Dengue in Grenada

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ABSTRACT

Objectives. Dengue fever is endemic in the country of Grenada and is grossly underreported as a source of morbidity. The goal of this study was to assess the status of dengue fever in a representative community in Grenada.

Methods. Surveys were conducted in the Mont Tout/Grand Anse Valley area in the parish of St. George’s from March to June 1996. The objectives of the survey were to: (1) to assess the knowledge, attitudes, and practices (KAP) of residents; (2) to determine the presence of larval and adult Aedes aegypti and their potential breeding sites; and (3) to identify the seroprevalence of specific immunoglobulin G (IgG) dengue antibodies in the local population.

Results. Out of the 102 respondents to the KAP survey, 100 of them (98%) reported never having had dengue fever. Of the 75 persons who agreed to have blood samples taken, 70 of them (93%) (95% confidence interval = 85.1%–97.8%) tested positive with the IgG enzyme-linked immunosorbent assay, indicating past exposure. In terms of water storage, 98 of 102 respondents (96%) stored fresh water in containers. The vector survey found 57 of the 102 households (56%) had Ae. aegypti larvae in water containers on their property, and 94 of 102 dwellings (92%) had adult Ae. aegypti mosquitoes indoors.

Conclusions. Although many people were familiar with dengue fever and mosquitoes, the 1996 survey found that their knowledge of the important relationships among mosquitoes, human behavior, and disease transmission was incomplete. Since 1996, continued education efforts have been made in the public school system and with national public health campaigns, yet little effort has been specifically targeted towards our study community. These data suggest Grenada has a need for continued community education that addresses dengue fever transmission and Ae. aegypti reduction.

Key words Dengue; Aedes; health knowledge, attitudes, practice; mosquito control; Grenada.

Dengue fever is a significant source of morbidity and mortality worldwide, annually affecting millions of people. The mosquito vector, Aedes aegypti, is peridomestic and lays its eggs in standing fresh water, most often found in a variety of containers. There are four known serotypes of dengue virus: DEN-1, DEN-2, DEN-3, and DEN-4. These are single-stranded RNA viruses of the family Flaviviridae. Between 1947 and 1972 the Pan American Health Organization (PAHO) succeeded in eliminating Ae. aegypti from 23 countries in the American tropics, but reduced funding allowed the mosquito to reclaim its lost territory by 1993 (1). With renewed fear of a dengue epidemic, public health officials developed education programs in the school systems as well as public health media campaigns.

Clinical manifestations of dengue fever vary in severity, from generalized myalgias to the classic symptom of retro-orbital pain. Although rare,
dengue hemorrhagic fever may result in death due to changes in the coagulation cascade (2). The primary infection is often asymptomatic or nonspecific in childhood (3), yet subsequent infections in adulthood may cause significant morbidity. This broad range of disease severity frequently creates problems in determining the true prevalence of infection in a community. The real level can be several-fold higher than official estimates, as often only the most severe cases are documented (4).

Dengue fever has been endemic in the three-island country of Grenada for decades. In 1956 a report indicated that dengue fever was prevalent in major coastal towns such as Gouyave, with fewer cases in smaller coastal communities (Grand Anse, Pearls) and with isolated cases in the interior parts of the country's main island, Grenada (5). The incidence of dengue fever in the country has waxed and waned in the past decade. In 1995, PAHO documented 74 cases of dengue fever caused by DEN-1, with one case of dengue hemorrhagic fever (DHF). Although cases decreased during the next four years, there was a resurgence in 1999, when 85 cases of DEN-2 were reported. Further increases occurred in 2002, when there were 264 cases of DEN-3 and 3 cases of DHF. As of week 39 of 2003 there had been no cases of dengue fever, household waste management, water supply, and household pest control.

The study was first approved through the institutional review board of the Windward Islands Research and Education Foundation. One investigator (AP) conducted all the questionnaire-based interviews. A second researcher (ERL) did yard inspections and counted potential water-collecting containers inside and outside dwellings as well as within 10–15 feet (3.0–4.6 m) of them. ERL also sampled for adult mosquitoes within the homes, using a modified Centers for Disease Control and Prevention (CDC) backpack aspirator (8). Each mosquito was frozen at −20 °C until identification was accomplished using a dissecting microscope.

The area of Mont Tout/Grand Anse Valley (National Census Enumeration District 05-5) is in St. George’s parish. The area was chosen for two reasons: (1) it had one of the highest densities of residential dwellings on the island and (2) it was serviced by an unreliable water supply that consisted of several standpipes for the majority of residents, with some residences benefiting from direct water line access into the home. The area is located in the southern tip of the island, which receives less rainfall than the interior. Originally a sugar plantation, it developed, without master planning, over two generations into a community of single-family homes as new light-manufacturing facilities and tourist hotels were built within walking distance. A construction and population boom occurred in 1985, leading to inadequate capacity in the water supply. At the time of the 1996 survey the residents described the water supply as intermittent, requiring them to store water for household needs.

For our 1996 study every household within the area was surveyed. If no one was home, we returned, often several times, until we found an occupant. Everyone we approached regarding the survey was eager to participate. Surveys were conducted between the hours of 8:00 a.m. and 5:00 p.m., from March 1996 through June 1996.

The seroprevalence survey was offered voluntarily to each person in each household. With a lancet, participants had blood drawn, which was then placed into 2-mL cryotubes and placed into a cooler filled with ice. At the end of each survey day, the samples were spun down at 3 500 rpm on a benchtop centrifuge for 10 minutes and stored at −20 °C until further testing was done at the Dengue Branch of the Division of Vector-Borne Infectious Diseases of the United States Centers for Disease Control and Prevention. The Dengue Branch is located in the city of San Juan, Puerto Rico. IgG enzyme-linked immunosorbent assay tests were conducted using a previously standardized protocol (9–12).

Data were keyed and entered into SPSS statistical analysis software (SPSS Inc., Chicago, Illinois, United States). Following the testing, letters were sent to all the participants, informing them of their test results, along with educational material to help them protect themselves and their families from mosquitoes and dengue fever.

RESULTS

During the survey period, 102 residents participated in the questionnaire, the breeding site survey, and the indoor mosquito aspiration. The KAP survey found that 93 of 102 respondents (91%) were familiar with the name of the disease, dengue fever. However, 69 of 102 (68%) were unfamiliar with the symptoms, and only 15 of 102 (15%) named fever. Two-thirds of the residents (68 of 102, or 67%) could name mosquitoes as the vector of dengue fever, yet only 3 of 102 (3%) could identify *Ae. aegypti*. The vast majority of the respondents—100 of 102
In terms of mosquito control, a large majority of households—80 of 102 (78%)—used methods that were more expensive than source reduction. These methods included insecticides and such other chemical means as mosquito coils and bug mats (electric burners with pads that vaporize pyrethrum).

The vector survey found 57 of 102 households (56%) had *Ae. aegypti* larvae in water containers within 15 feet (4.6 m) of the dwelling. Indoors, 94 of 102 dwellings (92%) contained adult *Ae. aegypti* mosquitoes, while 81 of 102 (79%) also harbored *Culex quinquefasciatus*. The most common breeding sites found around homes were 55-gallon metal drums, which were found positive for *Ae. aegypti* in 65 of 102 (64%) yards. Relatively few tires were seen. Homes with both a negative yard survey and a negative indoor survey accounted for only 5 of 102 households (5%).

The adults in the local community were very resistant to having blood drawn. However, after the risks and benefits were discussed, 75 of the participants, including several children, agreed to provide a blood sample. The age of the persons providing a sample ranged from 7 to 70 years, with a mean of 35 years. A total of 70 of the 75 blood samples drawn (93%, 95% confidence interval = 85.1%–97.8%) were positive for dengue IgG antibodies, with 34 positive females and 36 positive males. Of the five individuals who tested negative, three were siblings under 12 years old, one was a 27-year-old who had recently arrived in the area, and one was a 1-year-old child.

**DISCUSSION**

The data from our study suggest a lack of community understanding of the key interrelationships of exposure to dengue, knowledge about dengue, and information about prevention of the disease. The vast majority of the people surveyed did not expect to have been exposed to dengue fever in the past or to have had a family member who was exposed. Similar results were found in studies completed in Grenada in 1993 and in Trinidad and Tobago in 1995 (13, 14). In our 1996 survey in Grenada, fever was the most commonly mentioned symptom, but symptoms such as retro-orbital pain and myalgias and arthralgias were rarely mentioned. Two-thirds of the respondents identified mosquitoes as the vector of dengue fever, but a noticeable portion of the respondents could not identify the species of mosquito involved in the transmission cycle or relate the causative mosquito to specific breeding sites and thus possible control measures. The most common mosquito control methods used were options that were more expensive than source reduction. This pattern was probably due to differences in source reduction among nearby households.

Water is the major factor in *Ae. aegypti* proliferation (15, 16). Barrera (17) found a correlation between the frequency of water supply problems and *Ae. aegypti* infestation. These problems were solved by using different types of water storage containers. In our 1996 Grenada survey many people used covered buckets to store small amounts of drinking water, while nearby there were often one or two covered 55-gallon drums for storing larger amounts of water for washing or other household uses. An interesting difference between the questionnaire and the vector survey was noted in terms of these 55-gallon drums. Many respondents did not recognize the drums as frequently used water containers. That was in spite of the fact that the drums were ubiquitous throughout the survey area, supplying residents with ready access to potable water that they could not obtain from the public water supply. The drums were commonly covered with corrugated tin, which did not inhibit mosquitoes but did prevent larger material from falling in.

The high seroprevalence (93%) of dengue IgG antibodies in our survey population suggests a high level of endemicity for dengue viruses. While the DEN-4 serotype has not been identified in the Grenadian population, its presence could create optimal conditions for epidemics and an increased
incidence of DHF, as has been seen in Southeast Asia (18).

The control of dengue fever in the country of Grenada is complicated by difficulty in reducing both the vector population and the number of viremic hosts. An effective, laboratory-based surveillance system for the country has been put in place, assisted primarily by the establishment in January of 2001 of a dengue diagnostic laboratory at the Windward Islands Research and Education Foundation, which is located just south of the city of St. George’s, Grenada. With the capacity to quickly identify the arrival of new serotypes, the Ministry of Health of Grenada can alert the medical community and more effectively mobilize limited vector control resources to areas that are most affected. This will allow for more efficient and rapid vector and viremic host reduction (19). A stepwise approach is needed to break the cycles of epidemics that occur in Mont Tout/Grand Anse Valley. The first step of this approach requires the local population to acknowledge the presence of the pathogen.

Education has been the mainstay of local dengue fever prevention in Grenada for several decades. Andre Worme, the Acting Chief of the Department of Environment of the Ministry of Health (personal communication, 8 December 2004), noted that programs targeting schoolchildren have been the method preferred by the Ministry of Health to improve community awareness. Often, but not always, this information is communicated vertically to parents and other older members of the immediate family. Unfortunately, little community intervention has been conducted in the community in Grenada as well as to suggest potential areas for further community education, such as increasing the residents’ awareness of the mosquito species and limiting mosquito access to fresh water. Although sizable resources have been used on school-based prevention programs, local community involvement has been minimal. It is essential to work with leaders in the local community in order to create a sense of ownership and to motivate the entire community to take an active role in partnership with Government health agencies. It is commendable for individual families to work at mosquito control, such as by buying and using insecticides. However, that requires more resources than would be needed with source reduction techniques. The post-hurricane rebuilding effort will hopefully result in a critical reanalysis of the community water supply as well as a reassessment of the importance of debris around homes and of potential mosquito breeding sites. People have formed their own understanding of dengue from official Government sources, the media, and local community opinion. However, it is important to continue education programs and community involvement to prevent the cycle of transmission. This will improve the health of the community that we surveyed, the country of Grenada, and the other nations of the Caribbean basin.

CONCLUSIONS

This study demonstrates the very common, yet serious, problem of attempting to protect a population from a disease that is not perceived to be a threat. Similar attitudes towards a variety of infectious diseases can be found in many developing nations.

Our combined KAP, vector, and seroprevalence survey was the first to demonstrate the intimate association among mosquitoes, human behavior, and dengue fever transmission in a

REFERENCES

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Objetivos. La fiebre del dengue es endémica en el país caribeño de Granada y es grande su subnotificación como fuente de morbilidad. El objetivo del presente estudio fue evaluar la situación del dengue en una comunidad representativa de ese país.

Métodos. Se llevaron a cabo encuestas en la zona del valle de Mont Tout y de Grand Anse, en la parroquia de St. George’s, de marzo a junio de 1996. Los objetivos de las encuestas fueron: 1) explorar los conocimientos, actitudes y prácticas (CAP) de los habitantes; 2) determinar la presencia de formas larvarias y adultas de Ae. aegypti en posibles criaderos, y 3) identificar la seroprevalencia de inmunoglobulina G (IgG) con actividad específica contra el virus del dengue en la población local.

Resultados. De las 102 personas que respondieron la encuesta de CAP, 100 (98%) indicaron que nunca habían padecido de fiebre del dengue. De las 75 personas que consintieron que se les sacaran muestras de sangre, 70 (93%) (intervalo de confianza de 95% = 85,1%–97,8%) tuvieron resultados positivos en la prueba de inmunoadsorción enzimática para la detección de IgG, señal de que habían tenido una exposición anterior. En lo que respecta al almacenamiento del agua, 98 de las 102 personas (96%) encuestadas almacenaban agua fresca en recipientes. La encuesta de vectores reveló que en 57 de las 102 viviendas (56%) había larvas de Ae. Aegypti en recipientes de agua en el interior.

Conclusones. A pesar de que muchas personas estaban familiarizadas con la fiebre del dengue y el mosquito vector, la encuesta de 1996 reveló en ellas conocimientos incompletos acerca de las relaciones importantes entre los mosquitos, los hábitos del ser humano y la transmisión de la enfermedad. Desde 1996 se han puesto en marcha de continuo iniciativas educativas en las escuelas públicas y mediante campañas sanitarias a escala nacional, pero pocas han estado dirigidas específicamente a la comunidad aquí estudiada. Estos datos indican que el país de Granada necesita un sistema de educación comunitaria continua que se oriente a reducir la transmisión de la fiebre del dengue y la población de Ae. aegypti.

Palabras clave: Dengue; Aedes; conocimientos, actitudes y prácticas en salud; control de mosquitos; Grenada.