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Research Article

ASSOCIATION AMONG INFANT MORTALITY, SANITATION, AND HDI-M IN THE LARGEST BRAZILIAN MUNICIPALITIES

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ABSTRACT

The improvement of the indicator of infant mortality in municipalities depends on basics anitationactions, income and education. This study aims to analyze the association among basics anitation indicators and HDI-M and infantmortality in the 100 biggest Brazilian municipalities. Ecological study with association analysis of three indicators was carried out: infantmortality rate, and sanitation ranking HDI-M with application of multivariate linear regression. The average infant mortality rate was 12.8 per 1000 live births. The Ranking of sanitation and HDI-M, were 5.94 and 0.756 respectively. A Pearson correlation analysis shows that there is negative correlation between infant mortality and the variables of sanitation and human development. The multiple linear regression indicates that improving the ranking of sanitation and HDI-M infantmortality rate couldbringdown in 20.1% in thosemunicipalities. The improvement of the quality of life of cities depends one ducation, income and basics anitation because they might affect child mortality resulting in the reduction of inequalities among the largest Brazilian municipalities

INTRODUCTION

Infant mortality was singled out as one of the Millennium Development Goals-MDGS (2000-2015) to reduce poverty and promote sustainable development, being one of the main health indicators to be studied[1]. The Agenda of sustainable development goals – SDG consists of a statement with 17 sustainable development objectives and 169 goals, replaces the MDGS by integrating three dimensions of sustainable development: economic, social and environmental, and focus on the reduction of children mortality[2].

In a literature review, Heller[3] cemented the relationship between sanitation and public health. His review shows that improvement of health indicators can be detected, especially in infant mortality, as the expansion of the coverage of basic sanitation services increases. Infant mortality in Brazil, in 2014 was 14.40 per 1000 live births[4]. Brazil hit the target set in the MDGS relating to deaths of children under 1 year of age, surpassing that of 15.7 deaths estimated for 2015[5].

Basic sanitation in Brazil is monitored by the National Sanitation Information System "SNIS", that gathers information and indicators on the provision of water services, sewage and solid waste management. All that collected from the service providers that operate in Brazil.

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State companies, municipalities or municipal companies, municipal departments and private companies[6].

The Brazilian sanitation data based on SNIS 2014 indicate that 82.5% of Brazilians are served with treated water supply, that is, more than 35 million Brazilians without access to this basic service. Besides, only 48.6% of the population have access to the collection of sewage, with 100 million Brazilians without access to this service[6].

The Institute "TrataBrasil" is a civil society organization of public interest, formed by companies with an interest in the progress of sanitation and water resources protection in the country. The sanitation Ranking is published since 2007 by the Institute based on the information of the National Sanitation Information System[7].

Studies confirm the correlation between infant mortality and sanitation[8,9], and the correlation between improvement of living conditions and infant mortality[10,11].

The human development index-HDI was created to be a general and synthetic measure of the human development. It takes into consideration GDP, longevity and education. Its creator was MahbubulHaq with Amartya Sen, Nobel Prize of economics winner in 1998. The HDI is an indicator developed by the United Nations used to measure the quality of life of people in various regions of the world[12]. The methodology of the HDI-M Brazil considers the same dimensions of the Global HDI, adapting the global methodology to the Brazilian context and to the availability of national indicators[5].

A study on the use of the HDI-M in Santa Catarina (Brazil) municipalities found that the indicator describes the municipal development conditions[1]. The reduction of child mortality is one of the factors that influence the improvement of the Municipal Human Development Index (HDI-M) in Brazil[13].

In this context, the objective of the present work was to investigate the association between infant mortality, sanitation and HDI-M in the 100 largest Brazilian municipalities. The hypothesis studied was that the expansion of sanitation and increase of the IDH-M improve child mortality rate.

MATERIALS AND METHODS

The epidemiological method employed in this research was an ecological study that uses population groups as a unit of analysis. Brazil has 5,570 municipalities, according to the Brazilian Institute of Geography and Statistics[4[] The 100 largest municipalities in population in census 2010 are studied in this work as units of analysis.

The infant mortality rate, the human development index by municipality-HDI-Mand sanitation Ranking of the 100 largest municipalities are the variables studied, with information of secondary data from three distinct sources

Variables

The sanitation Ranking comes from the Institute "TrataBrasil", report of 2016. To make up the Ranking, this Institute considers various information provided by sanitation agencies present in each one of the Brazilian municipalities. The data are extracted from the National Sanitation Information System "SNIS", updated in 2014, prepared within the framework of the Program of modernization of the Sanitation Sector, linked to the National Secretariat of Environmental Sanitation of the Ministry of Cities. Among the variables are population, water supply, sewage collection and treatment, and investment losses. The methodology considers the use of "grades" for each of the indicators. The grades can go from zero toten; these are called Partial Grades (PG). The Ranking is made up of the sum of the Partial Grades intoFinal Grades (FG) of each of the indicators. The full report with all methodological specifications can be obtained at Institute *TrataBrasil*[7].

The 2014 infant mortality rate was calculated using the division between the number of infant deaths (2014) by number of live births from the previous year (2013), multiplied by 1000 (thousand). The data of live births of 2013 and 2014 children's deaths were obtained from the Department of Informatics of the SUS-DATASUS in tabnet-vital statistics[14].

The HDI-M of each municipality was obtainedfrom the Atlas on Human Development in Brazil available at UNDP BRAZIL[5]. The Brazilian HDI-M considers the same three dimensions of the Global HDI-longevity, education and income.

Analyses

The epidemiological analysis was developed according to a progressive process, in three stages, in such a way to allow progressive exposure determination effectively associated to indicators of 100 largest municipalities studied (Ranking of sanitation, HDI-M and infant mortality).

The first stage was to carry out descriptive analysis in each of the three indicators, with evaluation of normalcy with the Kolmogorov-Smirnov test. The Pearson correlation coefficient

was applied among the studied variables seeking the ones performed in the second step of the analysis of data in order to identify the variables for the third step. The third step was performed with multivariate linear regression analysis among the epidemiological indicators considering infant mortality as the dependent variable and the other indicators as independent variables (ranking of sanitation and HDI-M).

The multivariate linear regression seek to identify independent variables effectively associated with the dependent variable (infant mortality) studying in 5% level of significance ($p \leq 0.05$). The statistical package used was SPSS 20.0-Statistical Package for Social Sciences.

RESULTS

The 2014 infant mortality rate has an average of 12.8 per 1000 live births and 2.6 standard deviation (7.5-20.4). The 2014 environmental sanitation ranking has average of 5.94 and standard deviation of 2.12 (1.58-9.46). The average for HDI-M was 0.756 with standard deviation of 0.048 (0.571-0.847). The descriptive data refer to the 100 biggest Brazilian municipalities.

The Pearson correlation shows statistical significance between the dependent variable (infant mortality) and independent variables (ranking of sanitation and HDI-M) with $p \leq 0.05$. The independent variables, sanitation ranking and HDI-M, exhibit negative correlation with the dependent variable, displaying values of $R^2 = 0.150$ between infant mortality and sanitation ranking and $R^2 = 0.149$ to infant mortality and IDH-M.

The ANOVA analysis showed a result of F = 12.204 with statistical significance ($p \leq 0.001$) to the two independent variables. Multiple linear regression shows that independent variables together influence in 20.1% infant mortality rate in the 100 biggest Brazilian municipalities. Table 01 displays the results of multiple regression, showing that the two independent variables were statistically significant to influence the infant mortality of the 100 biggest Brazilian municipalities.

Table 1 Association among infant mortality, sanitation ranking and HDI-M, for the 100 biggest Brazilian municipalities.

	Beta	SE	*p-value*
Constant	25,300	3,942	0,000
Sanitation Ranking	-0,322	-0,129	0,014
HDI-M	-14,053	5,622	0.014

Source: Authors

DISCUSSION

This study indicates that the decrease of infant mortality is beyond the action of health services or the failures of health care, constituting a challenge also for other social sectors with direct influence on the living conditions of citizens[15]. In this study the average infant mortality rate (2014) varied from 7 .5 (minor) to 20.4 (bigger) showing differences among the 100 largest expressive Brazilian municipalities. The average among the municipalities was 12.8 per 1000 live births, a better result than the national average (14.40) not a huge gap to be faced in order to decrease this inequality. The children's deaths are strongly influenced by the social conditions of the population (housing, work, income, level of information and social protection) and the availability of basic sanitation and appropriate health services[11]. Ferrari & Bertolozi[10]indicate that the impact of the reduction in mortality must be studied to

establish a correlation with social and health interventions. Minayo[16]notes that the Brazilian health indicators have shown positive evolution, howeverthey are a reflection of the social issues.

The study of correlation between the improvement of sanitary conditions, economic and educational conditions conducted in this study, indicate that there is still much to evolve to achieve in improved quality of life. That will reflect in infant mortality, even in municipalities with largest population, and better health and economic conditions.

With regard to environmental issues, the challenges to promote a healthy society are immense in particular the issue of sanitation[16]. Diarrheal diseases, very connected to the sewerage, represent the second leading cause of death in children in developing countries. In Brazil the improvement of infrastructure (sewage and drinking water) led to the reduction of diarrheal diseases in children[17,18]. The water supply is a key issue for the entire population by the risks that its absence or inadequate supply can cause to the public health[19]. The deficiency of sanitation generates a negative externality to the economic system, as it brings damage to human health. Mendonça & Motta[20] compared health and sanitation spending and the implications for reducing child mortality, noting that the reduction in infant deaths was achieved through the improvement of health services, in education and in access to sanitation.

Oliveira &Simões[19] pointed out that there is still ample room to decrease the infant mortality rate with actions that go beyond the field of health, with advancement in national and regional income distribution, access to quality education and the incorporation of new social groups to basic sanitation infrastructure services. Social and economic inequalities present today still play a role by imposing restrictive barriers to a higher speed of condition change especially infant mortality indicators and in childhood. Regional inequalities and limited social access to the main public health services, poor education and basic sanitation, results, certainly, in a number of deaths that could and should be avoided[9].

The present study found that the improved HDI-M and sanitation would result in decreasing the infant mortality rate at 20.1%. The decrease in infant mortality reflected in gains in the quality of life of the population if access to public services such as education, health and basic sanitation is taken as essential[21]. Preventive sanitation, especially in water treatment costs are compensatory more economically than spending in health services later[22].

It can be considered that, for the most part, the low educational level and the low socio-economic standard of the mother are associated with a higher risk for the mother and the child, as it impedes access to information and education, hindering the ability of care and assistance[23]. The increased levels of education of the population as a whole, women in particular, raises the level of enlightenment and requirement, empowering women that can act more effectively on the need for health services in the case of occurrences of familiar diseases in particular for the children [9].

The quality of life public policy, like any other field, must have a critical posture and articulate with other sectors, sharing objectives and resources, by encouraging spontaneous sociability and the integral development of people, and also improving living conditions and the self-knowledge of the participants[24].

In a study on infant mortality trends in Guarulhos (Brazil), the authors indicate the need to develop new research, focusing on social, economic and environmental factors associated with infant mortality, in order to improve and implement action strategies in municipalities[25]. In a study aimed to determine whether children under 5 years old without access to improved water and sanitation facilities are at higher risk of death in Nigeria, concluded that the Nigerian government needs to invest more in water and sanitation to avoidable infant deaths[26].

The quality of life of cities improvement depends on education, income and basic sanitation because they affect child mortality, which may result in the reduction of inequalities among the largest Brazilian municipalities. More than ever, we must invest in reducing the large economic inequalities within the classes, and regions amongand within municipalities[16].

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