West Nile Virus Epidemic, Northeast Ohio, 2002

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Serum samples and sociodemographic data were obtained from 1,209 Ohio residents. West Nile virus immunoglobulin M (IgM) and IgG antibodies were detected by enzyme-linked immunosorbent assay and confirmed. Children were 4.5 times more likely to become infected yet 110 times less likely to have neuroinvasive disease develop.

Since its 1999 North American introduction, West Nile virus (WNV) has emerged as an important cause of illness and death. Although several at-risk populations have been identified, older age remains the major risk factor for developing encephalitis after infection (1–4).

WNV rapidly spread across the United States, resulting in intense epidemic activity in Louisiana, Illinois, Michigan, and Ohio in 2002; Colorado in 2003; and Arizona and California in 2004 (5,6). In Ohio, WNV infections were first recognized in animals in 2001. In 2002, Ohio reported 341 human cases of WNV encephalitis or meningitis (West Nile neuroinvasive disease [WNND]), incidence: 28 cases/million population) with 31 deaths. In meningitis (West Nile neuroinvasive disease [WNND], Ohio reported 341 human cases of WNV encephalitis or meningitis (West Nile neuroinvasive disease [WNND]), incidence: 28 cases/million population) with 31 deaths. In meningitis (West Nile neuroinvasive disease [WNND], Ohio reported 341 human cases of WNV encephalitis or meningitis (West Nile neuroinvasive disease [WNND]), incidence: 28 cases/million population) with 31 deaths. In meningitis (West Nile neuroinvasive disease [WNND], Ohio reported 341 human cases of WNV encephalitis or meningitis (West Nile neuroinvasive disease [WNND]), incidence: 28 cases/million population) with 31 deaths. In meningitis (West Nile neuroinvasive disease [WNND], Ohio reported 341 human cases of WNV encephalitis or meningitis (West Nile neuroinvasive disease [WNND]), incidence: 28 cases/million population) with 31 deaths. In meningitis (West Nile neuroinvasive disease [WNND], Ohio reported 341 human cases of WNV encephalitis or meningitis (West Nile neuroinvasive disease [WNND]), incidence: 28 cases/million population) with 31 deaths. In meningitis (West Nile neuroinvasive disease [WNND], Ohio reported 341 human cases of WNV encephalitis or meningitis (West Nile neuroinvasive disease [WNND]), incidence: 28 cases/million population) with 31 deaths. In meningitis (West Nile neuroinvasive disease [WNND], Ohio reported 341 human cases of WNV encephalitis or meningitis (West Nile neuroinvasive disease [WNND]), incidence: 28 cases/million population) with 31 deaths. In meningitis (West Nile neuroinvasive disease [WNND], Ohio reported 341 human cases of WNV encephalitis or meningitis (West Nile neuroinvasive disease [WNND]), incidence: 28 cases/million population) with 31 deaths. In meningitis (West Nile neuroinvasive disease [WNND], Ohio reported 341 human cases of WNV encephalitis or meningitis (West Nile neuroinvasive disease [WNND]), incidence: 28 cases/million population) with 31 deaths. In meningitis (West Nile neuroinvasive disease [WNND], Ohio reported 341 human cases of WNV encephalitis or meningitis (West Nile neuroinvasive disease [WNND]), incidence: 28 cases/million population) with 31 deaths. In meningitis (West Nile neuroinvasive disease [WNND], Ohio reported 341 human cases of WNV encephalitis or meningitis (West Nile neuroinvasive disease [WNND]), incidence: 28 cases/million population) with 31 deaths. In meningitis (West Nile neuroinvasive disease [WNND], Ohio reported 341 human cases of WNV encephalitis or meningitis (West Nile neuroinvasive disease [WNND]), incidence: 28 cases/million population) with 31 deaths. In meningitis (West Nile neuroinvasive disease [WNND], Ohio reported 341 human cases of WNV encephalitis or meningitis (West Nile neuroinvasive disease [WNND]), incidence: 28 cases/million population) with 31 deaths. In meningitis (West Nile neuroinvasive disease [WNND], Ohio reported 341 human cases of WNV encephalitis or meningitis (West Nile neuroinvasive disease [WNND]), incidence: 28 cases/million population) with 31 deaths. In meningitis (West Nile neuroinvasive disease [WNND], Ohio reported 341 human cases of WNV encephalitis or meningitis (West Nile neuroinvasive disease [WNND]), incidence: 28 cases/million population) with 31 deaths. In meningitis (West Nile neuroinvasive disease [WNND], Ohio reported 341 human cases of WNV encephalitis or meningitis (West Nile neuroinvasive disease [WNND]), incidence: 28 cases/million population) with 31 deaths. In meningitis (West Nile neuroinvasive disease [WNND], Ohio reported 341 human cases of WNV encephalitis or meningitis (West Nile neuroinvasive disease [WNND]), incidence: 28 cases/million population) with 31 deaths. In meningitis (West Nile neuroinvasive disease [WNND], Ohio reported 341 human cases of WNV encephalitis or meningitis (West Nile neuroinvasive disease [WNND]), incidence: 28 cases/million population) with 31 deaths. In meningitis (West Nile neuroinvasive disease [WNND], Ohio reported 341 human cases of WNV encephalitis or meningitis (West Nile neuroinvasive disease [WNND]), incidence: 28 cases/million population) with 31 deaths. In meningitis (West Nile neuroinvasive disease [WNND], Ohio reported 341 human cases of WNV encephalitis or meningitis (West Nile neuroinvasive disease [WNND]), incidence: 28 cases/million population) with 31 deaths.
sources of variation that resulted from the selection process were included by using standard Taylor series approximations. To calculate the confidence interval for the true prevalence ratio (PR), we approximated the variance of the logarithm of the sample PR by using standard Taylor series method. The end points of this interval were exponentiated to obtain the interval for PR.

Conclusions

Participants were recruited from 13 Cuyahoga County municipalities and 9 Cleveland neighborhoods. Of 4,676 households visited, 2,318 households had an eligible adult present; of these eligible households, 819 households (35.3%) agreed to participate. Of 1,747 eligible residents in 819 households, 1,251 (71.6%) consented to participate; 42 participants in 13 households had insufficient serum samples and were excluded. The study sample consisted of 1,209 participants from 806 households; they had a mean age of 43.2 years (range 5–94 years) and included 168 (12.4%) children 5–17 years of age. Compared to 2000 Cuyahoga County census demographics, our study sample contained a significantly larger proportion of adults 18–64 years of age (75.7% vs. 63.5%), female participants (57.8% vs. 52.8%), and African Americans (31.8% vs. 27.4%).

Initial screening identified WNV IgM and IgG antibody in 4 serum samples, IgG only in 90 serum samples, and IgM only in 2 specimens. Based on criteria listed in the Table 2, confirmatory testing of the 96 samples identified 27 confirmed and 7 probable WNV-infected persons. The countywide seroprevalence rate was 1.9% (95% CI 0.8–4.6) (Table 1), which suggests that 10,400–59,900 residents were infected. Based on 155 WNND cases reported from Cuyahoga County, ≈1 WNND case occurred for every 160 infected persons (95% CI 1:67–1:386).

Seroprevalence varied significantly between age groups (p<0.05) (Table 1). Based on reported WNND cases and age-stratified seroprevalence rates, we estimate that 1 case of WNND occurred per 1,417 infected children 5–17 years of age, per 154 infected adults 18–64 years of age, and per 38 infected persons >65 years of age (Figure). Strata-specific seroprevalence values ranged from 1.5% to 3.3% but were not statistically different (Table 1).

In 2002, Cuyahoga County experienced its largest epidemic of arboviral encephalitis and meningoitis, yet only 1.9% of the county’s population became infected during...
this first WNV transmission season. In the 733-km² area of Cuyahoga County, 155 cases of encephalitis and meningitis (WNND incidence: 111 cases/million population) occurred; the seroprevalence was 1.9% countywide and 2.5% in the selected highest risk survey stratum.

Little is known about WNV infection rates in children (15). In contrast to a previous study (8), our study demonstrated an age-dependent risk for WNV infection. The antibody prevalence in the 5- to 17-year age group was significantly greater than in older age groups. These data suggest that children were 4.5 times more likely to be infected than older persons. In this study, children reported spending more time outdoors and using less personal protective measures, which likely contributed to their higher seroprevalence rate. In 2002, only 4 cases of WNND were reported in the 5- to 17-year age group, resulting in a WNND:infection ratio of 1:4,200 compared to a 1:38 ratio among persons ≥65 years of age. Thus, the risk for WNND after infection may be as much as 110× greater in adults >65 years of age, as compared to children.

Inclusion of a larger number of children in this study compared to previous studies allowed these age-stratified analyses to be completed.

Although WNV seroprevalence was similar to those measured in previous outbreaks (7,8), our study was the first to demonstrate that the risk for WNV infection can be age-dependent. Children had a higher rate of infection than adults, but serious neurologic disease developed in few of them. This finding has implications for public health practice and emphasizes the need for children to use protective measures to prevent mosquito bites to further lower their risk for infection with WNV and other mosquitoborne viruses.

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