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Distribution of dengue cases in the state of Oaxaca, Mexico, during the period 2004–2006

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ABSTRACT

Background: Dengue virus infection is an emergent viral disease and the most important transmitted by a vector worldwide. In Mexico it has been an important public health problem since 1995 and Oaxaca is one of the most affected states in the country.
Objective: To determine the geographic distribution of confirmed dengue cases in the state of Oaxaca, Mexico, the serotypes circulating, and the main gender and age groups affected.
Study design: Information about confirmed dengue cases obtained by LESPO during the period 2004–2006 was classified, sorted, and analysed. A RT-PCR technique was used to determine the serotype of the virus in serum samples.
Results: A substantial increment in the number of dengue cases was noticed during the period of this study. The most affected sanitary jurisdiction was located on the coast where the climatic conditions were ideal for vector development and where there is significant migratory activity. The most affected group was the 11–15-year-old group. Dengue haemorrhagic fever was more frequent in men than in women over 16 years old, with a significant difference evaluated by χ^2-test ($p < 0.001$). Four serotypes of the virus were detected in the state and two co-infections with DEN2–3 and DEN3–4 were identified.
Conclusions: The increment in the number of dengue cases in the state of Oaxaca could be explained by several factors such as the presence of the four serotypes of the virus, the migratory phenomenon, the climatic conditions and the socioeconomic level of the population.

1. Background

The four dengue (DEN) virus serotypes are the infectious agents responsible for the most important mosquito-borne viral disease in the world, affecting more than 100 countries including America, Africa and South East Asia.[1–4] Approximately 50–100 million cases are reported annually, of which 250,000–500,000 require hospitalization and 24,000 are fatal.[3,5,6]

DEN virus is a member of the *Flaviviridae* family, *Flavivirus* genus and is transmitted to humans mainly by the mosquito *Aedes aegypti*, which is distributed worldwide between latitudes 35° North and 35° South.[6]

The infection caused by the four serotypes of DEN virus may be asymptomatic or displays symptoms of a mild disease named dengue fever (DF), which is characterized by fever, headache with retro-orbital pain, arthralgia, myalgia, anorexia and occasionally a rash. Secondary infections are more likely to be associated with a more serious illness known as dengue haemorrhagic fever (DHF), which is characterized by bleeding that usually requires hospitalization. DHF can evolve to a dengue shock syndrome (DSS) that might be fatal.[4,5,7]

The number of cases of DEN has increased worldwide since the seventies[1,2,4,8] as a consequence of several factors such as invasion of virulent genotypes of the virus to new geographic areas,[2,9] and increased vector distribution as a result of unplanned and uncontrolled urbanization, migration of the rural population to the cities, inadequate wastewater management, and failure of the vector control programmes.[1,4,5,10,11]

The first DHF outbreak in Mexico occurred in 1995[10,11] and at the present time, DEN is an important public health problem in the country[12] where Oaxaca is one of the most endemic states

Abbreviations: DEN, dengue; DF, dengue fever; DHF, dengue haemorrhagic fever; DSS, dengue shock syndrome; LESPO, Laboratorio Estatal de Salud Pública de Oaxaca (Public Health Laboratory of Oaxaca); PAHO, Pan American Health Organization; WHO, World Health Organization.

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in Mexico. In 2008, 25,040 cases of DF and 6114 of DHF were reported and, among the 25 states affected, Oaxaca was ranked sixth.[13]

2. Objectives

To determine the distribution of DEN cases in the state of Oaxaca, Mexico, the virus serotypes circulating and the main age and gender groups affected during the period 2004–2006.

3. Study design

3.1. Dengue cases

Patients from all six sanitary jurisdictions with probable clinical manifestations of DEN virus infection were selected according to the Panamerican Health Organization (PAHO) guidelines[14] by the staff of the Public Health Laboratory of the state of Oaxaca (Laboratorio Estatal de Salud Pública, LESPO), Mexico. All cases detected during the years 2004, 2005 and 2006 were included. They were classified as DF or DHF according to PAHO criteria.[14]

3.2. DEN virus diagnosis

Blood samples from all patients with suspected clinical manifestations of DEN virus infection collected during the period 2004–2006 in Oaxaca were analysed by LESPO staff using the Dengue IgM Capture ELISA (E-DEN01M Panbio diagnostics)[15] to detect specific anti-DEN IgM antibodies. Only the positive (confirmed) cases were included in our study and they were sorted by gender, age, sanitary jurisdiction and severity (DF or DHF).

3.3. DEN virus serotyping

Serum samples received by LESPO during the year 2005 were used for serotyping. One hundred and nine blood samples that were obtained during the first 7 days of clinical onset and immediately stored in ice were included in this study. They were collected from clinically suspected cases of DEN infection according to PAHO guidelines[14] by LESPO staff with previous authorization from the patient. The blood cells were removed by centrifugation, and the serum was processed for viral RNA extraction. For purification of viral RNA, 200 μl of serum sample was placed in a 1.5 Eppendorf microtube, and 1 ml of TRIZOL® (Invitrogen) was added. The rest of the procedure was performed according to the manufacturer's instructions and the RNA was resuspended in nuclease-free water. Then it was treated with 10 U of RNAse-free DNAse (Roche) for 15 min at room temperature. The enzyme was inactivated at 80 °C for 20 min, and the RNA was precipitated with 2.5 volumes of 100% ethanol (Merck) and 0.1 volume of sodium acetate 3 M (Sigma) for 30 min at −70 °C. It was quantified in a spectrophotometer (Beckman model DU 650). The detection and the serotyping of the virus was performed with the RT-PCR Access kit® (Promega) using the nested RT-PCR method reported by Seah[16] and modified by Günther.[17] Briefly, the RT reaction was performed at 48 °C for 45 min followed by 35 PCR cycles of 94 °C for 30 s, 55 °C for 60 s and 68 °C for 60 s with a final cycle of 68 °C for 10 min using DV1 sense and DV1 anti-sense primers. The positive samples were subjected to 30 additional PCR cycles using specific primers for each DEN virus serotype (DSP1–DSP4) in the same conditions described above. All reactions were run in a PerkinElmer thermocycler (Geneamp PCR System 2400) and analysed by 2% agarose gel electrophoresis stained with ethidium bromide.

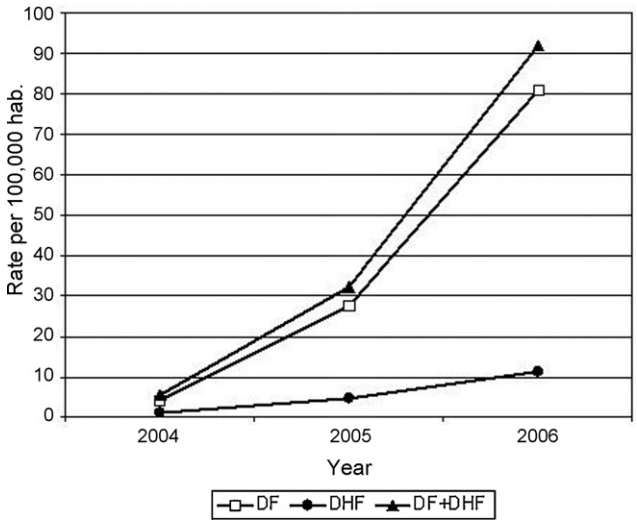

Fig. 1. Total number of DEN confirmed cases reported during the period 2004–2006. Rates per 100,000 habitants. DF, dengue fever; DHF, dengue haemorrhagic fever.

3.4. Statistical analysis

The data of confirmed cases of DEN were sorted by gender, age, and severity. The cases of DF and DHF in men and women from the same age group were organized in a 2×2 contingency table and analysed using the χ^2 (chi square) test and the SAS® software (U.S. Regional Offices, SAS Institute Inc. Headquarters, SAS Campus Drive, Cary, NC 27513-2414, USA), with one degree of freedom. A statistical difference was considered when $p < 0.05$.

4. Results

The information received by LESPO during the years 2004, 2005 and 2006 was collected, classified, and sorted. This period was selected because a significant gradual increment in the total number of cases of DEN in the state was notified compared with previous years.[18]

A substantial increase in the number of confirmed DF cases was observed, from 147 in 2004, to 970 in 2005 and 2836 in 2006, with rates per 100,000 inhabitants of 4.19, 27.66, and 80.87, respectively (Fig. 1). This means an increase of nineteen-fold (1830%) from year 2004 to 2006. For DHF the number of cases was lower but the pattern was similar, increasing from the 43 cases reported in 2004, to 164 in 2005 and 394 in 2006, with rates of 1.23, 4.68, and 11.23, respectively (increment of nine-fold, 813%) (Fig. 1). The state of Oaxaca includes six sanitary jurisdictions: I (Central Valley), II (Tehuantepec), III (Tuxtepec), IV (Pacific Coast), V (Mixteca) and VI (Mountains). During the period 2004–2006 the jurisdictions most affected by DEN virus were II, III, and IV, with rates per 100,000 inhabitants of 161.52, 62.56, and 437.13, respectively (Fig. 2). Sanitary jurisdiction number II occupied first place during the year 2005 with a rate of 95.52, number III during the year 2004 with 21.92, and number IV in 2006 with 437.13 (Fig. 2).

Jurisdictions I, II and IV had increasing numbers of DEN casualties during the period of study. For example, number IV had an increase of almost three hundred-fold (29,840%), number I seventy seven-fold (7586%) and number II eleven-fold (981%) (Fig. 2). Unfortunately, information about jurisdictions V and VI in 2004 was not available but, in general, they were less affected (Fig. 2).

The diagnosis method used by LESPO to confirm DEN cases in the state is the Dengue IgM Capture ELISA assay, which detects the presence of IgM-specific antibodies against DEN virus in the serum but is not able to determine the serotype involved. Therefore we analysed