Adult Susceptibility to Varicella in the Tropics Is a Rural Phenomenon Due to the Lack of Previous Exposure

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In the industrialized countries of the West, varicella is largely a childhood disease, whereas reports from tropical countries indicate a significant incidence of varicella among adults. High ambient temperature, epidemiologic interference from other viruses, and race have been blamed. We tested our hypothesis that less exposure to varicella-zoster virus (VZV) during childhood in rural areas accounts for the reported greater frequency of varicella in adults in tropical climates by comparing rates of VZV seropositivity among urban and rural adult Bengalee populations living in identical climatic conditions in India. Only 5 (3.4%) of 153 urban adults were seronegative compared with 74 (31.1%) of 246 rural adults. Ninety-six percent of urban adults were immune by the age of 25, compared with 42% in the rural group. The results suggest that higher adult susceptibility to varicella is seen only in rural areas of the Tropics and is due to reduced transmission of VZV.

Currently, there is considerable epidemiologic interest in the geographic variation observed in the age-related susceptibility to varicella-zoster virus (VZV). In the industrialized countries of the West, varicella is largely limited to childhood. Epidemiologic and serologic studies in the United Kingdom [1], the United States [2], Canada [3], Switzerland [4], Spain [5], Czechoslovakia [6], and Japan [7] have consistently shown that >90% of adults are immune to infection with VZV. However, numerous reports point to a different age-distribution pattern for VZV infection in developing countries in the Tropics. Some reports are based on surveys of antibody to varicella.

Sera from an age-stratified sample of 1810 people on the Caribbean island of St. Lucia showed that <10% of the population had experienced VZV infection before the age of 15 years, and the proportion rose to >70% by the age of 40 [8]. In a seroepidemiologic survey in Singapore conducted during 1989–1990, 40% of persons in the 15- to 24-year-old age group (sample size 100) and >80% in the 25- to 34-year-old age group (sample size 50) had evidence of past infection [9]. Only 30% of student nurses who were 17 to 20 years old possessed complement-fixing antibodies to VZV antigen in Vellore, India [10]. In a serologic survey of pregnant women, the proportion with VZV antibodies was 84% for 51 women born in the Tropics and 95% for 88 women in the United States [11].

There are also many clinical studies that report a high rate of varicella among adults in hospitals [10, 12, 13] and communities [14, 15] in the Tropics. Finally there are reports of outbreaks of varicella among immigrants and refugees from the tropical countries, such as Sri Lanka, India [16], the Philippines [17], and Puerto Rico [18].

Because of these reports, there is now a general belief that varicella among adults is universally common in tropical countries. Various hypotheses have been put forward as explanations for the contrasting epidemiologic scenes between the industrialized countries of the temperate north and the developing countries of the warmer south. It has been suggested that the high ambient temperature of the Tropics inactivates VZV in cutaneous lesions thereby lessening its transmission potential [8]. Sinha [15] postulated the concept of epidemiologic interference by the high prevalence of certain childhood viruses in the developing countries; the interference postponed the age of varicella infection. Dworkin [19] felt that race could be a possible factor; he referred to four studies, involving US Army and Navy personnel, the results of which suggested that black persons were more susceptible than white persons to varicella in adulthood [20–23].

In the current study, we looked at an alternative hypothesis, postulating that the higher adult susceptibility observed in tropical countries is a rural phenomenon and results from a lack of exposure to VZV because of rural living conditions in the Tropics where VZV circulates poorly. Most reports of higher infection rate in adults have involved either rural or island communities. To our knowledge, the VZV experience of urban and rural communities in the Tropics has not been compared. We tested our hypothesis by comparing the susceptibility to varicella in 2 groups of adults from the same ethnic and cultural background who were living in a geographically limited area with uniform weather conditions; however, 1 group lived in an urban area, and the other lived in rural conditions.

Materials and Methods

The study was conducted in West Bengal, India, during the autumn and winter of 1995 and 1996. Blood samples were obtained...
Table 1. VZV antibody prevalence in urban and rural populations, according to age group.

<table>
<thead>
<tr>
<th>Age (years)</th>
<th>Urban group</th>
<th>Rural group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No. tested</td>
<td>No. positive (%)</td>
</tr>
<tr>
<td>≤25</td>
<td>24</td>
<td>23 (96)</td>
</tr>
<tr>
<td>26–44</td>
<td>31</td>
<td>29 (93)</td>
</tr>
<tr>
<td>Over 44</td>
<td>98</td>
<td>96 (98)</td>
</tr>
<tr>
<td>Total</td>
<td>153</td>
<td>148 (96.6)</td>
</tr>
</tbody>
</table>

* By χ² test.

from 399 adults (>16 years). Of the samples, 153 were from the urban group—patients (77 males, 76 females) attending the outpatient clinics of two large teaching hospitals in Calcutta. Members of the urban group were poor or lower middle-class and lived in slums or overcrowded houses in the northern part of the city. The rural group comprised 246 patients (108 men, 138 women) who were attending a primary health center serving a cluster of six villages with a population of 4000–5000 each. The villages were near the border with Bangladesh, 70 km from Calcutta. The nearest railway station was 25 km away.

All participants were Bengalees who were long-term residents of their areas (urban or rural). None of them were known to be in the acute or convalescent stage of chickenpox at the time of blood collection. VZV antibodies were measured using a specific IgG ELISA kit (Human Ltd., Taunstein, Germany), and positive or negative status was determined according to the manufacturer’s instructions.

Discussion

The results of our study suggest that a significant number of adults in rural West Bengal do not contract varicella until they are adults, whereas, most urban adults are immune as a result of earlier infection. The seropositivity rate of the urban group is comparable to that seen in Western countries. This difference in susceptibility to varicella between urban and rural Bengalees, who lived within a small geographically homogeneous area, cannot be explained on the basis of high ambient temperature, epidemiologic interference from other viruses, or race. The most likely explanation is that urban living conditions in the Tropics allow early exposure to VZV much the same way as in industrialized countries of the temperate north. However, in the less populated rural communities in the Tropics, the virus is less successful in its transmission and circulation between households, allowing a greater number of children to reach adulthood without coming into contact with VZV.

Although to our knowledge there have been no previous studies comparing VZV susceptibility of urban and rural populations in a warm climate, studies in temperate climates have clearly shown the effects of urbanization on the transmission of varicella in communities. For example, in Massachusetts, the effects of increasing urbanization in the post–World War II period were reflected by a fall in the age at which most children acquired varicella [24]. Compared with measles, VZV is a less efficient virus [25], and closer proximity is more important for its transmission than for measles. Among close contacts in household settings, infectivity of VZV is 80% of that for measles, but in communities, it falls to 35%–65% [26]. Frequency and closeness of social interactions are therefore more important for varicella than for measles, which is easily transmitted among both close contacts and casual acquaintances. In many tropical countries, such interactions occur much less frequently in rural communities, where most people still live.

It is noteworthy that most reports of high adult susceptibility to varicella from the Tropics have involved either island or village communities, have not inquired into the residential background of the subjects studied, or have been based on an observation of a relatively high age among varicella cases in hospitals or communities (and thus were likely to be biased, since severity of varicella increases with age and only severe cases are likely to have access to scarce hospital facilities in resource-starved countries). We thus feel that less exposure during childhood in rural areas rather than temperature or race accounts for the reported greater frequency of adult varicella in the Tropics.

It may be argued that overcrowding in Calcutta households compensated for VZV’s diminished ability to spread in a warmer climate. This latter notion, however, is unsupported by any epidemiologic evidence. Climatic factors per se do not
seem to affect the transmission of varicella in temperate climates since the infectiousness of varicella in household contacts is the same throughout the year [25]. Studies of attack rates in urban and rural households in tropical climates (and how they compare with the Western experience) will help in the decision as to whether crowding and weather have anything to do with the observed differences in age-related susceptibilities to VZV in urban and rural populations in the Tropics.

References


