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School-Based Health Promotion For Mosquito-Borne Disease Prevention in Children

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Abstract

We enrolled 345 4th grade students in a classroom-randomized, controlled trial to evaluation of a school-based West Nile virus (WNV) health education program's impact on knowledge, attitudes, and personal protective behavior use. Immediate and sustained improvements in WNV knowledge and greater frequencies of reported personal protective behaviors resulted from the educational intervention.

Keywords

West Nile virus; Pediatrics; Health knowledge, attitudes, and practice; Risk reduction behavior; Health Education

Despite improvements in vector control, vector-borne diseases (VBD) continue to spread locally and globally, as highlighted by the recent US debut of West Nile virus (WNV).¹ The effects of these outbreaks on morbidity, mortality, and health systems have revealed a distinct vulnerability of certain regions and populations to arboviral pathogens. One such distinct risk group is the pediatric population.

Children are less likely to manifest severe WNV disease but 4.5 times more likely to become infected.^{2,3} Lessons learned studying WNV prevention can be applied to other more severe VBDs and may help prevent related childhood morbidity and mortality.

Personal protective behaviors (PPBs) have long been shown to be the most effective method of preventing WNV infection, reducing risk by 50%.^{4,5} Public health messages that endorse PPBs also reduce risk.⁵ This study assesses the efficacy of a school-based intervention for

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mosquito-bite prevention and is the first to formally evaluate a CDC program's impact on risk reduction for arboviral infection in children.

METHODS

Student participants were selected from a single Cuyahoga County school district's seven elementary schools. Inclusion criteria included fourth-grade student enrollment, parental consent and student assent. Study information packets were sent to each 4th-grade parent to allow for declined participation.

Each classroom was randomly assigned an "intervention" or "control" group. "Intervention" curriculum included mosquito biology and mosquito-bite prevention based on Neato Mosquito, a program developed by the CDC in response to LaCrosse encephalitis outbreaks.⁶ "Control" curriculum included tobacco health effects and prevention based on Tar Wars, a program developed by the American Academy of Family Physicians.⁷ Both classroom presentations consisted of a 30-minute scripted slide presentation and a 10 minute interactive art project and were conducted in May-June 2007. Identical pre- and post-test written pre-piloted surveys were distributed before and after the presentation. Ten-minute surveys consisted of 19 questions on knowledge, attitudes, and behaviors relating to WNV, mosquito-bite prevention, and tobacco use and health effects (Appendix 1; available at www.jpeds.com). Follow-up surveys, administered in September - October 2007, consisted of 21 questions (Appendix 2; available at www.jpeds.com), 19 identical to the pre- and post-test surveys, and two additional questions to assess PPBs.

Descriptive statistics and bivariate analyses were used to evaluate baseline differences between intervention and control groups. Changes in knowledge and behaviors were assessed using McNemar Test and Chi-squared tests. Clinically significant changes were defined as 10% or 1 point change in Likert scale. Changes in attitude and behaviors were assessed by Mann-Whitney U test. Baseline WNV awareness was defined by answering "yes" to the pre-test question: "Have you ever heard of West Nile virus?" A stratified analysis based on baseline WNV awareness eliminated a potential association between reported WNV awareness and knowledge scores. Data were analyzed using the Generalized Estimating Equations procedure in SPSS v15.0 (Appendix 3; available at www.jpeds.com). All models controlled for WNV awareness at pre-test, school site, and time period. Adjusted odds ratios are reported for the intervention with control group as the reference.

This study was approved by the University Hospitals Hospital System IRB and the school board.

RESULTS

345 fourth grade students in fourteen classrooms were enrolled: 181 (52.5%) were randomized to intervention and 164 (47.5%) to control (Table). 294 students (85.2%) participated in follow-up: 152 (51.7%) intervention and 142 (48.3%) control (Table).

Significant changes in both General Mosquito Knowledge (GMK) and WNV Knowledge (WNVK) resulted from the intervention. The intervention group (whether or not they had baseline WNV awareness) had significantly higher GMK ($p<0.01$) and WNVK ($p<0.05$) scores at post-test and follow-up and were twice (GMK) and 2.5 times (WNVK) more likely to answer correctly compared with controls (Appendix 3). Long-lasting changes in WNV attitude did not result from the intervention. Although the intervention group reported being more afraid of WNV at post-test than pre-test, this change was not present at follow-up.

Significant differences in one or more PPBs were reported at follow-up testing in the intervention group and their family members (Figure). In the nested logistic analysis, they were: 1) 2.39 (1.313, 4.356) and 2.2 (1.23, 3.97) times more likely to wear long sleeves; 2) 2.913 (1.71, 4.97) and 2.54 (1.59, 4.51) times more likely to wear pants outside, and 3) 4.64 (2.696, 7.97) and 2.54 (1.59, 4.51) times more likely to dump out standing water, respectively, when compared with controls.

DISCUSSION

Our study demonstrates significant knowledge improvement in response to the intervention, as seen in previous educational interventions.^{8,9} In addition, this knowledge was retained for at least 5 months. Behavioral changes were reported for both intervention participants and their families. The significantly higher reported frequency of three PPBs among intervention participants and their family members is important in light of research suggesting that persons using two or more PPBs are at half the infection risk as those using one PPB.¹⁰ We found the proportion of reported PPBs to be higher in our study than in adult comparison studies.^{4,5}

Despite the recent large Ohio WNV outbreak, many participants had never heard of WNV (75% control and 63% intervention). Many of these children were <6 years old during the outbreak, but the lack of awareness also suggests that ongoing WNV community health messages are lacking.

Previous research has evaluated several school-based health promotion projects for their efficacy, but none has focused on reducing arboviral risk.^{11,12} Our study demonstrated that a simple educational intervention could effectively and efficiently improve WNV knowledge and increase PPBs among children. As rising pesticide costs strain limited control resources, free programs such as Neato Mosquito, provide a cost-effective complement to other strategies. Strengths of the study include its novel design and the use of a single instructor and scripted presentations to limit instructional variability. Weaknesses include small sample size, the reliance on self-reported data, and potential social desirability bias.

Our study confirms that public health education can be a useful prevention tool for children, a vulnerable sector of society that is prone to be affected by vector-borne disease epidemics. As demonstrated by recent US history with WNV and other emerging diseases worldwide, determining cost-effective strategies to prevent vector-borne diseases is paramount.

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LIST OF ABBREVIATIONS

WNV	West Nile virus
CDC	Centers for Disease Control
GMK	General Mosquito Knowledge
WNVK	West Nile virus Knowledge
PPB	Personal Protective Behavior

IRB Institutional Review Board

REFERENCES

1. CDC. Outbreak of West-Nile like encephalitis-New York, 1999. *MMWR Morb Mortal Wkly.* 1999; 48:845–849.
2. LaBeaud AD, Kile JR, Kippes C, King CH, Mandalakas AM. Exposure to West Nile virus during the 2002 epidemic in Cuyahoga County, Ohio: A Comparison of Pediatric and Adult Behaviors. *Public Health Rep.* 2007; 122:356–361. [PubMed: 17518307]
3. Mandalakas AM, Kippes C, Sedransk J, Kile JR, Garg A, McLeod J, Berry RL, Marfin AA. West Nile virus epidemic, northeast Ohio, 2002. *Emerg Infect Dis.* 2005; 11:1774–1777. [PubMed: 16318737]
4. Campbell G, Marfin A, Lanciotti R, Gubler D. West Nile virus. *Lancet Infect Dis.* 2002; 2:519–529. [PubMed: 12206968]
5. Aquino M, Fyfe M, MacDougall L, Remple V. West Nile virus in British Columbia. *Emerg Infect Dis.* 2004;10. <http://www.cdc.gov/ncidod/EID/vol10no8/03-1053.htm>.
6. CDC. Neato Mosquito: An Elementary Curriculum Guide. <http://www.cdc.gov/ncidod/dvbid/arbor/neato.htm>
7. Tar Wars: Program History. <http://www.Tar Wars.org/x811.xml>
8. Madeira NG, Macharelli CA, Pedras JF, Delfino MCN. Education in primary school as a strategy to control dengue. *Rev Soc Bras Med Trop.* 2002; 35:221–226. [PubMed: 12045814]
9. Winch PJ, Leontsini E, Rigau-Perez JG, Ruiz-Perez M, Clark GG, Gubler DJ. Community-Based Dengue Prevention programs in Puerto Rico: Impact on Knowledge, Behavior and residential mosquito infestation. *Am J Med Hyg.* 2002; 67:363–370.
10. Loeb, M.; Elliott, SJ.; Gibson, B.; Fearon, M.; Nosal, R.; Drebot, M. Protective behavior and West Nile virus risk; *Emerg Infect Dis.* 2005. p. 11<http://www.cdc.gov/ncidod/EID/vol11no09/04-1184.htm>
11. Gortmaker SL, Peterson K, Wiecha J, Sobol AM, Dixit S, Fox MK, Laird N. Reducing Obesity via a School-Based Interdisciplinary Intervention Among Youth: Planet Health. *Arch Pediatr Adolesc Med.* 1999; 153:409–418. [PubMed: 10201726]
12. Main DS, Iverson DC, McGloin J, Banspach SW, Collins JL, Rugg DL, Kolbe LJ. Preventing HIV infection among adolescents: evaluation of a school-based education program. *Prev Med.* 1994; 23:409–417. [PubMed: 7971867]

Figure.

Proportion of participants in Neato Mosquito (intervention) and Tar Wars (control) groups who reported at follow-up testing specific behavior changes as a result of the classroom presentation. †Significant difference between groups, p-value < 0.05.

Table 1

Initial Sample Demographics

Variable	Groups		Total N=345
	Neato Mosquito n =181	TarWars n=164	
	n (%)	n (%)	
<i>Enrollment for each school</i>			
School 1	14 (7.7)	18 (11.0)	32
School 2	43 (23.7)	19 (11.6)	62
School 3	22 (12.2)	18 (11.0)	40
School 4	15 (8.3)	19 (11.6)	34
School 5	36 (19.9)	31 (18.9)	67
School 6	30 (16.6)	28 (17.0)	58
School 7	21 (11.6)	31 (18.9)	52
<i>Age at Pre-test (in years) *</i>			
8	1 (0.6)	0 (0.0)	1
9	46 (25.4)	44 (26.8)	90
10	119 (65.7)	108 (65.9)	227
11	14 (7.7)	12 (7.3)	26
12	1 (0.6)	0 (0.0)	1
<i>Sex *</i>			
Female	89 (49.2)	72 (43.9)	161
Male	92 (50.8)	92 (56.1)	184
<i>Overall Baseline WNV</i>			
<i>Awareness *^</i>			
Yes	49 (27.1)	33 (20.1)	82
No	132 (72.9)	131 (79.9)	263
Follow-up Completed*	152 (84.0)	142 (86.6)	294

* Denotes that there were no significant differences between Neato Mosquito and TarWars using Chi square test (gender: $p > 0.30$, age: $p > 0.70$).

^ Awareness defined by the question: "Have you ever heard of West Nile Virus?" at pretest.