Environment and dengue in districts of Aracaju

Relação ambiente e dengue nos bairros de Aracaju

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Desde o ano de 1999 muitas ações têm sido desenvolvidas no combate à dengue, mas o número de casos ainda é muito grande e vem crescendo em alguns estados, como o de Sergipe, que entre 2010 e as 26 primeiras semanas de 2011, apresentou crescimento de 644%. Aracaju vem apresentando o mesmo problema, embora com intensidades diferentes nos diversos bairros. Este artigo analisa os casos de dengue registrados na Secretaria de Saúde do Município de Aracaju, por bairro, correlacionando o volume registrado com as condições sócio-ambientais de cada bairro. A maior freqüência de ocorrência da dengue em alguns bairros, parece estar ligada diretamente à existência de problemas ambientais decorrentes da ocupação inadequada do solo, instalação inadequada da infra-estrutura básica, falta de manutenção/conservação do ambiente construído, da existência de terrenos baldios, existência de edificações que se constituem em reserva de valor imobiliário e se encontram desocupadas e em fase de degradação adiantada. A esses fatores do ambiente construído, somam-se a falta de comprometimento da própria população, cujo comportamento leva à proliferação de múltiplos pequenos focos do mosquito transmissor, geralmente dentro da própria residência.

Palavras chaves: Aracaju; Dengue; Condições sócio-ambientais

Since the year 1999 many actions have been developed to combat dengue, but the number of cases is still very large and is growing in some states, such as Sergipe, which between 2010 and the 26 first weeks of 2011, grew 644%. Aracaju is showing the same problem, but with different intensities in various urban districts. This article examines the reported dengue cases in the Health Department of the Municipality of Aracaju, by urban districts, correlating the volume registered with the socio-environmental conditions of each district. The higher frequency of occurrence of dengue in some quarters, seems to be directly linked to the existence of environmental problems resulting from inappropriate land occupation, improper installation of basic infrastructure, lack of maintenance / conservation of the built environment, the existence of vacant lots, existence of buildings that constitute a store of value and real estate are vacant and in early stage of degradation. Added to these factors of the built environment, lack of commitment to the general populations, whose behavior leads to the proliferation of multiple small focus of the mosquito, usually their own house.

Keywords: Aracaju; Dengue; Socio-environmental conditions

1. INTRODUCTION

Dengue is a higher incidence of arbovirus in the world, and Brazil has a socio-environmental conditions favorable to its expansion, enabling rapid proliferation of Aedes aegypti, which has shown great adaptability to different adverse environmental situations, making your control hard. Reportable disease, presents a seasonal pattern of occurrence and its magnitude is underestimated by confused with other diseases such as flu. Thus, its underreporting is more pronounced than those of other reportable diseases, its lethality is 5% of cases and severity of the epidemic has increased in Brazil, where a significant outbreak occurred in 2008 and 2011 has been expressing another outbreak, an increase of 644% compared to 2010 [1] [2] [3] [4] [5].

There is an increasing spread of the mosquito, resulting from the interaction of numerous factors, among which we highlight the precarious environmental conditions of urban centers, high humidity and temperature, which favor the spread of this vector, mainly due to behavioral

characteristics that facilitate vector their reproduction and makes it difficult to control, Aedes aegypti lays its eggs in a huge variety of containers, their control constituting a real challenge [6].

The resurgence of diseases linked to land use and sanitation, are also directly or indirectly linked to the general conditions of the urban and land use, considering both the urban site and its use. Another aggravating factor has recently emerged that are more intense weather events, which contribute to the occurrence of disasters and new cases of endemic diseases [7].

In the study of urban conditions for the occurrence of dengue, it is necessary that the potential causes are sought, not only related to changes in society, but to change in a set of factors which include the relative location and neighborhood, which favor the interaction factors that directly or indirectly associated, may facilitate the occurrence of outbreaks of diseases. This is what Blessed Son [8] calls the environment of opportunities that relate to the occurrence of events and maintains spatial correlation, therefore, linked to geographical basis. The analysis of disease occurrence and its relationship to hostile environments or vectors constitute important step in the generation of knowledge, because it allows the continuous monitoring of the situation and, by extension, the position adopted for the control of undesirable factors [9].

Aracaju, urban middle-sized, with less than a million people, has potentially greater ease of allocation of urban infrastructure, establishment of social control, regulation of land use and implementation of medical, health, therefore , volume reduction of the occurrence of infectious diseases. But this requires systematic knowledge of the causal factors associated with outbreaks of dengue, to support adequately the planning of preventive actions.

Studying the relationship between the occurrence of dengue and socio-environmental conditions was the main objective of this research, using the urban district as the unit of analysis.

2. MATERIALS AND METHODS

This study covers the whole of the urban area of Aracaju, which covers the entire municipal territory, focusing on each urban district as a unit, allowing to generate knowledge of the integration of characteristics: physical environment, social environment, distribution infrastructure urban occurrence of conservation areas and risk areas, areas with poor sanitation (channels rainwater used for sewage, waste lands and others) and other aspects of interest to study the distribution of the occurrence of dengue cases.

A study by Fonseca and Gonzaga Junior [10] was used as a base, which raised extensively, by an intensive field survey, the conditions of urban districts in Aracaju, focusing on the issues: population and socioeconomic characteristics, location and description of the use of land (residential, commercial, industrial, public and community use areas), location and characterization of the main traffic routes, location and characterization of permanent preservation areas, areas of restricted use, areas considered at risk, areas with poor sanitation , canals, rivers, wetlands, conservation land, garbage and open sewers, storm drains, vacant lots and condominiums or housing developments divided by social class.

This study by Fonseca and Gonzaga Junior primary and secondary data used, resulting in the classification of the observed conditions in each urban district in score between 1 and 5, with all the analysis allowed the elaboration of an array of values uniting all the districts of Aracaju in order to facilitate comparative analysis and to establish classes for thematic mapping. The present study on dengue, can only be performed using the results of this mapping Aracaju to the urban district level.

Through a review of documentary data were obtained the cases reported and confirmed by dengue in each district of Aracaju and related to the population of each of the 38 districts and the conditions raised by Fonseca Junior and Gonzaga [10]. Field observations were also conducted to survey the factors that could help explain the relationships observed in the analysis of the data processed by statistical probability, using the Spearmann Correlation Coefficient.

3. RESULTS

3.1. Spatial distribution by district

The distribution of the occurrence of dengue in each district of Aracaju, was observed for the cases reported and confirmed for the period 2005 to 2009. It was found a big difference between the two types of notification and, for this study included only confirmed cases of dengue fever during that period.

Table 1: Confirmed cases of dengue in Aracaju, by district, in the period 2005 to 2009

Districts	Period					Total
	2005	2006	2007	2008	2009	
Aeroporto	11	34	2	188	0	235
América	6	2	10	586	28	632
Atalaia	2	33	10	229	2	276
Bugio	4	23	22	374	16	439
Capucho	0	1	2	31	0	34
Centro	2	1	4	138	5	150
Cidade Nova	5	5	14	321	8	353
Cirurgia	0	3	0	85	4	92
Coroa do Meio	6	29	6	241	6	288
Dezoito do Forte	3	3	4	178	2	190
Farolândia	8	22	6	446	1	483
Getulio Vargas	1	2	1	143	1	148
Grageru	10	22	5	168	7	212
Inácio Barbosa	11	1	2	113	2	129
Industrial	3	18	5	878	15	919
Jabotiana	38	13	11	300	10	372
Jardim Centenário	4	1	4	201	7	217
Jardins	4	10	2	64	3	83
José Conrado de Araujo	1	1	7	157	13	179
Lamarão	0	1	11	308	10	330
Luzia	9	8	7	211	10	245
Mosqueiro	52	23	7	307	2	391
Novo Paraiso	2	3	1	256	9	271
Olaria	7	12	16	401	13	449
Palestina	0	2	3	66	1	72
Pereira Lobo	0	2	2	69	1	74
Ponto Novo	5	15	8	305	4	337
Porto Dantas	---	---	7	362	7	376
Salgado Filho	4	4	3	57	2	70
Santa Maria	8	11	2	832	26	879
Santo Antonio	2	3	3	233	4	245
Santos Dumont	4	8	19	827	22	880
São Conrado	20	14	23	375	16	448
São José	5	2	1	89	1	98
Siqueira campos	10	1	6	397	18	432
Soledade	0	5	8	144	2	159
Suissa	5	3	4	148	20	180
Treze de Julho	3	0	2	76	2	83
Total - Aracaju	**255**	**341**	**250**	**10.304**	**300**	**11.450**

The data allow us to observe that there is great variation in the occurrence of confirmed cases of dengue between the districts of Aracaju during these five years, especially in 2008, with a large number of occurrences.

The Table 2 shows the rates of confirmed dengue cases correlated with the population of districts of Aracaju, counting by IBGE in 2007. Some of these urban districts have very high rates and higher than the index obtained by the general population of Aracaju, indicating the need of better attention to fighting the epidemic in these spaces.

Table 2: Indices of dengue cases confirmed in Aracaju, by urban district, in the period 2005 to 2009

Districts	Resident Population in 2007 *	Scores of cases of dengue confirmed in the year, per 1000 inhabitants				
		2005	2006	2007	2008	2009
Aeroporto	9.389	1,17	3,62	0,21	20,02	0,00
América	15.692	0,38	0,13	0,64	37,34	1,78
Atalaia	11.379	0,18	2,90	0,88	20,12	0,18
Bugio	16.249	0,25	1,42	1,35	23,02	0,98
Capucho	889	0,00	1,12	2,25	34,87	0,00
Centro	8.117	0,25	0,12	0,49	17,00	0,62
Cidade Nova	24.045	0,21	0,21	0,58	13,35	0,33
Cirurgia	5.767	0,00	0,52	0,00	14,74	0,69
Coroa do Meio	14.950	0,40	1,94	0,40	16,12	0,40
Dezoito do Forte	21.025	0,14	0,14	0,19	8,47	0,10
Farolândia	33.696	0,24	0,65	0,18	13,24	0,03
Getulio Vargas	7.188	0,14	0,28	0,14	19,89	0,14
Grageru	16.223	0,62	1,36	0,31	10,36	0,43
Inácio Barbosa	9.487	1,16	0,11	0,21	11,91	0,21
Industrial	18.012	0,17	1,00	0,28	48,75	0,83
Jabotiana	12.844	2,96	1,01	0,86	23,36	0,78
Jardim Centenário	13.228	0,30	0,08	0,30	15,20	0,53
Jardins	5.175	0,00	0,00	0,39	12,37	0,58
José Conrado de Araujo	13.418	0,07	0,07	0,52	11,70	0,97
Lamarão	9.467	0,00	0,11	1,16	32,53	1,06
Luzia	20.007	0,45	0,40	0,35	10,55	0,50
Mosqueiro	18.933	2,75	1,21	0,37	16,22	0,11
Novo Paraíso	11.627	0,17	0,26	0,09	22,02	0,77
Olaria	15.012	0,47	0,80	1,07	26,71	0,87
Palestina	4.217	0,00	0,47	0,71	15,65	0,24
Pereira Lobo	6.617	0,00	0,30	0,30	10,43	0,15
Ponto Novo	20.931	0,24	0,72	0,38	14,57	0,19
Porto Dantas	9.546	0,00	0,00	0,73	37,92	0,73
Salgado Filho	4.298	0,93	0,93	0,70	13,26	0,47
Santa Maria	30.639	0,26	0,36	0,07	27,15	0,85
Santo Antonio	11.950	0,17	0,25	0,25	19,50	0,33
Santos Dumont	25.061	0,16	0,32	0,76	33,00	0,88
São Conrado	27.177	0,74	0,52	0,85	13,80	0,59
São José	5.940	0,84	0,34	0,17	14,98	0,17
Siqueira campos	15.705	0,64	0,06	0,38	25,28	1,15
Soledade	6.544	0,00	0,76	1,22	22,00	0,31
Suissa	11.208	0,45	0,27	0,36	13,20	1,78
Treze de Julho	8.384	0,36	0,00	0,24	9,06	0,24
Total - Aracaju	**520.303**	**0,48**	**0,64**	**0,48**	**19,80**	**0,58**

* Source: IBGE

These indices, although they are oscillating annually in each district, can give an idea of urban districts that deserve more attention in combating the proliferation of the mosquito that transmits dengue and can also allow the evaluation of the results of actions developed in the neighborhoods.

Some districts, although they showed high rates of dengue in the years 2005, 2006, 2007 and 2008, are low occurrence of confirmed cases of dengue or even did not present any case in 2009. This is the case of Capucho Airport districts, which had an index zero, and the districts of

Atalaia, Dezoito do Forte, Farolândia, Getulio Vargas, Mosqueiro, Pereira Lobo, Ponto Novo e São José, all with scores lower than 0.20 occurrences per thousand inhabitants.

3.2. Dengue, social conditions and environment

The relationship between dengue and social conditions and environment were analyzed for each district, using the Spearman correlation calculation, which uses posts for this comparison. Thus, comparisons were made between confirmed cases of dengue and different socio-environmental features raised by Fonseca Junior and Gonzaga [10]. The results allow us to infer that some aspects were potential facilitators for reproduction of Aedes aegypti and the exposure to these vectors of the disease should be monitored because they represented an advice of possible new focus.

The results for the calculation of Spearman correlation for each aspect are presented in Table 3, with two different levels of significance: $\alpha = 0,20$ and $\alpha = 0,10$

Table 3: Spearman correlation between socio-environmental conditions and number of dengue cases in the period 2005 to 2009, in the districts of Aracaju

Socio-environmental conditions	Ano					Total
	2005	2006	2007	2008	2009	
Correlation with garbage in the open	0,222	0,066	0,156	0,318	0,180	0,331
Correlation with maintenance of buildings	0,221	0,158	-0,125	-0,292	-0,233	-0,246
Correlation with wetlands	0,165	0,292	0,240	0,208	-0,048	0,238
Correlation with open sewers	0,292	0,103	0,034	0,289	0,057	0,304
Correlation with drainage waters	0,163	0,078	-0,157	0,088	-0,012	0,113
Correlation with social class	0,245	0,172	-0,243	- 0,291	-0,360	-0,254
Correlation with vacant land	0,186	-0,024	0,266	0,187	0,117	0,183
Correlation with condominium / sets per class	0,558	0,547	0,255	0,244	0,049	0,283
Correlation with maintenance of channels	0,083	0,013	-0,193	-0,384	-0,15	-0,348

$\alpha = 0,20$ significant value =0,212 $\alpha = 0,10$ significant value =0,271

The survey reveals serious problems still exist in relation to inappropriate waste destination. In the evaluation of dengue and garbage in the open, was registered the most significant amount of positive correlation with a significance level of 0.20 for the entire period, highlighting that the years 2005 the correlation is 0.222 and in 2009 is 0.318. The districts of Santa Maria, Capucho and Mosqueiro, are in the zone of expansion of Aracaju, with marked growth of land use, presenting a greater amount of garbage in the open and the highest rate of 2005 cases of dengue confirmed.

The comparison between dengue and conservation land was negatively correlated, indicating that the less maintained the property, the greater the occurrence of dengue cases. It should be noted that the vacant buildings were those with lower grades of preservation, and therefore there is a relationship between vacant property and the occurrence of dengue. Another aspect, equally important to effectively control this disease, but cannot be measured although it has good chance of occurring, is the relationship between water reservoir tank and dengue, because in areas where there is no regular supply of water, example of the urban expansion area in the south of the capital, is very common to use tanks, buckets, small cisterns, where conditions are conducive for breeding of Aedes aegypti.

Stand out in this category, the districts of Jabotiana, Santa Maria and Mosqueiro because they had high levels of confirmed dengue cases and examples of poor building maintenance. These urban districts, dwelling place of low and lower middle class, where many homes are without adequate water conditions to reserve water for consumption.

After analysis from the use of the characterization of the urban districts of Aracaju, based on on-site observation of the environmental aspects, were observed flooded and wetlands, with the

presence of clean and stopped water, which favors the spread of focus of dengue. However there are some wetlands that do not have high rates of dengue cases, a fact that may be associated with low population density in the urban district, as is the case of Jabotiana district, which still has high number of vacant lots, constituting significant demographic vacuum.

The Inacio Barbosa district, having considerable presence of wetlands and high population density, but low rates of dengue cases, except the year 2008 who became atypical for the entire capital of Sergipe, leading to be questioned the relationship between water stop and focus of dengue.

The infrastructure is a major factor related to the development of the larvae of the mosquito Aedes aegypti. Value of 0.304 was observed, with $\alpha = 0.10$ for the correlation between the occurrence of confirmed cases of dengue and open sewers in all the years analyzed, although it may be noted that in 2005 was the highest correlation value even greater than that of 2008, the year that there was an almost epidemic in Aracaju.

Remarkable, in this case, the Mosqueiro, Santa Maria, Industrial and Porto Dantas districts with high rates of dengue cases and poor sanitation, although the relationship dengue-sewage is not direct, since the mosquito prefers water cleared to reproduction. The relationship appears to be indirect, since the lack of sanitary conditions in these urban districts is related to invasion, poverty, low income, poor building maintenance, water supply problems.

Still working with the existence of apparent problems of basic sanitation, according to the characterization of the urban districts in Aracaju made by Fonseca and Gonzaga Junior [10], the correlation between storm water drainage and dengue showed no correlation. The districts of America, Capucho, Coroa do Meio, Farolândia, Getulio Vargas, Grageru, Soledad and Center who had poor drainage in the macro or micro levels had no significant correlation, indicating that although slow, the flow of rainwater does not allow stagnation and therefore are not conducive to the creation of focus of the dengue mosquito.

Apparently the disease not privileges social class, but the correlation calculation shows that the urban districts of higher social class tend to have fewer cases of the disease. Since those districts of residence of the population with lower income, such as Santa Maria, São Conrado and Mosqueiro have a high rate of dengue cases confirmed between 2005 and 2009. Meanwhile, residential urban districts of the upper classes, such as Jardins, 13 de Julho and Atalaia are those with the lowest correlation as the confirmed cases between 2005 and 2009, indicating better conservation on the part of responsible agencies.

There was no significant correlation between dengue and vacant land, except in 2007, with a value of 0.266 for $\alpha = 0.20$. But in other years, it is weak. It should be noted that most of the vacant land, from 2005, are being transformed into condominiums or occupied residential buildings with several floors, and in the implementation phase of these occupations to soil movement, materials and vehicles, can hamper establishment of focus of the dengue mosquito.

The relationship between dengue and condos for socioeconomic status proved to be surprising, given the higher incidence of dengue occurred in upper-class condominiums. Field observations point to the garden areas, large and quite common in upper-class condominiums, as responsible for the high correlation value, which reached $\alpha = 0.255$ to 0.20.

The relationship between dengue with maintenance of channels presented the value -0.348 channels with $\alpha = 0.10$, indicating a highly significant negative correlation: the better conservation the smaller occurrence of dengue. This correlation, not significant in the years 2005, 2006, 2007 and 2009, was notable in 2008, when there was almost an epidemic of this disease. Thus, there is strong indication that the conservation of the channels is important for the fight against dengue.

4. CONCLUSION

The characterization of the occurrence of dengue by urban district, in Aracaju, points out a number of factors, especially the provision of basic infrastructure generally, with significant emphasis to the need for continuous regular water supply, proper garbage collection and monitoring to prevent the random garbage disposal in the open, better conservation and

maintenance of buildings, whether residential use or not. There is also indication that is greater attention to public management with the highest-class neighborhoods, which reflects negatively on the spread of dengue. Still, it is quite evident the need to curb the indiscriminate occupation and raids in areas unsuitable for construction and without the allocation of the necessary basic infrastructure.

This study has observed, principally that social and environmental conditions, especially under the built environment and its preservation should be the subject of analysis and monitoring, as there is a correlation between these conditions and the occurrence of dengue cases, via proliferation of the mosquito Aedes aegypti. Thus, is not enough actions aimed directly at combating the dengue mosquito, but they are necessary actions to prevent the proliferation of vectors, requiring integrated approaches between different municipal departments, especially those responsible for health, the direction of land use and services urban, with the effective participation of civil defense and public security.

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