INTRODUCTION

The epidemiology of zoonotic infections within the Caribbean region is currently poorly understood. A limited number of studies have focused on zoonotic pathogens of humans and livestock and include a review of tick-borne transmission of rickettsial agents and studies on *Rickettsia africae* in livestock on eight Caribbean islands. Other studies have identified dengue virus (a mosquito-borne arbovirus) and leptospirosis on 10 English-speaking Caribbean countries. Sera from healthy, pregnant women were collected from Antigua-Barbuda, Belize, Bermuda, Dominica, Grenada, Jamaica, Montserrat, St. Kitts-Nevis, St. Lucia, and St. Vincent-Grenadines and tested for the presence of IgG antibodies to dengue virus, hepatitis E virus, hantaviruses, leptospiral agents, spotted fever group rickettsiae (SFGR), typhus group rickettsiae (TGR), and *Coxiella burnetii* (Q fever). The highest seroprevalence values were observed for dengue virus, SFGR, and leptospirosis, although the lowest seroprevalence values were observed for hepatitis E virus, *C. burnetii*, and TGR. Antibodies to hantaviruses were not detected in any individuals.

METHODS

From 2009 to 2011, blood samples were collected from up to 50 healthy, pregnant women from the following countries: Antigua-Barbuda, Belize, Bermuda, Dominica, Grenada, Jamaica, Montserrat, St. Kitts-Nevis, St. Lucia, and St. Vincent-Grenadines. This study was approved by the ethics committees of St. George’s University, Grenada and the University of Laval, Quebec, Canada. Informed consent was obtained from all participants. All samples were processed at Ross University School of Veterinary Medicine (RUSVM) in St. Kitts. A total of 442 serum samples were tested for IgG antibodies against *Coxiella burnetii* (Q fever). The highest seroprevalence values were consistent with previous studies indicating the nature of flavivirus antibodies, it is possible that a portion of the dengue seropositive specimens may be associated with exposure to other flaviviruses. However, the results from this study are consistent with previous studies indicating extensive circulation of dengue virus serotypes throughout the Caribbean.

RESULTS

The majority of individuals enrolled in this study were positive for IgG antibodies to dengue virus, with an overall seroprevalence of 83.0 ± 3.5%. Table 1. Seroprevalence values of 80–100% were observed for all countries except Bermuda (8%) and Belize (36%). This suggests that the risk for dengue exposure in these countries may be lower than in the others studied. Because of the cross-reactive nature of flavivirus antibodies, it is possible that a portion of the dengue seropositive specimens may be associated with exposure to other flaviviruses. However, the results from this study are consistent with previous studies indicating extensive circulation of dengue virus serotypes throughout the Caribbean.

A high seroprevalence to SFGR was detected throughout the countries studied. Overall, 33.5 ± 4.4% of the samples displayed a titer of ≥ 64 when *Rickettsia rickettsii* was used as the antigen. All samples reactive at a titer of ≥ 64 to SFGR were non-reactive against *R. typhi* antigen, indicating
that the serological response was specific to SFGR. In contrast to SFGR, a very low seroprevalence of 1.6 ± 1.2% for TGR was detected. However, the seroprevalence of leptospirosis was 18.6 ± 3.6% overall, with seropositive individuals detected in all countries studied, suggesting ongoing circulation of \textit{Leptospira} species throughout the region. The seroprevalences of HEV (1.4 ± 1.1%) and \textit{C. burnetii} (2.3 ± 1.4%) were low and no individuals were seropositive for hantaviruses.

**DISCUSSION**

This is the first study to examine the seroprevalence of a variety of bacterial and viral zoonotic agents in inhabitants of 10 Caribbean countries. Overall, the highest seroprevalence values were documented for dengue viruses, SFGR, and leptospirosis, whereas lower values were shown for HEV, TGR, and Q fever, and no individuals were found seropositive for exposure to hantaviruses (Table 1).

Dengue virus is one of the world’s most important mosquito-borne viruses and the Caribbean region has experienced a major surge in activity. Dengue virus can circulate in sylvatic cycles involving non-human primates and can therefore be considered zoonotic; however, most transmission occurs in urban cycles involving only humans and mosquitoes. Nevertheless, the importance of this virus as a major vector-borne pathogen justified its inclusion in this study and the high degree of seroprevalence observed is consistent with previous studies showing the hyperendemic nature of its circulation in the Caribbean. The results from this study agree with a recent publication on the prevalence of dengue virus antibody in healthy Jamaicans in which 100% of participants were seropositive.

Leptospirosis is an emerging bacterial zoonosis that has a greater incidence in tropical areas where conditions for transmission are favorable and many wild and domestic animals serve as reservoirs. Transmission to humans is usually by contact with water contaminated by animal urine and dengue-like febrile illness may result from infection. The results described here are consistent with recent studies that indicate that suspect dengue cases may actually be associated with \textit{Leptospira} infection and exposure rates may be higher in the Caribbean than previously believed.

\textit{Coxiella burnetii} is endemic worldwide and is transmitted to humans usually by contamination of the environment with the birth products from infected sheep, goats, or cattle. Acute Q fever typically presents as a flu-like illness with fever and headache, and some patients may present with pneumonia or hepatitis. In this study, the overall seroprevalence was determined to be 2.3% among women living in the Caribbean, using a cutoff of ≥ 64 for the determination of seropositivity. Interestingly, our results are consistent with the seroprevalence of Q fever in the United States, which was determined to be 3.1% among healthy adults, although the seroprevalence was higher in men (3.8%) than women (2.5%).

Previous studies have shown that \textit{R. africae}-infected \textit{Amblyomma variegatum} ticks are widespread in the Caribbean. However, only one human serosurvey has been published involving individuals from the Caribbean. In a study conducted in Guadeloupe, 49% of individuals tested had antibody titers of ≥ 50 to \textit{R. africae}, and the prevalence in men was significantly higher than in women (66% in men versus 39% in women at a titer of ≥ 50). Seroprevalence values among women in both the serosurvey from Guadeloupe and this study are consistent (39% versus 33.5%, respectively), suggesting a high rate of exposure to infected tick vectors within the Caribbean region. These results are also consistent with other studies that have found a high prevalence of \textit{R. africae} in \textit{Amblyomma variegatum} ticks in several Caribbean countries, such as Guadeloupe, St. Kitts-Nevis, Dominica, Montserrat, St. Lucia, and Antigua, with infection rates ranging from 7% to over 50% of all \textit{A. variegatum} ticks tested.

A low seroprevalence rate (1.6%) was observed for typhus group rickettsiae, suggesting that these are not common infections in the Caribbean. \textit{R. typhi} is the etiological agent of murine typhus, and is typically transmitted to humans via rat fleas with rodents serving as the primary reservoir. Although considered endemic worldwide, and prevalent in the coastal areas of tropical and subtropical regions, the results from this study suggest that \textit{R. typhi} is not a common zoonotic agent in the countries included in this study.

Hepatitis E is endemic in regions of poor sanitation and has been chiefly associated with cases in Africa, Asia, the Mediterranean, Mexico and South America. Several Caribbean countries have reported HEV circulation, but viral characterization has been limited. Although the transmission of the virus is primarily fecal–oral through contaminated water, there is also evidence of zoonotic transmission in certain cases. Recent studies have investigated swine, including pork meat, as a source of zoonotic hepatitis E infection.

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**Table 1** Seroprevalence of zoonotic pathogens in pregnant women from 10 Caribbean Islands*

<table>
<thead>
<tr>
<th>Country</th>
<th>Dengue virus</th>
<th>Hantaviruses</th>
<th>Hepatitis E virus</th>
<th>Leptospira species</th>
<th>SFGR</th>
<th>TGR</th>
<th>C. burnetii</th>
</tr>
</thead>
<tbody>
<tr>
<td>Antigua-Barbuda</td>
<td>94.7 ± 7.1</td>
<td>ND</td>
<td>ND</td>
<td>10.5 ± 9.8</td>
<td>ND</td>
<td>ND</td>
<td>5.3 ± 6.6</td>
</tr>
<tr>
<td>Belize</td>
<td>36.0 ± 13.3</td>
<td>ND</td>
<td>ND</td>
<td>8.0 ± 7.5</td>
<td>ND</td>
<td>ND</td>
<td>ND</td>
</tr>
<tr>
<td>Bermuda</td>
<td>8.0 ± 7.5</td>
<td>ND</td>
<td>ND</td>
<td>12.0 ± 9.0</td>
<td>ND</td>
<td>ND</td>
<td>ND</td>
</tr>
<tr>
<td>Dominica</td>
<td>98.0 ± 3.9</td>
<td>ND</td>
<td>ND</td>
<td>16.0 ± 10.2</td>
<td>ND</td>
<td>ND</td>
<td>ND</td>
</tr>
<tr>
<td>Grenada</td>
<td>98.0 ± 3.9</td>
<td>ND</td>
<td>ND</td>
<td>2.0 ± 3.8</td>
<td>ND</td>
<td>ND</td>
<td>ND</td>
</tr>
<tr>
<td>Jamaica</td>
<td>100.0 ± 0.0</td>
<td>ND</td>
<td>ND</td>
<td>2.1 ± 4.1</td>
<td>ND</td>
<td>ND</td>
<td>ND</td>
</tr>
<tr>
<td>Montserrat</td>
<td>80.0 ± 20.2</td>
<td>ND</td>
<td>ND</td>
<td>20.0 ± 20.2</td>
<td>ND</td>
<td>ND</td>
<td>ND</td>
</tr>
<tr>
<td>St. Kitts-Nevis</td>
<td>100.0 ± 0.0</td>
<td>ND</td>
<td>ND</td>
<td>9.1 ± 8.5</td>
<td>ND</td>
<td>ND</td>
<td>ND</td>
</tr>
<tr>
<td>St. Lucia</td>
<td>97.0 ± 4.1</td>
<td>ND</td>
<td>ND</td>
<td>19.6 ± 11.5</td>
<td>ND</td>
<td>ND</td>
<td>ND</td>
</tr>
<tr>
<td>St. Vincent-Grenadines</td>
<td>94.0 ± 6.6</td>
<td>ND</td>
<td>ND</td>
<td>2.0 ± 3.9</td>
<td>ND</td>
<td>ND</td>
<td>ND</td>
</tr>
<tr>
<td>All countries</td>
<td>83.0 ± 3.5</td>
<td>ND</td>
<td>ND</td>
<td>1.4 ± 1.1</td>
<td>ND</td>
<td>ND</td>
<td>2.3 ± 1.4</td>
</tr>
</tbody>
</table>

*CI = confidence interval; ND = not detected.
results from this study indicate a low prevalence of antibody in the individuals tested (although the possibility that these results may represent false-positives cannot be ruled out); however, the possible route(s) of transmission of this virus requires further study.

Hantaviruses are rodent-borne and contribute to significant numbers of cases associated with hemorrhagic fever and pulmonary syndromes. Antibodies to hantaviruses were not detected in any of the samples analyzed in this study; this is in contrast to a recent study that showed significant exposure rates among farm and abattoir workers in Trinidad. Further investigations to evaluate the risk for hantavirus infection in the Caribbean are thus warranted.

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REFERENCES


