

Geographical Accessibility to Obstetric and Neonatal Care and its Effect on Early Neonatal Mortality in Colombia, 2012-2014

Accesibilidad geográfica al cuidado obstétrico y neonatal y su efecto en la mortalidad neonatal temprana en Colombia 2012-2014

Acessibilidade geográfica aos cuidados obstétricos e neonatos e o seu efeito sobre a mortalidade neonatal inicial na Colômbia 2012-2014

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Abstract

Introduction: The distribution of health resources influences early neonatal mortality, granting access to obstetric care which is a major public health problem. However, the geographical dimension of this influence has not been studied in Colombia. **Objective:** To describe the geographical accessibility to obstetric and neonatal care beds and its association with early neonatal mortality in Colombia and its municipalities. **Method:** An ecological study at municipal level was carried out. Ordinary least squares (OLS) regression and a geographically weighted regression (GWR) were used to explore statistical and spatial associations. **Results:** The municipalities in Colombia with Higher mortality tend to have lower geographical accessibility to obstetric and neonatal beds after controlling the fertility and economic characteristics

of these municipalities. This association is significant only in municipalities of the west coast. The strength of this association decreases in inner municipalities. **Discussion:** The centralization of obstetric and neonatal beds in major municipalities around the central region leaves municipalities with high risk of mortality underserved. The decentralization of obstetric and neonatal healthcare resources is a mandatory issue in order to reduce geographical disparities in mortality and to improve neonatal survival, and a healthy beginning of life. [Rojas-Gualdrón DF, Caicedo-Velásquez B. *Geographical Accessibility to Obstetric and Neonatal Care and its Effect on Early Neonatal Mortality in Colombia, 2012-2014. MedUNAB 2017; 20 (1): 7-18*].

Keywords: Medically Underserved Area; Healthcare Disparities; Health Services Accessibility; Maternal-Child Health Services; Early Neonatal Mortality; Spatial Analysis.

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Resumen

Introducción: La distribución de los recursos de salud influencia la mortalidad neonatal temprana, garantizar el acceso atención obstétrica es un problema de salud pública. Sin embargo, la dimensión geográfica de esta influencia no ha sido estudiada en Colombia. **Objetivo:** Describir la accesibilidad geográfica a camas obstétricas y neonatales y su asociación con la mortalidad neonatal temprana en Colombia por municipios. **Método:** Se realizó un estudio ecológico a nivel municipal. Se recurrió a regresión por mínimos cuadrados y a regresión geográficamente ponderada para explorar las asociaciones estadísticas y espaciales. **Resultados:** Municipios con mayores tasas de mortalidad tienden a mostrar menor accesibilidad geográfica a camas obstétricas y neonatales, después de controlar las características municipales, económicas y de fecundidad. Esta asociación solo es significativa en municipios de la costa oeste. La fuerza de la asociación disminuye en municipios del interior. **Discusión:** Centralizar las camas obstétricas y neonatales en ciudades principales de la región central deja desatendidos a los municipios con mayor mortalidad. La descentralización de recursos de cuidado obstétrico y neonatal es un asunto obligatorio para reducir desigualdades geográficas en mortalidad, aumentar la supervivencia neonatal y lograr un inicio de vida saludable. [Rojas-Gualdrón DF, Caicedo-Velásquez B. *Accesibilidad geográfica al cuidado obstétrico y neonatal y su efecto en la mortalidad neonatal temprana en Colombia 2012-2014. MedUNAB 2017; 20(1): 7-18*].

Palabras clave: Área sin Atención Médica; Disparidades en Atención de Salud; Accesibilidad a los Servicios de Salud; Servicios de Salud Materno-Infantil; Mortalidad Neonatal Precoz; Análisis Espacial.

Introduction

Millennium Development Goal strategies successfully contributed to child mortality reduction around the world (1) but talking about newborn mortality (2), the achievements were unsatisfactory. For example, neonatal deaths (between birth and the 27th day of life) account for 36% of all under-five deaths (3), 73% of them happened during the early neonatal period (between birth and the 6th day of life) (4). Many factors are associated to early neonatal deaths; among these, the preterm birth and intrapartum related conditions which account for around 68% of these deaths (5) are highlighted. Prevention and care of those life-threatening complications are closely related to obstetric and neonatal medical care (6). Bhutta et al. (7) estimated that improving maternal and newborn care coverage could prevent 71% of neonatal deaths; in which labor and birth interventions due to obstetric complications account for 41% of the mortality reduction, and postnatal care to ill and small newborn babies account for 30%.

There is also evidence that the distribution of health resources influences neonatal mortality (8). For instance,

Resumo

Introdução: A distribuição dos recursos da saúde tem influência na mortalidade precoce do neonatal, garantir o acesso aos cuidados obstétricos é um problema da saúde pública. A pesar de que, a dimensão geográfica desta influência não foi estudada na Colômbia. **Objetivo:** Descrever a acessibilidade geográfica aos leitos obstétricos e neonatos e, a sua associação com a mortalidade neonatal precoce na Colômbia, nos municípios. **Método:** O estudo ecológico foi realizado nos municípios. A regressão de mínimos quadrados e a regressão geograficamente ponderada foram utilizadas para explorar as associações estatísticas e espaciais. **Resultados:** Os municípios com taxas de mortalidade mais elevadas tendem a mostrar menor acessibilidade geográfica aos leitos obstétricos e neonatos após o controle das características municipais, econômicas e da fertilidade. Esta associação é apenas significativa nos municípios do litoral oeste. A força da associação diminui nos municípios do interior. **Discussão:** A centralização de camas obstétricas e neonatas nas principais cidades da região central, deixa os municípios não atendidos com a maior taxa de mortalidade. A descentralização dos recursos dos cuidados obstétricos e neonatos é uma questão obrigatória para reduzir as desigualdades geográficas na mortalidade, aumentar a sobrevivência neonatal e alcançar um bom início de vida saudável. [Rojas-Gualdrón DF, Caicedo-Velásquez B. *Acessibilidade geográfica aos cuidados obstétricos e neonatos e o seu efeito sobre a mortalidade neonatal inicial na Colômbia 2012 – 2014. MedUNAB 2017; 20(1): 7-18*].

Palavras-chave: Área Carente de Assistência Médica; Disparidades em Assistência à Saúde; Acesso aos Serviços de Saúde; Serviços de Saúde Materno-Infantil; Mortalidade Neonatal Precoce; Análise Espacial.

Comber et al (9) found that closure of maternity units has increased the traveling time for pregnant women in rural areas, and that one of 30 minutes or more increased risks of fetal heart rate anomalies, meconium-stained amniotic fluid, out-of-hospital births, and pregnancy hospitalizations, which are factors that increase neonatal mortality. Similarly, Merlo et al (10) found that neonatal mortality was lowest in larger regional hospital with full access to neonatal care and that low risk deliveries mortality decreased with better access to neonatal resources.

Despite this evidence, granting access to obstetric care is a major public health problem (11). Health financial resources, trained health workforce and health service delivery have been identified as the major health system obstacles to improve labor and birth care (8). According to de Graaf (12), available obstetric and neonatal care resources tend to be geographically located in densely populated urban areas, which leave poor, rural and remote areas with limited accessibility to health care services.

In Colombia, the distribution of obstetric and neonatal resources and its influence on early neonatal mortality is an unexplored research area. A study of 2013 (13) describes the

availability and geographical distribution of specialists, including obstetricians and pediatricians, but there are no studies that explore the association between the geographical distribution of obstetric and neonatal care and early neonatal mortality rate. Therefore, the objective of this paper was to explore such relationship in Colombia.

Methodology

Study design and setting

An ecological study was conducted at a municipal level in Colombia; a South American upper middle-income country with 48.4 million inhabitants approximately. Colombia has a surface area of 2,070,408 km² of which 1,141,748 km² are continental area and 928,660 km² are maritime area. Its territory has a political-administrative division of 32 departments, 1,096 municipalities, 5 districts and 20 non-municipalized areas (14). In 2014, its Gross Domestic Product (GDP) was around US\$ 377.7 thousand millions and its Gross National Income per capita was around US\$ 7,970 (15).

Data source

This study made use of data concerning deaths and births that happened in Colombia between 2012 and 2014. This data was obtained from the Colombian National Administrative Department of Statistics and from the Special Registry of Healthcare Providers websites. The counting of early neonatal deaths (END) and live births (LB) per municipality was obtained from Vital Statistics registries (16, 17). The counting of women aging 15 to 49 years old per municipality were obtained from population projections (18), and the one of obstetric and neonatal beds per municipality were extracted from the registry of health providers (19). The municipality economic importance in departmental accounts indicator was obtained from the Departmental National Accounts for 2013 (20).

Variables

Municipality early neonatal mortality rate was set as the dependent variable. This was estimated as the ratio between the number of deaths, among birth and 6th day of life, and the total of live births per municipality multiplied by 1,000. Four variables were used as independent variables: 1) geographical accessibility (GA) to obstetric beds, 2) GA to basic neonatal beds, 3) GA to intermediate neonatal beds, and 4) GA to neonatal intensive care beds, in which obstetric care refers to the service for deliveries and performing obstetric and gynecological procedures and interventions; basic neonatal care refers to the service for the hemodynamically stable newborn, and intermediate neonatal care refers to the service in which comprehensive newborn health care activities are performed and medical and nursing monitoring are more frequent; also neonatal intensive care

refers to the service for the critically ill newborns with permanent medical and nursing monitoring. The complete service description can be found elsewhere (21).

GA was defined as the number of beds available around a catchment area per 1,000 live births for each municipality. This variable was measured following the two-step floating catchment area method (2SFCA) as it follows (22):

$$A_i = \sum_{j \in \{d_{ij} \leq d_0\}} \left(\frac{S_j}{\sum_{k \in \{d_{kj} \leq d_0\}} P_k} \right)$$

In which A_i represents the number of beds accessible for the municipality i newborns, S_j represents the total number of beds in the municipalities with at least a bed. P_k is the number of births everywhere in Colombia with distance d to j less than the catchment area, d_0 . The distance was measured as the Euclidean distance from/to each municipality mean center. The distance for d_0 was set to the first quartile of all the possible distances between i and j municipalities as follows: 237.8 km for obstetric beds, 240.6 km for basic neonatal, 248.2 km for intermediate neonatal, and 245.8 km for neonatal intensive care beds.

Given that demographic (23–25) and economic conditions (26–28) of the municipalities could act as potential confounding factors for the hypothesized association, the variables of general fertility rate and municipal economic importance in departmental accounts indicator were considered as adjustment variables. The general fertility rate was estimated for each municipality as the number of live births divided by the number of women of reproductive age multiplied by 1,000. Municipal economic importance in departmental accounts is an indicator measuring the municipalities' contribution to departmental gross domestic product by disaggregating the departmental accounts into 35 branches of economic activity and 166 products and the estimated production value of each municipality. Details about this indicator are described elsewhere (20).

Statistical analysis

A descriptive analysis using frequency distribution of the variables was performed. Quartile distribution and Getis-Ord hot spot analysis were used to evaluate significant spatial autocorrelation of early neonatal mortality rates. Dot density maps were used to represent graphically the GA to obstetric and neonatal beds. The association between early neonatal mortality rate and GA to obstetric and neonatal beds (basic, intermediate and intensive care) was carried out by a linear ordinary least squares (OLS) regression. Two models were estimated: 1) a crude model exploring the association of geographical accessibility with early neonatal mortality rate, and 2) an adjusted model which additionally included general fertility rate and municipal economic importance in departmental accounts indicator. In addition, a geographically weighted regression (GWR) was used to

analyze spatially varying relationships. The significance of regression coefficients of the GA variables are presented on maps for both unadjusted and adjusted models. An analysis was conducted by using ArcMap v. 10.2.2.

Ethical considerations

The approval for this study, protocol number 466/2015, was obtained from the research ethics committee of CES University in Medellín, Colombia.

Results

Between 2012 and 2014, Colombia registered 1,998,211 live births and 9,904 early neonatal deaths. The national

early neonatal mortality rate was estimated at 4.96 deaths per 1,000 live births. According to the Special Registry of Health Care Providers data, in 2014 there were 7,171 obstetric beds, 738 basic neonatal, 1,978 intermediate and 1,774 intensive care beds across the country. Around three-quarters of the municipalities have at least one obstetric bed, 6.6% at least one basic neonatal bed, 6.8% at least one intermediate neonatal bed, and 5.7% at least one bed for neonatal intensive care.

Table 1 shows a description of the municipal variables. Three out of four municipalities had 6.8 or less early neonatal deaths per 1,000 live births with a municipal early neonatal mortality average rate of 4.4 deaths per 1,000 live births. The general fecundity average rate was 16.6 live births per 1,000 women of reproductive age, in which the general fecundity rate was lower than 7.1 in one out of four municipalities. In terms of economic importance, one of

Table 1. Descriptive statistics of mortality, fecundity, economic importance and geographical accessibility to obstetric and neonatal beds in Colombia from 2012 to 2014

Variable	Ratio per 1,000
Early neonatal mortality Rate ^a	
First quartile	1.8
Second quartile	4.4
Third quartile	6.8
Maximum	58.8
General fertility Rate ^b	
First quartile	7.1
Second quartile	16.6
Third quartile	30.8
Maximum	300.6
Municipal economic importance in departmental accounts indicator ^{c, d}	
1 (3,203.3 - 48,255.9)	0.7% (8)
2 (502.5 - 3203.1)	5.4% (61)
3 (199.3 - 502.2)	6.9% (77)
4 (132.2 - 198.9)	6.5% (73)
5 (71.6 - 131.9)	10.9% (122)
6 (30.6 - 71.3)	27.6% (310)
7 (0.3 - 30.1)	42% (471)
Geographical accessibility to obstetric beds ^a	
First quartile	9.1
Second quartile	11.5
Third quartile	13.6
Maximum	30.0

Geographical accessibility to basic neonatal beds ^a	
First quartile	0.9
Second quartile	1.2
Third quartile	1.5
Maximum	2.3
Geographical accessibility to intermediate neonatal beds ^a	
First quartile	2.0
Second quartile	3.0
Third quartile	4.0
Maximum	5.5
Geographical accessibility to neonatal beds for intensive care ^a	
First quartile	1.9
Second quartile	2.4
Third quartile	3.2
Maximum	11.7

^a Rate per 1,000 live births, ^b Per 1,000 women of reproductive age,
^c Percentage (count) of municipalities, ^d US million dollars.

each five municipalities contributes to departmental gross domestic product with more than US132 million dollars (categories 1 to 4), while 42% of them were classified in the lowest category of economic importance contributing with less than 30 million dollars to departmental accounts. Mothers and newborns from 75% of the municipalities had geographical accessibility to 13.6 obstetric beds per 1,000 live births or less, with 9.1 beds per 1,000 live births or less accessible for 25% of the municipalities with the lowest GA. Basic neonatal beds are the least geographically accessible type of bed with an average of 1.2 beds per 1,000 live births and no more than 1.5 beds accessible from 75% of the municipalities. Also, 75% of the municipalities have geographical accessibility to at least two intermediate neonatal beds and the ones for intensive care per 1,000 live births. The maximum geographical accessibility observed was 30.0 obstetric beds, 2.3 basic neonatal beds, 5.5 intermediate neonatal beds, and 11.7 neonatal intensive care beds per 1,000 live births. On the other hand, some municipalities have null geographical accessibility to any kind of bed, which means that mothers and their newborns must make a greater effort to reach attention in distant cities (further than 240 km).

From **Figure 1a to Figure 1d**, the density maps of geographical accessibility to obstetric and neonatal beds (basic, intermediate, intensive care) is shown; where areas with higher density are represented in red (the highest) to yellow colors and areas with lower density are represented in green to white (the lowest) colors; the dot represents municipalities with at least one bed available. According to

the results, the geographical distribution of accessibility to obstetric and neonatal beds is very similar. Higher accessibility areas focus on the central region near to several main municipalities like Bogotá, Medellín, Barranquilla and Bucaramanga. For all types of beds, there are common underserved areas: the west coast (Department of Chocó), the northern peninsula (Department of La Guajira), and the east (Orinoco region) and south (Amazonas region) municipalities.

Table 2 shows the results of the regression analysis performed to study the association between geographical accessibility to obstetric and neonatal beds and early neonatal mortality rate. The crude analysis shows how higher geographical accessibility to obstetric beds is significantly associated with a lower early neonatal mortality rate (p-value = 0.01). The variables like geographical accessibility to basic, intermediate and neonatal intensive care beds, municipal economic importance in departmental accounts and General fertility rate do not show a significant association with the risk of early neonatal mortality.

The adjusted analysis shows that an increase of one obstetric bed per 1,000 live births is significantly associated with an average reduction of up to 3.4 deaths per 10,000 live births. Municipal economic importance in departmental accounts also shows statistical significance (p-value = 0.03) in which municipalities with lower contribution to departmental gross domestic product tend to have higher early neonatal mortality rates.

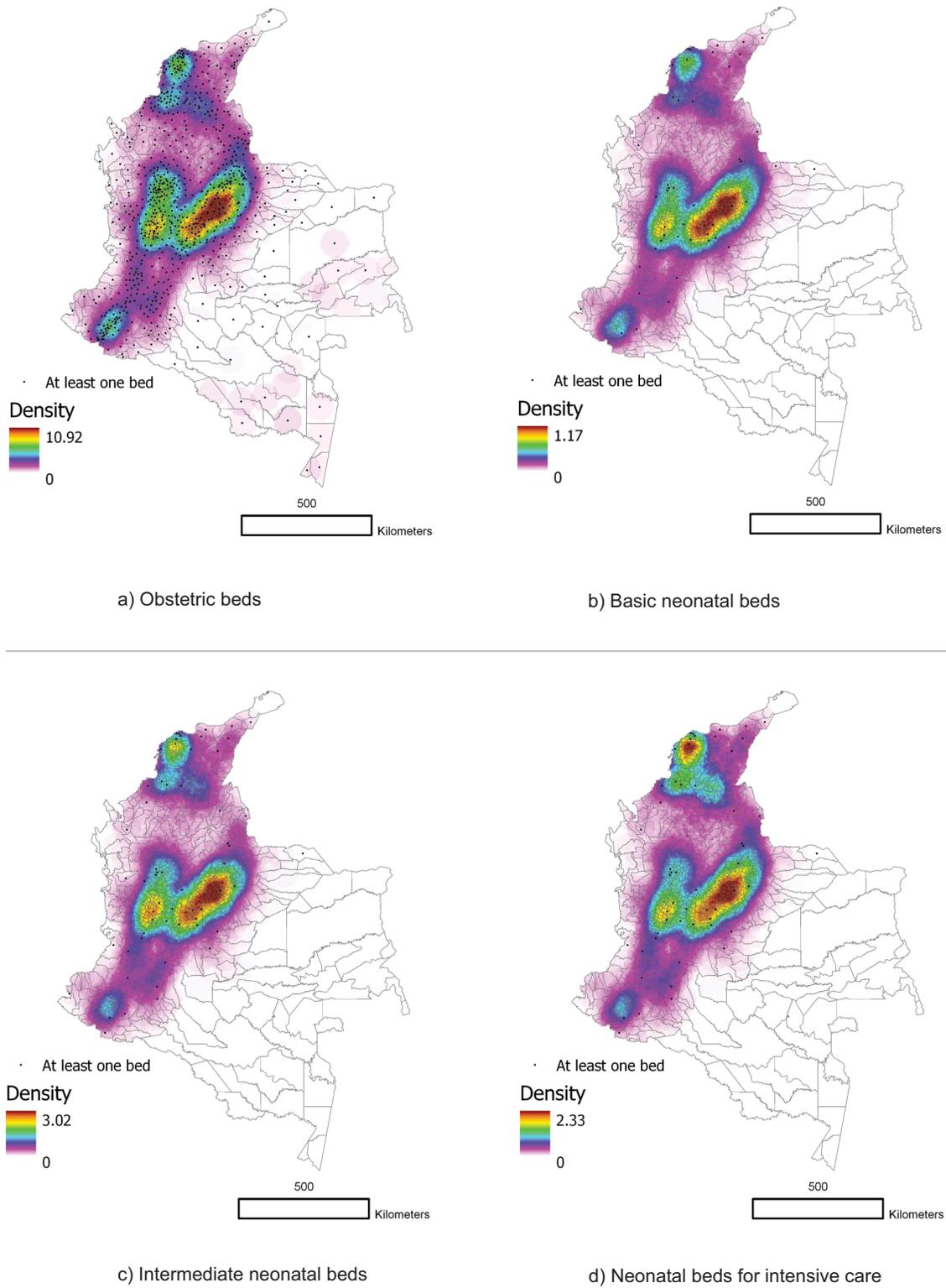


Figure 1. Geographical accessibility to obstetric and neonatal care beds in Colombian municipalities, 2012-2014

Table 2. Exploratory ordinary least squares regression (OLS) of geographical accessibility to obstetric and neonatal beds on early neonatal mortality rate in Colombian municipalities, 2012-2014

Variable	Crude analysis		Adjusted analysis	
	β (IC95%)	p-value	β (IC95%)	p-value
Geographical accessibility to basic neonatal beds	-0.63 (-1.39 - 0.13)	0.10	-0.86 (-2.51 - 0.79)	0.31
Geographical accessibility to intermediate neonatal beds	-0.12 (-0.36 - 0.13)	0.36	0.47 (-0.23 - 1.17)	0.18
Geographical accessibility to neonatal intensive care beds	-0.14 (-0.41 - 0.13)	0.30	-0.05 (-0.51 - 0.41)	0.83
Geographical accessibility to obstetric beds	-0.14 (-0.25 - 0.04)	0.01	-0.19 (-0.34 - 0.04)	0.01
Municipal economic importance in departmental accounts	0.10 (-0.10 - 0.30)	0.31	0.18 (0.02 - 0.34)	0.03
General Fertility Rate	0.00 (-0.01 - 0.01)	0.48	0.01 (0.00 - 0.01)	0.08

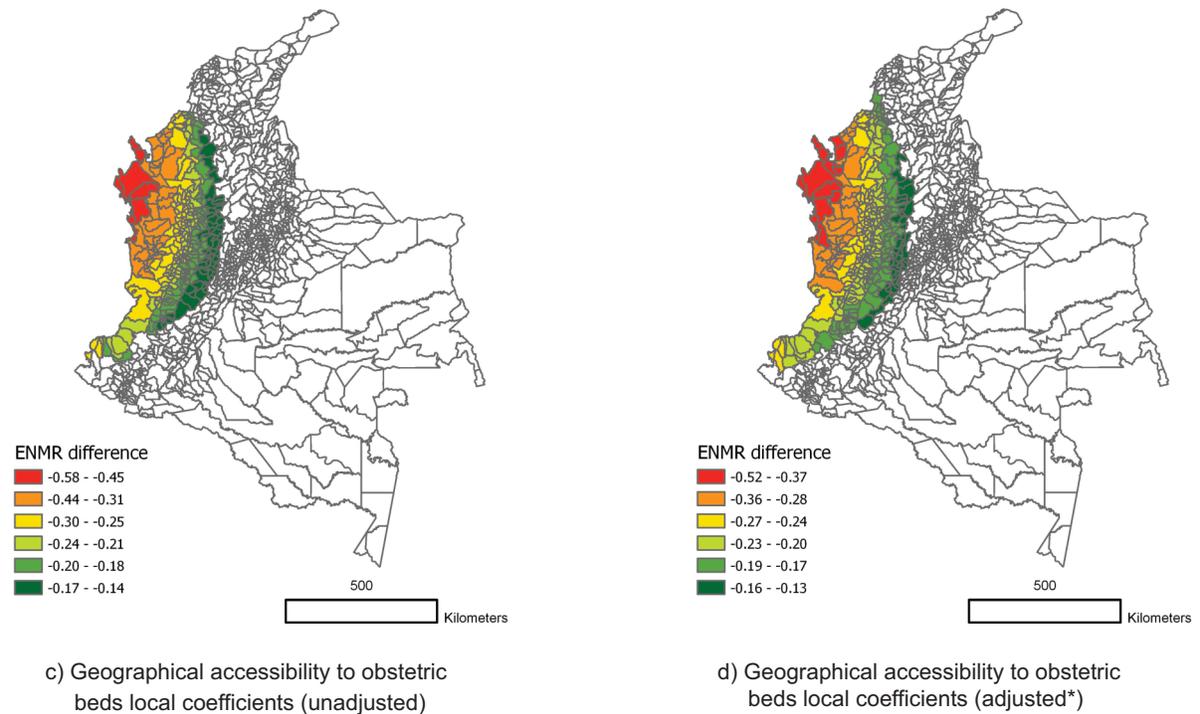
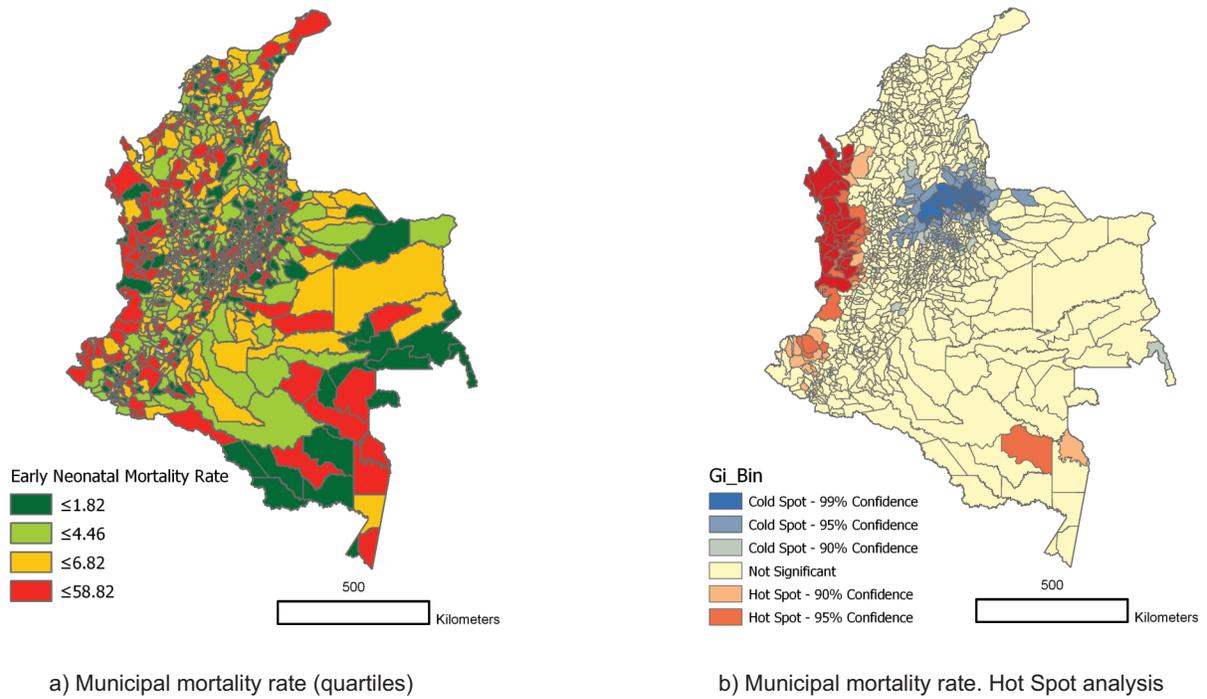
β : Regression Coefficient, CI 95%: Confidence interval.

Geographically weighted regression analysis was adjusted to explore geographical variations in the analyzed association. This model included the variables municipal economic importance in departmental accounts and general fertility rate as adjusting factors of the relationship between Geographical accessibility to obstetric beds and early neonatal mortality rate. The results are shown in **Figure 2a to Figure 2d**. **Figure 2a** shows the early neonatal mortality rate quartile distribution and **Figure 2b** shows its spatial clustering patterns. A hot spot (high-high mortality rates clustering) was identified in the west (pacific) coast and a cold spot (low-low mortality rates) was identified in the central area. There are some similarities between the spatial distribution of the early mortality rate and the density of geographical accessibility to obstetric beds (**Figure 1a**).

Figure 2c shows the crude coefficients for the local estimations of the association between geographical accessibility to obstetric beds and early neonatal mortality rate and **Figure 2d** shows the adjusted ones. In both maps,

uncolored municipalities show no statistical significance for the association and colored municipalities and color range indicate municipalities in which the association was significant.

The crude analysis (**Figure 2c**) shows that in about a third of the Colombian municipalities there is a significant association between geographical accessibility to obstetric beds and early neonatal mortality rate, in which municipalities with lower geographical accessibility to obstetric care tend to have higher early mortality rates. All municipalities with significant association are located in the west coast. After adjusting (**Figure 2d**) the fertility rate and municipal economic importance, the association became significant in more inner municipalities. Nevertheless, the further from the coast the lower the strength of the association (green municipalities). Increasing one obstetric bed per 1,000 live births implies an average reduction of 2.1 deaths per 10,000 live births (95%CI 0.03 – 4.2) with an interquartile range of 2.4 deaths per 10,000 live births.



* Adjusted for municipal economic importance in departmental accounts and general fertility rate.

Figure 2. Geographical weighted regression of geographical accessibility to obstetric beds on early neonatal mortality rate in Colombian municipalities, 2012-2014

Minimum effect observed was a reduction of 1.3 deaths per 10,000 live births (95%CI 0.00 – 2.6) and the maximum effect observed was a reduction of 5.2 deaths per 10,000 live births (95%CI 3.5 – 6.9).

Discussion

These results showed a spatial clustering of early neonatal mortality rate and a geographically concentrated density of geographical accessibility to obstetric and neonatal beds. It was also found that GA to obstetric care and early neonatal rate are associated even after adjusting for general fertility rate and for the municipality participation in departmental GDP. Geographically weighted analysis suggests that this association is only significant in the west coast.

Colombia has been classified as a country with low early neonatal mortality rate (7); however, in the findings some municipalities have shown higher rates when compared to the national estimate. Moreover, high rates showed spatial clustering in the pacific coast and in the Amazonas region. The fact that low improvements in survival have been made in the most needed areas, have been pointed out as a non-expected result of the Millennium Development Goals (29, 30). In Colombia, high early neonatal mortality does not distribute randomly in the country; which could reveal geographical disparities. A similar behavior is observed with the distribution of health care resources. Obstetric and neonatal beds are unevenly distributed across the country, in a similar way that has been reported in different regions for beds and other kind of obstetric and neonatal resources like intensive and emergency care staff and units (31–33).

The fact that obstetric beds are the most available kind of bed, as well as the one that has higher geographical accessibility and the kind of resource that is found to be associated to early neonatal mortality rate is noteworthy. This is consistent with literature that indicates that birth and the assistance of its complications have the most important effect on the inevitability of early neonatal deaths (7). Although significant results were not found for neonatal beds, these are of extreme importance for the newborns to receive specific care in life-threatening situations like preterm birth, low weight or illness among others. When considering geographical variations in the association, the findings suggest that GA to obstetric beds and early neonatal mortality are significantly related to only the west (pacific) coast, where low density geographical accessibility matches high mortality rate clustering (34, 35). This is consistent with the literature which states that the effect of accessibility and health care coverage improvement depends on the magnitude of mortality (36, 37).

The findings of this paper have major implications. Health care resources distribution is a political process that can result in evitable and unfair regional differences in geographical accessibility (38, 39), particularly if equity is

not an explicit and an a priori planning objective. Back to 1971, Tudor-Hart proposed the inverse care law which states that “the availability of proper medical care tends to vary inversely with the need for it in the population served” (40). The law seems to apply to this paper as a possible explanation for the findings, in which not only accessibility was lower in higher mortality municipalities but also, it shows a significant association in areas where both conditions exist. In other words, resources are not placed where they are the most needed and where they could have a potential effect. A possible explanation for this is that resources are allocated attending other criteria such as demographic and economic characteristics of the municipality, which ignore the risk characteristics.

More recently, Victora et al. (41) proposed the inverse equity law which states that inequalities get worse, or remain the same, because of socioeconomic stratifying of access to quality health care. The health economist calls this event “cream skinning”, where health care is offered, in first place, to areas where offering the services have low costs and to people with a high income. People with lower income have delayed the access to health care; which is mainly done when the cost to offering the service does not increase significantly (42). This is an ethically questionable practice. Even when this cannot be directly supported by the results of this paper, the statistical significance of the municipal economic importance in departmental accounts may be taken as an ecological proxy. These are potential explanations to take into consideration in further deeper analysis. This paper contributes with other research, such as Merlo's (10) and Combier's (9); which suggests that decentralization of obstetric and neonatal healthcare resources is a mandatory issue to reduce not only the geographical disparities in mortality, but also to improve neonatal survival and a healthy beginning of life.

This study has a number of limitations. The association between geographical accessibility to obstetric beds and the early neonatal mortality rate was analyzed to an ecological-level, without considering the potential confusion effect of the variability between municipalities with pregnant women and newborns exposed to risk factors for early neonatal death. Merlo (10) found that the association between neonatal mortality and access to neonatal care remained significant after adjusting for individual level confounders. However, it is important to confirm this in the Colombian setting. Another limitation to be considered is health care definition. Health care was operationalized as obstetric and neonatal beds. Other resources like human, technological and medical supplies (43) must be considered in future studies. The methodology also has some especial considerations. Spatial analysis is a dependent scale (44). This study analyzed the association at municipality level, so an analysis at lower scales is necessary for the complementation and deeper understanding of the findings. In addition, area catchment was defined as the main center of the municipalities and measured as the Euclidian

distance. This distance is shorter than real “on road” distance and does not consider roads availability, topographic conditions or transportation modality (45, 46). This means that accessibility concentration could be greater than reported and it must be considered when reading maps and calculations. A final limitation deals with the problem of births and early neonatal deaths registries. Under registration is more common for early neonatal deaths than in other age groups, even that for post neonatal (28 -365 days of birth) deaths (47, 48). This is because the misclassification of early neonatal deaths as fetal deaths tends to underestimate early neonatal mortality rates. The effect of under registration of neonatal deaths on survival improvement analysis has been reported (47, 48) as well.

Conclusions

Describing obstetric and neonatal health care and its association with early neonatal mortality is a key concept to understand unequal access to specialized lifesaving interventions. Recognizing regional and local mortality profiles is mandatory in health care resources geographical distribution planning. The explanation for both considerations could be a way to prevent inverse care law and inverse equity law effects. Countries like Colombia, where national success in reducing neonatal mortality could distract from considering regional variability in those achievements, should consider the gap reduction objectives and national goals altogether. Equity must be a priority point in post-2015 national and international newborns survival agendas.

Conflict of interests

The authors state that they have no conflict of interest.

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