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THE HEALTHY URBAN SPACES IN BRAZIL[1]

OS ESPAÇOS URBANOS SAUDÁVEIS NO BRASIL

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ABSTRACT

Based on exploratory spatial data analysis (ESDA) the article maps the healthy urban spaces in Brazil and points the Social Determinants of Health (SDH), which can influence the quality of life in urban

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spaces. To map the healthy urban spaces in Brazil it considers how the rate of mortality from infectious and parasitic diseases behaves and how it relates with the Social Determinants of Health. The data used comes from the database of National Health System (DATASUS) and from Brazilian Demographic Census for the years 1980, 1991, 2000 and 2010. Results suggest an increasing randomness of healthy urban spaces, although such spaces are still concentrated in the South and Southeast.

Keywords: Social Policies. Public Health. Healthy Urban Spaces. Social Determinants of Health. exploratory spatial data analysis.

RESUMO

Com base na análise exploratória de dados espaciais (ESDA), o artigo mapeia os espaços urbanos saudáveis no Brasil e aponta os Determinantes Sociais da Saúde (DSS), que podem influenciar na qualidade de vida nos espaços urbanos. Para mapear os espaços urbanos saudáveis no Brasil, considera-se como se comporta a taxa de mortalidade por doenças infecciosas e parasitárias e como esta se relaciona com os Determinantes Sociais da Saúde. Os dados utilizados são provenientes do banco de dados do Sistema Único de Saúde (DATASUS) e do Censo Demográfico Brasileiro dos anos 1980, 1991, 2000 e 2010. Os resultados sugerem uma aleatoriedade crescente de espaços urbanos saudáveis, embora tais espaços ainda se concentrem na região Sul e Sudeste.

Palavras-chave: Políticas Sociais, Saúde Pública, Espaços Urbanos Saudáveis, Determinantes Sociais da Saúde, análise exploratória de dados espaciais.

1. INTRODUCTION.

Cities are usually thought to represent opportunities, since they make a great number of services available, especially with regards to health care. One should also consider that cities generate negative impacts related to the lack of social organization, such as pollution, chaotic traffic and poor housing, thus contributing to worsen health problems. According to Schwartz, Dockery, Neas, *et al* (1994); Freudenberg (2000); Geronimus (2000); Merzel (2000); Vianna and Oliveira (2011), the risk of illness in urban areas is higher for the poor population. Thus, the urban environment influences health and human behavior, pointing towards the need for a better understanding of the health determinants for city-dwelling populations.

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The World Health Organization (WHO, 1995) defines health as a state of complete physical, mental and social well-being, and not as the mere absence of diseases and infirmities. In addition, the WHO defines a Healthy Municipality as the one that continuously creates and improves its physical and social environment, strengthening community resources to allow its inhabitants to support each other in the performance of their duties and in the total fulfillment of their potential.

According to the WHO (1995), there are ten requirements for a municipality to be considered healthy: i) Clean and safe physical environment; ii) Stable and Sustainable Ecosystem; iii) Society with no forms of exploitation; iv) High degree of social participation; v) Population with basic needs met; vi) Access to experiences, resources, contacts, interactions and communications; vii) Diversified and innovative local economy; viii) Pride and respect for the cultural and biological heritage; xix) Health services accessible to all; x) High health level.

On the other hand, the homonymous team of the World Health Organization defines the SDH as the social, economic, cultural, ethnic, racial, psychological and behavioral factors that can influence the occurrence of health problems and their risk factors in the population. It states that the SDH are the conditions in which people are born, grow, work, live, and age, and the wider set of forces and systems (economic policies and systems, development agendas, social norms, social policies and political systems) shaping the conditions of daily life. Krieger (2001) points that the SDH are the factors and mechanisms that influence social health.

The Healthy Cities Movement can be approached as a "structuring project in the health field," in which social actors (government, civil society organizations and non-governmental organizations) aim, through social management, to transform the city into a space for "social health production" (MENDES, 1996), since health is understood as quality of life (WESTPHAL and MENDES, 2000). The government should act as a driving force in this process. The success of the project occurs in counties whose rulers are said to be "progressive", i.e., willing to manage the project (ALMEIDA, 1997). The project implementation is a matter of political will (HANCOCK, 1993 and FLYNN, 1996).

In this context, the present study aims to identify healthy urban spaces in Brazil, verifying if these are configured as spatial clusters, and to identify the requirements for a space to be considered healthy, that is, identify the Social Determinants of Health (SDH). In methodological terms, to map the healthy urban spaces in Brazil we considered how the rate of mortality from infectious and parasitic diseases behaves and how it relates with the Social Determinants of Health. The identification of spatial cluster is done using Exploratory Spatial Data Analysis ESDA) and medium tests that qualify the urban space

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as healthy or not. To be healthy, the urban space must have four indicators of SDH above the average in two consecutive Census, being one the year of 2010.

Space is where factors leading to disease take place. Disease is a spatially-determined phenomenon (SORRE, 1933; PAVLOVSKY, 1966; BRAS AND MALVI, 2004; ROSA-FREITAS *et al*., 2007; ROSA-FREITAS *et al*., 2010). The correct identification of the spatial factors plays a key role in prediction, prevention and control of disease.

This paper is divided into five sections besides this introduction. The next section presents the concept of healthy municipality, the third section brings database details, the fourth section discusses the methodology, the results are present in the fifth section and the last section makes the final remarks.

2. DATABASE.

The health variables are taken from the Database of the Department of Health System (DATASUS), and the social determinants of health, which denote the quality of life in urban spaces, comes from the Brazilian Demographic Census, carried on by Brazilian Institute of Geography and Statistics (IBGE). The period of analysis comprises the years 1980, 1991, 2000 and 2010.

Each urban space corresponds a Minimum Area Compared (AMC 70) that is municipal aggregation defined by IPEADATA. After making compatible the AMCs of four Census, 3669 are considered.

The urban health variable corresponds to the rate of mortality due to infectious and parasitic diseases by place of residence per 100 000 inhabitants for each of the urban areas in Brazil. This group comprises the following diseases: tetanus, leptospirosis, pertussis, meningitis, malaria, rubella, rabies, herpes, hepatitis, yellow fever, scabies, Chagas disease, dengue fever, botulism, cholera, leprosy, syphilis, measles, trachoma, AIDS, among others (MINISTRY OF HEALTH, 2010). These diseases are usually associated with the social problems resulting from the rapid process of urbanization. Since the greatest concentration of people (increased demand) requires a magnifying basic service (increased supply) (OMS, 1995; DOYLE *et. al.*, 2009). The eradication / reduction in such mortality depend on improvements in health conditions, involving the basic issue of the individual survival. Furthermore, infectious and parasitic diseases can be avoided with an effective prevention service. Ideally, the urban space should reduce or control its mortality rates along the years, in particular those caused by this group of diseases.

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We notice that some urban areas do not report their deaths, either because they are too small to possess an organized health system to register such deaths, and / or because their health policy leads them to transfer the most serious cases of disease to neighboring municipalities. To minimize such a deficiency, we consider the number of deaths according to the place where the patient resides or used to live.

To compare the urban spaces along the time, the mortality rate for infectious and parasitic diseases was divided into quartiles (Table 1). It is observed that the average, minimum and maximum values are similar between quartiles from 1991 on, and the exception is the maximum value of the fourth quartile in 2000. Some urban areas show a decline in the mortality rate, which is clear when observing the value of the first quartile over the years, thus remaining in the first quartile of the distribution. The biggest drop in the mortality rate occurred between 1991 and 2000. However, the minimum value was relatively close in the first quartile.

The Social Determinants of Health (SDH), chosen according to the requirements of the UN (1995) for an urban area become healthy, are detailed in Table 2:

The Illiteracy Rate is the variable that measures the education level in the region. Illiterate individuals are the ones aged 15 or over who cannot read and write. Regions holding low illiteracy rates tend to have higher levels in terms of quality of life (DUHL, 1993; OMS, 2010).

The economic theory points that *the Average Household Income Per Capita* is the major locational factor influencing the economic activity. This factor acts by attracting good doctors and health units, as well as by clustering health services in one location (BUSS e FILHO, 2007; OMS, 2010). The income is adjusted for each year based on the National Consumer Price Index (NCPI) in July 2010, being converted into Real in 1980 and 1991. On the other hand, *the Unemployment Rate* measures whether the urban space can provide jobs for the local population. This rate is computed based on people older than 10 years old, who were looking for a job in the reference week. The *Total Mortality Rat*e is given by the total number of deaths per 100 thousand inhabitants per residence location. This variable was used in Doyle *et al.* (2009) to describe that large population concentrations demand more care and, when such care does not meet the local needs, there is an increase in the number of deaths.

Table 1: Quantile Distribution of Mortality rate for infectious and parasitic diseases

YEAR	QUARTILE	MEAN	STANDARD DEVIATION	MN	MAX

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1980	1°	13.02	5.96	1.06	22.71
	2°	33.49	6.37	22.72	44.41
	3°	59.97	9.11	44.5	76.48
	4°	130.03	72.64	76.68	727.8
1991	1°	6.99	2.74	0.87	11.27
	2°	16.06	2.75	11.33	20.85
	3°	27.07	3.99	20.89	35.27
	4°	58.38	29.66	35.33	219.2
2000	1°	6.1	2.2	0.93	9.85
	2°	13.63	2.24	9.86	17.78
	3°	23	3.35	17.82	29.53
	4°	49.03	34.31	29.55	535.5
2010	1°	5.97	2.09	0.93	9.57
	2°	13.19	2.27	9.58	17.4
	3°	22.3	3.01	17.5	28.08
	4°	45.3	21.1	28.15	205.8

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Table 2: Social Determinants of Health

Variable	Description	Source	Justification (Measure)
Illiteracy Rate	Illiteracy Rate for the population aged 15 or over	Census	Education
Average Household Income per capita	Minimum salary in 2010. The income from the main activity is used as a basis.	Census	Income
Unemployment Rate	Percentage of population aged 16 and over who is economically active but is idle.	Census	Employment
Mortality Rate	Deaths by place of residence per 100 thousand inhabitants.	SIM*	Demand *proxy*
Homes with electric power	Percentage of households with eletric power	Census	Access to energy sources
Homes with water supply	Percentage of households with water supply via general distribution network	Census	Accesss to potable water
Homes with sewage	Percentage of dwellings with bathroom or toilet and sewage	Census	Sewage
Population Density	hab/ km²	Census	Urbanization
Distance from the capital	Distance in km between the urban space and the capital	Census	Distance from the main pole in the State

*SIM: Information System on Mortality

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The *Percentage of Dwellings with Electric Power* connected by the general network is a measure of access to energy sources. Access to electric power reflects basic infrastructure. The *Percentage of Dwellings with Water Supply* via general distribution network is a measure of access to potable water, which is one of the basic conditions for an urban space to be healthy. The *Percentage of Dwellings with Sewage* is given by the percentage of households with toilet (sewer) connected to the general network, which is a measure of basic sanitation (DUHL, 1993; FERRAZ, 1999; WESTPHALL and MENDES, 2000; WESTPHAL, 2000).

The *Population Density*, given by the total population divided by the urban space in km^2, is used as an urbanization measure. It is assumed that a negative association indicates an excess of demand for health services, i.e., the larger the pressure done by the population regarding resources; the less available they are to the inhabitants (VIANNA and OLIVEIRA, 2011). On the other hand, the positive association indicates a greater supply of services, which are typically available in areas with higher concentrations of people (RODRIGUES, 2010).

The *Distance from the Capital* is the distance between the urban space and the capital for each state. It is understood that the state capital is the largest pole of services regarding health in the region. Thus, it is expected that the urban spaces surrounding these poles have better health conditions (RODRIGUES and ALFRADIQUE, 2001). On the other hand, the more distant the urban space is from the capital, the higher the mortality rate from infectious and parasitic diseases.

Finally, the *homicide rate* was used to identify the requirement regarding safe environment, while the Human Development Index (HDI) and the *Gini coefficient* are used to complement the requirement regarding the accomplishment of basic needs.

3. METHODOLOGY.

The goal in using the ESDA is to analyze the formation of *healthy* clusters, those urban spaces which have low mortality rates caused by infectious and parasitic diseases and whose surrounding municipalities are in the same condition. We should also check the existence of clusters in the SDH, for example, if an urban space with low or high illiteracy rate has neighbors in the same condition. In addition to the geographical issue, the ESDA allows us to observe the changes taking place over time, that is, if the existing clusters in 1980 persisted or if others emerged in 1991, 2000 and 2010.

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In the ESDA, to verify the existence of spatial autocorrelation, the spatial weight matrix (W) was firstly chosen[5]. The matrix dictates the spatial arrangement of the interactions concerning urban spaces. It indicates whether the interaction in the mortality rate for infectious and parasitic diseases is stronger, in the closer urban spaces, or weaker, in the more distant ones. The matrix is square and the spatial weights W_{ij} represent the power of influence of the urban space *j* in *i*. Therefore, conventionally $W_{ii} = 0$. Moreover, the identification of clusters is based on the local Moran's I index. The local Moran's I index value is calculated by the Local Indicator of Spatial Association (LISA). LISA is any statistics which meets the two following criteria: i) bringing to each urban space significant spatial clustering indicators whose values are similar over the area concerned (healthy clusters); ii) the sum of all LISAs for all the urban spaces is proportional to the global indicator of spatial association (ANSELIN, 1995)[22]. The univariate LISA can be interpreted in two ways: i) in case it shows positive values it means there is a spatial clustering with similar values regarding the rate of mortality from infectious and parasitic diseases and the SDH, being either high or low; ii) if it shows negative values, there is a spatial clustering with distinct values.

The analysis of the relationship between the death rate from infectious and parasitic diseases and the DSSs is based on bivariate cluster maps. These maps show the bivariate Local Moran's I coefficient for the rate of mortality from infectious and parasitic diseases and the SDH (represented in the form of their spatial lags). The central hypothesis is that regions with either high or low mortality rates from infectious and parasitic diseases are surrounded by neighbors with either high or low values for the SDH depending on the relationship that the rate of mortality from infectious and parasitic diseases has with the SDH.

To assess whether the basic health demands are met in urban spaces, the mortality rate from infectious and parasitic diseases is analyzed, being divided into quartiles. The quartiles refer to the cutoff value for each quarter of the distribution. The first quarter contains the observations with the lowest rates of mortality from infectious and parasitic diseases, and the last quarter contains the observations with the highest rates.

Thus, it is classified as a candidate for healthy urban space that one which remained in the first quarter of the distribution for at least two consecutive years, including 2010. Thus, there are three groups of candidates for healthy urban spaces: those which remained in first quartile of the distribution for mortality from infectious and parasitic diseases from 1980 (group 1), those which remained from 1991 (Group 2) and those from 2000 (Group 3).

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[5] The matrix used was the queen type.

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The healthy candidates for urban spaces with the best mean values for the SDH are identified through the t-test for means, comparing the means for the groups of candidates with all urban areas. It is expected that when the mortality rate from infectious and parasitic diseases present a lower mean value for the candidates to healthy urban spaces, and this value is significant, the urban spaces should present better results than the average for the SDH.

A healthy urban space is considered truly healthy, if it has at least four indicators among the SDH under better conditions than the other urban spaces, i.e., above or below average depending on whether the relationship of the SDH with the mortality rate from infectious and parasitic diseases is positive or negative.

Other indicators are considered in the analysis to support the qualification of an urban space as being healthy, since among the ten requirements for a city to be considered healthy, as established by the WHO, some were not included in the SDH, given the difficulty to gather data regarding the whole period of analysis. Thus, the following indicators were used to compare the urban spaces identified to each other and to the other urban areas in the State in which they are located: the rate of homicides in 2009, the Human Development Index (HDI) in 2000 and the Gini Index in 2010. The basic assumption is that these indicators should be better in healthy urban spaces.

4. RESULTS

In the analysis of spatial autocorrelation, we compute the Moran's I Index for the years 1980, 1991, 2000 and 2010 (see attachment 2). The queen-type matrix is used, i.e., it is understood that this matrix captures better the expected space overflow effect from Moran’s I of all variables for each year (Table 3).

Table 3: Moran's I through the Queen-Type Matrix for 1980, 1991, 2000 and 2010.

Variables	1980	1991	2000	2010
Illiteracy rate	0.852***	0.068***	0,065***	0,071***
Unemployment rate	0,182***	0,004	-0,003	-0,002
Average household income per capita	0.100***	0,038***	0,044***	0,040***
Population Density	0,025**	0,019*	0,025**	0,027***
Percentage of households with water supply	0.588***	0.636***	0,033***	0,033***
Percentage of households with sewer	0.661***	0.779***	0,074***	0,055***
Percentage of households with electrical power	0.049***	0.062***	0.041***	0.022**
Total mortality rate	0.041***	0.0304***	0.025**	0.031***
Mortality rate from infectious and parasitic diseases	0.1146***	0.1272***	0.0959***	0.0705***

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*** p<0.01, ** p<0.05, * p<0.

As the mortality rate from infectious and parasitic diseases is significant at 1%, the existence of a spatial autocorrelation is highlighted. Given the positive values of I, the statistics indicate that there is data concentration, with greater dependence in 1991, the year when the Moran's I Index reaches its highest value, and the lowest value was found for the year 2010, indicating that the spatial phenomenon weakens from 1991 on.

The unemployment rate variable is only significant for 1980, when the queen-type matrix was used. The other variables are significant. The variables regarding water, sewage, electricity and total mortality accompany the mortality rate from infectious and parasitic diseases, as they show a higher Moran's I in 1991, whereas the variables concerning illiteracy, unemployment and income have their largest Moran's I in the year 1980.

When analyzing the bivariate cluster map for the mortality rate from infectious and parasitic diseases and illiteracy rates, it is expected that the urban areas with low mortality rates from infectious and parasitic diseases are surrounded by others with low illiteracy rates, constituting Low-Low type clusters. This type of cluster is mostly observed in the South region of Brazil, although this relationship is lost over the years. In the Southeast, this type of cluster is primarily found in the State of São Paulo. The Northeast region of Brazil and the north of Minas Gerais state are marked by the presence of high-high type clusters, indicating that in these places the urban spaces with a high mortality rate from infectious and parasitic diseases have neighbors with a high illiteracy rate.

The initial assumption of this work is that urban areas with a low urban health indicator are expected to be surrounded by urban areas with low unemployment, even though this formation decreases throughout the years, particularly in the South. In the states of Bahia, Minas Gerais and São Paulo High-High type clusters are identified, representing regions with high mortality rate from infectious and parasitic diseases and high unemployment rate.

We analyze the relation of mortality rate from infectious and parasitic diseases with the average household income per capita. It is possible to observe the formation of High-Low type clusters in São Paulo and in the South. The clusters of Low-High type prevail in the Northeast Brazil and in the northern. We notice the presence of Low-High type clusters in the state of Minas Gerais, showing that the urban spaces with low population density have high mortality rate from infectious and parasitic diseases, while in the South the opposite is observed.

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Through the analysis of bivariate cluster maps regarding the water, sewage and electrical power variables compared to the mortality rate from infectious and parasitic diseases, High-Low type clusters occur, particularly in Regions South and Southeast. For water, these clusters are mostly concentrated in the state of São Paulo.

Electrical shows that the southern region is marked by Low-Low type clusters, that is, urban spaces with low mortality rate from infectious and parasitic diseases are surrounded by urban spaces with lower total mortality rates. In the State of São Paulo, it is found that urban spaces with low mortality rates from infectious and parasitic diseases have high total mortality rates.

To conclude it is worth noting that most indicators in North and Northeast hold the worst results. These are the areas which deserve special attention concerning social policies in order to fight health disparities.

Those urban spaces which remained in the first quarter of mortality rate from infectious and parasitic diseases were classified as candidates for healthy urban spaces, taking into consideration the mortality rate from infectious and parasitic diseases in at least two consecutive years, including 2010. There are 149 possibly healthy urban spaces, divided into three groups (See Attachment 1). The urban spaces which remained in the first quarter of the distribution in the years 1980, 1991, 2000 and 2010 (Group 1) totalized 42.

A steep decline in the mortality rate from infectious and parasitic diseases was noticed from 1980 to 1991 in some of these urban spaces, like Mondaí (SC) and Santa Teresa (ES). Among the 35 urban spaces remaining in the first quarter from 1991 on (Group 2), Angicos (RN), Cabedelo (PB) and São Gonçalo dos Campos (BA) were those which improved the most. Since 2000, 72 more urban spaces remained in the first quarter (Group 3), especially the urban space of Esperança (PB) which achieved the greatest improvement.

The states of Tocantins, Acre, Mato Grosso, Rondônia and Roraima had no candidate for healthy urban space. Thus, it is an alert of the neediness of better policies aiming to improve the living conditions in the region.

To check whether applicants for healthy urban spaces have the best averages for the variables, t tests on the equality of means were done. Table 4 shows the comparison between groups 1, 2 and 3 to all urban areas.

Table 4: t-test for means between the possible healthy urban spaces and all urban spaces.

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Variables	1980	1991	2000	2010
Group 1 - mortality rate - infectious and parasitic diseases - first quartile - 1980, 1991, 2000, 2010				
Illiteracy rate	-2.81	-2.53	-1.72	-1.15
Unemployment rate	-0.61	0.51	1.30	0.71
Average Household Income Per Capita	9.69**	39.04*	59.18*	49.79
Population Density	155.65***	187.07***	202.54***	205.94**
% of households with water supply	15.05***	15.49***	11.56***	10.36***
% of households with sewer	13.55***	13.68***	17.32***	2.85*
% of households with electrical power	11.11*	6.71*	3.78*	1.09
Distance from the capital	-	-	28.04	-
Total mortality rate	203.05***	106.41**	6.27	-31.95
Mortality rate from infectious and parasitic diseases	46.99***	21.48***	17.94***	16.47***
Group 2 - mortality rate - infectious and parasitic diseases - first quartile - 1991, 2000 and 2010				
Illiteracy rate	-6.34*	-5.09	-2.92	-2.07
Unemployment rate	-0.84	-1.37**	-1.60*	-0.95
Average Household Income Per Capita	7.02	17.53	19.30	32.90
Population Density	164.35***	199.20***	220.12***	237.54***
% of households with water supply	5.51	5.82	-0.12	1.72
% of households with sewer	4.11	4.07	7.47	1.39
% of households with electrical power	3.39	0.98	1.28	0.31
Distance from the capital	-	-	46.19	-
Total mortality rate	-48.70	-12.50	-106.29	-227.95
Mortality rate from infectious and parasitic diseases	2.51	20.17***	17.75***	15.75***
Group 3 - mortality rate - infectious and parasitic diseases - first quartile - 2000 and 2010				
Illiteracy rate	-3.89	-4.16*	-2.97	-2.4
Unemployment rate	-1.23	0.56	0.57	0.13
Average Household Income Per Capita	-14.63***	52.88***	91.19***	109.81***
Population Density	159.99***	193.67***	205.92***	222.11***
% of households with water supply	7.16**	6.91*	5.32	3.22
% of households with sewer	6.31*	8.79*	9.11*	0.12
% of households with electrical power	6.88*	4.3	0.39	0.27
Distance from the capital	-	-	-8.51	-
Total mortality rate	-56.47	-8.3	29.96	31.193
Mortality rate from infectious and parasitic diseases	32.17	0.17	16.64***	15.94***

*** p<0,01, ** p<0,05, * p<0,1.

When comparing the means, a drop is noticed in the illiteracy rate for healthy urban space candidates, while the variables regarding income, population density, water, sewage and electricity showed an upward trend. The variable regarding unemployment presents its lowest average for Group 2 in all years. In all groups analyzed there was no significance in the variable regarding distance from the capital. The difference in the means of the variable regarding population density is significant in all years for all

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groups. For group 1 the difference of the means of the variables regarding Illiteracy and unemployment are not significant, however the variables regarding water, sewage and electricity are significant for all years. The variables regarding income and electricity lost significance over the years, becoming non-significant in 2010.

The first group corresponds to those urban spaces which demonstrate a stronger relationship with SDH, which can be explained by the straight definition of Healthy Urban Space, that is, such spaces continuously seek to improve the physical and social environment, and time is favorable to the association between the increased mortality rate from infectious and parasitic diseases and the SDH. These spaces have the best results regarding mortality rate for infectious and parasitic diseases, which means lower mortality rates.

On the other hand, group 1 has the highest mean for population density, which shows that those urban areas with a greater accumulation of people are those where basic health conditions are best met. Such a positive association indicates greater supply of services, which are present in areas with higher population density (RODRIGUES, 2010).

Concerning group 2, the difference in the variables regarding income, water, sewage, electricity and total mortality were not significant. The illiteracy rate was only significant in 1980, and the unemployment rate was only significant in the years 1991 and 2000.

As for group 3, the difference in the means of the variables regarding unemployment and total mortality are not significant and the difference regarding the variable income is 1% significant in all years. The variables concerning water, sewage and electrical power lose their significance, until they become weak or non-significant in 2010.

The mean test for the variable income loses significance over the years shows that this factor is no longer just as important as it was in the past, thus an urban space with low income would have no greater difficulties in becoming healthy. Furthermore, only 13 candidates to be a healthy urban space show an income above the average of all urban spaces. In this sense, having a higher income does not necessarily imply more satisfactory health indicators.

In short, the possible healthy urban spaces have lower illiteracy and unemployment rates. The variables regarding: income, density, water supply, sewerage, electrical power, total mortality rate and mortality from infectious and parasitic diseases have higher means than the means for all urban areas analyzed.

It is observed that the states of South and Southeast have the highest number of possible healthy urban spaces above average position. This fact was to be expected, since other regions hold a smaller number

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of candidates to healthy urban spaces, in addition to the fact that the South and Southeast regions are those which hold the best urban infrastructure in the country (DA MATA, 2007).

The State of São Paulo (SP) has the largest number of possible urban spaces, since they showed the best conditions regarding illiteracy, access to water, sanitation and access to electric power.

The last step to define the healthy urban spaces consist of the selection of those candidates of health urban spaces that present at least four of the SDH in better conditions than the others. According to this rule, only 55 candidates can be in fact defined as healthy urban space (Attachment 1).

Comparing the states holding at least one healthy urban space based on the indicators adopted to identify public safety and basic needs (Attachment 1), it appears that the State of Minas Gerais holds 9 healthy urban spaces. The only healthy urban space in the Northern Region is Viseu, in the state of Pará (PA). In the Northeast Region, the only healthy urban space is Escada, located in the state of Pernambuco (PE). The Midwest Region features 3 healthy urban spaces: Luiziânia (GO), Ponta Porã (MS) and Rio Brilhante (MS).

Figure 9 shows the spatial dispersion of the 55 healthy urban spaces in Brazil, which are divided according to the year when they were classified as being healthy. It is observed that the highest number of healthy urban spaces is concentrated in the South and Southeast. The three healthy urban spaces in the Midwest and the Northeast Regions have belonged to group 3 from 2000 on, which shows the most recent concern with health promotion in these regions.

5. CONCLUDING REMARKS

The article identifies the healthy urban areas in Brazil and whether such spaces make up spatial clusters. It also points to the Social Determinants of Health (SDH) which may influence the quality of life in urban spaces. Ranking the indicators of social, economic and political nature to study the social determinants of health is a common challenge for the researchers, since it is hard to identify a direct cause-effect relationship among them on the social determinants of health; it is difficult to capture a direct, cause-and-effect relationship between such indicators (BUSS and FILHO, 2007). Still, some conclusions can be drawn from the present work.

Out of the 1224 urban areas analyzed, only 149 were considered as being possible healthy urban spaces, i.e., showed a better result according to the health indicator than the others. Among them, those 42 which kept the mortality rate from infectious and parasitic diseases in the first quartile of the distribution

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since 1980 were the ones which showed the best results in terms of social determinants. Only 55 out of the 149 urban areas analyzed were considered to be healthy, since they present four of the SDH in better conditions than the others.

In terms of space, we observe an increase in the spatial randomness in healthy urban spaces. The same is observed for the social determinants of health. The dispersion can be explained by the fact that policies designed to improve the quality of life are becoming increasingly of local nature. That is, such policies focus on improving the living conditions of the local population and the municipal government is the primary agent for the management and organization of resources

The three healthy urban spaces in the Midwest and Northeast Regions are in group 3 (healthy from the year 2000), demonstrating the latest concern about health promotion in these regions.

. It was observed that most healthy urban spaces, which amount to 50, are in the South and Southeast regions, and these regions hold the best SDH in the country. However, the State of Rio de Janeiro showed no healthy urban space. The North and Northeast regions showed only one healthy urban space each, while the Midwest presented three healthy urban spaces. Furthermore, it is emphasized that the states of Acre, Roraima, Rondônia, Tocantins and Mato Grosso showed no possible healthy urban space. These states require social policies to encourage the improvement of living conditions.

To improve the quality of life, local policies should be integrated, that is, they cannot focus on health only, but attend other areas such as education, employment, sanitation and recreation, among others.

REFERENCES

ALMEIDA, E. S. Cidade/município saudável – a questão estratégica**:** o compromisso político. **Saúde Social**, 6:71-81, 1997.

ANSELIN, L. Local Indicators of Spatial Association – LISA. **Geographical Analysis**, 27, n.2, 1995.

AKERMAN, M; MENDES, R; BÓGUS, C.M; WESTPHAL. M. F; BICHIR, A e PREDROSA, M. L. Avaliação em promoção da saúde: foco no “município saudável”. **Rev. Saúde Pública**, 36(5): 638-46, 2002.

BAUMONT, C. **Spatial Effects in housing price models: do house prices capitalize urban development policies in the agglomeration of Dijon (1999)?** Université de Bourgogne, 2004.

BRAS M. LE and MALVI, J. M. D. “Le complexe pathogène tropical regard nouveau sur un concept ancien” **Medecine Tropicale**, vol. 64, pp. 613–618, 2004.

BUSS, P.M e FILHO, A. P. A Saúde e seus Determinantes sociais. **Rev. Saúde Coletiva**. Rio de Janeiro, 17 (1): 77-93, 2007.

CRUVINEL, T. A. C. **Promoção da saúde e qualidade de vida nos idosos na saúde da família**. Dissertação de Mestrado. Universidade Federal de Minas Gerais, Uberaba- MG, 2009.

vol. 12, nº 3. ISSN 2317-7721
DOI: 10.12957/rdc.2020.50668

DA MOTTA, G. P. O **setor de saúde e seus impactos intersetoriais: uma abordagem de equilíbrio geral computável para a economia brasileira.** Dissertação (Mestrado em Economia Aplicada) – Faculdade de Economia da Universidade Federal de Juiz de Fora, Juiz de Fora, 2010.

DOYLE, Y. G. *et al.* Practical lessons in using indicators of determinants of health across 47 European cities, **Health Promotion International**, Vol. 14 N° 4, p. 289-299, 1999.

DUHL, L. J. Ciudades Sanas: mito ou realidad. In Ashton, J., organizador. **Ciudades sanas.** Barcelona: Masson, p. 15 – 21, 1993.

FERRAZ, S. T. **Cidades saudáveis: uma urbanidade para 2000**. Brasília, Paralelo 15, 103 p.,1999.

FLYNN, B. C. Healthy Cities: toward worldwide health promotion. **Rev Public Health**, 17: 299- 309, 1996.

FORUM 21: Cidade do Rio de Janeiro. Informe n. 2, abr. 2000.

FREUDENBERG N. Time for a national agenda to improve the health of urban populations. **Am J Public Health**. 2000;90:837–840.

GAROFOLO, A. C. S.; TORRES, T. Z.; COSTA, F. A. Implantação da coleta seletiva de lixo na cidade de Cosmópolis, São Paulo: qualidade e sustentabilidade. **II Congreso Internacional Sociedad Digital.**Madri, 2011.

GERONIMUS A.T. To mitigate, resist, or undo: addressing structural influences on the health of urban populations. **Am J Public Health.** 2000;90:867–872.

HANCOCK, T. The evolution, impact and significance of the healthy cities/healthy communities' movement. **Journal of Public Health Policy**, 14(1): 5-18, 1993.

KRIEGER N. A Glossary for social epidemiology. **J. Epidemiology Community Health**, n. 55, p. 693-700, 2001.

MENDES, R. **Cidades saudáveis no Brasil e os processos participativos: o caso de Jundiaí e Maceió.** Tese de doutorado: USP, 2000.

MERZEL C. Gender differences in health care access indicators in an urban, low-income community. **Am J Public Health**. 2000;90:909–916.

MINISTÉRIO DA SAÚDE. **Doenças Infecciosas e Parasitárias**. Brasil, Brasília-DF; 2010.

ORGANIZAÇÃO MUNDIAL DE SAÚDE (OMS). Comissão de Determinantes Sociais em Saúde. Relatório Final. Available in: http://determinantes.saude.bvs.br/docs/Relatorio_Final_CDSS_OMS.pdf (Accessed in 03/12/11).

ORGANIZAÇÃO PANAMERICANA DE SAÚDE (OPAS). Divisão de Promoção e Proteção da Saúde. Municípios e comunidades saudáveis: guia dos prefeitos para promover qualidade de vida. Available in: http://www.paho.org/Portuguese/AD/SDE/HS/MCS_Recomendacoes.pdf (Accessed in 03/12/11).

PAVLOVSKY, E.N. Natural Nidality of Transmissible Diseases with Special Reference to the Landscape Epidemiology of Zooanthro-ponoses, Edited by N. D. Levine, University of Illinois Press,1966.

RODRIGUES, C. R. **Dinâmica demográfica e internações hospitalares: uma visão prospectiva para o Sistema Único de Saúde (SUS) em Minas Gerais, 2007 a 2050**. Tese de doutorado - CEDEPLAR – UFMG, Minas Gerais, 2010.

RODRIGUES, R. N., ALFRADIQUE, M. E. M., **Identificação e caracterização dos aglomerados de saúde do estado de Minas Gerais** (Mimeo) 47 p., 2001.

 vol. 12, nº 3. ISSN 2317-7721
DOI: 10.12957/rdc.2020.50668

ROSA-FREITAS M. G., TSOURIS P.PETERSON A. T. *et al.*, "Anecoregional classification for the state of Roraima, Brazil. The importance of landscape in malaria biology" **Memorias do Instituto Oswaldo Cruz**, vol. 102, no. 3, pp. 349–357, 2007.

ROSA-FREITAS M. G., TSOURIS P., REIS I. C, MAALHAES M.A.F.M, NASCIMENTO T. F. S., AND HONORIO N. A. "Dengue and land cover heterogeneity in Rio de Janeiro" **O ecologia Australis**, vol. 14, no. 3, pp. 641–667, 2010.

ROSA-FREITAS M. G., HONORIO N. A., CODECO C. T., WERNECK G. L., AND DEGALLIER N. Spatial Studies on Vector-Transmitted Diseases and Vectors. **Journal of Tropical Medicine**, 2014

SCHWARTZ J, DOCKERY DW, NEAS LM, et al. Acute effects of summer air pollution on respiratory symptom reporting in children. **Am J Respir Crit Care Med.** 1994;150 (5 pt 1):1234–1242.

SEN, A. Why health equity? **Health Economics**. Vol. 11, p. 659–666, 2002.

SORRE, M. "Complexes pathogenes et geographie medicale," **Annales de Geographie**, vol. 42, no. 235, pp. 1–18, 1933.

TARLOV, A. Social Determinants of Health: the sociobiological translation. In: BUSS, P.M e FILHO, A. P. A Saúde e seus Determinantes Sociais. **Rev. Saúde Coletiva**. Rio de Janeiro, 17 (1): 77-93, 2007.

VIANNA, P. V.C; OLIVEIRA, J. Saúde e Cidade: possibilidades e limites de transformação urbana nas propostas da saúde coletiva. **XIV Encontro Nacional da ANPUR**. Rio de Janeiro, 2011.

WERNA, E. As políticas urbanas das agências multilaterais de cooperação internacional para países em desenvolvimento. **Espaço e debates** (39): 10-12, 1996.

WORLD HEALTH ORGANIZATION (WHO). **Vinte pasos para formular un proyeto de ciudades sanas**. Washington, 1995.

WESTPHAL, M. F., MENDES, R. Cidade Saudável: uma experiência de Interdisciplinaridade e intersetorialidade. **Revista de Administração Pública – RAP** - Rio de Janeiro, FGV, 34 (6): 47-61, Nov./Dez. 2000.

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Attachment 1: Healthy urban spaces and the number of indicators in better conditions than the average

Region	States	Urban spaces	Qtd	HDI	Homicide rate	Population
Urban spaces which remained in the first quartile of the distribution of mortality rate from infectious and parasitic diseases in 1980, 1991, 2000 and 2010						
North	PA	Viseu	4	0.605	1.8	141100
Southeast	ES	Castelo	5	0.762	12.04	37910
		Santa Teresa	4	0.789	9.65	79232

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	MG	Nova Serrana	6	0.801	39.73	40051
		Ribeirão das Neves	6	0.749	34.64	86505
	SP	Álvares Machado	4	0.772	4.21	107089
		Cabreúva	4	0.774	4.68	63721
		Embu	6	0.772	29.75	104150
		Itaquaquecetuba	5	0.744	41.47	321770
		Mairiporã	5	0.803	53.06	80956
		Poá	6	0.806	8.89	25531
		Tremembé	4	0.834	12.15	27690
South	PR	Matinhos	4	0.793	58.52	38541
		Salto do Lontra	4	0.76	23.39	42153
	RS	Arvorezinha	4	0.798	-	33112
		Crissiumal	4	0.786	6.63	34427
		Júlio de Castilhos	4	0.804	10.03	19579
	SC	Mondaí	5	0.809	-	45680
		Seara	4	0.832	5.61	211141
Urban spaces which remained in the first quartile of the distribution of mortality rate from infectious and parasitic diseases in 1991, 2000 and 2010						
Southeast	MG	São João Nepomuceno	4	0.763	7.64	18446
		Ibirité	4	0.729	29.85	14744
		Santa Rita do Sapucaí	5	0.789	13.83	50024
		Congonhas	6	0.788	6.16	118843
	SP	Campo Limpo Paulista	5	0.805	18.7	371630
		Cosmópolis	8	0.799	10.12	14603
		Cravinhos	4	0.815	6.48	39633
		Jandira	6	0.801	24.97	357077
		Pilar do Sul	5	0.774	3.51	103895
		Piratininga	5	0.797	8.34	50126
South	RS	Rio Pardo	6	0.754	5.13	32026
	SC	São Francisco do Sul	6	0.82	22.48	40222
Urban spaces which remained in the first quartile of the distribution regarding mortality rate for infectious and parasitic diseases in 2000 and 2010						
Northeast	PE	Escada	4	0.645	41.53	23906
Midwest	GO	Luziânia	4	0.756	36.66	7122
	MS	Ponta Porã	5	0.78	68.47	29735
		Rio Brilhante	5	0.747	57.34	20426
	ES	Guarapari	5	0.789	56.44	28804
		Itapemirim	4	0.687	24.42	24186
	MG	Elói Mendes	5	0.768	7.83	108728
		Itanhandu	5	0.795	6.56	15085
		Sabará	8	0.773	-	21746

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Southeast		Vespasiano	5	0.747	30.44	28628
	SP	Buri	5	0.701	11.02	52823
		Dois Córregos	5	0.786	3.84	18891
		Jacupiranga	6	0.76	-	64409
		Laranjal Paulista	5	0.799	7.61	81590
		Mairinque	6	0.801	36.65	38702
		Pederneiras	4	0.78	16.19	231054
		Santo Anastácio	6	0.792	-	22236
		Tanabi	4	0.792	16.27	14866
		Várzea Paulista	6	0.795	6.53	51436
South	PR	Colombo	5	0.764	50.15	27931
	RS	Cerro Largo	4	0.807	-	281779
	SC	Ibirama	5	0.826	17.18	107168
		Rio Negrinho	5	0.789	13.44	27281
		São Miguel D'Oeste	6	0.838	14.18	148764

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ATTACHMENT 2: Moran's I Analysis.

Illiteracy Rate							
k3	k4	k5	k10	k15	k20	Tower	Queen
0.860***	0.859***	0.853***	0.844***	0.838***	0.831***	0.852***	0.852***
0.078***	0.070***	0.065***	0.066***	0.065***	0.066***	0.073***	0.068***
0.069***	0.064***	0.060***	0.063***	0.060***	0.060***	0.069***	0.065***
0.074***	0.070***	0.065***	0.065***	0.061***	0.062***	0.076***	0.071***

Average Household Income Per Capita						
k1	k2	k3	k4	k5	k10	k15
0.155***	0.131***	0.111***	0.115***	0.110***	0.103***	0.101***
0.050**	0.039***	0.036***	0.031***	0.034***	0.040***	0.039***
0.082***	0.063***	0.050***	0.043***	0.042***	0.041***	0.041***
.079***	0.057***	0.048***	0.040***	0.038***	0.040***	0.042***

Percentage of households with electrical power							
k3	k4	k5	k10	k15	k20	Tower	Queen
0.047***	0.048***	0.046***	0.051***	0.045***	0.045***	0.052***	0.049***
0.055***	0.058***	0.052***	0.050***	0.045***	0.045***	0.065***	0.062***
0.039***	0.036***	0.035***	0.027***	0.022***	0.024***	0.043***	0.041***
0.028***	0.026***	0.025***	0.015***	0.012**	0.016***	0.024**	0.022**

Percentage of Households With Sewer						
k1	k2	k3	k4	k5	k10	k15
0.636***	0.644***	0.639***	0.638***	0.631***	0.625***	0.614***
0.785***	0.782***	0.779***	0.774***	0.773***	0.759***	0.748***
0.062***	0.079***	0.069***	0.072***	0.075***	0.075***	0.074***
0.064***	0.054***	0.046***	0.047***	0.043***	0.047***	0.046***

Population Density							
k2	k3	k4	k5	k10	k15	k20	Tower
0.204***	0.209***	0.211***	0.207***	0.198***	0.193***	0.190***	0.182***
-0.003	0.002	0.010	0.010	0.013*	0.008	0.009*	0.005
0.000	0.009	0.007	0.004	0.006	0.008	0.010*	-0.004
-0.013	-0.002	-0.001	-0.004	0.005	0.009	0.011**	-0.005

Unemployment Rate						
Queen	k2	k3	k4	k5	k10	k15
0.182***	0.007	0.011	0.008	0.006	0.005	0.005
0.004	0.009	0.014	0.010	0.008	0.007	0.006
-0.003	0.009	0.014	0.011	0.008	0.008	0.007
-0.002	0.010	0.016	0.012	0.009	0.010	0.008

Urban Health Indicator							
k2	k3	k4	k5	k10	k15	k20	Tower
0.054***	0.057***	0.0556***	0.053***	0.035***	0.031***	0.028***	0.042***
0.039***	0.037***	0.039***	0.036***	0.029***	0.028***	0.031***	0.030***
0.034***	0.030**	0.028**	0.027***	0.030***	0.030***	0.030***	0.028***
0.042***	0.034**	0.033***	0.027***	0.022***	0.021***	0.023***	0.035***

Total Mortality Rate						
Queen	k2	k3	k4	k5	k10	k15
0.041***	0.204***	0.209***	0.211***	0.207***	0.198***	0.193***
0.0304***	-0.003	0.002	0.010	0.010	0.013*	0.008
0.025**	0.000	0.009	0.007	0.004	0.006	0.008
0.031***	-0.013	-0.002	-0.001	-0.004	0.005	0.009

Percentage of Households With Water Supply							
k3	k4	k5	k10	k15	k20	Tower	Queen
0.602***	0.596***	0.588***	0.565***	0.552***	0.542***	0.587***	0.588***
0.661***	0.654***	0.649***	0.621***	0.603***	0.592***	0.636***	0.636***
0.024*	0.030***	0.031***	0.032***	0.030***	0.030***	0.032***	0.033***
0.024*	0.029**	0.029***	0.029***	0.030***	0.031***	0.031***	0.033***

n data from *SIM* and Brazilian Demographic