Global Advanced Research Journal of Microbiology (ISSN: 2315-5116) Vol. 9(3) pp. 030-039, May, 2020 Issue.
Available online http://garj.org/garjm

Full Length Research Paper

Advances in the Community Surveillance of the Zika virus in a country border: Huaquillas, El Oro. Ecuador

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Accepted 28 April, 2020

Background: New insights promote the term "Community Participation" as a condition to exercise freedom, democracy, social control over public actions and therefore, for equity. Vector-borne disease control of arboviruses such as Zika Virus (ZIKV) should actively involve the population, since human resources and health logistics are insufficient to address the problem. Objectives: identify the risk factors by the community to contract the ZIKV, determine the age and sex group of the participants, identify positive blocks with breeding sites of *Ae. aegypti,* indicate the more prevalent stage of the vectors and the number of pregnant women suspected of the virus. Materials and Methods: was a participatory, descriptive, field-based, non-experimental and longitudinal-cut action research, executed in Neighborhood 18 de Noviembre, Huaquillas-El Oro-Ecuador during the months of March to September, 2018. Results:The age group of 20-49 years for both sexes (n = 25, 78.13%) and (n = 36, 85.71%) In relation to the family heads interviewed, the predominant age group was also 20-49 years old. Males (n = 692, 43.2%) and female (n = 814; 50.84). The deposits inspected were 3251. The 48 blocks of the neighborhood were explored; of them (28) were positive. Positive breeding sites were found (58.33%). Of the positive blocks (67.85%), they were positive for larvae, 3.57% for pupae and 28.57% for both. The number of pregnant women identified was 15; 5 of them suspected of ZV, later discarded. Conclusions: This study represents an evidence on community epidemiological surveillance, for the control of *Ae. aegypti* and Zika prevention.

Keywords: prevention, community, *Aedes aegypti,* virus, zika

INTRODUCTION

Since the promulgation of the concept of Health, issued by the World Health Organization (WHO) in 1948, a series of criticisms have been raised in this regard. The new insight focuses on the ability of individuals or communities to adapt, or to self-manage the physical mental or social challenges that come into their life (Vélez Arango, 2007).

The term “Community Participation” takes more prominence in health as a condition to exercise freedom, democracy, social control over public action and therefore, for equity. Represents an essential condition to guarantee the effectiveness and satisfaction of the services and constitutes a desirable end by itself (Marston et al., 2016). Community participation establishes a close relationship on factors that promote growth and development to facilitate the common good (Sáinz-Ruiza et al., 2019). The population is responsible to resolve what is within their possibilities, thus trying to ensure the general welfare (Cáceres and Hernández, 2008). To guarantee the promotion of a community health surveillance system – which consists of a strategy of local health surveillance and monitoring through the participation and direct collaboration of the neighbors and members of the community in order to early identify a health problem that affects them – (Pogrebinschi, 2017), its inhabitants need to participate permanently.

Recent evidence suggests that one of the problems in which the permanent participation of the communities is required, is in the threats of epidemics caused by diseases transmitted by vectors. Geographic vulnerability, climatic aspects, absence of basic services and the habits of stocking containers that can accumulate water, mark the cause of these epidemics (Pyszczek and Sáez-Sáez, 2016).

Diseases involving the vector *Aedes aegypti* such as Dengue, Chikungunya and Zika are viral diseases caused by the bite of this mosquito infected with the virus (Hernández-Escolar et al., 2014). The symptoms are similar in all the mentioned arbovirosis: fever, rashes, conjunctivitis, muscle and joint pain, malaise and headaches; they are usually mild and last between 2 and 7 days (WHO, 2018).

After the ZIKV began circulating as a spread in the Americas in 2015, reports of microcephaly and other neurological disorders increased in affected areas. Since then, it has been concluded that ZIKV infection in pregnancy is one of the causes of microcephaly and other serious fetal brain defects. ZIKV has also been associated with pregnancy loss (abortions) and other problems in newborns, including eye defects and hearing loss (PAHO, 2016).

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Since Epidemiological week (EW) 44 of 2016, no new country or territory in the Americas confirmed vector autochthonous transmission of ZIKV; therefore, the number of countries and territories in the Americas that confirmed the cases of vector transmission of ZIKV and sexually transmitted ZIKV are maintained at 48 (PAHO, 2017). In this respect, since EW 14 of 2017, exists a decreasing trend of suspicious and confirmed cases in this sub-region (PAHO, 2017), with the exception of Ecuador, where an increase in the number of suspected and confirmed cases is observed (between EW 4 – 20 of 2017, and EW 21 - 30 of 2017, there was an average of 293 suspected and confirmed weekly cases in South America) (PAHO, 2017). For the triennium 2016 to 2018, a total of 965 cases of pregnant women with ZIKV infection were reported. Likewise, for the year 2016, until EW 14 of the year 2018, 17 children with vertical transmission of zika without congenital malformation, were registered, product of positive pregnant women and suspected of ZIKV infection, from the provinces of Manabí , Guayas, El Oro and Santo Domingo de los Tsáchilas (MSP,2018).

Epidemiological surveillance has become an element of population health. This allows knowing the level of health, identifying their deviations and developing actions in each unit (Garcia Pérez and Alfonso Aguilar, 2013). Community surveillance emerges, to propose joint actions to improve the quality of life of the most vulnerable population at risk (Mitton et al.,2009). But nevertheless, participation requires the will of the human being, and the direct contact of the population with the programs of health (Aguilar-Idáñez, 2001; Mitton et al., 2009).

In relation to this, the WHO (1990) states: "The insistence that people should take responsibility for their own health is an important aspect of individual and collective development." Figueroa-Pedraza (2002) refers that neighbors and residents should transmit this information, since human and economic resources available in the State (for prevention and control activities, as well as the permanence over time) are insufficient. On the other hand, although fumigation campaigns are carried out at homes, this does not seem to be enough (Maguiña and Galán-Rodas, 2016; Kauffman and Kramer, 2017).

There are few experiences of community participation studies related to ZIKV involving surveillance by communities in Ecuador. In this regard, Novillo Rameix (2017) conducted a research entitled "KAP study - knowledge, attitudes and individual and collective practices - on the prevention and control of the ZIKV in selected areas of intervention of the project: Together Against Zika" in Ecuador. Similarly, there was an experience involving conceptual and methodological tools, generated from the theoretical compilation on community epidemiological surveillance, performed by Tognoni (1998) in Ecuador.

Figure 1: Neighborhood 18 de Noviembre. Huaquillas. El Oro. Ecuador. Source: Googlemaps

Given the proximity of the province of El Oro to the neighboring country Peru (important site of commercial and pedestrian traffic) and motivated by the fact of being one of the provinces where cases of microcephaly were identified, this investigation arises to identify early cases using the community surveillance.

This study was settled out to determinate the usefulness of identifying the risk factors indicated by the community to acquire the ZIKV, the age group and sex in the trained individuals, the representatives and heads of family interviewed in the homes, the particularities work groups to carry out work in the community. It also analyses the impact to characterize the variables contained in the summary of home visits and highlights the importance of identify positive neighborhoods with breeding sites of *Ae. aegypti,* the stage of the vector found. In the same way, gives an account of the number of pregnant women suspected of the virus. Likewise, investigate the level of knowledge of the community interviewed about vector and disease.

MATERIALS AND METHODS

It was a participatory, descriptive, field-based, non-experimental and longitudinal-sectioned action-research. The research was executed in Neighborhood 18 de Noviembre, an urban community of Ecuador belonging to Huaquillas, located in the Province of El Oro in the south of the country (Figure 1) and carried out in the period between March - September 2018. The Neighborhood 18 de Noviembre is located at the Latitude: -3.4752300°, Longitude: -80.2308400°. The temperature fluctuates between 22ºC and 28ºC. The relative humidity of the environment is 90%. It is located at a height of 1.9 meters above sea level(GEODATA, 2018). It has an estimated rainfall of 1000 mm per year. The wind direction is 4-13 km / h(INAMHI, 2018). There are three types of climates from east to west, mesothermic - semi-humid, tropical monsoon and tropical savanna(GADCH, 2014). The vegetation is conditioned by climate, humidity and height. The area of Huaquillas have semi-desert areas classified as tropical desert. (Burbano Becerra and Pasquel, 2015)

For the selection of the locality there was considered the last two years, due to an increase in the reported cases of the main arbovirosis. The town has an estimated population of 15540 habitants. The female population represented 41% as opposed to the male population that occupies 59%. By 2018, the age group of 10-14 years and 65 and over, represented 10% of the total population, respectively. It was considered inhabitants who were at the age of majority, of both sexes, illiterate or not, and being a resident of the study area for a period of two years, as inclusion criteria to participate in the pilot program.

This study seeks to obtain data, which will help to address these research gaps through five Phases or Stages. **Pre-project Phase:** In this lapse, previous contacts were established with community leaders,

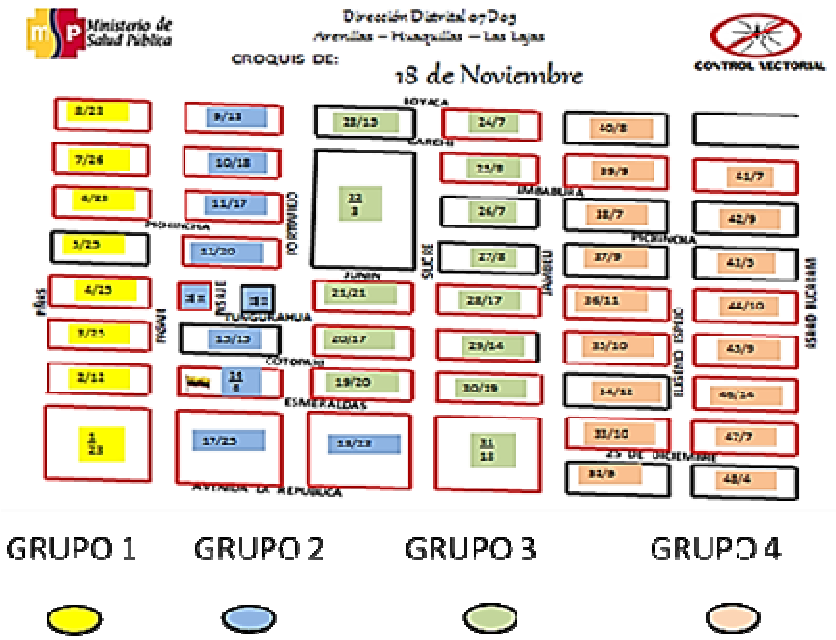

Figure 2: Distribution of the blocks and houses. Neighborhood 18 de Noviembre. Huaquillas. El Oro. Ecuador. Source: Study data

Figure 3: Pre-project Phase. Members of the Community Board, consulting team, boys and girls doing recreational activities in the community. Launching of the Community Pilotage Surveillance System Huaquillas - El Oro. Community Field of Huaquillas. April 2018.

directors, provincial epidemiologists, social workers, health personnel and researchers (Figure 3). Subsequently, an assembly of citizens were attended through the activity "The Community Tree"(Hernández-Hernández and Garnica-González, 2015)(Figure 3, Figure 4). **The Design Phase:** corresponded to a learning-by-doing strategy in the aspects: education, epidemiological, entomological and socio-anthropological surveillance. The training was executed by students of the medicine and nursing careers of the Technical University of Machala and Volunteers of the Red Cross of the town. In addition, two practical sessions were carried out, to recognize the immature forms of the vector: eggs and larvae in different stages (L1, L2, L3) as well as pupae of *Ae. aegypti* and other immature culicids.

The Implementation Phase: consisted of the approximation to each of the houses, to inspect possible breeding sites and recording data contained in the

Figure 4: Pre-project Phase. Guidelines for the development of the elements of "The community tree". Neighborhood 18 de Noviembre. Community Field. April 2018.

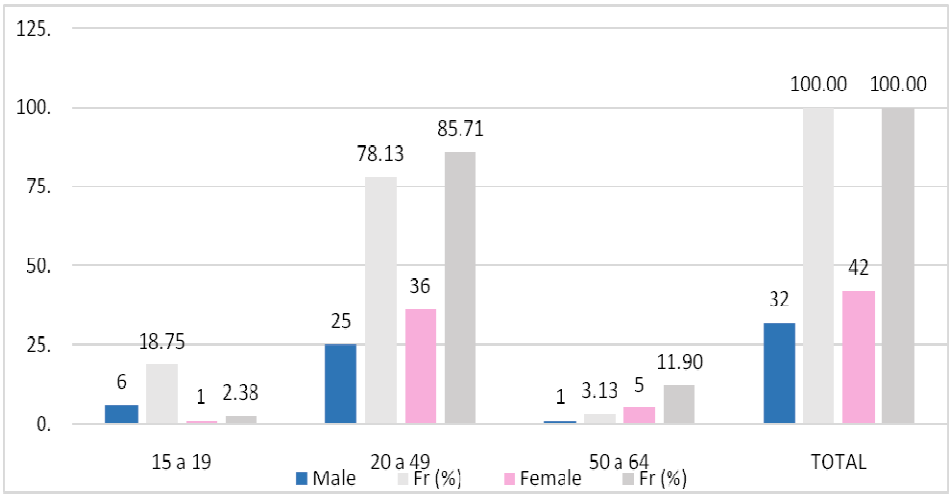

Figure 5: Training. Distribution of the community, students (Technical University of Machala) and Volunteering (Red Cross) according to age and sex groups. Community surveillance system. Huaquillas El Oro. Ecuador. March-September. 2018.

information collection instruments, with previous training of the monitors for the approach and application of the survey in the homes. To do this, four working groups were formed (Figure 2). Each group included 5-7 monitors and a responsible coordinator per group. This person was in charge for verifying the entomological inspections, as well as carrying out the quality control of the survey once the interview with each head of the family finished. In addition, another work team was formed, represented by two vector control technicians who were delegated to review the forms, once the daily activity of each group was completed.

For the registration of the information, it was employed the modified form usually used by the vector control team of the MSP of Ecuador for the home visit (AA-2 of the MSP visitor).

In the Results Evaluation Phase, were executed already defined strategic actions, such as the training to the house representatives, including information about techniques for the elimination of vector breeding sites. Finally, in the **Impact Phase of the actions**, were evaluated the results obtained in conjunction with the working group and members of the community.

The data obtained was systematized in a master table made in Microsoft Excel, for later analyzed in the statistical processor Statgraphics Plus 5.1 represented in frequency distributions and shown in statistical tables.

RESULTS

Figure 5, shows the distribution of trained monitors according to age and sex groups. It was observed the prevalence of the age group of 20-49 years, belonging to male and female sex, (n = 25, 78.13%) and (n = 36; 85.71%), also the group of 15-19 years corresponding to

Table 1. Summary of home visits. Neighborhood 18 de Noviembre. Huaquillas El Oro. Ecuador. 2018

GROUPS	Members of the household who participated in the inspection	Totaloffamiliesvisited	Totalof houses inspected	Totalofclosed houses	Totalofreluctant houses	Totalofvacantland	Membersoffamilies (male)	Membersoffamilies (female)	Totalbeneficiaries	N°Pregnantwomenfound	N°Suspected cases found	N° Suspected cases of pregnant women found	Total deposites	N°Depositswithlarvae	N°Depositswithpupae	N° Deposits with larvae and pupae	Totalof positives deposites
Group 1	119	119	115	61	10	16	219	225	444	5	3	0	641	6	0	4	10
Group 2	102	102	102	32	18	11	193	224	417	2	0	0	743	4	1	3	8
Group 3	116	116	103	50	18	9	210	207	417	5	2	0	1027	6	0	1	7
Group 4	83	83	89	48	11	6	165	158	323	3	0	0	840	4	0	1	5
TOTAL	**420**	**420**	**409**	**191**	**57**	**42**	**787**	**814**	**1601**	**15**	**5**	**0**	**3251**	**20**	**1**	**9**	**30**

Table 2. Percentage of Positives to Aedes aegypti vector breeding sites. Boarding house per house. Piloting "Huaquillas El Oro Community Surveillance System." Neighborhood 18 de Noviembre. El Oro. Ecuador. May 2018.

Blocks	Fa	Fr (%)
Positives blocks	28	58,33
Positives tolarvae	19	67,85
Positives topupae	1	3,57
Positives to larvae and pupae	8	28,57
Negative Blocks	20	41,66
Total Blocks	48	100

the male sex (n = 6; 18.75%) and the group of 50-64 years (n = 5; 11.90%) belonging to the female sex. (Figure 3)

In relation to the family heads interviewed, the predominant age group was also 20-49 years old. (n = 692, 43.2%) In relation to sex, it corresponded to the female (n = 814; 50.84%). Table 1, shows 420 heads of family interviewed with the same number of homes visited. There were 191 closed houses (45.47%); 57 reluctant (13.57%) and 42 vacant lots (10%). The total of inspected deposits was 3251; 20 of these were positive for larvae, 1 for pupa and 9 positive for larvae and pupae. The number of pregnant women identified in the households was 15; 5 of them suspects the Zika virus (Table 1).

Table 2 shows the inspected blocks in Neighborhood 18 de Noviembre (48). Of all the blocks inspected, 28 were positive. Breeding sites were found (58.33%). Similarly, (20) blocks were negative (41.66%). Of the positive blocks (67.85%) they were positive for larvae, 3.57% for pupae and 28.57% for larvae and pupae).

DISCUSSION

The community is associated actively to the representations of the communal council (12 commissions). The strategy "The Community Tree" allowed the members to express the most relevant risk factors to be identified by the attendees to the activity. During the assembly, the community identified 9 key factors that could be generating ZIKV cases: 1) irregular water supply, 2) inadequate garbage disposal, 3) temporary breeding sites, 4) presence of invasive weeds, 5) dead animals on the roads and outside of the institutions, 6) sewer system in poor condition, 7) indiscriminate use of water tanks, 8) deficient number of downgrades and 9) lack of

sustainability of the actions for the elimination of the mosquitoes.

Other authors(WHO et al., 2016) indicate in the KAP Zika survey carried out in Honduras, that 82% of the interviewees consider that the ZIKA is contracted due to the bite of mosquitoes. In addition, other relevant aspects were also pointed out as factors to contract ZIKV: contaminated water and the presence of an unhealthy environment. Only about 1% of the interviewees mentioned sexual relations, breast milk or blood transfusion as mechanisms of contagion of the ZIKV. On the other hand, in another study carried out in the South zone of Cercado Cochabamba (Bolivia) a relevant factor for the proliferation of *Ae. aegypti*, was the high number of barrels that are used by families for water storage, due to the partial or total lack of basic services. This same factor: the proliferation of larvae from water storage tanks, such as that found in this study, coincides with that observed in other countries of the region (Rodríguez Cruz, 2002; Chang Camero et al., 2013).

In relation to trained community monitors, groups of 20-49 years prevailed (with predominance of female sex). The WHO(2016) points out in a survey of knowledge, attitudes and practices (aimed to adress the disease and possible complications), that the profile of the interviewers should be carefully examined (sex, religion, ethnic origin, age and belonging or not to the local community). In this study it was established from 18 years old, the age to receive the training and to be part of the research. In this sense, Salamanca-Ramos(2015) in a study aimed at knowing the lifestyles of health promoters in women of the social programs of Villavicencio-Colombia, indicated that the observation team, was made up of the women attached to local health promotion programs, with the following inclusion criteria: over 18 years old and actively enrolled in the presidential program of social action of the municipality.

As for the family heads interviewed, women were in the 20-49 age range. This result coincides with Yepes (2016) who, to apply the KAP Zika Colombia survey, indicates that the number of women participating was greater than that of men (M = 218, H = 180). However, in the ZIKV Emergency Results Report in Honduras, the Knowledge, attitudes and practices survey (KAP) was applied to 198 men and 207 women aged between 19 and 65 years; in effect, they highlight the collaboration of women. Likewise, in a study by John Hopkins University(HC3, 2017) aimed at evaluating the capacity for collaboration and communication skills of Health in knowledge and behaviors for the prevention of Zika in the Dominican Republic, El Salvador, Guatemala and Honduras. Results indicated that the highest average age was 28.9 years in the Dominican Republic, and the lowest average age was 25.1 years in Guatemala. In El Salvador and the Dominican Republic, the number of women was slightly higher, 56.1% and 56.0%, respectively.

Once the distribution of the groups for the housing approach was found, Group N ° 1 turned out to be the one that showed the greatest skill to inform a significant number of beneficiaries (444) about the prevention of ZIKV, through allusive messages, prevention strategies and elimination of breeding sites. Likewise, this group found the greatest number of positive deposits at homes. The strategy of placing an officer of the Vector Control Program leading each work group, allowed to perform a better-quality control in the filling of the forms, clarifying doubts to the monitors and heads of family, clean common areas, protect or eliminate water containers and follow up visits if necessary. This aspect gained greater importance and was guaranteed in the second control carried out by the inspectors, once the daily work done by the monitors had been completed.

In this study 3251 deposits were inspected; 0.93% were positive (n = 30). It should be noted that during the previous monitoring carried out by the vector control program (done to obtain a baseline) the value resulted to be 0.67%. The observed difference could be due to the greater number of inspected deposits (4323) in the annual programming

The frequently found deposit in the houses were the high-rise tanks. This result coincides with Rubio-Palis et al.(2011) in a study related to the population fluctuations of *Ae. aegypti* (Diptera: Culicidae) and dengue casuistry in six municipalities of Aragua state, Venezuela, who found that tanks of ≥1000L had a higher larval index per positive recipient. However, it differs from the results found by Terazón et al. (2014) in a study of risk factors associated with the proliferation of *Ae. aegypti* in the Popular Council "Los Maceos" of Santiago de Cuba, where it was found that ground-level tank appear as the deposit with greater frequency of appearance in the houses, and a high incidence of colonization by this vector was reported.

Regarding the larval stage frequently found in the breeding sites present in the homes visited, it was L3. In studies of this nature (Torres Sarmiento and Zayas Vinent, 2014) during the period of the research carried out (in the councils of Los Maceos, Guillermo Moncada, and Rafael Heredia) in Havana, Cuba, 2595 blocks were inspected: 514 had larval foci of this species, for an average of 198 blocks per cycle. In this study, the block 8 presented the highest number of houses with breeding sites of the vector. Recently, the insecurity of the personnel carrying out the study (closed houses, reluctant homes, little support from the community, among others) has increased.

The Larval Indexes obtained from the home visits in Neighborhood 18 de Noviembre from Huaquillas city were: House index 6.8; deposit index 0.9 and Breteau index 7.3. Likewise, lower indices were found in a systematization of entomological surveillance and vector control of selected regions of Peru by the project OPS / ECHO (2011), like those made in the present investigation. The authors indicated that ranged between <1 and> of 7; IR <1 and> of

2 and IB <1 and> of 6.2. However, in order to establish comparisons, it is necessary to take into consideration the time of the year in which the data was obtained (as the deposit index reaches its highest peak in May and its lowest in January) (Velásquez Serra et al., 2017). In the same way, it will depend on the range and number of places intervened. For this reason, Maestre Serrano et al.(2015) point out that it is important to know the infestation levels of the vector, taking into account rain and drought regimes, in order to know if there really is variation between climatic periods and thus strengthen the control actions in the times of greater infestation, accompanied by education measures. It should be noted that the indexes in the present study were conducted in the dry season of Ecuador, so it is convenient to carry out such interventions in both periods to be able to determine analogies.

Despite the claim that larval indexes do not adequately reflect adult production and its limitations in terms of interpretation and validity (Torres Sarmiento and Zayas Vinent, 2014; Marín Rodríguez et al., 2009), they still constitute the main tool for measuring success in vector control programs, and they continue to be essential indicators in epidemiological surveillance of dengue.

On the other hand, during the aaproximation to the homes, 15 pregnant women were detected; 5 of them were suspicious of ZIKV, which were discarded by serology (CDC, 2018). However, considering the importance of the early detection of ZIKV in pregnant women, it is essential to continue monitoring the community under study given the situation of risk that it represents for the country. In addition, adequately communicate the detection of cases to the health authorities.

The existence of the vector was only recognized by 68,8 % of the community. In this regard, a KAP survey conducted in the Canton of Huaquillas indicated that 58.6% of the respondents had received clear and easy to understand messages, so they recommended that in later pilots programs this aspect should be taken into account, to recover, review and adapt the communicational messages in which the study was carried out(Figueroa-Pedraza, 2002). The communicational message used by the monitors: "*Without breeding places there are no mosquitoes, without mosquitoes there is no Zika, Dengue and Chinkunguya and thus we are all healthy*" caused sympathy among the community and especially the children. In relation to the knowledge of vector biology within the children, they recognized the larvae of the vector. This identification could be due to the previous training in the community. Similarly, they knew about the disease but not fully about the different transmission mechanisms.

It should be noted that when the piloting was launched in the community, they responded willingly to participate. The community and the communal council in assembly approved the planned activities. Greater acceptance of the proposal was approved, the positive response led by a group of young people. Posteriorly, the active participation of the community was later reduced to 9 members. They argued that the commercial activity that demands their sustenance prevented them from collaborating permanently. It also observes that the students who reside in the community participated as monitors, transmitting all the information to their parents.

Regarding the degree of inter-sectorial correlation, a high participation commitment of the Vector Control and Epidemiological Surveillance Program was observed, this was reported in 63% of the respondents. The research team could corroborate this information since they were present in all the piloting activities, including the preliminary meetings, launching, revision of the working methodology, accompaniment, implementation of the house-to-house approach, as well as, in the consolidation of information and evaluation of results. This assessment was not the one expected for the GADCH, whose respondents (8%) reported that this institution favored the launching activities but not the execution of the piloting in any of the stages. When the study was carried out, 6.87% of the houses were positive. After four weeks of piloting, the impact of the actions was measured; it was found that the number of positive houses reached the value of 5.27%.

CONCLUSIONS

This study represents an effort to generate evidence on community epidemiological surveillance, for the control of Ae aegypti and Zika prevention. In this investigation, no confirmed cases of Zika were detected in pregnant women. Women actively participated. The community does not know in depth all the transmission mechanisms of the virus, but is aware of the vector's hourly activity.

ACKNOWLEDGEMENT

The authors wish to express their gratitude to the entire community of Huaquillas who participated in this experience, belonging to the Project "Together Against Zika" (*in spanish "Juntos Contra el Zika"*USAID / CARE) for supporting the development of this research,which is an unpublished and extraordinary example of surveillance in borders and peripheral communities of developing countries in South America.

Conflicts of interests

The authors declare that there are no conflicts of interests associated to this article.

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