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INCREASING THE USE OF PERMETHRIN TO PREVENT ZIKA INFECTIONS AMONG UNIVERSITY STUDENTS

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Background*. In summer 2016, Miami-Dade County, Florida, declared a public health emergency when reports of locally acquired Zika infections were confirmed. Officials at a large public university in the county warned students of the risks and advocated the use of repellents and permethrin to prevent mosquito bites. A subsequent study showed few students (2.9%) sprayed their clothes with permethrin.* ***Purpose.*** *In the absence of a safe and effective vaccine, a team of Master of Public Health students sought to determine if a brief educational intervention might increase permethrin use.* ***Methods.*** *Students living in six dormitories were chosen as the population of interest. Three dormitories were randomly assigned to an experimental condition (information about Zika) and three to a control condition (information about psychological counseling services). A questionnaire was distributed to participants immediately before and again immediately after a 20-30-minute educational presentation. The educational intervention was developed following the six steps of Intervention Mapping for Health Promotion Planning. Responses to questionnaire items were coded and analyzed.* ***Results****. After exposure to an educational program on Zika infections and prevention, significant increases (p<.001) were recorded for 61 student volunteers regarding: (1) having ever heard of permethrin (10.5% to 86.2%), (2) best to spray permethrin on your clothes (8.9% to 86.4%), and permethrin is entirely safe (9.5% to 47.5%). Students who indicated they would definitely use permethrin to prevent mosquito bites increased from 17.3% at baseline to 40.7% at follow-up (p=.01). No significant differences in pre- and post-intervention scores were noted for the 51 students in the control condition.* ***Discussion.*** *A brief educational intervention can be effective in promoting permethrin use to prevent Zika and other mosquito-borne infections among college students. Permethrin and instructions for proper use should be included in Zika prevention kits.*

Introduction | Miami-Dade County was placed on a state of public health emergency in summer 2016 with reports of locally acquired Zika infections.[1] With no vaccine available, Zika presented an imminent threat, especially to pregnant women and women of childbearing age.[2] Zika virus had been linked to microcephaly and Guillain-Barre Syndrome.[3] Local investigators conducted a study of students at risk for Zika and found that few had used permethrin to prevent mosquito bites.[4]

Permethrin is an effective, odorless, over-the-counter insecticide approved for human use by the U.S. Environmental Protection Agency.[5] Clothing should be washed or sprayed with permethrin to deter bites by mosquitoes, ticks, and other arthropods.[6] To increase knowledge of a threat, change attitudes towards prevention practices, modify beliefs about permethrin, and encourage its' proper use to protect student health, we designed, implemented, and evaluated a brief educational intervention for those at-risk for mosquito-borne infections.

*Background***.** Our major goal was to find a way of increasing permethrin use among students who might be bitten by mosquitoes capable of transmitting Zika, dengue, chikungunya, and West Nile virus infections.[5,6] We began by using the PRECEDE-PROCEED model for health promotion planning[7] to design an effective, yet inexpensive, educational intervention that could be easily incorporated into the Healthy Living Program supported by the Division of Student Affairs. The PRECEDE-PROCEED model offered our planning team of Master of Public Health (MPH) degree students a comprehensive approach for assessing student health needs before developing an appropriate health promotion program to prevent mosquito-borne infections. PRECEDE, which stands for "Predisposing, Reinforcing, and Enabling Constructs in Educational Diagnosis and Evaluation,"

provided the structure we needed for planning a targeted program focused on preventing mosquito bites.

We conducted a social, epidemiological, and ecological assessment of the problem to identify the behavioral and environmental determinants that predispose, reinforce, and enable behaviors related to Zika prevention. Additionally, we conducted an administrative and policy assessment to identify those factors that influence program implementation and encourage desired and expected changes. PROCEED, which stands for "Policy, Regulatory, and Organizational Constructs in Educational and Environmental Development," identified the desired outcomes and strategies for program implementation and evaluation. The PRECEDE-PROCEED model had effectively supported other one-time interventions[8] for related health concerns as well as more complex multisector, multilevel, and multi-phased programs, such as the REACH 2010 community demonstration project that successfully reduced disparities in HIV disease in African-American and Afro-Caribbean communities in Broward County a decade earlier.[9]

Conceptual Framework. Behavior-oriented and environment-oriented theories were reviewed and considered before the planning team decided to draw from the Reasoned Action Approach[10] and health communication theory[11] and to adopt a systematic approach to health promotion planning. The six steps of Intervention Mapping[12] helped us obtain, assess, and organize evidence to design, develop, implement, and evaluate a simple health education program that would increase knowledge, change attitudes, modify beliefs, and stimulate behavior change. We realized that basic facts about Zika and how it is spread that were culturally competent, easily understood, and useful to the susceptible population had to be transmitted effectively to our fellow students. Attitudes towards the behaviors that must be taken and a product that must be used properly to prevent infection (permethrin) must be made favorable. Beliefs about the benefits of the health behaviors we were recommending had to outweigh perceived barriers. Zika preventive practices had to be integrated easily into the lifestyles of young men and women who had many other competing interests for their time and attention.

Given these assumptions and the Intervention Mapping framework for critical decision making, the planning team considered various behavior-oriented and environmental-oriented theories of the problem and possible solutions. Behavior-oriented theories examine the determinants and processes that affect human health behaviors (such as deciding to be vaccinated for H1N1 or adopting the use of permethrin) and environmental-oriented theories examine the context that allows, shapes, or inhibits human health behaviors (such as making the HIN1 vaccine easily available at a low or no cost on a college campus or making permethrin available in residential hall laundry rooms and easy to administer). The Intervention Mapping framework requires that a health promotion program be developed that includes the completion of six steps: (1) establish a planning group, conduct a needs assessment, create a logic model of the problem, and state program goals; (2) indicate expected outcomes, specify performance objectives for behavioral and environmental outcomes, select determinants, construct matrices of change objectives, and create a logic model of change; (3) generate program themes, components, scope and sequence, choose theory- and evidence -based change methods, and design practical applications; (4) fine tune program structure, draft a plan and protocol, messages, and materials, pretest, edit, and produce program materials; (5) develop a program implementation plan, and (6) prepare an evaluation plan to measure effects.[12]

The Reasoned Action Approach[10] that was selected by the health promotion planning team maintains that intentions to engage in a behavior (e.g., wash one's clothes with permethrin) combined with control (the ability to wash one's clothes) will predict to a considerable extent what a person will do to prevent disease. Intentions, in turn, are determined by one's attitudes toward the behavior, subjective norms, and perceptions of behavioral control. Salient beliefs about anticipated outcomes, normative expectations, and facilitating and inhibiting factors are critical in understanding the complexities of personal decision making.

The Research Problem. We sought to: (1) assess whether students perceived Zika and other mosquito-borne viral infections as significant risks, (2) examine levels of knowledge of preventive measures, (3) explore overall attitudes and beliefs toward the Zika virus, and (4) determine students' health practices with respect to Zika and other potential threats. A behavior-oriented conceptual framework was adopted as we considered appropriate interventions by moving through the six steps of Intervention Mapping.[12] The concept of "intention" as presented in the Reasoned Action Approach of Fishbein and Ajzen[10] seemed to be particularly relevant for increasing the use of permethrin. Behavioral intentions proved to be important in predicting acceptance of a potential Zika vaccine among college students[13] and other US populations.[14] The primary aim of our research was to determine if an intention to use permethrin to prevent mosquito bites could be increased through a

systematically constructed educational intervention for college students.

Methods | To improve prevention practices for Zika and other mosquito-borne infections, a pilot study was conducted among a sample of students residing in dormitories on the main campus of a large, urban, Hispanic-serving, state university. Pre-intervention and post-intervention self-administered questionnaires assessed knowledge, attitudes, beliefs, and practices.[15] The research protocol was approved by the university's IRB as "Exempt."

Sampling Frame and Recruitment. Students enrolled in at least one three-credit course during spring semester 2018 and at least 18 years of age were eligible to participate. Of the six dormitories selected, three were selected at random to provide the experimental condition (permethrin) and three served as controls by providing information about on-campus mental health services. Flyers prepared to advertise a health-education event were posted and handed out to residents of participating dormitories (Figure 1).

Educational Interventions. A 20-30-minute PowerPoint presentation on Zika and other health threats (experimental condition) or psychological counseling services available at the Student Health Center (comparison condition) was developed. Permethrin interventions and psychological counseling interventions were delivered in April 2018. All activities were scheduled to begin at 8:00 PM.

Theoretical Concepts, Operational Definitions, and Major Variables. Each participant was given a printed pre- and post-intervention questionnaire identified only by identical numbers.[16] Surveys were administered immediately before and immediately after a PowerPoint presentation and discussion emphasizing the major take-away points by teams of 4-5 MPH degree-seeking students.[17]

Seventeen items on the two questionnaires were identical. Six questions asked about mental health issues and psychological counseling services. Eleven inquired about the threat of Zika and measures taken to prevent mosquito bites and sexual transmission. Six items on the post-intervention questionnaire identified the sex, age, ethnicity, class, relationship status, and living situation of the respondent. Questions on both the pre- and post-test questionnaires included:

"Q12. Have you ever heard of permethrin?"
"Q13. On a scale of 1 to 10, how safe do you think it is to use permethrin?"
"Q14. What is the best way to make permethrin most effective?" and
"Q15. If permethrin were made available on campus for free, how likely would you be to use permethrin to prevent Zika (and other vector-borne diseases)?"

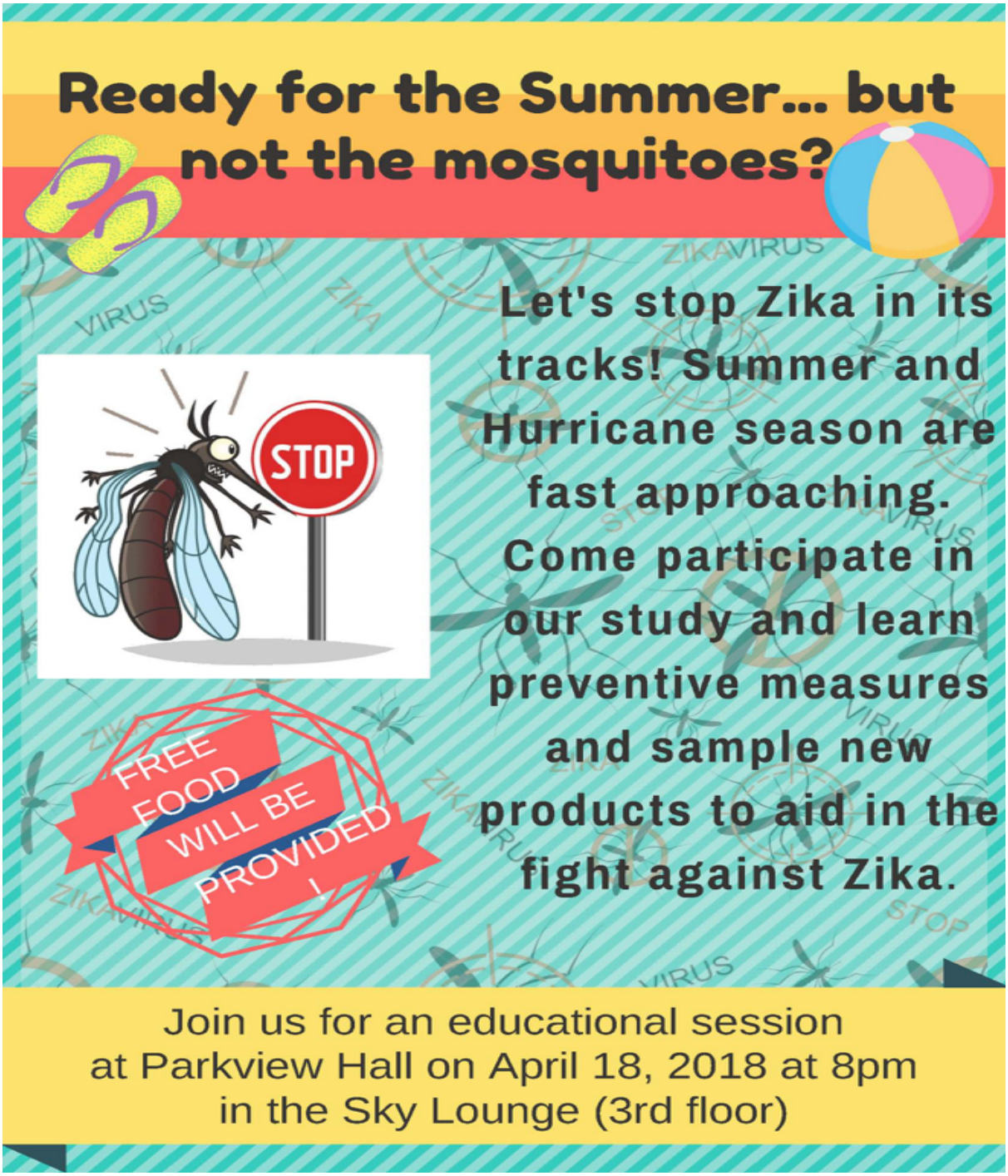
Data Collection and Management. Data collection occurred about 5-10 minutes before the presentation was delivered and again immediately after each presentation and all questions were answered. Following the presentations and data collection, a permethrin sample, displays, and other promotional materials were set up in each of the three dormitories that received the permethrin educational intervention. Questionnaires collected from participants were coded and entered into an Excel file. Data editing was performed in various versions of SPSS.[18]

Data Analysis. Data analysis included frequency distributions, measures of central tendency, tests for statistical significance, and measures of association to examine differences in pre- and post-intervention scores for students exposed to either the experimental or control condition.[19] Frequency distributions and other descriptive characteristics were tabulated using SPSS version 25. Statistics included Pearson's Chi-square test and Fisher's Exact Test for cross-tabulations of categorical and ordinal variables and the independent samples t-test for differences in equality of means for the continuous variable age.[20] A generalized estimating equation procedure was used to assess factors that might predict intention to use permethrin.[21] The multivariate imputation by chained equations (mice) procedure within the R Project for Statistical Computing (Vienna, Austria) package (conditional MI)[22] was used when missing responses exceeded 20%.

Results | The total number of questionnaires collected was 229. One pre-intervention questionnaire could not be matched with a post-intervention questionnaire and four post-intervention questionnaires could not be matched with a pre-intervention questionnaire. The 112 students who completed a pre-intervention and matching post-intervention questionnaire included 61 participants (54.5%) enrolled in the experimental condition and 51 participants (45.5%) enrolled in the control condition.

The mean age of participants was 20.5 years (SD = 2.03). Most respondents were women (60.9%) and single, not engaged, or in a dating relationship (64.3%). The majority identified with a racial or ethnic minority group: 40.5% identified as African American or Black, 34.7% as Hispanic or Latinx, 9.2% as mixed race-ethnicity or other, 8.2% as Asian, and 7.1% as non-Hispanic white.

Figure 1. Recruitment poster placed in the entrance of a residence hall



Three fourths (75.3%) of students indicated that they had never travelled to a country where Zika was known to exist, but 16.5% either lived in or had visited a country where Zika transmission had been reported. Over one third (36.7%) indicated they had visited the on-campus health clinic for a medical appointment at least once. Slightly fewer (35.7%) reported they had sought consultation or counseling at least once. Almost half (45. %) who had sought consultation or counseling had also scheduled one or more medical appointments.

Comparisons at Baseline. The experimental and comparison samples were comparable with respect to sex, ethnicity, and relationship status (p>.05), but were dissimilar with respect to age (p=.025) and educational status (p<.001). Students in the experimental condition were slightly younger and more likely to be enrolled in the freshman class (Table 1).

Knowledge. Nearly all participants (> 95%) reported knowing something about Zika before enrolling in our study. Half (49.6%) reported first hearing something about Zika three or more years ago. Most of the remainder (46.5%) reported first hearing about Zika within the last year or two. Three students in the comparison condition (6.7%) and none in the experimental condition reported never having heard or knowing about Zika on the baseline questionnaire (p=.179).

Most students learned about Zika through mass media reports: television (54.9%), Internet (36.3%), radio (17.6%), an app on their smartphone (12.7%), or newspaper (7.8%). Personal sources of information were important to a lesser extent: family and friends (29.4%), classmate or co-worker (10.8%), physician or other health care provider (2.9%). On-campus sources of information were helpful in increasing awareness and knowledge about Zika to an even lesser extent: student health services (9.8%), posted announcement or brochure (8.8%), and classroom lecture or discussion (7.8%).

Beliefs and Attitudes. Respondents indicated at baseline that "the flu" represented the greatest threat to their health (47.1%). Only three study participants (2.9%) believed that Zika was the most imminent threat. All three were convinced if they didn't do something, they would become infected with the Zika virus. Although others didn't seem highly motivated to prevent mosquito bites, 34.6% expressed a favorable attitude by indicating it was important for them to prevent a Zika infection.

Practices. Almost half of 104 respondents (47.1%) reported using a repellent to spray mosquitoes. One third (32.7%) indicated that they had worn long-sleeve clothing and 18.6% avoided places where Zika had been reported. One sixth (16.3%) reported using a condom during sexual relations and another 6.7% abstained because of some concern about Zika infection. Four respondents (3.9%) reported using permethrin. One student indicated he had ordered a Zika prevention kit from the Florida Department of Health. One third of study participants (33.3%) indicated that they had done nothing to prevent Zika since first learning about the possible threat of infection.

Table 1. Characteristics of participants in the comparison and experimental conditions

Variables	Comparison Group (N=51) Mean (SD) or N (%)	Experimental Condition (N=61) Mean (SD) or N (%)	Total (N=112) Mean (SD) or N (%)	P- Value
Age in years	21.0 (1.5)	20.1 (2.3)	20.5 (2.0	0.025
Sex				0.222
Female	34 (66.6)	33 (54.1)	67 (59.8)	
Male	17 (33.3)	28 (45.9)	45 (40.2)	
Ethnicity				0.588
Black or Afro-Am	23 (45.1)	21 (34.4)	44 (39.3)	
Hispanic	14 (27.5)	24 (39.3)	38 (33.9)	
Asian	5 (9.8)	5 (8.2)	10 (8.9)	
Other	9 (17.6)	11 (18.0)	20 (17.9)	
Educational Status				<0.001
Freshman	4 (7.8)	28 (45.9)	32 (28.6)	
Sophomore	8 (15.7)	8 (13.1)	16 (14.3)	
Junior	25 (49.0)	12 (19.7)	37 (33.0)	
Senior/Grad School	14 (27.5)	13 (21.3)	27 (24.1)	
Relationship Status				0.316
Single	29 (56.9)	43 (70.5)	72 (64.3)	
In a relationship	22 (43.1)	18 (29.5)	40 (35.7)	

Differences at Follow-Up. Students exposed to the educational program about Zika and permethrin showed statistically significant increases at follow up. They were more likely to indicate that Zika could be sexually transmitted and they could be at risk of infection. They also were more likely to indicate: (1) having ever heard of permethrin (10.5% to 86.2%), (2) it is best to spray permethrin on your clothes (8.9% to 86.4%), and (3) permethrin is entirely safe to use (9.5% to 47.5%). Students in the experimental condition who indicated they would "most likely or definitely" use permethrin to prevent mosquito bites more than doubled from 17.3% before the educational presentation was delivered to 40.7% immediately after (p=.01). No significant differences in pre-intervention and post-intervention scores were noted for the 51 students in the control condition (Table 2).

Table 2. Pre-intervention and post-intervention results for control and experimental groups

	Comparison Group			Experimental Condition		
Variables	Pre-Int (N=51) N(%)	Post-Int (N=51) N (%)	Proportion Test (p-value)	Pre-Int (N=61) N (%)	Post-Int (N=61) N (%)	Proportion Test (p-value)
Q3d. Can Zika be sexually transmitted?						
No/Don't know/ Not sure	28 (58.3)	17 (42.5)		25 (44.6)	6 (10.2)	
Yes	20 (41.7)	23 (57.5)	P = 0.139	31 (55.4)	53 (89.8)	P <0.001
Q4. Which disease are you most at risk for?						
Flu/HIV/HPV/Other	43 (93.5)	38 (95.0)	Fisher's	57 (100.0)	49 (83.1)	Fisher's
Zika	3 (6.5)	2 (5.0)	P = 1.00	0	10 (16.9)	P = 0.001
Q9. Have you done anything to prevent Zika?						
Didn't use repellent	24 (51.1)	23 (59.0)		31 (54.4)	41 (70.7)	
Used repellent or spray	23 (48.9)	16 (41.0)	P = 0.463	26 (45.6)	17 (29.3)	P = 0.071
Q10. How important is it to you to prevent Zika infection?						
Not or somewhat	11 (23.9)	11 (28.9)		27 (47.4)	14 (24.1)	
Important or essential	35 (76.1)	27(71.1)	P = 0.601	30 (52.6)	44 (75.9)	P = 0.009
Q11. How likely is it you will become infected with Zika?						
No/Little chance	32 (71.1)	23 (63.9)		39 (69.6)	35 (61.4)	
Likely/Already infected	13 (28.9)	13 (36.1)	P = 0.489	17 (30.4)	22 (38.6)	P = 0.357
Q12. Have you ever heard of permethrin?						
No/Don't know/Not sure	47 (100)	36 (94.7)	Fisher's	51 (89.5)	8 (13.8)	
Yes	0	2 (5.3)	P = 0.197	8 (10.5)	50 (86.2)	P <0.001
Q13. How safe do you think it is to use permethrin?						
Unsafe/Somewhat safe	26 (78.8)	24 (72.7)		29 (69.0)	10 (16.9)	
Harmless/Entirely safe	7 (21.2)	9 (27.3)	P = 0.566	13 (31.0)	49 (83.1)	P <0.001
Q14. What is the best way to make permethrin most effective?						
Incorrect/Don't know	45 (95.7)	33 (89.2)	Fisher's	51 (91.1)	8 (13.6)	
Spray it on clothes	2 (4.3)	4 (10.8)	P = 0.398	5 (8.9)	51 (86.4)	P <0.001
Q15a. How likely would you be to use permethrin?						
Unlikely/Somewhat likely	29 (70.7)	22 (68.8)		30 (65.2)	24 (40.7)	
Highly likely	12 (29.3)	10 (31.2)	P = 0.855	16 (34.8)	35 (59.3)	P = 0.013
Q15b. How likely would you be to use permethrin?						
Unlikely/Somewhat likely	32 (78.0)	27 (84.4)		38 (82.6	35 (59.3	
Most likely/Definitely	9 (22.0)	5 (15.6)	P = 0.496	8 (17.4)	24 (40.7)	P = 0.01

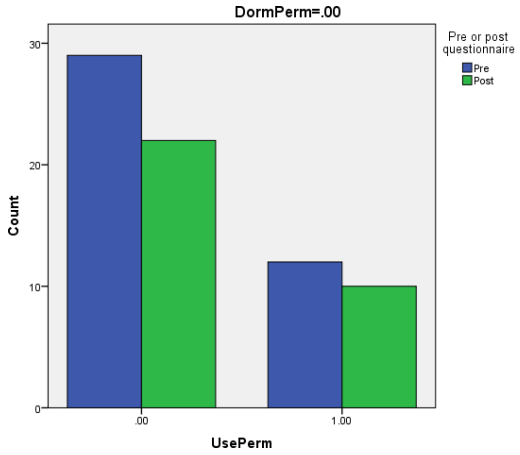
Although respondents exposed to the educational intervention about the threat of Zika infection were more likely to indicate at follow up that they might use permethrin, a considerable number failed to answer the question. At baseline, 19.7% in the comparison condition and 24.6% in the experimental condition provided no answer. After exposure to the psychological counseling intervention, the proportion in the comparison condition who failed to answer the question about future permethrin use increased to 37.3%. Among those exposed to the Zika prevention intervention, the proportion who failed to answer the question about future permethrin use decreased to 3.3%. To adjust for this discrepancy, an analysis that could account for missing data showed that differences between the two groups were probably even greater

than originally observed, with estimates of 19.6% in the comparison group (p=.630) and 57.4% in the experimental group (p<.001) likely to use permethrin post-intervention (Figure 2).

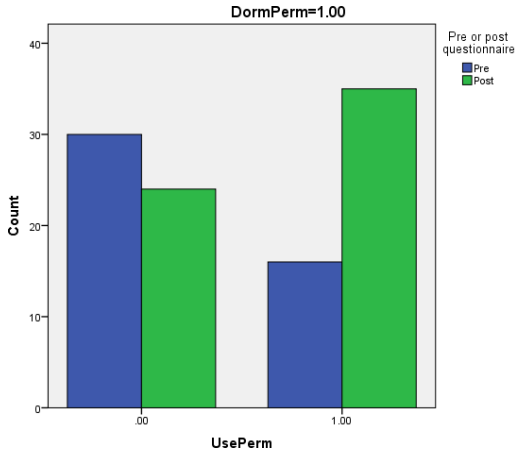
Figure 2. Likelihood of using permethrin: Observed responses and imputed values for comparison and experimental conditions before and after a brief educational intervention

Observed Responses

Comparison: Psychological Counseling

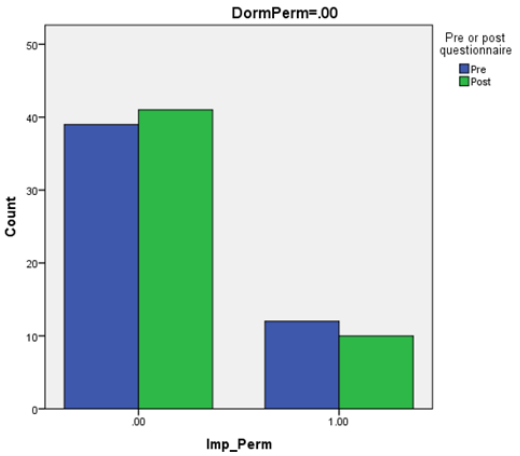


Experimental: Zika Virus Prevention

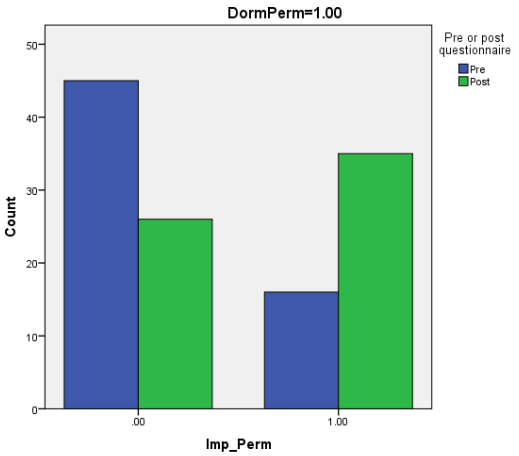


Imputed Values

Comparison: Psychological Counseling



Experimental: Zika Virus Prevention



Binary logistic regression analysis of variables associated with the likelihood of permethrin use among students exposed to the educational intervention showed that two variables were associated with the expected outcome: (1) beliefs about the safety of permethrin and (2) perceptions of the likelihood of Zika infection (Table 3). Students who believed that spraying permethrin on their clothes was safe and might be effective in preventing mosquito bites and perceived themselves to be at high risk of a possible exposure to the Zika virus were significantly more likely to indicate they would use permethrin than those who were less convinced (p<.001).

Table 3. Logistic regression analysis of perceived likelihood of Zika infections, believed safety of permethrin, and likelihood of using permethrin among students exposed to an educational intervention.

	Variables in the Equation					
	B	S.E	Wald	df	Sig	Exp (B)
Step 1a. Permethrin is safe (1)	-1.002	0.466	4.636	1	0.31	0.367
Prevent Zika infection	-1.474	0.496	8.849	1	0.003	0.229
Constant	0.845	0.311	7.382	1	0.007	2.329

a. Variable(s) entered on Step 1: PermSafe (Permethrin is safe), PrevZika (Important to prevent Zika infection).

Discussion | Results confirmed that permethrin was not known by many university students as a product that effectively deters mosquito bites. Eight respondents (7.7%) had ever heard of permethrin in April 2018 and only four (3.8%) reported previous use. The educational intervention on Zika was able to increase knowledge of an existential threat and awareness of an easy-to-use and inexpensive means of prevention. After exposure to a brief intervention about Zika and an opportunity to ask questions, the number of respondents who reported ever hearing about permethrin increased from eight to 50 (86.2%) of 58 who returned a matching questionnaire. The likelihood of using permethrin increased significantly after exposure to an educational intervention, suggesting that more could be done by state legislators, college administrators, and health promotion practitioners to prevent the spread of mosquito-borne diseases among susceptible young adults living on college campuses in Florida.[23]

Findings from our systematically constructed, implemented, and evaluated Zika prevention program for at-risk college students in south Florida can be compared and contrasted with other recent educational intervention efforts. In a Puerto Rican housing project, community-based participatory research was used with beneficial effects to design and deliver educational messages about Zika prevention and control through theatrical performances, community fora, and workshops.[24] In Puerto Rican WIC clinics, 20 to 30 minute one-on-one educational and counseling sessions with pregnant women resulted in improvements in Zika prevention practices.[25] In our university, a brief educational intervention to promote HBV-vaccine uptake among undergraduate students--very similar to our Zika prevention program--was successful in increasing knowledge, changing attitudes and beliefs, and encouraging study participants to initiate and complete their HPV vaccinations.[26]

Implications for Public Health Practice. Public Health authorities responded to Zika outbreaks in Puerto Rico and Florida differently. The Centers for Disease Control and Prevention (CDC) and the Puerto Rico Department of Health (PRDOH) promoted the use of a Zika Prevention Kit (ZPK) among pregnant women in Puerto Rico and evaluated the effectiveness of a 20-30 minute educational presentation, a mass media campaign, and free professional home spraying services.[25] In Puerto Rico, the ZPK "was a tote bag containing insect repellent, condoms, a mosquito bed net, larvicide, and printed Zika education materials. Approximately 26,000 ZPKs were distributed."[25(p2251)] Interview data collected from WIC mothers showed that "performance of Zika prevention behaviors varied widely," but "kits containing prevention products for at-risk populations should be considered a best practice, particularly in low-resource settings."[25(p2258)]

The State of Florida Department of Health (FDOH) also tried to warn residents of the risks of Zika infection.[27] Between July and December 2016, FDOH-Miami distributed 2,277 ZPKs.[28] Some 461 ZPKs were distributed to pregnant women who requested a kit. The Florida ZPK contained an insect repellent with DEET, condoms, a mosquito net, mosquito "dunk" tablets to kill insect larvae in standing water, Zika education flyers, and a sixth product, permethrin spray. A follow-up survey of 90 women who had received a ZPK showed that 88.9% reported using repellent and 87.7% had used permethrin.

Our research was greatly motivated by an infectious disease specialist in our medical school who advocated the use of permethrin to prevent mosquito bites, but a cross-sectional survey conducted on our campus in November-December 2016 found that only one female student reported doing so.[4] Only one student reported on our April 2018 pre-intervention questionnaire that he had ordered a ZPK, which was surprising because the kits were to be distributed to at-risk women in south Florida. Intention to use permethrin following an educational intervention on our campus and its' use among pregnant women in the community encourage us to support CDC's recommendation that ZPKs be considered "a best practice." We recommend that permethrin spray and instructions for proper use be included in kits that are distributed to the public in future outbreaks of mosquito-borne infections.

Limitations. Data collection occurred late in spring semester 2018. We were unable to measure the use of permethrin by dormitory residents because many students had already moved out of their rooms when we attempted to follow up.

Implications for Future Research. A brief, inexpensive, and systematically constructed educational intervention designed to increase knowledge about Zika virus infections, change attitudes towards Zika prevention, modify beliefs and increase intentions to use permethrin proved to be effective among at-risk university students. Marketing research to promote awareness and adoption of effective interventions for vector-borne viral diseases should be continued.[29] Qualitative research that focuses on the reasons why young adults adopt certain protective measures and others do not would also be helpful in maximizing protection. Longitudinal studies must be conducted to determine if intentions to use permethrin can be realized and maintained.

Conclusion | A brief educational presentation about Zika and the use of permethrin to prevent mosquito bites was effective in increasing awareness of a potential threat and knowledge of an effective means of prevention. Perceived safety of the product and recognition of a potential risk of exposure by the bite of a mosquito were associated with an intention to use permethrin. Simple tools of health promotion can be used to increase awareness of a public health threat and encourage prudent modifications in behavior among susceptible populations.

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