Using social media to increase preventative behaviors against arboviral diseases: a pilot study among teens in the Dominican Republic

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Background: Social media presents new opportunities for community-based interventions. However, studies demonstrating effectiveness and practicality in resource-poor areas of Latin America and the Caribbean are lacking. In these areas at high risk for vector-transmitted illnesses, disease prevention practices at the community level are necessary for sustainable improvement. This study evaluated social media as a peer-to-peer health communication tool to promote education and encourage preventative behaviors against arboviral diseases among youth in the Dominican Republic.

Methods: In 2016, 31 youth ages 14–18 years from three cities in the Dominican Republic were enrolled into either of two Facebook groups receiving a 3-month arbovirus prevention-focused intervention with weekly educational posts, or a control group. Arboviral prevention, knowledge, and practice were evaluated with pre-and post-surveys. The level of online engagement was analyzed through online metrics. Linear regression models were used to determine the association between metrics of online activity and pre- and post-survey score difference.

Results: Knowledge scores increased significantly in the intervention groups (51.1% increase) compared to the control group (1.2% increase, P<0.0001). The intervention groups also showed a significant increase in the frequency of preventative behaviors in all categories (primary bite prevention P=0.017, household vector control P=0.0024, community vector control P=0.0021). Increased online engagement parameters were associated with statistically significant increases in survey scores (P<0.0001) and preventative behaviors in all categories (P=0.0007–0.0011), even between intervention groups (P<0.0001).

Conclusions: This study provides evidence of the effectiveness of engagement in social media peer-to-peer education groups as an accessible and practical intervention to improve arboviral disease knowledge and prevention practices among youth in a low- and middle-income country. The different levels of online engagement that were observed between intervention groups strongly correlated to changes in participant knowledge and behavior. Possible explanations of the divergent online activity between study groups are discussed within a theoretical framework and should be taken into consideration in future studies.

Keywords: Social media; Facebook; youth; arboviral disease; prevention; Dominican Republic

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Introduction

Social media for use in public health

In recent years, social media platforms have become increasingly popular and have rapidly transformed patterns of communication. Online networking offers opportunities for more frequent interactions and an increasing ability to share and access information. In public health, social media presents an opportunity for consumer-centered, cost-effective interventions for health communication, social support, and promotion of healthy behaviors (1-4). While authors have described potential advantages, real-world trials to evaluate efficacy and pragmatism are lacking (3,5,6). Furthermore, while the uses of social media in population health have been primarily investigated in high-income countries, very little research has evaluated online-based interventions in low- and middle-income countries (LMICs), where public health resources are scarce (7-10).

Burden of arboviral disease in Latin America and the Caribbean

The persistence of arboviral diseases such as dengue, chikungunya, and Zika in Latin America and the Caribbean has been partially attributed to shortages of human resources, deficient information systems, weak institutional capacity, inadequate health technologies, and insufficient financial resources (11). Though many public health efforts addressing these underlying causes have failed to result in reduced disease burden, innovative, community-based approaches have had some success, including those using social media (12-15).

Social media use in Latin America and the Caribbean

Social networking sites (SNS) are widespread in Latin America and the Caribbean. In 2016, Facebook was the second most popular website in Latin America, with an estimated 260 million social media network users (16). As a demographic with a large social media presence, youth have access to significant health education and online communication resources and have the potential to be conduits for programs designed to increase public health education, community awareness, and involvement.

Study purpose

This double arm, pre-post study evaluated whether using Facebook as an education platform could impact knowledge and prevention behaviors related to arboviral disease among youth living in communities at high risk for arboviruses within the Dominican Republic. We explored whether youth would engage with online Facebook groups focused on arbovirus prevention, and whether there was evidence that participation in these online Facebook groups impacted arboviral disease prevention at the individual and community level.

Methods

Design

The study was conducted from July to November 2016 in three rural-urban communities in the Dominican Republic: Group 1 (La Vega, 'LV'), Group 2 (San Francisco, 'SF'), and Group 3 (Puerto Plata, 'PP'). These sites were included due to their high risk for arboviral disease and prior working experience with the study team.

Participants

Youth ages 14–18 years who lived in the study communities, who completed a written assent, and whose parents completed a written consent were included.

Recruitment

Eligible youth were recommended by community leaders and peers and recruited in-person by the research team. The community leaders in this study consisted of adults living in the study areas who work in local public service organizations and had previously collaborated with the study team members. Potential youth participants were contacted in-person with a local community leader and provided basic study information and written consent and assent forms. Follow up for study enrollment was performed via the youth's preferred communication method of phone call, email, or in-person visit. Eligibility was assessed by research team members, and consent forms were collected from individuals prior to joining the social media groups.

Facebook intervention

Prior to study initiation, Groups 1 and 2 were randomly selected to receive the intervention of an online Facebook group dedicated to preventing Zika, while Group 3

Figure 1 Example online social media content. (A) Example of Group 1 Facebook group page; (B) example of weekly, online educational post.

was assigned to receive no intervention. Facebook was selected as the SNS for its user capability to interact with and observe other peer members, which would integrate elements based on social cognitive theory (17,18). The Facebook groups were specific to each community and named "Guerreros Contra el Zika" ("Zika Warriors"), which was chosen following participant feedback and supported by the social identity theory, which emphasizes the individual's perceived membership and social role in the group (19). During the 3-month intervention period, participants from Groups 1 and 2 were invited to join their respective Facebook groups and given full access to the site functionality. The youth were encouraged to focus on Zika and general arboviral prevention, but allowed to interact freely, in order to promote external validity and reinforce the theory of psychological ownership (20). The research team's online involvement was limited to weekly educational posts of informational content obtained from reputable, open-access health organizations (Pan American Health Organization, Centers for Disease Control and Prevention, United Nations International Children's Emergency Fund, British Broadcasting Corporation World) that were published to the Facebook pages of the intervention groups from an administrative account. The weekly post format was chosen to make available accurate and relevant health information, model online behaviors, foster group interaction, and maintain baseline exposure to health resources (21,22) (*Figure 1*).

Measures

Technology use

The number of online activities of the participants were obtained anonymously through Facebook analytics and recorded as parameters of advocacy and engagement throughout the trial period. These online activities include posting comments, images, videos, views, likes, shares, etc., and have been identified as common indicators of exposure, reach, and engagement on SNS (23). Additionally, the number of friends invited to the two Facebook groups were recorded over time as the weekly total number of members in each group.

Study participants completed online, self-administered pre- and post-surveys containing three sections: (I) demographic information, (II) basic knowledge test, and (III) preventative behavior frequency (*Table 1*). The basic knowledge test evaluated basic understanding of vector feeding and hatching patterns, and disease recognition, treatment, and prevention, with emphasis on Zika. The content for questions corresponded to basic informational pages from the aforementioned international health organizations and was adapted to an elementary reading level in Spanish and designed in collaboration with two youth representatives who did not participate in the study, in an attempt to promote engaging, youth-centered materials (24). The test consisted of 18 true/false, multiple choice, multiple answer, and image recognition questions

Table 1 Characteristics of study subjects from three participating sites, Dominican Republic [2016]

Site	Group 1 (LV)	Group 2 (SF)	Group 3 (PP)	P value[†]
# of participants	10	10	11	–
Age (median, range)	16, 14–18	16.5, 14–18	16, 14–18	0.81
Sex (# male, percentage)	6 (60%)	6 (60%)	6 (55%)	0.96
History of Zika (yes, no, unsure)	2, 5, 3	3, 5, 2	2, 7, 2	0.96
Average # in household w zika	0.8	0.9	1.2	0.95
Average self-rated knowledge (0–100)	49.4	51.1	48.3	0.92
Previous Facebook user	100%	100%	100%	–

[†], Demographic and epidemiologic characteristics were compared using χ^2 tests for categorical variables, and analysis of variance for continuous variables.

Table 2 Online activity of youth participants in "Zika Warriors" Facebook group during 3-month trial period

Site	Group 1 (LV)	Group 2 (SF)
Posting comments/dialogue	27	5
Posting image/photo	14	0
Posting video	4	0
Issuing challenge	9	0
Views	287	24
Likes	76	9
Shares (of previously posted content)	2	0
# of peers invited to group	68	4
Total	487	42

and scores were reported as a summed score of items that were correctly answered. The preventative behaviors survey included multiple choice responses regarding the frequency of 16 different behaviors in categories of primary bite prevention (PBP), household vector control (HVC), and community vector control (CVC) (*Table 2*). Numeric scores were assigned to the frequency responses: "1" =1–2 times, "2" = once per month, "3" =2–3 times per month, "4" = once per week, "5" =2–3 times per week, and "6" = daily frequency.

Ethical considerations

This study was reviewed and approved by the Colorado Multiple Institutional Review Board and Consejo Nacional de Bioética, República Dominicana. Written assent and parental consent were obtained by all study participants in their native language (Spanish).

Statistical analysis

Survey data were collected and stored using REDCap secure software. SAS statistical package 9.4 (Cary, NC) was used for all analyses. Baseline demographic variables were compared across the study groups using χ^2 tests for categorical variables, Student's *t*-test for 2-way comparisons of continuous variables and generalized linear models for 3-way comparisons of continuous variables. Linear regression models were used to determine the association between the number of peers invited, comments posted, photos posted, videos posted, challenges issued, views, likes, shares, and a summary measure of all online activity (predictor variables) and pre- and post-survey score difference (outcome variable).

Table 3 Comparison of test scores and frequency of preventative behaviors between intervention groups pre- and post-3-month trial period

Site	Group 1 (LV)	Group 2 (SF)	Control (PP)	P value (1,2 *vs.* control)
Knowledge Test				
Self-rated knowledge score means (standard deviation)				0.02
Pre	49.4 (18.5)	51.1 (10.3)	48.3 (16.9)	
Post	72.7 (12.2)	65.9 (12.6)	53.3 (11.4)	
Mean % change	47.2	29	10.4	
Overall score % mean (standard deviation)				<0.0001
Pre	39.4 (12.4)	40.0 (14.8)	41.4 (10.9)	
Post	74.4 (11.2)	45.6 (12.5)	41.9 (10.0)	
Mean % change	88.7	13.9	1.2	
Behavioral survey				
Primary bite prevention mean frequency score†				0.017
Pre	3.3	3.6	3.8	
Post	4.3	3.7	3.8	
Mean % increase	31.6	4.8	1.0	
Household vector control mean frequency score†				0.0024
Pre	3.8	4.0	4.1	
Post	5.2	4.2	4.2	
Mean % increase	36.6	6.3	2.2	
Community vector control mean frequency score†				0.0021
Pre	1.4	1.1	1.4	
Post	3.3	1.4	1.5	
Mean % increase	130.2	27.3	6.7	

†, Frequency score: 0= never, 1=1-2 times, 2= once per month, 3=2-3 times per month, 4= once per week, 5=2-3 times per week, 6= daily.

Results

Study population

Of the 44-youth invited to participate, 37 (84%) enrolled and completed the initial pre-trial survey, of which 31 completed both the pre- and post-trial surveys (84% completion). There were no statistically significant demographic differences between study groups (*Table 1*).

Survey results

Following completion of the intervention, survey responses were compared between the study groups (*Table 3*). Survey knowledge scores increased significantly in the intervention groups compared to the control group (P<0.0001). The subjective self-rated knowledge scores also significantly increased (P=0.015). When comparing preventative behaviors, the intervention groups showed a statistically significant increase in all categories: PBP (P=0.017), HVC (P=0.0024), and CVC (P=0.0021).

Variation in online activity between groups

In a sub-analysis comparing the two intervention groups, there was significant variation in online behavior and survey score differences. During the 3-month intervention period, Group 1 had a total of 487 online activities, including 68 new friends invited, compared to Group 2 with 42 online activities and 4 new friends invited. Differences were observed with a notably increased level of posting,

distributing online materials, and higher numbers of passive "views" of the content in Group 1 compared to Group 2. Subsequently, Group 1 had a statistically significant increase in survey knowledge scores (P<0.0001) and preventative behaviors in all categories (PBP P=0.0009, HVC P=0.0011, CVC P=0.0007) compared to Group 2. In comparing Group 2 to Group 3 (control), change in survey scores and self-rated knowledge did not reach statistical significance (P=0.06, P=0.14, respectively), nor did preventative behaviors differ between groups (PBP P=0.37, HVC P=0.30, CVC P=0.38). In separate regression models, all individual measures and the summary measure of online activity were significantly associated with improved knowledge scores (all P values <0.0001).

Discussion

This study supports the use of social media peer-to-peer education groups as an accessible, low-cost public health intervention to improve arboviral disease knowledge and prevention practices among youth in an LMIC. A significant increase in basic arboviral knowledge and the frequency of preventative behaviors was observed in youth who participated in the online Facebook group, whereas minimal change was observed in the control group.

Interestingly, engagement varied significantly between the two intervention groups; Group 1 had greater participation in the Facebook group and improved outcomes. Group 2 had minimal online engagement and showed no increase in knowledge or prevention practices compared to the control group. Thus, the statistically significant difference in knowledge and behavior observed between the two intervention groups as well as the control group appears to be driven by the increased online engagement of the teens in Group 1. Both predictor variables of online activity and the number of peers invited were significantly associated with outcome variables in the intervention groups, suggesting that the level of online activity was strongly associated with the impact of the intervention. This finding is consistent with other studies that have utilized social media for health promotion (25,26).

There are several possible explanations for the variations in online behavior between the trial groups. As seen in *Table 2*, the intervention groups differed significantly between the numbers of materials posted from participants, which indicate online engagement. It can be reasonably assumed that this increase in activity in Group 1 significantly impacted the metrics of exposure, with more views, likes, and comments, in addition to the metric of reach, with the increased number of friends invited to the group (23). This trend in behavior can be explained through the social cognitive theory, which proposes that the acquisition of knowledge can result from observing modeled behaviors in peers (27,28). Strong youth advocates in Group 1 led a more active Facebook group, where information was more widely distributed, including initiating events and peer challenges. The concept of "reciprocal determinism" provides attention to how role models can be strong influencers of behavior. Other studies have also noted greater online response and engagement from peer role models and influencers using social media, as opposed to moderators (29-31). In contrast to Group 1, Group 2 participants observed few behaviors from their peers and therefore may not have received the same amount of social influence. This potential explanation of peer-to-peer influence is further supported by the fact that administratively disseminated content was equal between the two intervention groups. This finding suggests that the simple dissemination of health information on social media venues alone may not have the power to modify behavior and increase knowledge of corresponding health topics. Strong peer players may be necessary in social networks to encourage behavior change. Thus, identifying and recruiting a few proactive peers may have power to influence an entire cohort.

Other possible explanations for the decreased engagement in Group 2 compared to Group 1 include a larger geographic area within the community site, lack of group integration seen with minimal online interaction, and lack of group ownership. Although Group 2 was initially enthusiastic to enroll in the SNS health program, a lack of psychological ownership may have resulted in more passive membership. In addition, weaker social ties among geographically distanced members may have resulted in reduced social identity as members of the Facebook group and led to lower online participation. Previous work has found that fewer clustered networks and redundant ties among members within a SNS group may fail to produce the necessary reinforcement to adopt the behavior of engaging online (32). Although this study did not characterize the breakdown of subject recruitment via peer versus community leader recommendation, it is possible that recruitment of study participants by recommendation of peers may prove more beneficial than through community leader preference and should be further explored. Future studies should focus on initiating online programs within a familiar circle of peers with strong peer leaders to foster

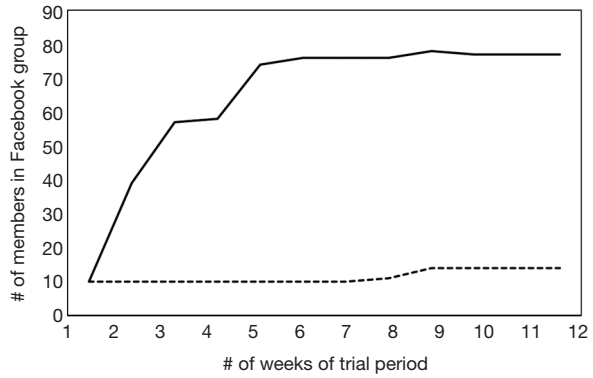

Figure 2 Growth of the number of youth members in "Guerreros Contra el Zika" Facebook groups in 2 cities of the Dominican Republic from August 2016-November 2016. Group 1 (La Vega, solid line), Group 2 (San Francisco, dotted line).

interaction and engagement.

This study has several limitations. Participants were self-reporting frequency of preventative behaviors, which may have led to response bias. However, equivalent, consistent responses were seen in participants in the control group and the less active intervention group, suggesting that the bias may have been minimal or resulted in non-differential misclassification. While the sample size was relatively small, the effect of the intervention in a Facebook group with a positive peer model was still statistically significant. Temporal patterns of online activity were not recorded, which is a limitation of analyzing the online activity. However, surrogate indicators of friends invited peaked at five weeks and then remained stable (*Figure 2*). This is consistent with another study investigating Facebook support group engagement in young adult cancer survivors, which found that online interaction significantly decreased in the second month of the intervention (29). Future studies would benefit from additional strategies, outside of weekly posts, to promote sustained engagement in teenagers in SNS.

Conclusions

This study demonstrated that among youth living in resource-poor communities in the Dominican Republic, exposure to an arbovirus-oriented Facebook group in which members had a greater online engagement was associated with positive changes in self-reported health behavior, compared to a non-intervention group (control) and an intervention group with low participant engagement. With the widening accessibility of online connectivity in LMIC communities, online tools offer novel, cost-effective strategies for public health education in regions at high risk for arboviral disease. Due to their online presence, education, and motivation, youth should be utilized to promote the prevention of arboviral and other diseases that depend on community-based prevention, via online channels. Future studies should evaluate applications of peer-to-peer engagement in social media to promote public health and disease prevention in other resource-limited settings.

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Footnote

Conflicts of Interest: The authors have no conflicts of interest to declare.

Ethical Statement: This study was approved by the Colorado Multiple Institutional Review Board (IRB approval #16-0584) and the Consejo Nacional de Bioética, República Dominicana. Informed assent and parental consent were obtained from all participants before enrollment into the study. The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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