BURDEN OF PREMATURE DELIVERIES IN ROMANIA[1]

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Abstract

Premature births represent a major public health problem shared by many stakeholders inside and outside of the health care system. On one side, the direct implied part: child, mother, family, and on the other side, institutions designing and implementing policies towards better health of their populations. The WHO (2014) claims that every year globally, a "estimated number of 15 million of babies are born preterm". In Romania the preterm birth rate was estimated, in 2010, to be 7.3% according to WHO (2010) report. Even if across the world this value may be considered low, in Europe only few countries (Switzerland, Bulgaria and Slovenia) have greater values. In this case, socio-demographic analysis of this problem may offer some hints to different institutions in order to take relevant measures to reduce the impact of this burden.

Key words: premature deliveries, territorial analysis, GIS, quantitative methods

1. Introduction

The preterm births complication represents the most frequent cause of death for the children. Moreover, WHO (2014) report, mention that almost 75% of this kind of deaths can be avoided through cost-effective interventions.

Premature deliveries are associated with several determinants related to mother and the environment she lives. Unfortunately, even with the most recent studies there is no consensus regarding the number and the importance of determinants of premature deliveries. However, psychosocial and or physical stresses, pollution, poor nutrition, drugs consumptions, some infections (Greg, 2007), (Dolatian *et al.*, 2014), education (Lopez and Breart, 2013) etc. are mentioned as direct and causal factors, proven generally by cohort or case-control studies.

Preterm births are associated with different socio-demographics factors like race, education level, urbanization, mother's age, household condition, but also with some intrinsic previous behaviors like smoking, chronic conditions, multiple births, abortions, parity etc. Greg (2007), Florescu *et al.*, (2009), Poalelungi *et al.*, (2013), Dolatian *et al.*, (2014), Lopez and Breart, (2013), Chander *et al.*, (2015).

2. Data and methods

2.1. Data

The first indicator selected in our case is given by the total number of preterm births, defined as gestational period less than 37 weeks, registered in the inpatient care during 2013, and having birthdate registered between 01.01 and 31.12. 2013. The sample of these preterm births was searched within hospitalizations from 2013. The volume of sample represent 15.437 live preterm birth, codified in international classification of diseases, 10th edition (ICD-10) with P07.1x, P07.2x and P07.3x codes, as primary or secondary diagnosis. The sample also retains the locality of the mother (child) at the moment of birth, and the hospital where the newborn was delivered.

Also, a selection of other indicators collected from different sources was used within the statistical analysis. Therefore from Romanian National Institute of Statistics (NIS) were included: (i) population structured by education and occupation (2011, census data); (ii) family physician availability; (iii) live births by age of father and mother (Statistical Research regarding nativity). From the same source (NIS census data) were selected certain data about socio-economic development of communities like: (iv) number of household connected to water pipes or sewerage systems, and (v) share of Roma people within the municipality.

A locality social development index, a measure similar to Human Development Index, developed by Sandu (2010) was also used in the analysis.

2.2. Methods

In order to analyze the impact of several factors considered to be determinants of premature deliveries, two non-linear multiple regression models estimated on an initial sample of 3180 Romanian localities (municipalities) representing the NUTS3/ LAU2 level in the Eurostat classification, NUTS were constructed.

The effect variable used in first model was the number of preterm births in 2013 in each locality.

For the second model we computed the preterm births rate in the locality as the proportion of total number of preterm births on the total number of live births registered in the locality in 2013.

For both models we analyzed multiple possible determinants and or their mix, retaining only the most relevant of them. The general description of them is given below:

- [WAVAGE] - the mean age of females been in the normal age of fertility (15-49 y.o.), assumed as continue variable;
- [RESIDENCE]-a binary variable representing the type of locality with code 1 for urban and 0 for rural;
- [MF] a binary variable having code 1 for localities where a family physician is present;
- [IDSL] a continuous variable representing the level of development of locality as defined by Sandu D (2010);
- [ROMA] –a continuous variable representing the share of Roma people in total population of the locality;
- [SEWAGE*WATER] -a continuous proxy variable for the share of households without sewage nor water system
- [EDU] - women aged over 10y.o. without any formal education as percent of total women aged over 10, in the locality.

3. Results

Some descriptive analysis was performed to facilitate a better understanding of data distribution and behavior. Thus the preterm births recorded are characterized by residence status, and hospital category.

Table 1. Preterm deliveries rates by residence

Residence	Number of live-births	Preterm births	Preterm birth rates (%)
Urban	108,288	7,860	7,26
Rural	89,928	7,577	8,43
Total	**198,216**	**15,437**	**7,78**

In Romania, the obstetrical wards are classified according to their complexity in three categories, 1 being the lowest (usually local city hospitals), and 3 being the highest (referral obstetrical and neonatology centers at regional level), therefore the highest the hospital ranking the more premature births are attended in that facility. The rate of premature deliveries as percentage out of the total deliveries performed in different hospitals according to their complexity level is shown in table 2.

Table 2. Average preterm deliveries rates by obstetrical ward complexity level

Obstetrical ward complexity level	Hospital type	Average premature delivery rate (%)
3	Clinical university hospitals	9.9
2	District hospitals	9.3
1b	Major municipal hospitals	7.4
1a	Minor municipal and local hospitals	5.7

Even if the absolute figures for preterm births in urban and rural are quite similar, the preterm birth rate recorded in rural area is significantly higher. In order to observe if

geographical distribution of preterm births in Romania is uniform across the country we completed the following map:

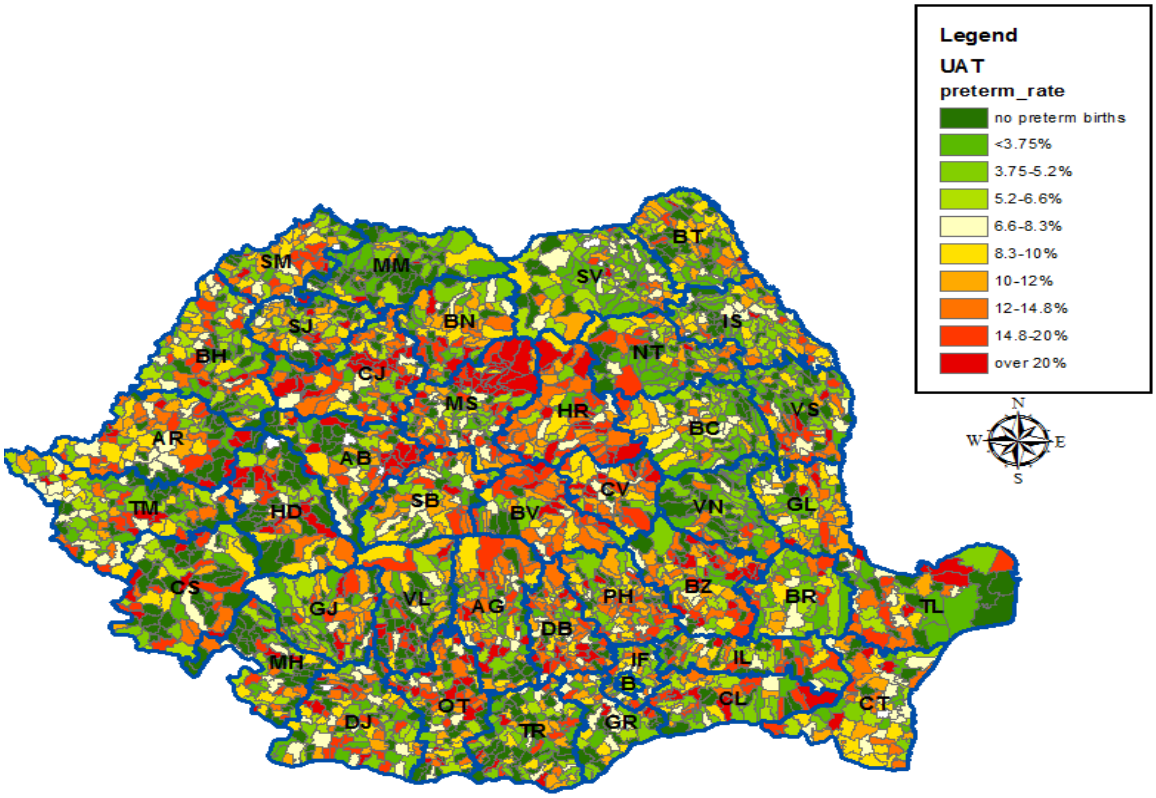

Figure 1. Distribution of preterm delivery rate at NUTS3 level in Romania, 2013, by decile

According to the map, the territorial distribution of preterm deliveries rates is highly heterogeneous. The highest rate appears to be in southeastern Transylvania (a large part of Mures, Harghita and Covasna counties) as well as small parts (non-mountain locations) from Alba and Sibiu counties. On the contrary, Maramures county appear to be the district with the lowest rate of premature deliveries. In the rest of the districts, the results are mixed presenting both very low as well as very high rate of premature deliveries at community level.

In order to analyze the possible link between premature deliveries and a number of socio-economic determinants we employed two models.

The primary model (M1), which has the number of births as count, was treated as Poisson regression. Multiple techniques were tested during estimation process. The best results were achieved when ML estimation was used with Berndt-Hall-Hall-Hausman optimization algorithm and with GLM robust standard errors.

For the second model, due to the fact that some localities have "outliers" regarding the dependent variable or in the covariates values, the classical OLS doesn't perform adequate. As a result we used the Robust Least Square M-estimation with Huber type I SE and covariance.

Both models were run in Eviews 8, and further raw results are listed in the Annex 1 and 2.

Table 3. Analysis of possible factors associated with preterm deliveries in Romania

Model	Factors/Covariates								Adj R^2	Prob(F-stat)/ Prob(LR)
	WAVAGE	RESIDENCE	MF	IDSL	ROMA	SEW*WATER	EDU	C		
M1	0.416***	1.487***	0.709***	0.038***	1.237***	0.251***	-0.028***	-5.34***	0.148	0.00
M2	-0.065***	-0.191***	-0.194***	-0.004***	1.173***	-0.085	-0.021***	-1.34***	0.043	0.00

Note: *** level of significance less than 1%,
** level of significance between 1-5%,
*level of significance between 5-10%

Most of the variables included in the model have statistically significant parameters, showing thus a significant influence on the preterm number of births or rates. When data is somehow normalized (model M2 analyses rates instead of absolute figures) for some dependent variables the coefficients' signs are changed (age, residence, medical doctors' availability, development level, education).

The positive signs of some determinants such as residence and family doctors are not abnormal since the number of preterm births is highly correlated with total number of births (Pearson r=0.98). Measuring as effect the number of preterm births in absolute values they are showing that in better condition we have more births and as a secondary result more preterm births. When rates are computed the signs are generally become as expected.

4. Conclusions

Preterm deliveries in Romania are highly heterogeneous across the country due to several factors such as: social composition (mother's age, mothers' education, share of Roma, access to GP services), as well as community infrastructure (health, sewage, running water). The most relevant factors from those include in the analysis were the one related to infrastructure (access to running water and sewage), followed by the residence status (rural) and percentage of Roma in locality.

One factor that needs to be taken into account as well as a limitation, is the impossibility to verify the accuracy of diagnostic coding knowing that more complex cases are entitled to receive higher budgets. This might explain the unusual high rate of premature delivery rates in some low ranking obstetrical wards, as well as "artificial high" rates of premature deliveries in communities without any unfavorable factors that were included in the analysis.

Lower values for R squared are underlying the presence of some local influences or unmeasured factors (disturbances) that require further investigations.

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Annex 1

Model 1. Determinants of the number of preterm births.
Dependent Variable: NR_PRETERM
Method: ML/QML - Poisson Count (BHHH)
Sample (adjusted): 1 3181
Included observations: 3168 after adjustments
Convergence achieved after 361 iterations
GLM Robust Standard Errors & Covariance
Variance factor estimate = 14.7119128495
Covariance matrix computed using first derivatives

Variable	Coefficient	Std. Error	z-Statistic	Prob.
EDU	-0.028741	0.006255	-4.594942	0.0000
MF	0.709122	0.094345	7.516284	0.0000
ROMA	1.237338	0.213268	5.801812	0.0000
WAVGAGE	0.416986	0.006928	60.18615	0.0000
IDSL	0.038723	0.000539	71.86343	0.0000
RESIDENCE	1.487591	0.034673	42.90305	0.0000
WATER*SEWAGE	0.251872	0.111619	2.256543	0.0240
C	-5.348180	0.129052	-41.44202	0.0000

R-squared	0.150871	Mean dependent var	4.872475
Adjusted R-squared	0.148990	S.D. dependent var	25.46799
S.E. of regression	23.49428	Akaike info criterion	8.854955
Sum squared resid	1744260.	Schwarz criterion	8.870260

Log likelihood	*-14018.25*	*Hannan-Quinn criter.*	*8.860445*
Restr. log likelihood	*-25087.02*	*LR statistic*	*22137.54*
Avg. log likelihood	*-4.424952*	*Prob(LR statistic)*	*0.000000*

Annex 2

Model 2. Determinants of the preterm rate
Dependent Variable: LOG(PRETERM_RATE)
Method: Robust Least Squares
Sample (adjusted): 1 3181
Included observations: 2525 after adjustments
Method: M-estimation
M settings: weight=Bisquare, tuning=4.685, scale=MAD (median centered)
Huber Type I Standard Errors & Covariance

Variable	*Coefficient*	*Std. Error*	*z-Statistic*	*Prob.*
EDU	*-0.021539*	*0.005904*	*-3.648315*	*0.0003*
MF	*-0.194294*	*0.059450*	*-3.268190*	*0.0011*
ROMA	*1.173340*	*0.216816*	*5.411677*	*0.0000*
WAVGAGE	*-0.065214*	*0.019147*	*-3.405910*	*0.0007*
IDSL	*-0.004840*	*0.001424*	*-3.398309*	*0.0007*
RESIDENCE	*-0.190949*	*0.047565*	*-4.014442*	*0.0001*
*WATER*SEWAGE*	*-0.085410*	*0.073669*	*-1.159371*	*0.2463*
C	*-1.343937*	*0.193747*	*-6.936543*	*0.0000*

Robust Statistics

R-squared	*0.030799*	*Adjusted R-squared*	*0.028103*
Rw-squared	*0.043259*	*Adjust Rw-squared*	*0.043259*
Akaike info criterion	*2298.945*	*Schwarz criterion*	*2348.545*
Deviance	*952.6983*	*Scale*	*0.645582*
Rn-squared statistic	*88.58509*	*Prob(Rn-squared stat.)*	*0.000000*

Non-robust Statistics

Mean dependent var	*-2.443715*	*S.D. dependent var*	*0.674859*
S.E. of regression	*0.662779*	*Sum squared resid*	*1105.657*

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