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ORIGINAL ARTICLE

DENGUE EPIDEMIOLOGICAL PROFILE IN SOUTHERN MATO GROSSO, BRAZIL (2008-2012)

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ABSTRACT

Dengue is an arboviral disease that is a serious public health concern, especially due to its increasing incidence in the past decades. This study aimed to characterize the epidemiological incidence of dengue in 2008–2012 in Southern Mato Grosso, Brazil. This is an epidemiological and descriptive study of dengue in the 19 municipalities of the Rondonópolis Regional Health Office using data obtained from the Information System of Diseases Notification. An analysis of the number of confirmed cases of dengue, according to year, age, and gender was performed. Data was associated with the rainfall of the region as well. There were 13,580 reported dengue cases; 2010 had the highest number of cases, with 7,244 dengue cases. In 2011, the number fell dramatically to only 236 notified cases. With regard to age, the most often affected were young adults (20-39 years of age); no difference was noted regarding gender. As expected, dengue cases were higher during the rainy season. In 2009 and 2010, in Southern Mato Grosso, there was a significant increase in the proportion of dengue cases compared with other years during the period evaluated. However, a rapid decline in the subsequent year was noted, possibly because of the intensification of preventive actions in vector control. Interestingly, 2012 presented an increasing number of dengue cases. This fact highlights the importance of actively combating dengue in order to prevent future epidemics.

KEY WORDS: Dengue; epidemiology; disease notification.

INTRODUCTION

Dengue infection is currently the most widespread mosquito-borne viral illness among humans. Its etiological agent belongs to the genus *Flavivirus* (*Flaviviridae* family), grouped into four known serotypes (DENV-1, DENV-2, DENV-3, and DENV-4) (Messina et al., 2014). These

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viruses are transmitted to humans by the bite of infected mosquitoes in urban environments. Female *Aedes aegypti* mosquitoes are the main vector involved in urban transmission followed by other species, such as *Aedes albopictus* (Carrington & Simmons, 2014). Once infected, female mosquitoes remain infectious for their entire lives and potentially transmit the virus during human feeding (WHO, 2014). In addition, eggs and larvae may be infected by vertical transmission, consequently, maintaining the virus in adult mosquitoes regardless of their feeding upon infected and viremic individuals. This ensures the constant presence of the virus in endemic areas during epidemic periods (Angel et al., 2008). The spread of the mosquito vector and virus has led to a resurgence of dengue fever epidemics associated with a higher number of severe clinical manifestations (WHO, 2014).

In humans, dengue infection is usually an acute febrile illness with a wide clinical spectrum that includes asymptomatic infection, mild fever, and severe dengue (Horstick et al., 2012). This last form may include hemorrhagic events and shock syndrome, possibly due to abnormal capillary permeability and plasma leakage. The pathophysiological basis for such severe manifestations is multifactorial and related to the balance of host immunological and genetic background and viral determinants of virulence (Guzman & Harris, 2015). Additionally, simultaneous circulation of different serotypes in endemic settings has been reported as a trigger factor to the increase in incidence of severe forms of the disease (Wahala & Silva, 2011).

This fact, associated with the nonexistence of effective treatment, combined with environmental factors, such as difficulties in controlling the *Aedes* populations, climate changes, uncontrolled urbanization, and population growth have contribute significantly to dengue being considered a serious public health problem in over 100 countries, all located in tropical and subtropical regions of the world (Bhatt et al., 2013; WHO, 2014). In these areas, it is estimated that 2.5 billion people live at risk of dengue infection and global incidence reaches 50-100 million cases, with up to 20,000 fatal outcomes (WHO, 2014). Furthermore, dengue also constitutes a high economic burden. In the Americas, the illness itself costs an estimated 2.1 billion USD annually, excluding vector control programs (Shepard et al., 2011). However, the real disease burden is underestimated, especially in Africa, India, Indonesia, China, and Brazil (Bhatt et al., 2013).

The Brazilian government spends approximately 135.2 million USD per annum on the dengue illness and another 594.15 million USD on the National Dengue Control Plan (Suaya et al., 2009). Despite these investments, several outbreaks have been registered with a considerable increase in the number of dengue cases over the last few years (San Martin et al., 2010). Recent data indicate that 1.2 million new cases were reported

in Brazil in 2010 alone; these resulted in 94,887 hospitalizations and 673 deaths (CONASS, 2011; Vieira Machado et al., 2014). Thus, the country encompasses approximately 70% of the cases reported on the American continent and 60.4% worldwide (Campos et al., 2015). Among other factors, this high disease burden is probably associated with the widespread presence of *A. aegypti* in the territory, since all the Brazilian states, and currently 3,587 municipalities are infested with the vector (Viana & Ignotti, 2013).

The Brazilian state of Mato Grosso has reported several dengue outbreaks since this arbovirus was introduced in the region in 1991(SESMT, 2004). The panorama found in Southern Mato Grosso does not differ substantially from other regions of the state. The high incidence of dengue also detected in the nineteen cities in this region is probably related to favorable environmental conditions, successive migratory waves, rapid and unplanned growth, precarious basic sanitation, and inefficient local public policies (Machiner et al., 2009). Taken together, these factors favor the persistence of vector populations and hinder its control.

The study of the epidemiological pattern of dengue in such a region is, therefore, vital considering there is no previous report available in the literature. In addition, access to this information should provide important subsidies for local health authorities in order to plan control interventions to reduce the impact of dengue in the studied area. Thus, this study aims to describe the epidemiological profile of dengue in Southern Mato Grosso from 2008 to 2012.

MATERIAL AND METHODS

This is a descriptive and retrospective epidemiological study in Southern Mato Grosso, Brazil, covering its nineteen municipalities grouped at the Rondonópolis Regional Health Office (Roo/RHO) (Figure 1). This area covers approximately 89,471 Km² and has 466,567 inhabitants distributed as follows: Alto Araguaia (16,284 inhabitants), Alto Garças (10,655), Alto Taquari (8,615), Araguainha (1,058), Campo Verde (33,759), Dom Aquino (8,134), Guiratinga (14,137), Itiquira (11,822), Jaciara (25,927), Juscimeira (11,335), Paranatinga (19,887), Pedra Preta (16,079), Poxoréo (17,232), Primavera do Leste (53,910), Rondonópolis (202,309), Santo Antônio do Leste (4,038), São José do Povo (3,673), São Pedro da Cipa (4,259) and Tesouro (3,454) (IBGE, 2010) (Figure 1).

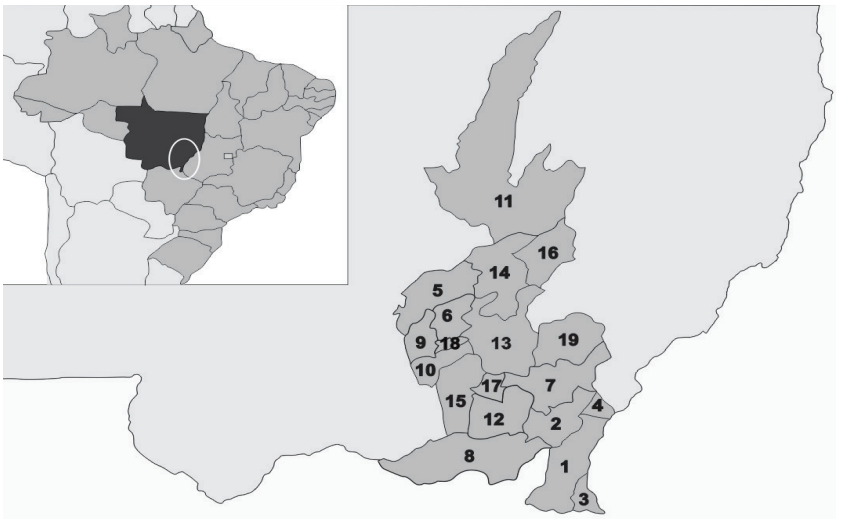

Figure 1. Geographical localization of Rondonópolis Regional Health Office (Roo/RHO) municipalities in Southern Mato Grosso.

Roo/RHO comprises the following nineteen municipalities: (1) Alto Araguaia, (2) Alto Garças, (3) Alto Taquari, (4) Araguainha, (5) Campo Verde, (6) Dom Aquino, (7) Guiratinga, (8) Itiquira, (9) Jaciara, (10) Juscimeira, (11) Paranatinga, (12) Pedra Preta, (13) Poxoréo, (14) Primavera do Leste, (15) Rondonópolis, (16) Santo Antônio do Leste, (17) São José do Povo, (18) São Pedro da Cipa and (19) Tesouro.

The data for annual incidence, clinical form, age group, and gender were obtained from the databank of the Diseases Notifications Information System (SINAN Net, 2016), which records data generated from the Epidemiological Vigilance System of the Brazilian Ministry of Health through compulsory notification files on diseases. This study consists of all confirmed cases of dengue, by laboratory and clinical-epidemiological criteria, per municipality of residence notified between 2008 and 2012. The rainfall data obtained from the National Institute of Meteorology (INMET) in the Brazilian Ministry of Agriculture, Livestock and Supplies are represented as the monthly average rainfall recorded over the past 30 years (from 1983 to 2013) (BDMEP, 2016) in each municipality of the Roo/RHO.

Ethical Considerations

The study was carried out according to ethical precepts, as secondary data available for public consultations were used from the website of the Disease Notification Information System.

RESULTS

Data obtained in this study showed that there was a high occurrence of dengue in the state of Mato Grosso between 2008 and 2012 with 13,580 notified cases (Figure 2). During 2008, 177 dengue cases were registered and a consistent increase in this number was observed in the following two years — 4,039 cases in 2009 and 7,244 in 2010. 2011 presented a marked decrease in notifications (236 cases), while in 2012 this number increased substantially, reaching a total of 1,884 cases. Considering dengue notified cases and their clinical classification from 2008 to 2012, the following criteria were used for notification: ignored/blank, inconclusive, classic dengue fever, dengue with complications, dengue shock syndrome, and dengue hemorrhagic fever. According to the new World Health Organization dengue classification (WHO, 2014), the last three forms were grouped as severe dengue. 162 cases occurred in 2009 while 2010 presented 89 cases of severe dengue. Both 2011 and 2012 presented a reduced number of cases, only one and six cases including severe dengue, respectively (Figure 2).

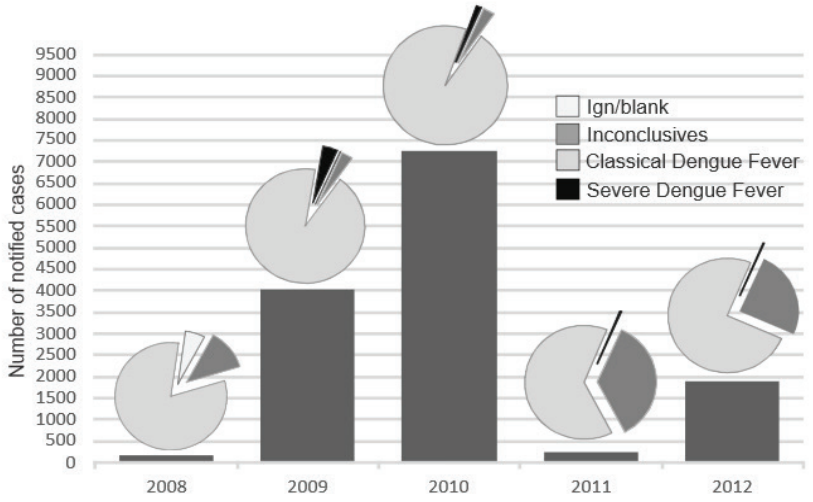

Figure 2. Annual distribution and final classification of notified dengue cases in municipalities in the Rondonópolis Regional Health Office (Roo/RHO) from 2008 to 2012.

The bar chart shows the sum of the regional number of cases reported in the period evaluated. The pie chart shows final classification of regional notified dengue cases.

The incidence of dengue in Southern Mato Grosso was heterogeneous among the municipalities of the region between 2008 and 2012 (Table 1). Considering periods with fewer dengue cases, such as 2008 and 2011, a high incidence (> 30 cases per 10,000 inhabitants) was observed in three municipalities: São José do Povo (36.19 per 10,000 inh. in 2008), Santo Antônio do Leste (50.54 per 10,000 inh. in 2011), and São Pedro da Cipa (36.07 per 10,000 inh. in 2011). In 2012, only eight municipalities showed a high dengue incidence, and the municipalities of Jaciara and Paranatinga presented the highest dengue incidence rates, 112.29 per 10,000 inh. and 136.85 per 10,000 inh., respectively (Table 1).

Due to high dengue incidence rates, some municipalities registered a high number of cases during the period evaluated. Rondonópolis with 5,210 cases, followed by Primavera do Leste (2,955 cases), Paranatinga (1,240 cases), Jaciara (1,077 cases) and Campo Verde (855 cases) (Table 1).

All the notified dengue cases were analyzed according to gender and age group (Figure 3). Ages were categorized in five groups: infants 0−9 years old, adolescents (10−19), young adults (20−39), middle-aged adults (40-59) and older adults (60 or older). Most of the cases were found in the young adult group (5,156 cases), followed by middle-aged adults (3,178 cases) and adolescents (2,580 cases). Infants and older adults presented the lowest total number of notifications, 1,704 and 953 cases, respectively (Figure 3). Regarding gender there was no marked difference between males and females in any of the five groups. On the other hand, a slight difference of approximately 1,000 cases between male (6,283) and female (7,295) was noted in the total number of cases.

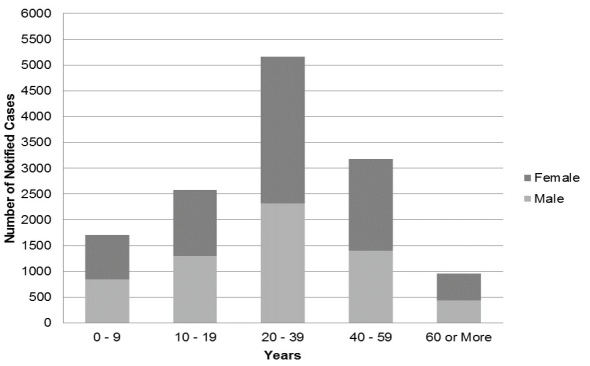

Figure 3. Total number of dengue fever notified cases, by gender and age group, Rondonópolis Regional Office of Health (Roo/RHO), Southern State of Mato Grosso, Brazil, 2008 to 2012.

* Age of one men and six women were ignored.

Table 1. RHO/ Rondonópolis Municipalities dengue cases and incidence (per 10,000 inhabitants), from 2008 to 2012.

Municipalities	2008		2009		2010		2011		2012		Total	
	Cases	Incid.	Cases	Incid.	Cases	Incid.	Cases	Incid.	Cases	Incid.	Cases	Incid.
Alto Araguaia	3	1.9	34	21.7	191	122.1	1	0.6	0	0	229	191.1
Alto Garças	8	7.7	86	83.1	24	23.2	0	0	15	14.5	133	128.5
Alto Taquari	0	0	0	0	57	70.6	1	1.2	3	3.7	61	75.6
Araguainha	0	0	0	0	3	27.4	2	18.2	0	0	5	45.6
Campo Verde	15	4.7	15	4.7	316	100.0	46	14.6	309	97.8	855	270.7
Dom Aquino	1	1.2	3	3.7	55	67.3	0	0	19	23.3	78	9.5
Guiratinga	3	2.2	29	20.8	82	58.8	12	8.6	1	0.7	127	91.1
Itiquira	0	0	4	3.5	208	181.2	1	0.9	5	4.4	218	189.9
Jaciara	6	2.3	381	148.6	396	154.4	6	2.	288	112.3	1.077	419.9
Juscimeira	5	4.4	155	135.6	145	126.9	4	3.5	72	63,0	381	333,3
Paranatinga	39	20,2	855	433,2	68	35,3	14	7,3	264	136.9	1,240	642.8
Pedra Preta	19	12.1	120	76.2	58	36.8	18	11.4	19	12.1	234	148.5
Poxoréo	7	4.5	18	10.2	109	61.9	30	17.0	127	72.2	291	165.4
Primavera do Leste	8	1.5	357	68.6	2,477	475.7	22	4.2	91	17.5	2.955	567.5
Rondonópolis	45	2.3	1,633	83.5	2,880	147.3	37	1.9	615	31.5	5,210	266.5
Santo Antônio do Leste	0	0	65	171.4	117	311.7	19	50.6	28	74.6	229	610.0
São José do Povo	13	36.2	52	144.8	36	100.2	5	13.9	6	16.7	112	311.8
São Pedro da Cipa	5	12.0	78	187.6	22	52.9	15	36.1	18	43.3	138	331.9
Tesouro	0	0	0	0	0	0	0	8.8	4	11.7	7	20.5
Total	177		4,039		7,244		236		1,884		13,580	

Cases: Number of notified cases; Incid.: Dengue Incidence cases per 10,000 inhabitants. Source: IBGE; SES/SINAN (SINAN).

Rainfall average over the past 30 years presented an established pattern in the pluviometric index in Mato Grosso. The rainy seasons frequently occur from January to April and from October to December, with rainfall averages ranging from 100 to 300 mm. Precipitation data (Figure 4) are represented in line charts and were obtained from the National Institute of Meteorology (INMET) in the Brazilian Ministry of Agriculture, Livestock and Supplies (BDMEP, 2016). The bar chart shows the number of cases reported each month in the period evaluated. As expected, dengue notifications in the region rise during the rainy seasons.

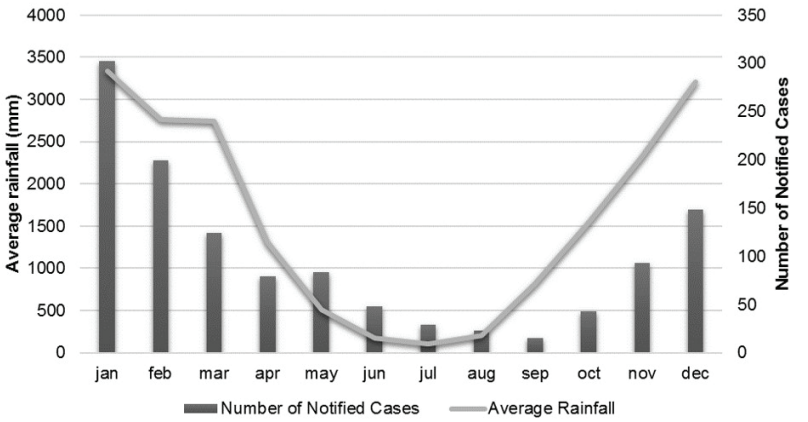

Figure 4. Average rainfall and dengue fever notified cases per month, Southern State of Mato Grosso, Brazil, 2008 to 2012.

Association between dengue cases notification and monthly rainfall average in municipalities of Rondonópolis Regional Health Office (Roo/RHO) from 2008 to 2012.Precipitation data is represented in a line chart obtained from the National Institute of Meteorology (INMET) in the Brazilian Ministry of Agriculture, Livestock and Supplies over the past thirty years. The bar chart shows the sum of the number of cases reported each month during the period evaluated.

DISCUSSION

Dengue incidence rates have increased greatly in the Americas, and Brazil presents a considerable number of reported cases (San Martin et al., 2010). The state of Mato Grosso, in the Midwest region of the country, had its first confirmed dengue case in 1991 due to the introduction of serotype DEN-1.

Thereafter, different serotype introductions and spatial alterations resulted in the spread of infection in a disorderly manner across this state with successive outbreaks in 1995, 1996, 1998, 2002, 2003 and 2006. From 2002 to 2012, Mato Grosso reported 188,113 cases, making it one of the Brazilian states with the highest prevalence of dengue (SINAN Net, 2016). In addition, it is estimated that Mato Grosso concentrates 28% of the Brazilian cases of dengue hemorrhagic fever (MS, 2010).

The data obtained in the current study showed that there was a higher occurrence of dengue cases in Southern Mato Grosso and suggests an epidemic pattern in 2009 and 2010. Although 2011 presented a reduced number of dengue cases followed by a massive increase of cases in 2012, this fact is consistent with the endemo-epidemic nature of dengue in the Americas, where recurring peaks of reported cases occur at two to three year intervals (San Martin et al., 2010).

One limitation occurring in studies performed with secondary data, such as those obtained from SINAN, is related to sub-notification, especially during endemic periods. Asymptomatic cases, and even symptomatic patients from remote locations, are not correctly diagnosed due to lack of information, medical treatment, and difficulties in reaching municipalities with better medical assistance (Marzochi, 2004).

Growing population rates and inadequate urbanization are considered risk factors associated with the dissemination of dengue and its vector, *A. aegypti* (Guzman & Harris, 2015). High numbers of reported dengue cases may be related to the growth of the regional population, environmental characteristics, and lack of adequate sanitation as well.

Dengue incidence rates have varied in the studied region from 2008 to 2012, although four municipalities still presented a high incidence in 2012, namely Campo Verde, Jaciara, Paranatinga, and Poxoréu. High dengue incidence may be related to the increase of severe dengue, even though a consistent decrease was observed in the number of cases in 2012, with only six notified cases. It is possible that this decrease in severe dengue cases is associated with the circulation of a specific viral serotype; some novel dengue lineages, such as DENV-3 genotype II strains, are probably responsible for these severe cases of the disease (Cavalcanti et al., 2011). Unfortunately, no data regarding dengue serotype and lineages are available in Southern Mato Grosso. However, all four dengue serotypes have been reported in different regions of Mato Grosso state during the study period (Cruz et al., 2015; Heinen et al., 2015).

An epidemiological study conducted by San Martin and colleagues (2010) from 2000 to 2007 demonstrated that the highest incidence of dengue fever occurs among young adults (San Martin et al., 2010). A similar pattern was observed in the current study. These results also corroborate two other dengue epidemiologic studies in the state of Mato Grosso (Machiner et al., 2009; França et al., 2011).

Regarding gender, no difference was observed in this study, although some case reports have indicated that women were more frequently infected with dengue (Machiner et al., 2009; França et al., 2011), which is probably associated to their presence in higher vector population areas, such as residential facilities. However, the higher number of dengue cases in women can also be attributed to their more frequent use of health services, resulting in a possible notification bias (Flauzino et al., 2009).

It is known that environmental factors are directly associated with the increase of notified dengue cases. In the present study, a well defined rainfall average was noted in southern Mato Grosso over the last 30 years. Although the Cerrado biome is predominant in the region, the proximity to the Amazon biome provides tropical characteristics to the climate with remarkable decreases in the precipitation index from May to September, corresponding to the dry season, which interestingly coincides with a decline in reported cases (França et al., 2011). The rise in number of dengue cases during the rainy season has also been reported in other regions (Sandoval et al., 2003; Viana & Ignotti, 2013). In fact, high dengue incidence during the rainy season is a pattern of temporal distribution of this infectious disease in Brazil, which is associated with better climate conditions for vector development, when temperature, humidity, and precipitation increase the number of available breeding grounds (Teixeira et al., 2002). This relationship between precipitation and dengue cases reinforces the need and intensification of epidemic combat actions during the rainy season. In fact, strategic controlling actions regarding epidemiologic vigilance must be performed throughout the year to avoid future outbreaks.

Combat actions against the dengue vector have presented unsatisfactory effectiveness due to the complexity of the *Aedes* species and their ability to adapt to urban environments (Schechtman & Souza, 2015). Concern on the part of the sanitation authorities has resulted in vector combat actions, which are extremely important. However, the effectiveness of strategies to prevent dengue epidemics will only be successful through societal awareness.

In conclusion, the high number of dengue cases reported to SINAN in Southern Mato Grosso during 2009 and 2010, with a consistent decrease in 2011, was probably related to vector control. The distribution of dengue cases during the studied period may be related to precipitation, elevated population grown, inadequate sanitation and the introduction of different dengue virus serotypes. Dengue incidence is higher in young adults and affects both genders.

This study provided important epidemiological information about dengue circulation in Southern Mato Grosso. However, additional studies are necessary to enrich the epidemiology of this arboviral disease in the region, especially regarding serotype circulation. These studies may contribute to the control of dengue and other arbovirus not only in the studied region, but also in regions with similar social and environmental characteristics.

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