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Assessing the Level of Perception of Knowledge about Ticks and Tick-Borne Diseases among the Residents of Several Cities in the Transboundary Region of U.S.-Mexico

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ASSESSING THE LEVEL OF PERCEPTION OF KNOWLEDGE ABOUT TICKS AND TICK-BORNE DISEASES AMONG THE RESIDENTS OF SEVERAL CITIES IN THE TRANSBOUNDARY REGION OF U.S.-MEXICO

A Thesis

by

CONSUELO AGUILAR

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ASSESSING THE LEVEL OF PERCEPTION OF KNOWLEDGE ABOUT TICKS AND TICK-BORNE DISEASES AMONG THE RESIDENTS OF SEVERAL CITIES IN THE TRANSBOUNDARY REGION OF U.S.-MEXICO

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ABSTRACT

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The transboundary region of U.S.-Mexico possesses similar weather conditions and habitats favoring insects (vectors) like ticks. Several tick species found in the transboundary region of U.S.-Mexico can transmit pathogens. In the last three years, a total of 40 cases of Rickettsial infections, 28 in Tamaulipas and 12 in the Lower Rio Grande Valley, have been reported. A low level of knowledge about diseases that ticks can transmit along with a lack of appropriate protection practices can severely affect human health. Limited surveys on ticks and tick-borne disease are available. Our goal was to (1) assess the perception of knowledge of ticks and tick-borne diseases among residents in cities of the transboundary region of U.S.-Mexico and (2) create awareness on how to prevent tick-borne diseases.

We hypothesized that a survey would provide data to assess the level of perception of knowledge that residents have about ticks and tick-borne diseases. We predicted that residents that live in the transboundary region have low perceived knowledge about ticks and tick-borne diseases. We validated a survey and distributed it using the UTRGV Qualtrics platform from October to December 2020. The analysis revealed that 54.80 % reported knowledge, whereas 45.20 % reported no knowledge, which contradicted our prediction. The results revealed that residents of the transboundary region have a high perception of tick-borne diseases, but they lack protection practices to prevent and protect from tick bites to their children and themselves. The

implementation of English and Spanish videos, and flyers to prevent tick-borne diseases in the transboundary region of U.S.-Mexico can be beneficial to prevent tick-borne infections.

DEDICATION

The completion of my graduate studies would not have been possible without the grace of God and the love of my family. My son Francisco Bazan, my father, Nemecio A. Aguilar, my mother, Maria R. Machuca, my siblings and friends who believed in me. Thank you for your love and support.

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My thanks go to my thesis committee members: Dr. Mirayda Torres-Avila, for her input and patience in guiding me with the IRB application. Her collaboration with the search for details and terms used in the biology field for a better understanding of the survey questions and her help with Qualtrics platform and the ideas in the approach to the community. Thanks for trusting in my work and admiring my ideas. Thanks to Dr. Oraby for his patience, teaching, and guidance with the pilot's statistical analysis and the official survey for this study. Thanks for believing in my potential. Thanks to all the committee members for challenging me and motivating me to face the community by approaching agencies on both regions US and Mexico, which helped me create a vast network of research.

I want to thank Dr. Marcela Hebbard for the language input for the survey. I would also like to thank Dr. Lowe for revising my first draft of the survey when she was my Scientific writing professor. I want to thank Dr. Vitek and the Vector Borne Disease for allowing me in his lab as a volunteer in the collection of ticks from several veterinary partners along the Lower Rio Grande Valley as part of the Tick CDC project. It provided me a great experience handling the ticks. Thanks for the funding of the Aedes mosquito publication in the Subtropical Agriculture and Environments Journal. I also want to thank Dr. John Thomas III for allowing me to do an internship in his laboratory to conduct molecular studies on ticks searching for pathogens.

Thanks to Gisel Garza, Ruth Galan, Elizabeth Gonzalez, Liserena Madrigal, Juan Garcia, Valerie Hernandez, Eli Ruiz, Alejandra Alvarado, Jose Ayala, Vanesa Ochoa, Frida Cuellar, Maxdaniel Garza, and many others who assisted me with the survey distribution, and laboratory work. A special thanks to all the participant departments and organizations that granted permission and distributed the online survey. Thanks to the participants from the counties of Hidalgo, Willacy, Cameron, and Starr, Texas. Three precincts at Starr County, commissioners, Ruben D. Saenz, Jaime M. Alvarez, Raul Pena III; nonprofit organizations, Ricardo Brambila, First Baptist Church San Isidro. Thanks to the municipalities and the Tamaulipas vector control agencies, Pascual Camacho and Cuauhtémoc Quintero in Mexico. Thanks to all the survey participants, without their contribution, the study could not have been possible. Special thanks to the IRB personnel Kimberly Fernandez, Edith Ramos, and Nadia Garza De Ramirez, who assisted throughout the application process. Finally, I would like to thank UTRGV for giving me the honor to form part of its prestigious Grad school and the Biology Department, Dr. Dearth, for his advice and help during graduate studies and staff (Diana Ocanas and librarian Justin White).

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CHAPTER I

INTRODUCTION

Ticks

Ticks can be found worldwide (CDC 2017), yet some species are restricted to specific regions. Ticks are classified into two major families, Ixodidae (hard ticks) and Argasidae (soft ticks) (CDC 2017; WHO 2019). A key morphological feature that distinguishes a hard tick from a soft tick is that hard ticks have scutum in the dorsum, whereas in males, the scutum almost covers the whole dorsum (Pratt, 1967), in females, the scutum partially covers the dorsum. (Figure 1).

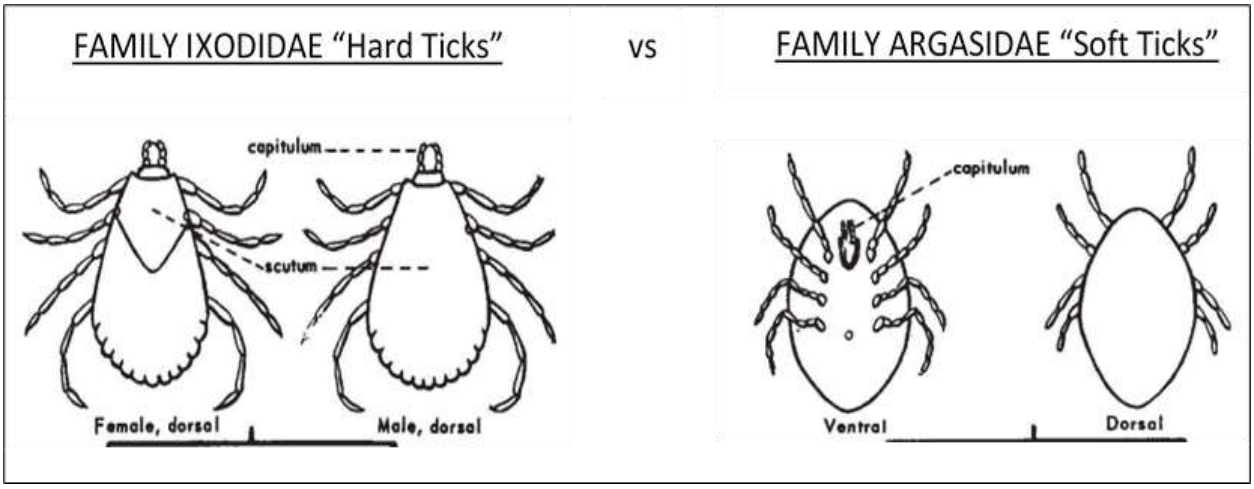

Figure 1. Left to right. Families Ixodidae (hard ticks) and Argasidae (soft ticks). Images from source and content of Pictorial Key-Ticks (Pratt, 1967).

Soft ticks have flattened bodies and quadrangular plates, and eyes absent (Platt, 1967). Several Ixodidae and Argasidae families are of public health importance, e. g., a hard tick, *Ixodes* vector for Lyme Disease, or *Rhipicephalus* vector for Rocky Mountain Spotted Fever (RMSF). For the family Argasidae, *Ornithodoros hermsi* and *O. turicata,* are vectors for tick-borne relapsing fever (TBRF) (CDC, 2017; Mullen et al., 2019; Figure 2).

Figure 2. Hard ticks and soft ticks. To the left, *Rhipicephalus sanguineous*, hard tick. Right, *Ornithodors hermsi*, a soft tick. Images from source and content of Medical and Veterinary Entomology 2nd Edition book (Mullen et al., 2019).

Ticks go through four life stages: (1) egg, (2) six-legged larva, (3) eight-legged nymph, and (4) adult. (Figure 3). Soft ticks can have two or more nymphal instars, while hard ticks go through one only nymphal instar (Nichelson et al., 2009). Ticks can take two to three years to complete their life cycle, depending on the species and environmental conditions (Nichelson et al., 2009). Tropical climates favor the tick's development, whereas dry climate conditions can prolong the life cycle because ticks cease host-seeking action. Some ticks extend their life cycle because they undergo diapause (suspended development) during the cold months, for example, *Dermacentor variabilis* (Nichelson et al., 2009). Ticks can feed on different hosts like mammals, birds, reptiles, and amphibians. (Figure 3). Some ticks have one host specificity meaning they

prefer to feed on one host only depending on their life stage and their species. Some Ixodid ticks have one host during their life cycle, others two, others three hosts, meaning that they can change host at every stage. Most of the Argasid ticks have a multi-host life cycle, which involves more than three hosts (Nichelson et al., 2009). Ticks find their hosts by detecting their breath, body odors, body heat, moisture, and vibrations. Ticks cannot jump or fly; instead, they go and rest on the tips of grasses and shrubs; the action is called "questing" until the host arrives to climb aboard (CDC, 2020).

How Ticks Spread Diseases

Ticks transmit pathogens that can cause diseases to humans and animals through the process of feeding. The feeding process and time depend on the tick species and life cycle stage. (Figure 3). Ticks contain substances in their saliva that helps to keep them attached to the host's skin, using anesthetic properties to go unnoticed (Dantas-Torres, 2008). Ticks can suck blood for several days from the host; if the host has a bloodborne infection, the tick will ingest the pathogen while feeding; during that process, they can also transmit any carried pathogens in their saliva to the host it is feeding on (Dantas-Torres, 2008). Once the tick completes its feeding, it will drop off and go to the next life stage. Later, it can transmit any carrying pathogen that can cause an infectious disease to its new host. (Figure 3). In the United States, *Ixodes scapularis*, a tick that transmits Lyme disease, needs to be attached to the host body for 36 hours to transmit the pathogen. However, *Hyalomma spp*., the African species, transmits diseases via tick bite, exposure to the viscera or blood of infected livestock, and can also cause nosocomial infections. *Hyalomma* ssp. are vectors for Crimean-Congo hemorrhagic fever (CCHF) and are among the most widespread tick-viral diseases affecting humans (Al-Abri et al., 2017).

The following figure shows an example of the life cycle of the tick *R. sanguineous* tick. (Figure 3).

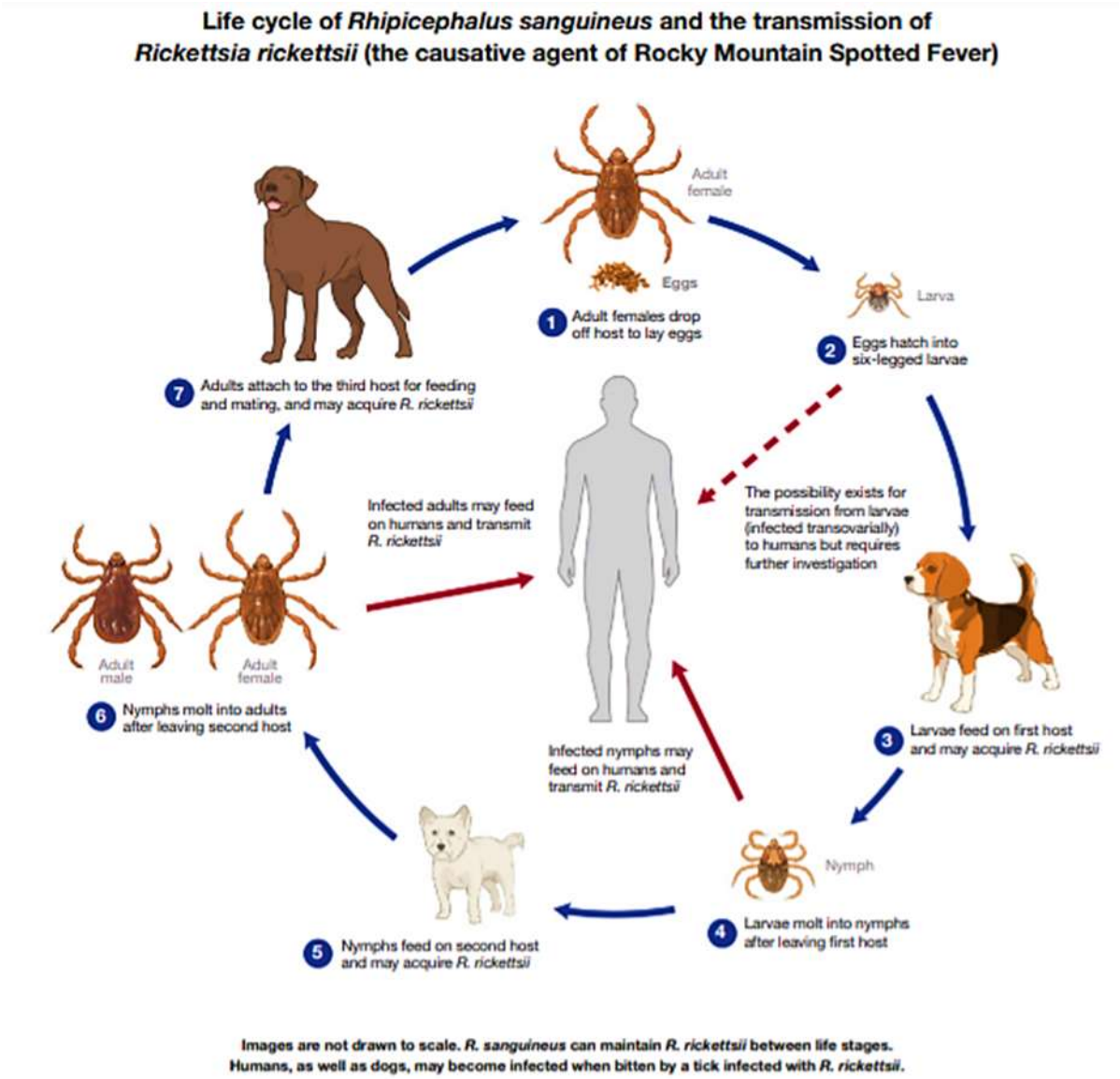

Figure 3. The tick *Rhipicephalus sanguineous* and its life cycle. Ticks-CDC is the original source of image and content (CDC, 2020). Accessed from https://www.cdc.gov/ticks/life_cycle_and_hosts.html

The Transboundary Region of U.S.-Mexico

There are thirteen border crossings along the Rio Grande Valley that connect the U.S. and Mexico, which forms part of the transboundary region of U.S.-Mexico. In 2018 alone, approximately 7.2 million pedestrians traveled through these border crossings, 65,876 passenger buses, and 15.2 million personal vehicles (Texas Department of Transportation, 2021). (Figure 4).

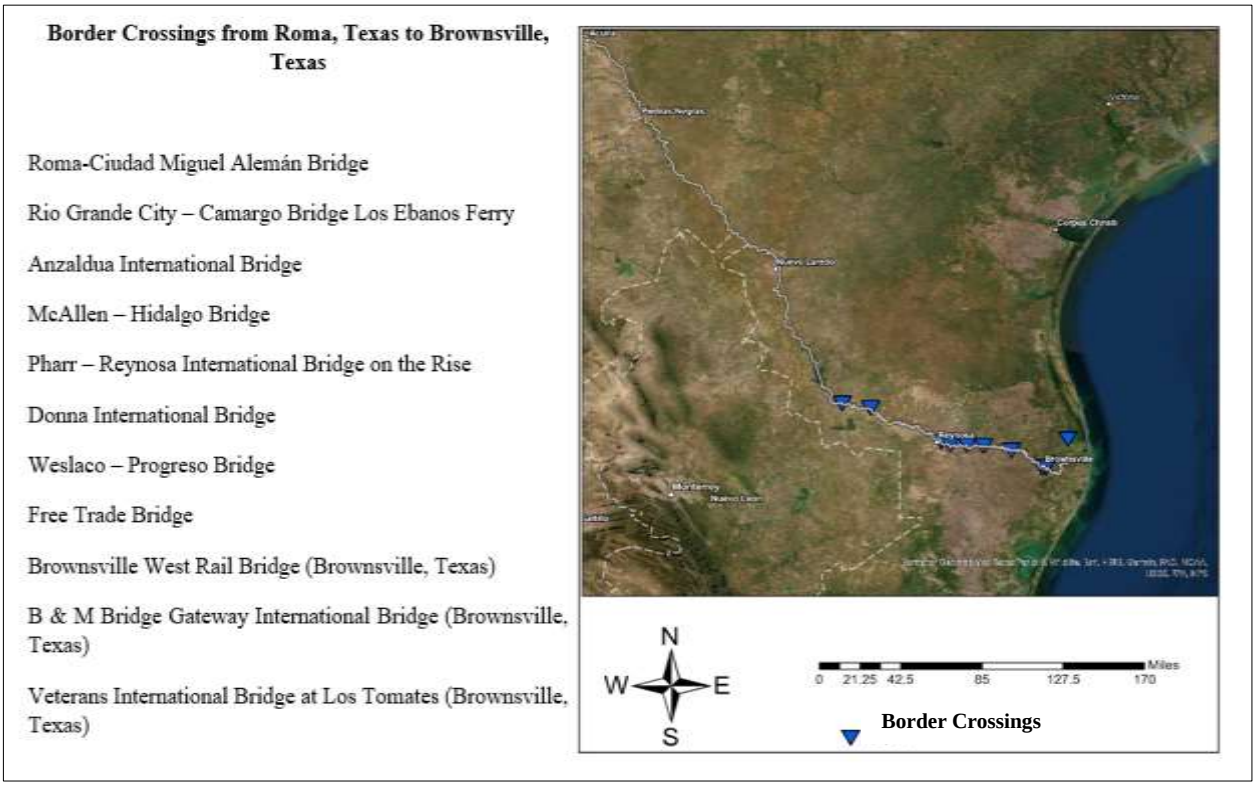

Figure 4. Border crossings list along the Rio Grande Valley in the transboundary region of U.S.-Mexico. Figure map elaborated n ArcGIS Desktop 10.6 by Consuelo Aguilar, 2021.

The Rio Grande River defines the Tamaulipas-Texas border with the territory strip extending northwestward between Nuevo Leon and Texas (Britannica, 2012). Tamaulipas is bounded to Texas (to the north), to the Gulf of Mexico (to the east), and Nuevo Leon (to the west). Tamaulipa's vegetation and climate favor several crops, making agriculture number one in

the state's economy. The Gulf of Mexico's fisheries, livestock raising, and copper mining form essential income sources; furthermore, Tamaulipas is one of the highest producers of Mexico's natural gas and petroleum. Population growth in this region began in 1990 with the cross-border trade boom in some cities such as Nuevo Laredo (across from Laredo, Texas), Reynosa (on the south of McAllen), and Matamoros (across from Brownsville) (Britannica, 2012).

The transboundary region of U.S.-Mexico shares similar habitats and weather conditions favoring the presence of vectors like mosquitoes, ticks, kissing bugs etc. (Feria et al., 2014 & 2020). Nevertheless, each nation has its health policies and vector control management (Esteve-Gassent et al., 2014). The transboundary region of U.S.-Mexico is a suitable region for tick species such as *R. sanguineus, D. variabilis, A. maculatum* (CDC, 2020). In the Southwestern United States, along the U.S.-Mexico border, *R. sanguineus*, the brown dog tick (or kennel tick), is the vector and reservoir for pathogens that affect humans and animals, causing Rocky Mountain Spotted Fever RMSF (CDC, 2020). *R. sanguineus*, at the adult stage, can feed on several mammals such as cattle, horses, wild carnivores, hedgehogs, sheep, goats, and others. However, their primary hosts are dogs (CDC, 2020; Figure 5). It is possible to see *R. sanguineus* at home in cats in the absence of dogs (Unpensky, 2009). Some hosts of the tick *A. maculatum* are birds, rabbits, mice, rats, squirrels, woodrats, black bears, bobcats, raccoons, foxes, coyotes, wolves, and domestic cats and dogs. (Teel et al., 2010).

The increase of tick-borne disease in the transboundary region of U.S.-Mexico has created more interest in tick-borne disease research (De la Fuente et al., 2015), becoming of great importance in the veterinary and medical field (Fuente et al., 2008). In the last three years, a total of 40 cases of Rickettsial infections recorded 28 RMSF in Tamaulipas, Mexico, and in the Lower Rio Grande Valley (part of South Texas) 6 cases of Rickettsia unspecified, and 6 cases of

Spotted fever group rickettsioses (Epidemiologia, 2020; Texas Department of State Health Services, 2021). Despite the continued research, the transboundary region of U.S.-Mexico needs more information on vector-host interaction to control tick-borne disease (Merino et al., 2020).

Preventing/Controlling Tick-Borne Diseases

To establish a good program to prevent/control tick-borne diseases, local people must know the risks (Williamson et al., 2010). Everyday human activities could play a role in possible transmitted diseases by vectors; these factors may be travel, tourism, and migration; this becomes a way of transport ticks attached to humans or animals (Bermúdez, Miranda, Zaldívar, & Page, 2010). Natural flows as the movement of plant and animal species can spread infectious diseases at borders between neighboring areas (National, 2018). These factors contributing to the spread of diseases cannot stop, but they could change with preventive measures created by collecting information via research.

Research through surveys has successfully educated and created awareness of tick-borne diseases. Institutions use surveys focusing on self-care and the prevention of tick bites questions (Caputo et al., 2019; Nieto et al., 2018). Online surveys have been used in Europe and the United States to access participation from the community to collect data that can enhance the knowledge, preventative measures, and awareness regarding ticks and tick-borne disease and vaccination (Caputo et al., 2019; Gupta et al., 2018; Niesobecki et al., 2019; Nieto et al., 2018). The combination of efforts from institutions and health departments has promoted tick-borne disease awareness in several areas of the USA.

Our goal was to (1) assess the perception of knowledge of ticks and tick-borne diseases among residents in cities of the transboundary region of U.S.-Mexico and (2) create

awareness on how to prevent tick-borne diseases. We hypothesized that creating and conducting a survey would provide data to assess the perception of knowledge residents of the transboundary region have about ticks and tick-borne diseases. We predicted that residents who live in the transboundary region of U.S.-Mexico would have low perceived knowledge about ticks and tick-borne diseases. To test this hypothesis, we developed an online survey following samples from previous surveys in other states and other countries. The online survey (Appendix B) was approved by the UTRGV Institutional Review Board (IRB 19-0253). The online survey was distributed to people 18 years of age and older. The survey was open from October to December 2020 using the University of Texas Rio Grande Valley's (UTRGV) Qualtrics software. The distribution (link and QR code) was conducted with the help of participant agencies: Starr County Precinct 1, 2, and 4. First Baptist Church San Isidro, UTRGV, nonprofit organizations, BUCKNER (Rio Grande Valley), and Heart for Kids (International) and the general public. In the Mexico side, the participants were the Tamaulipas vector control agency of Reynosa, Matamoros, Ciudad Victoria, and Miguel Alemán, and the general public.

CHAPTER II

MATERIALS AND METHODS

The Pilot Study

We created a pilot survey using an online platform called google forms to validate and then to form an official survey to be later distributed to the residents of the transboundary region of U.S.-Mexico. Following Caputo et al. (2019) and Gupta et al. (2018), the pilot survey consisted of 32 questions and was answered by 120 participants. The pilot survey was conducted online from November to December of 2019. The data collected was analyzed and validated using International Business Machines Statistical Package for Social Sciences IBM SPSS (Appendix A). The 32 questions were separated into six sections: (1) Title, introduction, and consent, (2) Questions about the place where participants live and outdoor activities, (3) Questions about knowledge of ticks, (4) Questions about how prevention and protection of self and their family against tick bites, (5) Questions about ticks and tick-borne diseases, and (6) Demographic Information. After reliability, validity, and factor analysis using IBM SPSS, we kept 19 questions. The Cronbach's Alpha for these questions represented the factors loaded onto the same factor within each section to determine and represented protection practices against tick bites with .70 Alpha or higher. The Cronbach's Alpha is a coefficient of reliability (or consistency). A reliability coefficient of .70 or higher is considered "acceptable" in most social science research situations. (Appendix A).

Institutional Review Board (IRB) Permit

The UTRGV IRB approved our study. The IRB application requested to complete and turn in the following:

1) The Collaborative Institutional Training Initiative (CITI Program) is described in the section Certification for the study, page 11.
2) The Outside Activity Disclosure (OAD) Certification Form is used to determine potential conflicts of interest as per institutional policy.
3) The Recruitment Script are letters used to invite the participants.
    a. Professor Permission Script
    b. Telephone Recruitment Script
4) The Online Informed Consent Form is the consent statement used in the survey.
5) The Email Recruitment Letter is the invite to the participants via email.
6) The Internal Permission Letter is to invite the participants from departments within the UTRGV.
7) The Outside Site Letter is used to invite the participants from outside UTRGV.
8) The Survey (English and Spanish version)
9) Flyer for the Survey

All the recruitment letters, scripts, and forms included the survey link and QR code to access the survey.

Certification for the Study

The IRB requires the research study personnel who conducts research involving human subjects to obtain training. The CITI Program is an online program funded by the Office of Research Integrity, the Department of Health and Human Services. The CITI Program training aims to educate faculty and students on possible issues involving research with human subjects. The aim was to protect and avoid violating the ethical rights of the participants. Each participant received formal consent. The introduction and consent section of the survey was the first question in the questionnaire. The formal consent included: A statement declaring that the participation is solely voluntary, the participant must be 18 years of age or older, no identifiable information will be requested, and the participant can withdraw from the survey at any time. The project IRB-19-0253 was submitted to the UTRGV IRB for review on June 28, 2020, and met the exemption DHHS 45 CFR 46.104(d). We submitted an amendment for translation of the survey in October 2020, approved in the same month.

The Survey

For the survey, we translated the English survey into Spanish using back-translation by bilingual UTRGV professors Dr. Mirayda Torres and Dr. Marcela Hebbard. We revised the survey to avoid misunderstandings in the meaning of the Spanish language used in both sides of the transboundary region of U.S.-Mexico.

The survey was composed using UTRGV Qualtrics software with several sections. (Table 1). (See complete survey in Appendix B).

Table 1. The Survey-Blocks and Questions.

SURVEY CONTENTS: Blocks and Questions			
BLOCK	**BLOCK TITLE**	**NUMBER OF QUESTIONS IN THE BLOCK**	***QUESTIONS/STATEMENTS***
1	**Introduction and Consent**	1 Question	
2	**Ticks and The Diseases they Transmit**	4 Questions	
3	**Protection Strategies for Children Against Tick Bites**	2 Questions	*a, b, c, d, and e* *a, b, c, d, and e*
4	**Prevention Strategies Against Tick Bites**	1 Question	*a, b, c, and d*
5	**How Well you Search for Ticks**	4 Questions	
6	**Ticks' information**	Informative Slides	
7	**Self-Efficacy**	2 Questions	*a & b* *a & b*
8	**Demographic Information**	5 Questions	

(See complete survey in Appendix B)

Recruitment for the Study in the Transboundary Region of U.S.-Mexico

Our online survey was distributed by all the institutions and organizations that participated voluntarily (Table 3). The transboundary region participant counties aimed in Texas were Hidalgo, Willacy, Cameron, and Starr. The COVID-19 state made the recruitment strictly online; the IRB office announced “UTRGV Reiterates Pause on Research Procedures with Human Subjects; Pause to Apply to Studies Approved to Continue under Risk Mitigations Plan,” released on August 12, 2020.

To avoid the risk of participation duplication, we took measures on the settings of the survey in the UTRGV Qualtrics software: “Prevent Ballot Box Stuffing,” (Keep people from taking this survey more than once); “Prevent Indexing” (A tag will be added to the survey to prevent search engines from indexing it); “Show a custom message when a respondent revisits a previously completed link”; “Survey Expiration” (The survey will only be available for a specified date range); “Anonymize Response” (Do NOT record any personal information and remove contact association). Both English and Spanish-speaking residents from the transboundary region U.S.-Mexico 18 years of age and older people participated. We approached all the participants through agencies who signed consent voluntarily; they distributed the link and QR code for the public's survey study and the general public. (Table 2).

Table 2. List of participant agencies and the public. USA (left) and Mexico (right).

PARTICIPANTS OF THE TRANSBOUNDARY REGION OF U.S.-MEXICO	
USA	***MEXICO***
Starr County Precinct 1.	Tamaulipas vector control agency of Reynosa
Starr County Precinct 2.	Tamaulipas vector control agency of Matamoros
Starr County Precinct 4.	Tamaulipas vector control agency of Ciudad Victoria
UTRGV	Tamaulipas vector control agency of Miguel Alemán
Nonprofit Organizations, BUCKNER (Rio Grande Valley).	General Public
First Baptist Church San Isidro	
Nonprofit Organizations, Heart for Kids	
First Baptist Church San Isidro	
General Public	

The time for distribution of the online survey was from October 2020 to December 2020. The online survey was designed with skip logic in Qualtrics software to close automatically if

the participants selected the option "I do not Consent"; by selecting that option, the survey was going to end automatically (Qualtrics, 2020). The time to complete the online survey was approximately ten minutes. No identifiable information was collected. The survey was anonymous.

Statistical Analysis

We used IBM SPSS to run statistical analysis to run descriptive statistics for demographic information of gender, age, and race in the survey. We also conducted descriptive statistics for the rest of the questions in the survey regarding ticks and tick-borne diseases and prevention practices among the participants of the Transboundary region of U.S.-Mexico. A Chi-Square test was used to measure the level of significance between variables that could manifest any association between knowledge and protection practices against tick bites.

CHAPTER III

RESULTS

In total, 543 people ranging from ages 18 to 67 answered the survey. We created a map of distribution using ArcGIS Desktop 10.6 software to geo-referencing surveys using de ZIP Code cartography for Texas (CENSUS.GOB) and the Mexican Postal Service from Tamaulipas Zip Codes (SEPOMEX). The map represents the study area located in the transboundary region of U.S.-Mexico. The figure map was elaborated by Rene Santos Luna from El Centro de Investigación en Evaluación y Encuestas, Instituto Nacional de Salud Pública. (Figure 5).

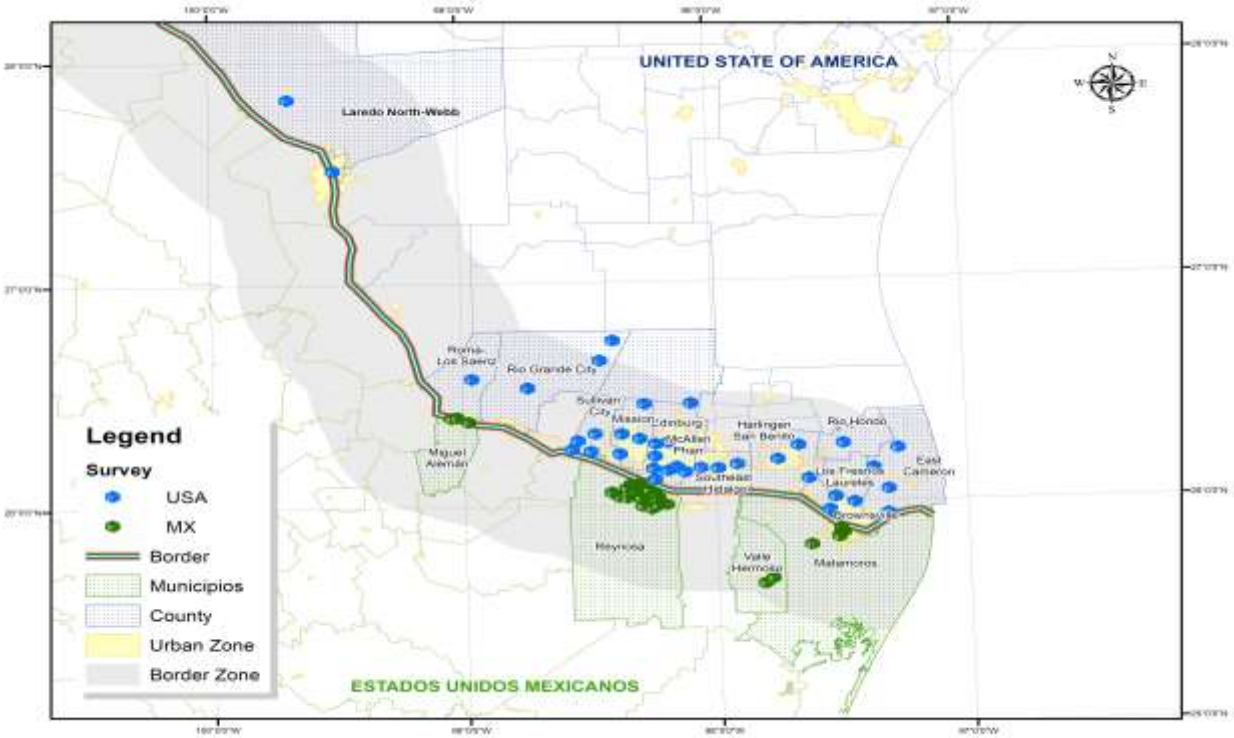

Figure 5. Map of distribution of the transboundary region of U.S.-Mexico study area. Map created by the reported zip codes from all the participants. Blue survey distribution in the USA, green survey distribution in Mexico. Image by Rene Santos-Luna.

We used IBM SPSS software to conduct descriptive statistics reflecting the demographic information and level of participation for the participants in the transboundary region of U.S.-Mexico in the following figures. Descriptive statistics by age among the participants of transboundary region of U.S.-Mexico representing participation by age 18-24 (45.91%), 25-34 (20.96%), 5-44 (18.66%), 45-54 (9.85%), 55-64 (3.14%), and 65+ (1.47%). (Figure 6).

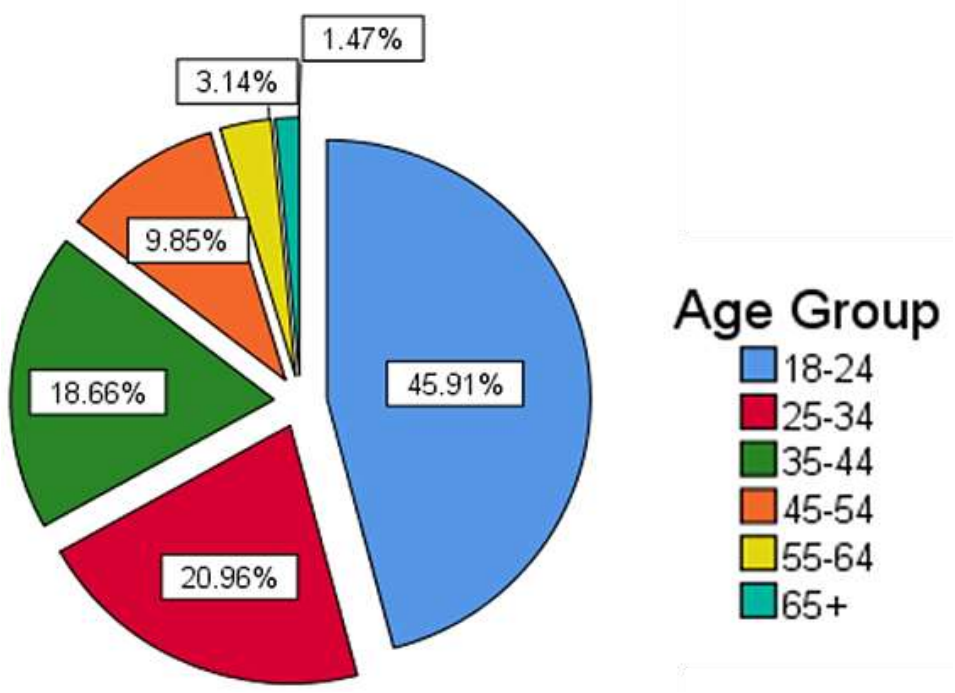

Figure 6. Descriptive statistics by *age* among the participants of transboundary region of U.S.-Mexico.

Descriptive statistics by age among the participants of transboundary region of U.S.-Mexico representing participation by age Female (65.8%), Male (33.1%), Other not described here (0.6%), and I prefer not to say (0.4%). (Figure 7).

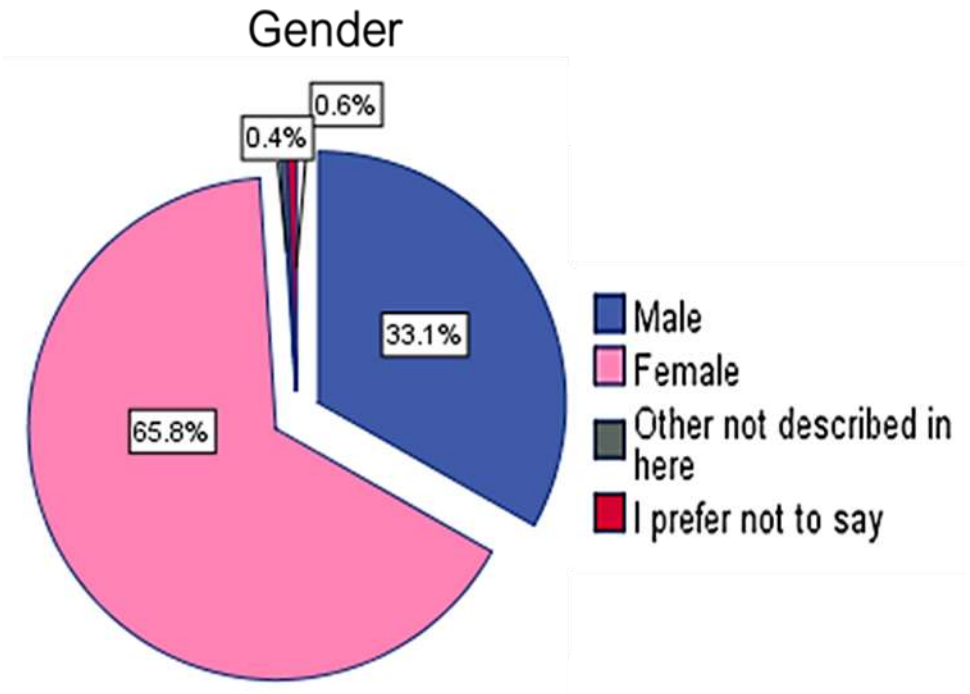

Figure 7. Descriptive statistics by *gender* among the participants of transboundary region of U.S.-Mexico.

Descriptive statistics percentages of participation by race in the transboundary region of U.S.-Mexico was Hispanic/Latino (82.9%), Black (0.4%), White (7.6%), Asian (.8%), Prefer not to answer (4.3%), Other (1.4%), Mix Race (1.6%), Pacific Islander (0.2%), and Native American (0.6%) (Figure 8).

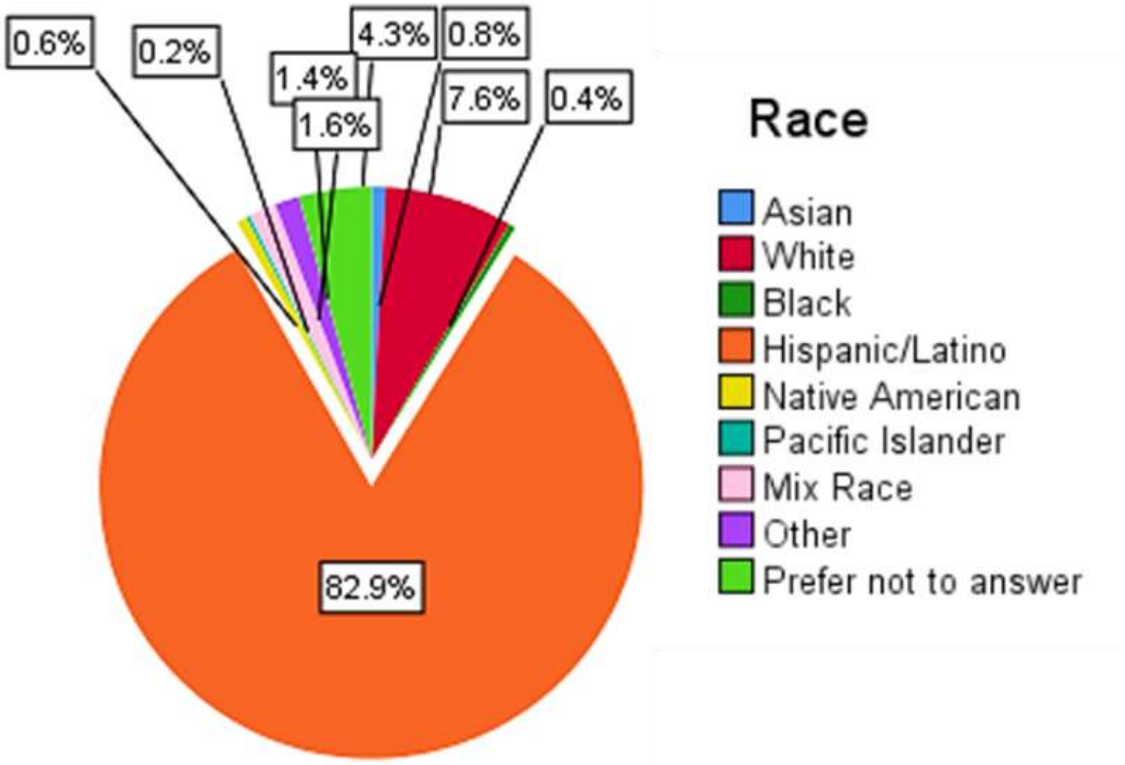

Figure 8. Descriptive statistics by *race* among the participants of transboundary region of U.S.-Mexico where the highest percentage of participation was “Hispanics/Latino” (82.92%).

Descriptive statistics percentages of participation by race in the transboundary region of U.S.-Mexico was No school (0.2%), Elementary (0.5%), Middle School (3.0%), I did not complete High School (1.2%), High School Diploma or GED (16.6%), I have some college hours, no diploma (15.0%), Technical or Vocational Training/Certificate (10.1%), Associate's degree (4.4%), Bachelor's degree (40.3%), Master's degree (7.5%), and Doctoral degree (1.2%) (Figure 9).

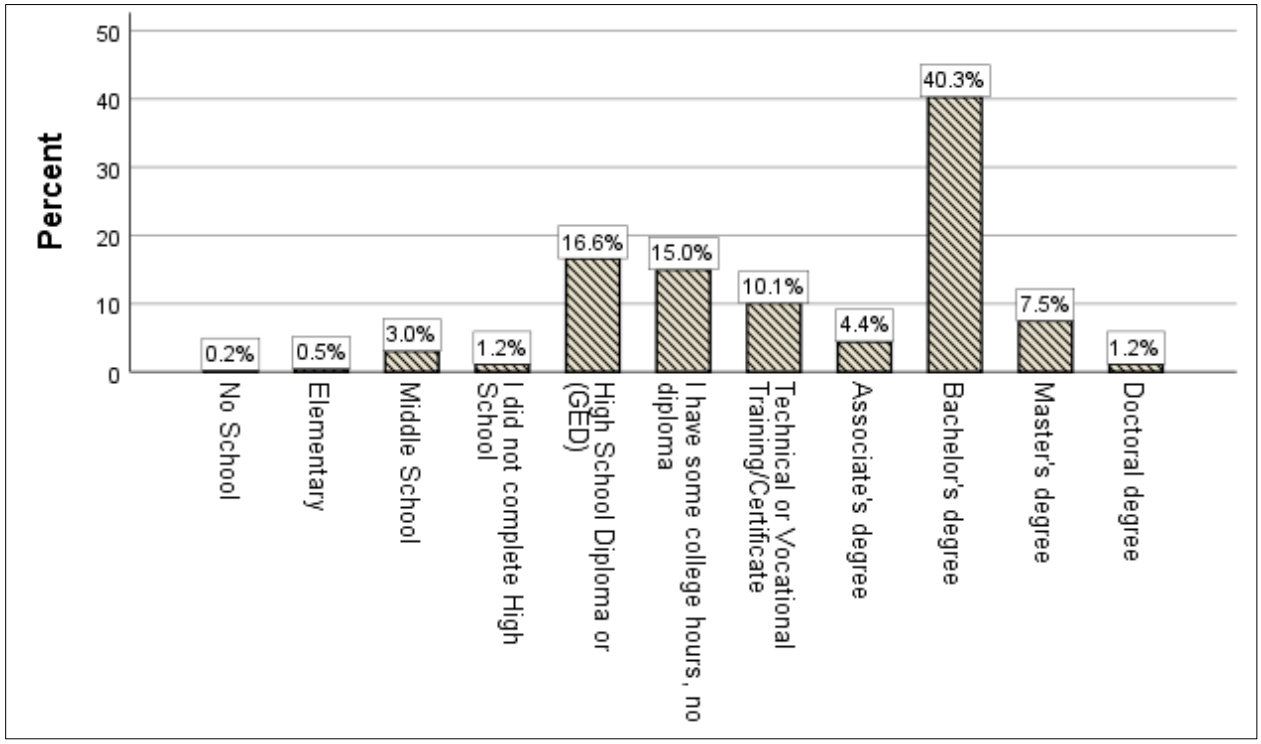

Figure 9. Descriptive statistics by *level of education* among the participants of transboundary region of U.S.-Mexico where "Bachelor degree" was reported as the highest (40.3%) in participation.

The following question about reported knowledge of diseases transmitted by ticks was asked at the beginning of the survey. The participants who answered "Yes" (blue) continued answering all the questions within the survey, whereas the ones who answered "No" (red), the survey directed them to the teaching information slides containing prevention practices against tick bites promoted by the CDC. The respective responses to this question was going to categorized the participants as having a perceived knowledge/no knowledge based on their reported answer yes/no. The selected question was "Do you know what diseases can be transmitted to humans and animals?" (Figure 10).

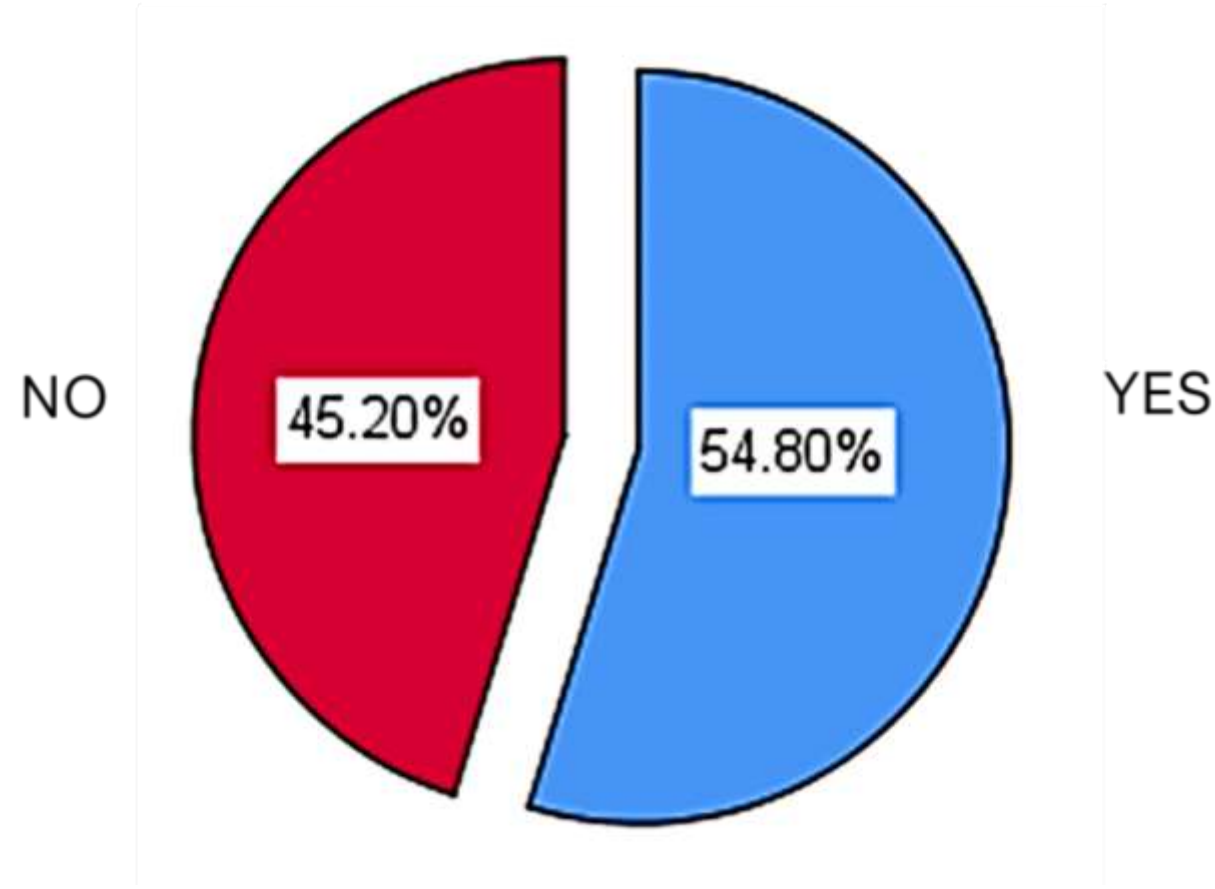

Figure 10. Descriptive statistics for the question *Do you know what diseases can be transmitted to humans and animals?* The answer "Yes" was classified as having knowledge and "No" represented no knowledge.

The results found from the demographics revealed that the age group (18-24) predominated in participation and this same group was found to have the highest percentage in reported knowledge about ticks and tick-borne diseases (25.6%). We conducted a Chi-square test to see if there was a correlation among these two variables *Do you know what diseases can be transmitted by ticks to humans and animals?* and *Age group* Chi-Square test: *p-value*=.870 showing no significance meaning that age has no relationship with the answer (Figure 11).

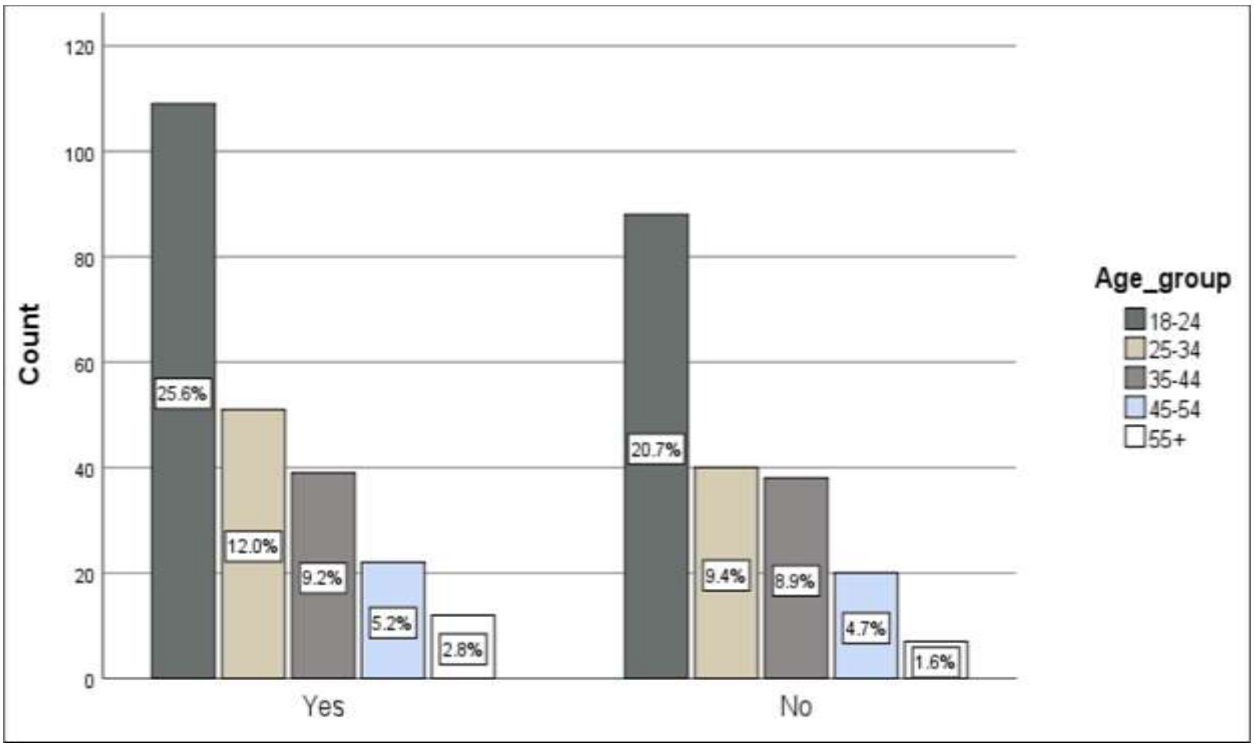

Figure 11. Chi-square test between the questions *Do you know what diseases can be transmitted by ticks to humans and animals?* and *Age group* Chi-Square test: *p-value*=.870 showing no significance among these questions.

The results found that the majority of the participants had a high level of education in participation (43%) and this same group of respondents reported the highest percentage in knowledge of ticks and the diseases they transmit (20.6%). We conducted a Chi-Square test for association between the two variables, *Do you know what diseases can be transmitted by ticks to humans and animals?* and *Level of education,* Chi-Square test: *p-value*=.019 showing significance among these questions. (Figure 12).

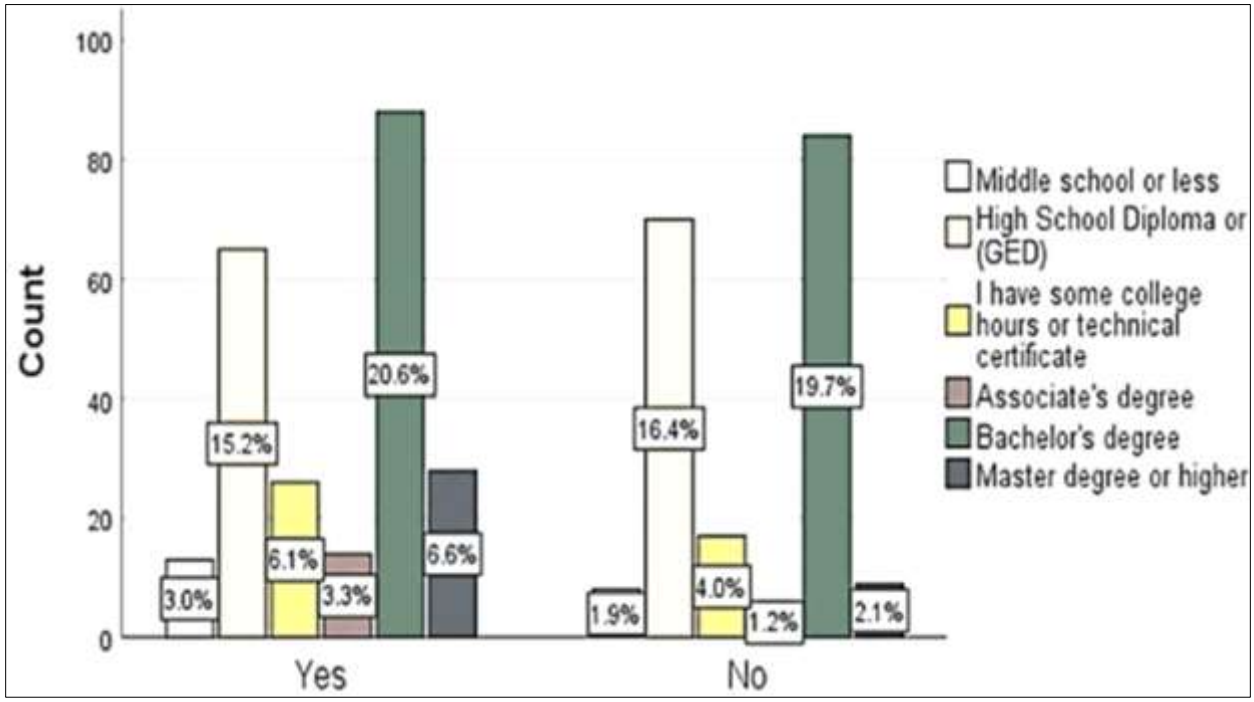

Figure 12. Chi-square test between the questions *Do you know what diseases can be transmitted by ticks to humans and animals?* and *Level of Education*, Chi-Square test: *p-value*=.019 showing significance among these questions.

Among all the participants (54.8%) who reported knowledge that ticks could transmit diseases to humans and animals, those who had children in their household reported limited knowledge about protection practices for their children against ticks and tick-borne diseases. The descriptive statistics results for the Likert scale questions ("Never", "Sometimes", "Rarely", "Frequently", and "Always") options reported as follows in figures 13 to 17.

The descriptive statistics for the question *Do you tuck children's pants into their socks when going outside?* the responses were, "Never" (63.5%), "Sometimes" (16.1%), "Rarely" (14.6%), "Frequently" (4.4%), and "Always" (1.5%). (Figure 13).

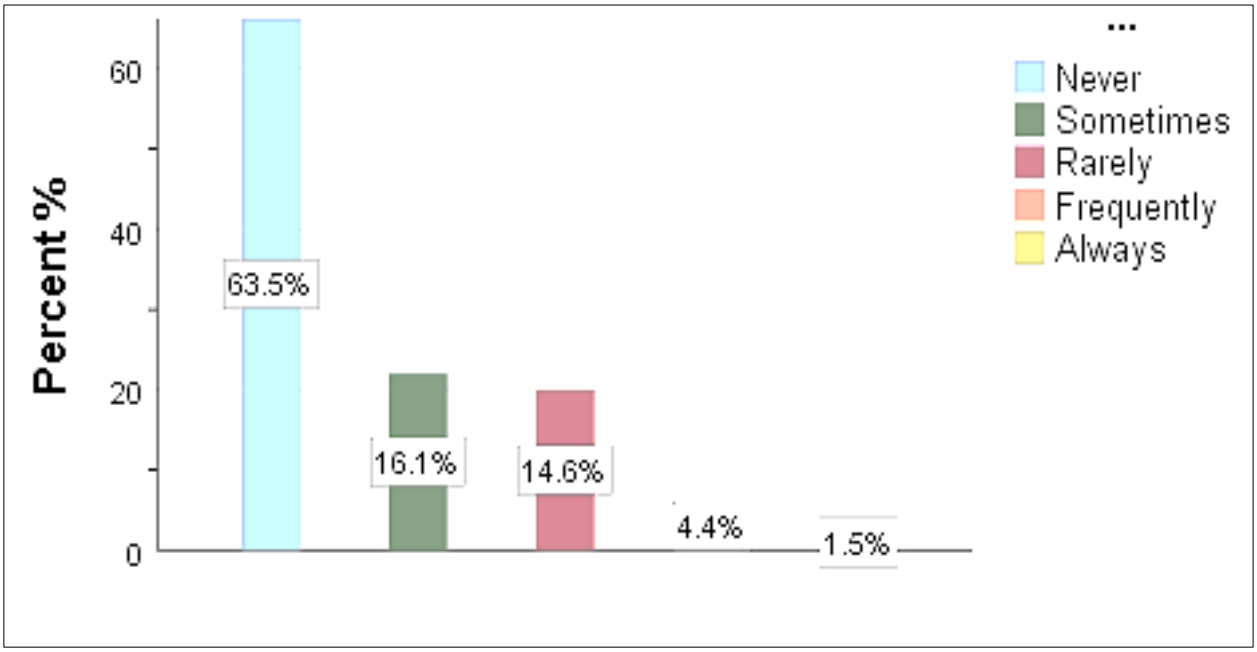

Figure 13. Descriptive statistics *Do you tuck children's pants into their socks when going outside?* The highest percentage was for the response "Never" (63.5%) among the participants of the transboundary region of U.S.-Mexico.

The descriptive statistics for the question *Do you dress the children in clear colors so you can easily check for ticks?* "Never" (37%), "Rarely" (15.2%), "Sometimes" (27.5%), "Frequently" (13.8%), and "Always" (6.5%). (Figure 14).

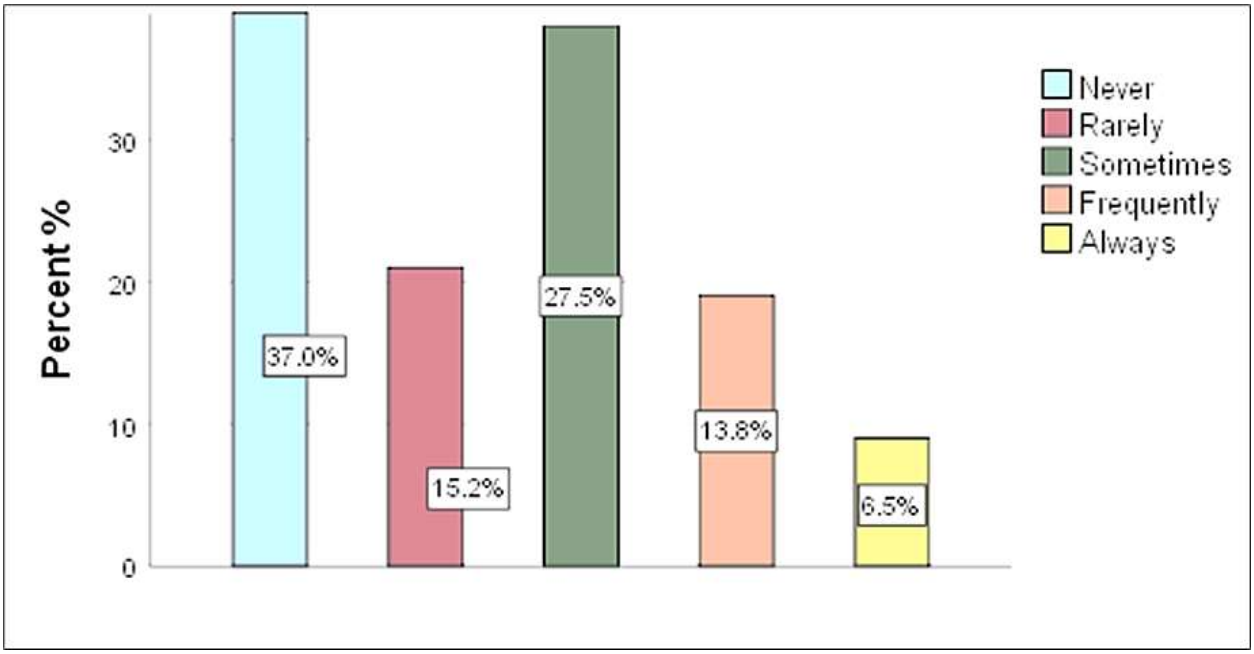

Figure 14. Descriptive statistics *Do you dress the children in clear colors so you can easily check for ticks?* The highest percentage was for the response "Never" (37%) among the participants of the transboundary region of U.S.-Mexico.

The descriptive statistics for the question *Do you apply any type of tick repellent to the children when going outside?* "Never" (54.7%), "Rarely" (15.1%), "Sometimes" (18.0%), "Frequently" (8.6%), and "Always" (3.6%). (Figure 15).

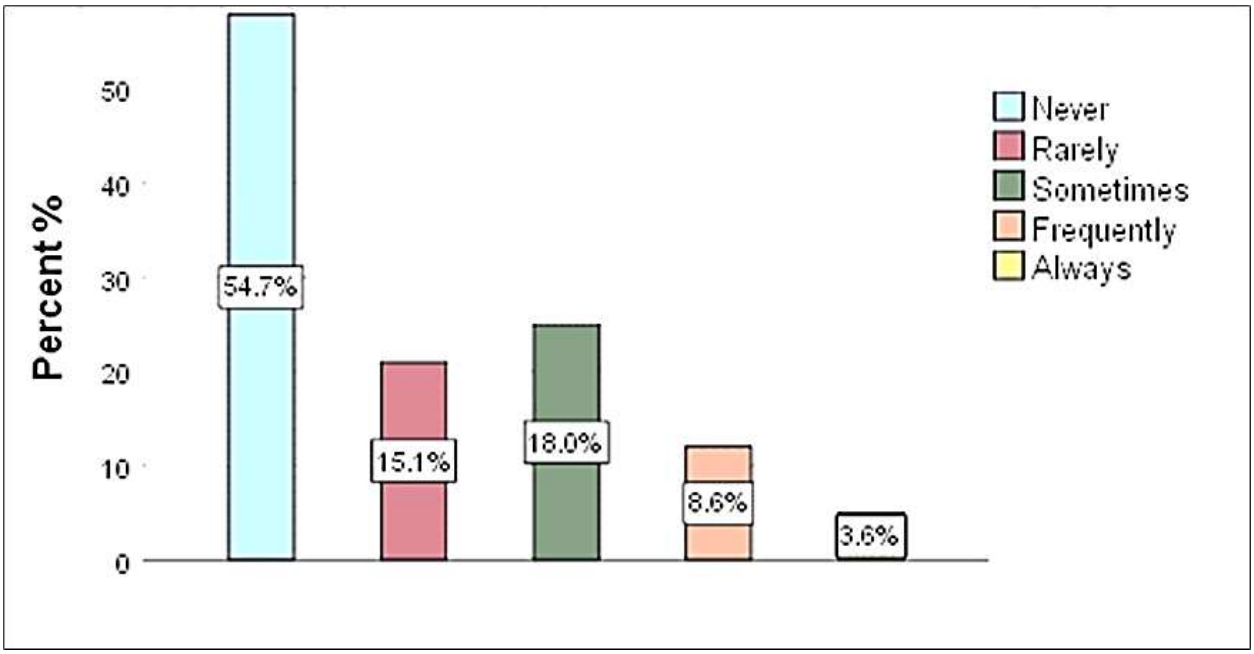

Figure 15. Descriptive *statistics Do you apply any type of tick repellent to the children when going outside?* The highest percentage was for the response Never (54.7%) among the participants of the transboundary region of U.S.-Mexico.

The descriptive statistics for the question *Do you check the children for ticks after returning indoors?* "Never" (36.2%), "Rarely" (22.5%), "Sometimes", (21.0%), "Frequently" (11.6%), and "Always" (8.7%) (Figure 16).

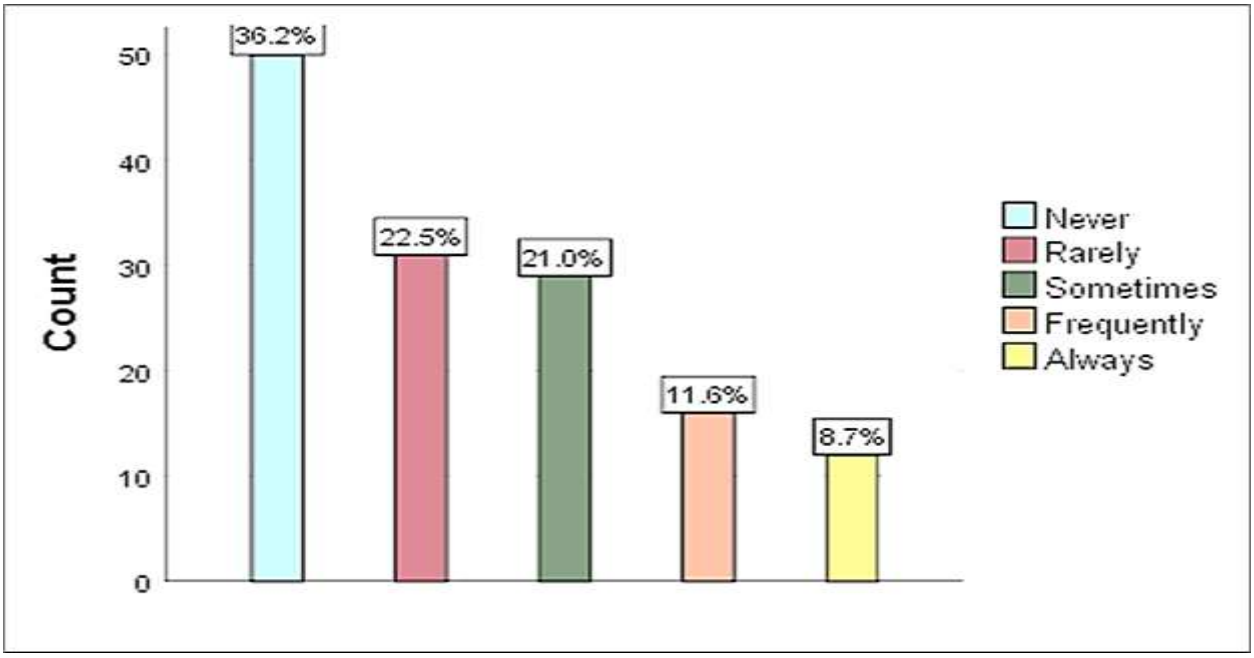

Figure 16. Descriptive statistics *Do you check the children for ticks after returning indoors?* The highest percentage was for the response "Never" (36.2%) among the participants of the transboundary region of U.S.-Mexico.

The descriptive statistics for the question *Do you have the children shower right after returning indoors?* "Never" (21.6%), "Rarely" (9.4%), "Sometimes", (17.3%), "Frequently" (23.7%), and "Always" (28.1%), (Figure 17). Among the five protection practices suggested by the CDC asked the participants in the transboundary region of U.S.-Mexico, the highest percentage reported in this particular protection practice question was only 28.1% always shower their children after returning indoors.

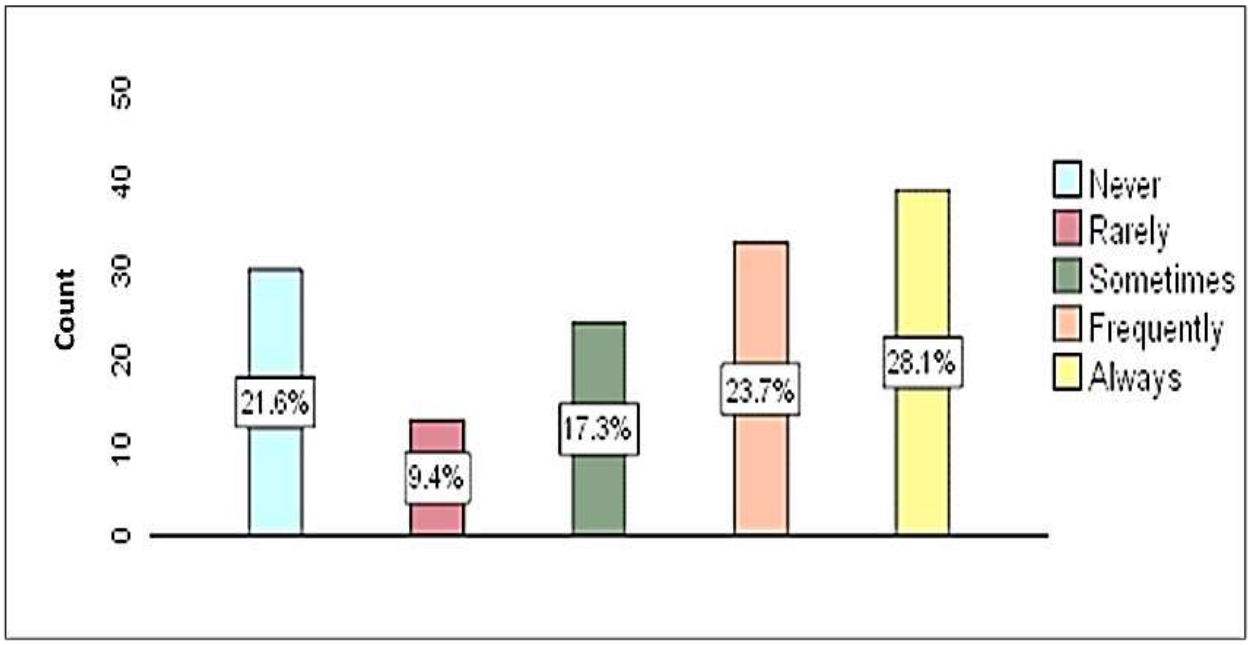

Figure 17. Descriptive statistics *Do you have the children shower right after returning indoors?* The highest percentage was for the response "Always" (28.1%) among the participants of the transboundary region of U.S.-Mexico.

In addition, for the CDC recommendations to protect children against tick bites, the Chi-square three-way test for the questions *dress the children with light colors to see ticks easily*, *never check for ticks on the children after returning indoors*, and *knowledge* was highly significant with *p-value*= .000. Furthermore, the Chi-square three-way test for the questions *tuck pants into socks*, *apply repellents when going outdoors*, and *knowledge* was also significant, *p-value*= .000 revealing a significant association between the CDC recommendations and reported knowledge. The tests reveal that residents of the transboundary region of U.S.-Mexico reported knowledge about tick-borne diseases, but they do not necessarily follow the CDC protection practices to prevent and protect their children and themselves from tick bites.

The descriptive statistics for the question *How many diseases do you know that are transmitted by ticks?* Majority of the participants reported knowledge of three or more disease transmitted by ticks. (Figure 18).

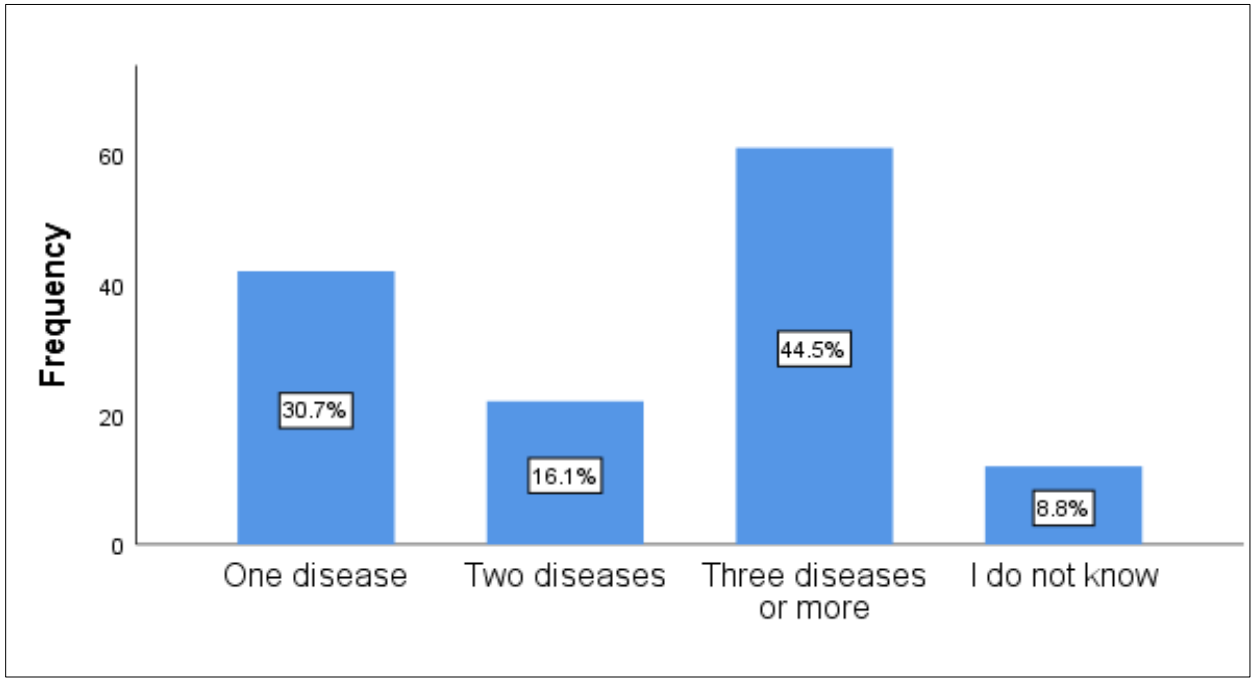

Figure 18. Descriptive statistics for the question *How many diseases do you know that are transmitted by ticks?* The highest percentage reported among the participants of the transboundary region of U.S.-Mexico was (44.5%).

The descriptive statistics for the question *Do diseases transmitted by ticks have a cure?* A majority of the participants reported knowledge that diseases transmitted by ticks do not have a cure (77.4%). (Figure 19).

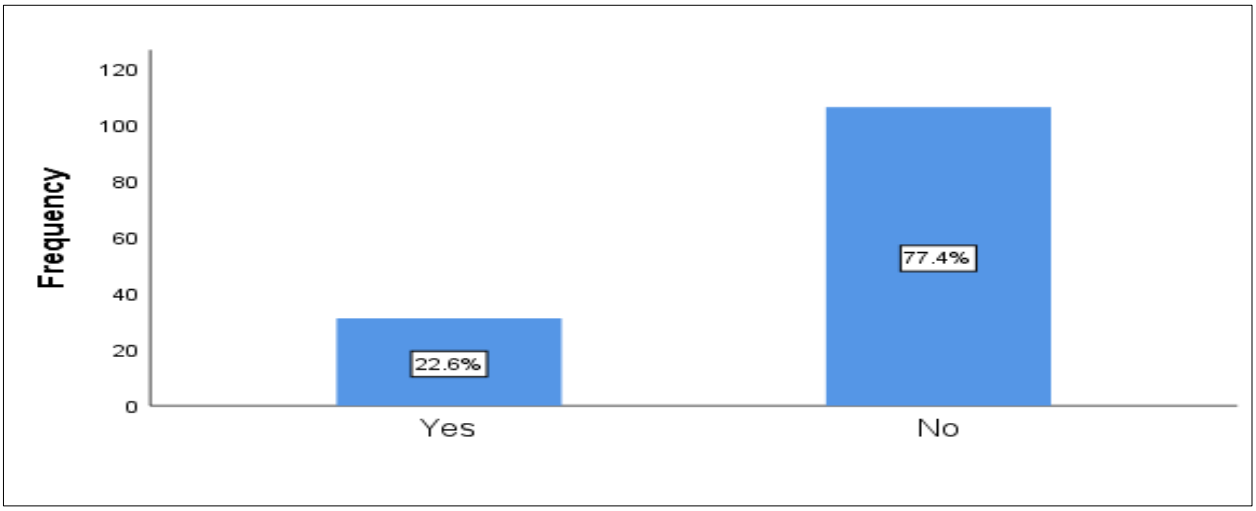

Figure 19. Descriptive statistics for the question *Do diseases transmitted by ticks have a cure?* The highest percentage reported was for "No" (77.4%), no knowledge on a cure for tick-borne diseases among the participants of the transboundary region of U.S.-Mexico.

The descriptive statistics for the question *Do you frequently see ticks in the area where you live?* (32.8%) of the participants reported that they see tick in the area where they live. (Figure 20).

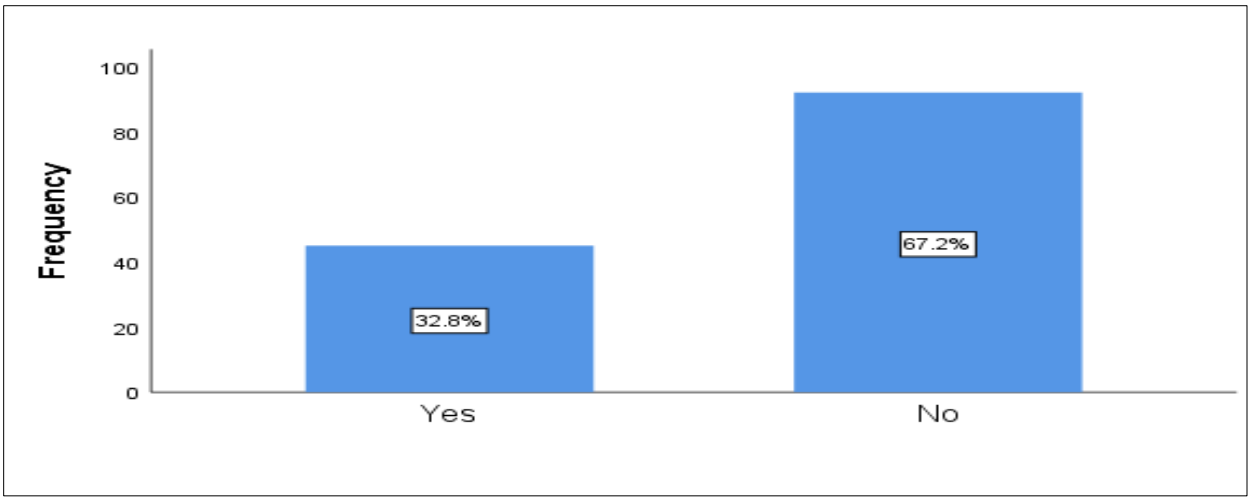

Figure 20. Descriptive statistics for the question *Do you frequently see ticks in the area where you live?* A (32.8 %) of the participants reported that they see ticks in the area where they live in the transboundary region of U.S.-Mexico.

Descriptive statistics results for the Likert scale questions of the section “Protection Strategies for Children Against Tick Bites” in the survey answer choices (“Protects very well,” “Protects well,” “Does not protect well,” and “I do not know”) were reported as follows. (Figures 21 to 24).

Descriptive statistics for the reported knowledge regarding protection practice against tick bites on the statement *The wear of long sleeves and long pants when going outdoors* gave the percentages “Protects very well” (33.1%), “Protects well” (57.1%), “Does not protect well” (4.5%), and “I do not know” (5.3%). (Figure 21).

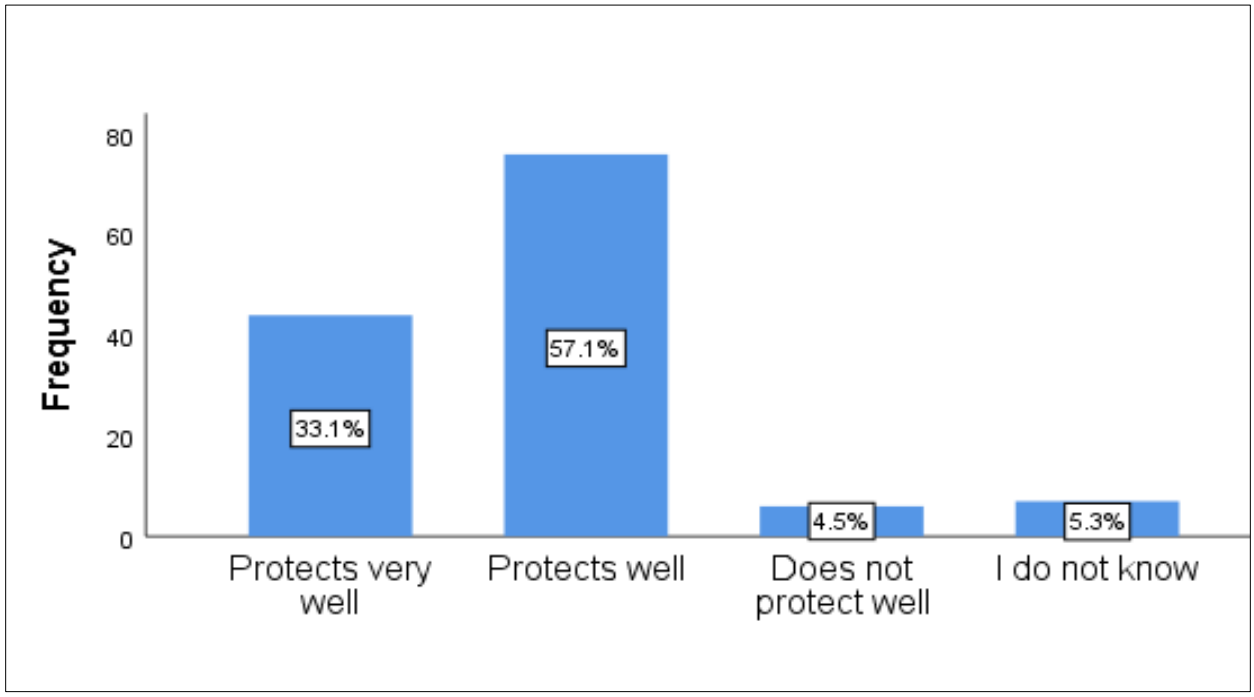

Figure 21. Descriptive statistics for the statement *The wear of long sleeves and long pants when going outdoors*. The highest percentage reported by the participants was for “Protects well” (57.1%), assigning it as a good protection practice.

Descriptive statistics for the reported knowledge regarding protection practice against tick bites on the statement *The wear of ankle-high shoes when going outdoors* gave the percentages “Protects very well” (28.0%), “Protects well” (53.8%), “Does not protect well” (9.8%), “Does not protect at all” (1.5%), and “I do not know” (6.8%). (Figure 22).

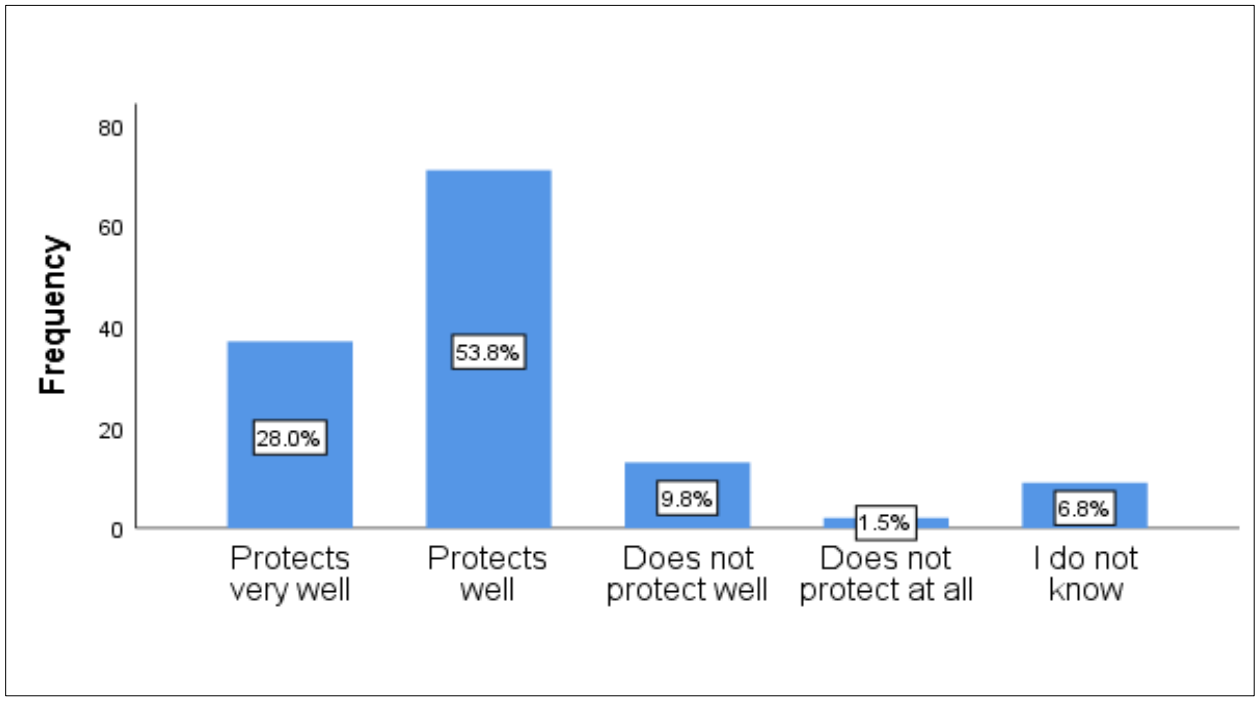

Figure 22. Descriptive statistics for the statement *The wear of ankle-high shoes when going outdoors.* The highest percentage reported by the participants was for “Protects well” (53.8%), assigning it as a good protection practice.

Descriptive statistics for the reported knowledge regarding protection practice against tick bites on the statement *The application of anti-tick agents or bug repellents when going outdoors* gave the percentages “Protects very well” (40.2%), “Protects well” (48.5%), “Does not protect well” (4.5%), “Does not protect at all” (0.8%), and “I do not know” (6.1%). (Figure 23).

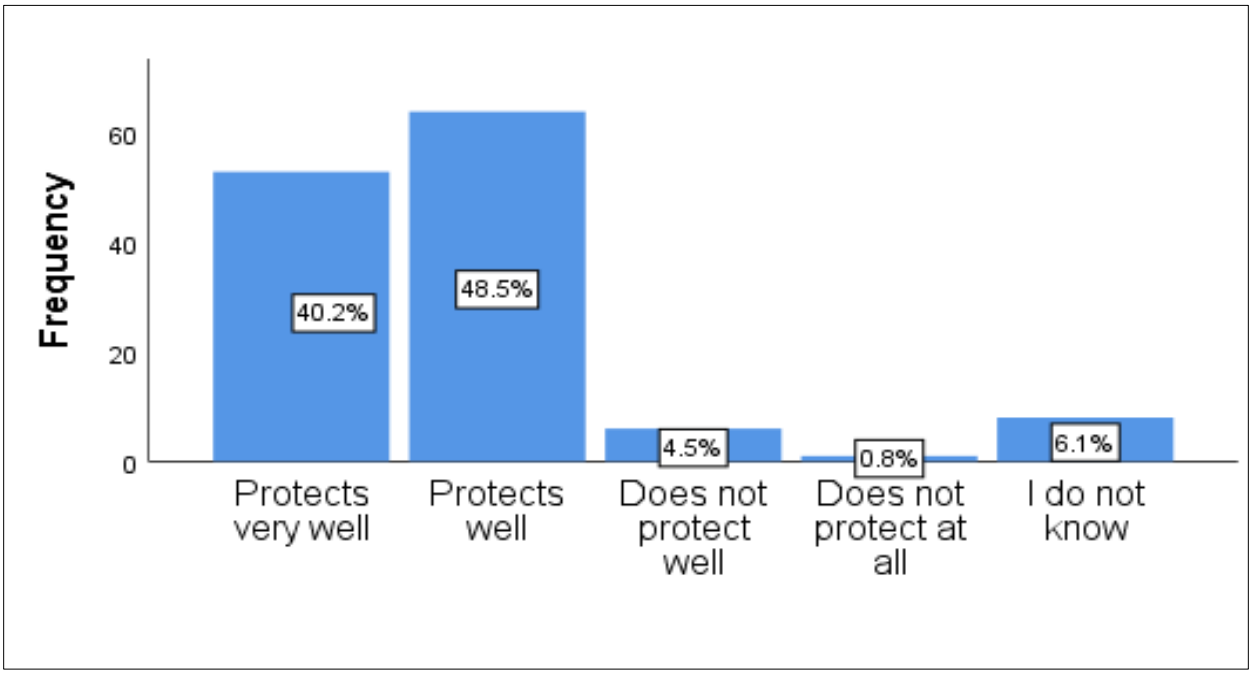

Figure 23. Descriptive statistics for the statement *The application of anti-tick agents or bug repellents when going outdoors*. The highest percentage reported by the participants was for “Protects well” (48.5%), assigning it as a good protection practice.

Descriptive statistics for the reported knowledge regarding protection practices against tick bites on the statement *The search for ticks on the body when returning from being outdoors* revealed the percentages “Protects very well” (36.4%), “Protects well” (53.0%), “Does not protect well” (4.5%), “Does not protect at all” (2.3%), and “I do not know” (3.8%). (Figure 24).

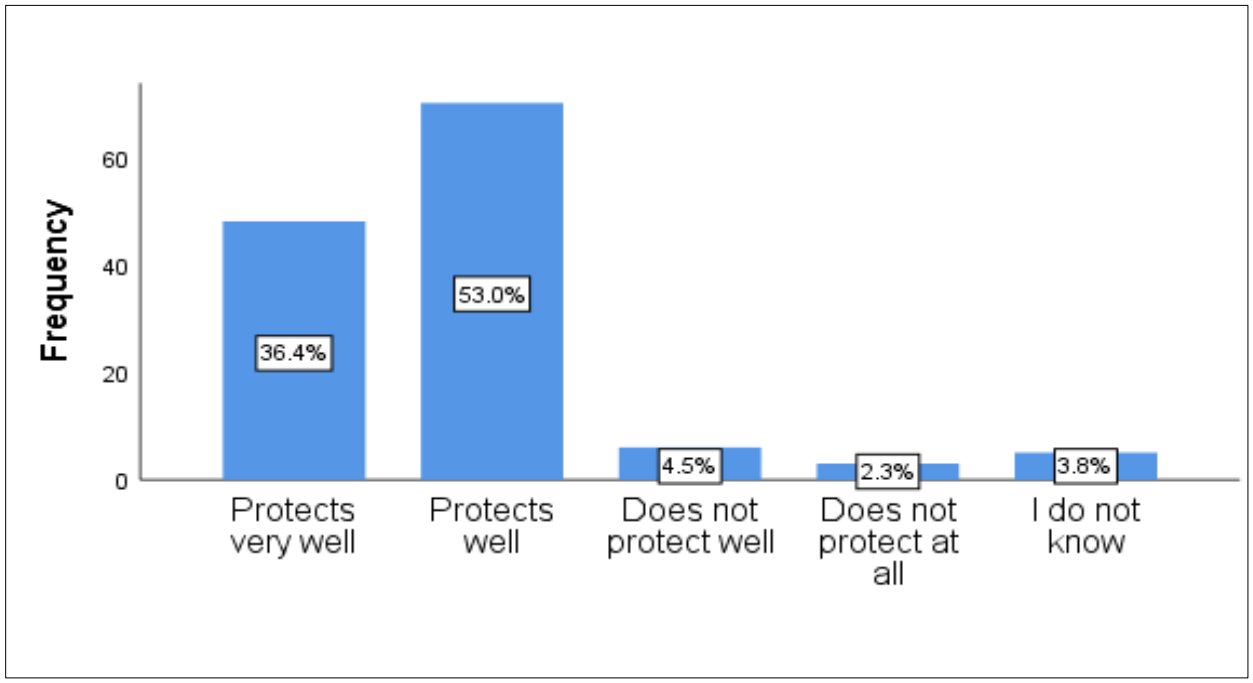

Figure 24. Descriptive statistics for the statement *The search for ticks on the body when returning from being outdoors*, the highest percentage reported by the participants was for “Protects well” (53.0%), assigning it a good protection practice.

The participants of the transboundary region of U.S.-Mexico reported a high perception of knowledge by majority selecting the "Protects well" option on all the protection practice promoted by the CDC to protect themselves against ticks and tick-borne diseases. However, when we asked similar questions to protect their children from ticks and tick-borne diseases, they never practice CDC protection practices on their children.

Further questions were asked to the participants about conducting a full check for ticks on their bodies. The participants reported the following:

Descriptive statistics for the question *Do you conduct a full body check up for ticks on yourself after being outdoors or in areas where ticks can be found?* they answered, "Yes" (55.6%) and "No" (44.4%). (Figure 25).

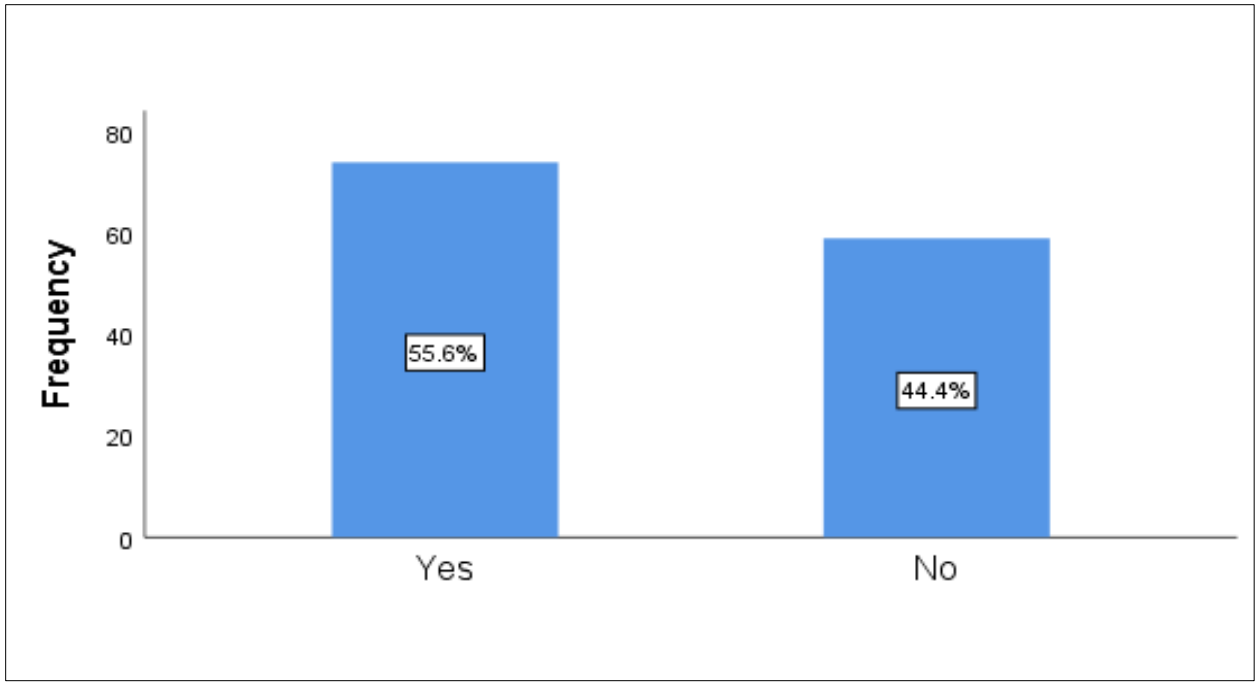

Figure 25. Descriptive statistics for the question *Do you conduct a full body check-up for ticks on yourself after being outdoors or in areas where ticks can be found?* (55.6%) answered, "Yes".

The participants reported a full check-up for ticks on their bodies, but when we asked explicitly, *What areas of your body do you normally check when searching for ticks after being outdoors or in areas that ticks can be found?* they reported the following, “I conduct a full check-up” (31.1%), “I check only a few areas” (40.2%), and “I do not check at all” (28.8%). (Figure 26).

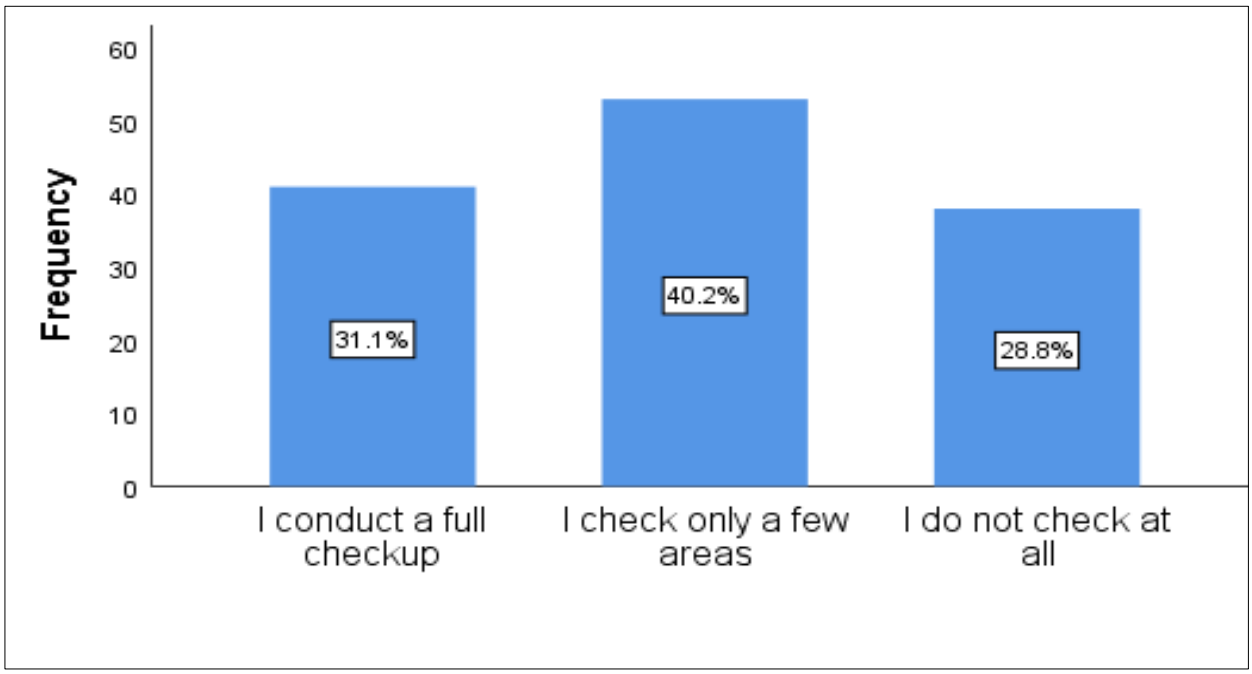

Figure 26. Descriptive statistics for the question *What areas of your body do you normally check when searching for ticks after being outdoors or in areas that ticks can be found?* This time only (31.1%) reported they conduct a full check up for ticks on their body whereas (28.8%) reported to not check at all.

Descriptive statistics for the question *If you have pets, do you conduct a full body check-up for ticks on your pets' bodies after being outdoors or in areas that ticks can be found?* The participants reported “Yes” (63.6%), “No” (21.2%), and “I do not have any pets” (15.2%). (Figure 27).

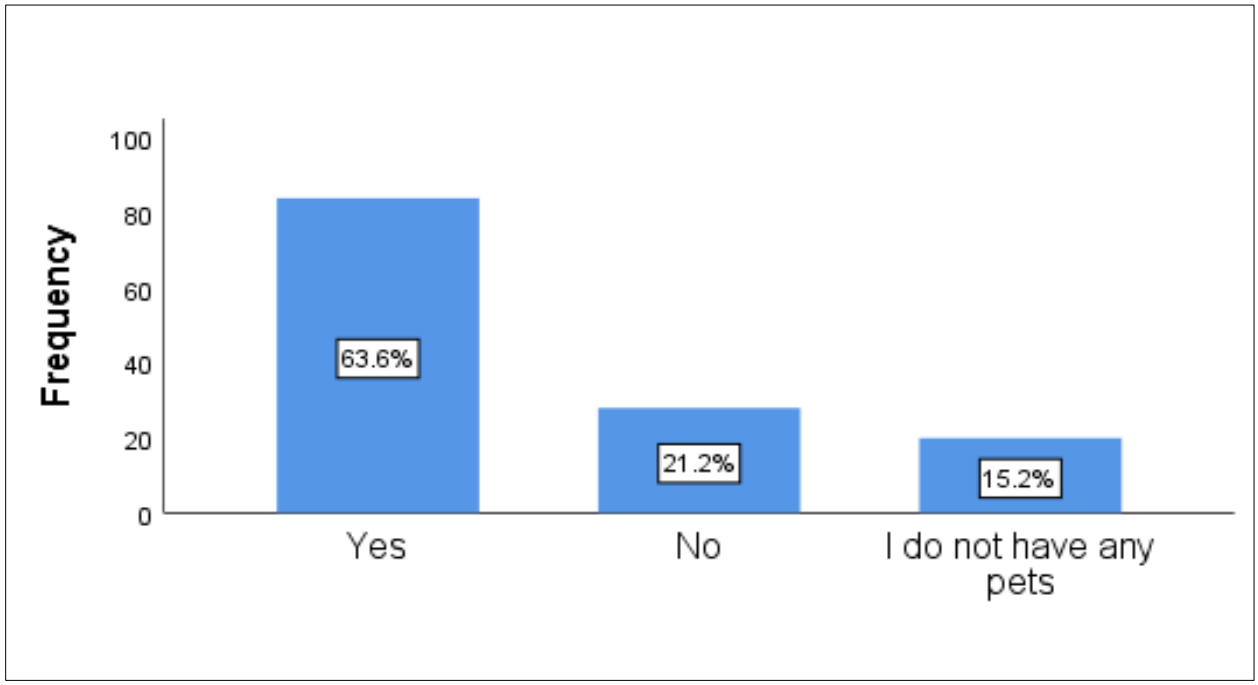

Figure 27. Descriptive statistics for the question *If you have pets, do you conduct a full body check-up for ticks on your pets' bodies after being outdoors or in areas that ticks can be found?* More than half of the participants who own pets reported they conduct a full body check-up for ticks on their pets (63.6%).

Descriptive statistics for the question *What areas of your pets' bodies do you normally check when searching for ticks after being outdoors or in areas that ticks can be found?* The participants reported, “I conduct a full check” (70.2%) and “I check only a few areas” (29.8%). (Figure 28).

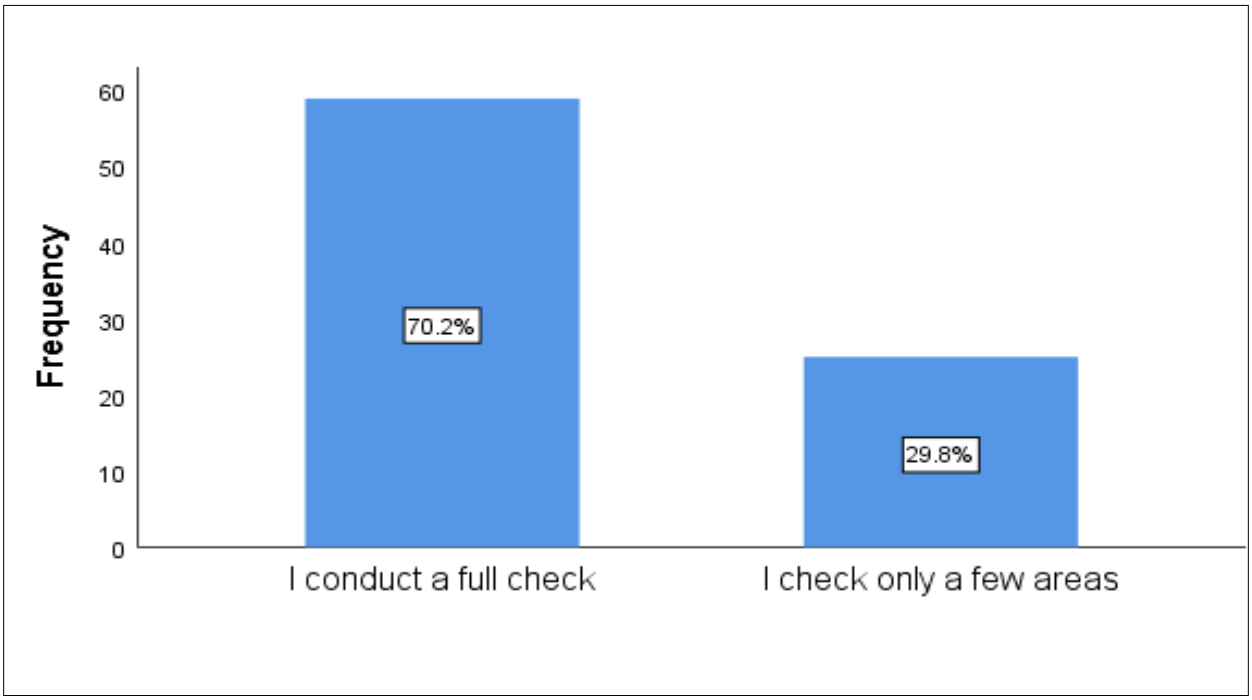

Figure 28. Descriptive statistics for the question *What areas of your pets' bodies do you normally check when searching for ticks after being outdoors or in areas that ticks can be found?* The majority of the participants reported (70.2%) conduct a full check on their pets.

The participants of the transboundary region of U.S.-Mexico reported (31.1%) of them conduct a full check-up for ticks on their own body; however, a higher percentage (72.2%) reported conducting a full check-up on their pets' body.

For the "Self Efficacy" section of the survey, we asked two questions right after the CDC teaching information on ticks and tick-borne diseases, *How much do you think you know about how to protect yourself, your family, and/or your pets from tick bites?* Here in the last two questions asked to all the participants reported the following: "A lot" (11%), "Enough" (48.0%), "A little" (34.6%), "Nothing" (2.4%), and "I am not sure" (3.9%). (Figure 29).

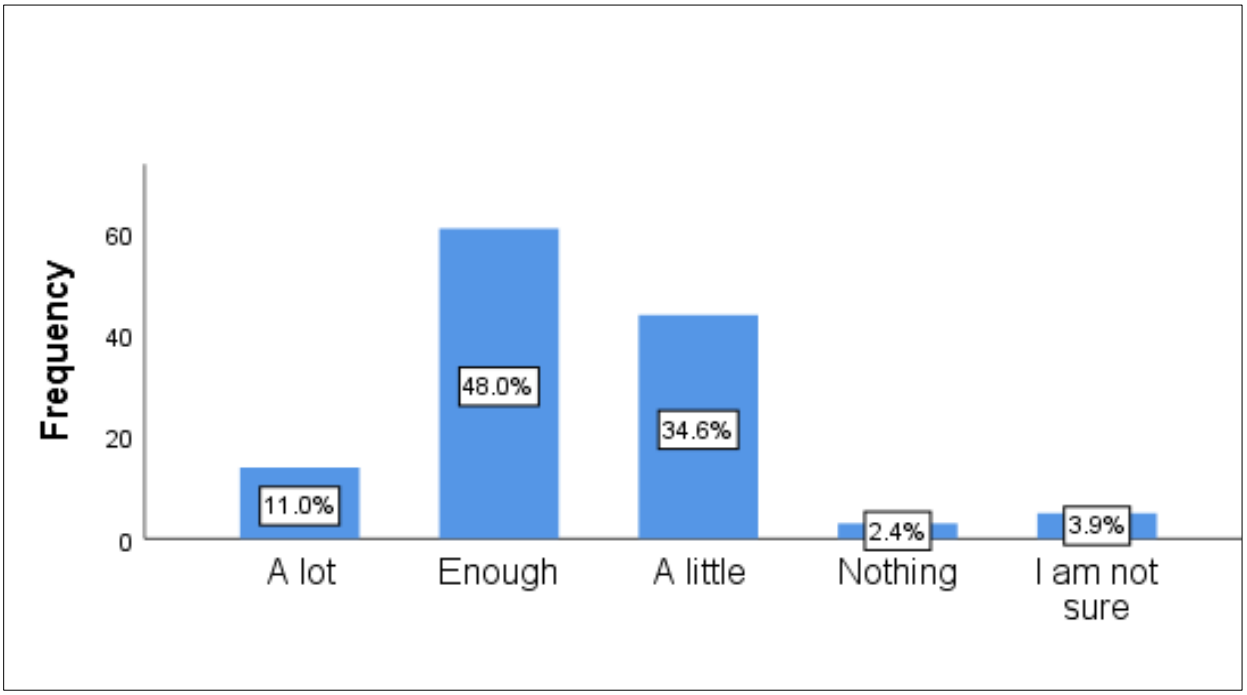

Figure 29. Descriptive statistics for the question *How much do you think you know about how to protect yourself, your family, and/or your pets from tick bites?* The highest percentage on the responses were between "A little" (48.0%) and "Enough" (34.6%).

We asked two questions right after the CDC teaching information on ticks and tick-borne diseases, *How much do you think you know about how ticks can transmit diseases?* Here in the last two questions asked to all the participants reported the following: “A lot” (10.3%), “Enough” (41.3%), “A little” (41.3%), “Nothing” (3.2%), and “I am not sure” (3.2%). (Figure 30).

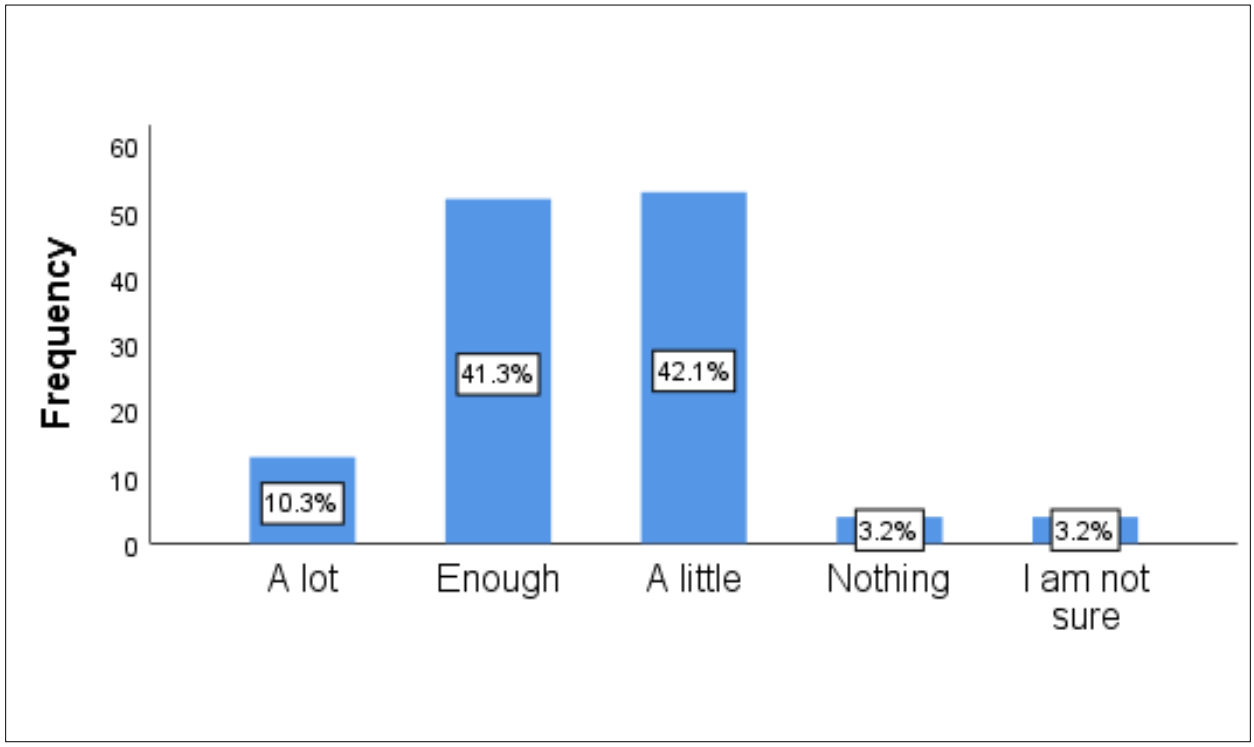

Figure 30. Descriptive statistics for the question *How much do you think you know about how ticks can transmit diseases?* The highest percentage on the responses were between “A little” (42.3%) and “Enough” (42.1%).

The last two questions about knowledge in the survey were asked to the 543 participants of the study area of the transboundary region of U.S.-Mexico. These questions were classified as the "Self Efficacy" because they were asked after the slides within the survey content with CDC promoted protection practices against tick bites. To test the relationship between responses and the reported knowledge of the participants, we conducted a Chi-square test between the questions *How much do you think you know about how to protect yourself, your family, and/or your pets from tick bites? How much do you think you know about how ticks can transmit diseases? And Do you know what diseases can be transmitted by ticks to humans and animals?* Chi-Square test: *p-value*=.0001 revealed high significance among these questions.

Other important questions that we measured were about the protection practices for pets because dogs and cats are hosts of ticks that can cause disease among domestic animals. We asked *What areas of your pets' bodies do you normally check when searching for ticks after being outdoors or in areas that ticks can be found? (*32%) of the participants responded that they conduct a full check for ticks on their pets.

CHAPTER IV

DISCUSSION AND CONCLUSIONS

The transboundary region of the U.S-Mexico shares similar weather conditions and habitats (Feria et al., 2020); these favor the presence of vectors and their possible carrying infections. Regardless of the rural or urban areas that people live in, they can still encounter vectors like ticks that live in the brushy, grassy, wooded areas, and even animals (CDC, 2020). Residents from the transboundary region of U.S.-Mexico share culture, business, goods, and language; it is a bilingual community that could share similar ideas and perceptions towards tick-borne diseases. Our study conducted via an online survey to assess a level of perceived knowledge about ticks and tick-borne diseases from October to December 2020 in the transboundary region of U.S.-Mexico revealed findings that rejected our prediction.

Our results reported that most people participating in the survey know about the tick-borne disease. However, these numbers could be biased due to the nature of the survey. For example, the survey distribution in the USA side extended among youths ages 18 to 25 and others up to 35 years old, whereas in the Mexico side, the participants had access to the survey only through the participant agencies who voluntarily accepted to distribute the survey. To give a visual representation of the study area, we created a map of distribution with the zip codes reported from the participants representing the localities where they live. (Figure 5).

Chi-square test between the questions, *Do you know what diseases can be transmitted by ticks to humans and animals?* And *Age group* Chi-Square test: *p-value*=.870 showing no significance among these questions, whereas a Chi-square test for *Do you know what diseases can be transmitted by ticks to humans and animals?* and *Level of Education* Chi-Square test: *p-value*=.019 showing significance among these questions. The questions about the CDC recommendations to protect children against tick bites Chi-square three-way test for the questions *dress the children with light colors to see ticks easily, never check for ticks on the children after returning indoors,* and *knowledge* was highly significant with *p-value*= .000.

Furthermore, the Chi-square three-way test for the questions *tuck pants into socks, apply repellents when going outdoors,* and *knowledge* reflected a *p-value*= .000, revealing significant association between the CDC recommendations and reported knowledge. These findings were similar to studies in Delaware (Gupta et al., 2018), the resident's lack of protection practices against tick-borne diseases. Our test results revealed that residents of the transboundary region of U.S.-Mexico reported knowledge about tick-borne diseases, but they do not necessarily follow the CDC protection practices preventing and protect their children and themselves from tick bites.

The Lower Rio Grande Valley community, part of the transboundary region of U.S.-Mexico, is rapidly increasing in population and developing in Hidalgo County communities (Demographics, 2021). Nevertheless, economy, travel, migration biodiversity, the climate, land use/change, migration of animal species, movement of plant and animal species are factors that contribute to the spread of vectors and infectious diseases (Feria et al., 2014; Feria et., al 2020; Colunga-Salas et al., 2020). The increase of infectious disease in the world and U.S.-Mexico region is of concern causing the increasing research on tick-borne diseases. The transboundary

region of U.S.-Mexico has reported between Tamaulipas and the Lower Rio Grande Valley 40 cases of Rickettsial infections for the last three years (Epidemiología, 2020; Texas Department of State Health Services, 2019). One of the main vectors for these infections is the *R. sanguineous* or the Brown dog tick, widespread in the transboundary region of U.S.-Mexico (Alkishe et al., 2021; CDC 2020).

The lack of knowledge of tick-borne infections and a low number of reported cases compared to other areas where tick-borne diseases are massive could be affecting the lack of approaches to tick-borne diseases in the transboundary region of U.S.-Mexico. Research is crucial because it can change the perspective on tick-borne diseases among a community. Studies of species distributions modeling to predict potentially suitable habitat for tick species studies are ongoing in the U.S.-Mexico region (Alkishe et al., 2021). A combination of factors could play a significant role in forming synergistic scenarios (Vitousek, 1994), blending abiotic and biotic factors to provide a picture for the future status of the tick associated with diseases in North America. Increasing temperature is suspected to affect tick availability, opportunistic behavior, biting rates, and pathogen development rates, potentially increasing risk for disease incidence for the future (Vitousek, 1994; Feria et al., 2014; Feria et., al 2020; Colunga-Salas et al., 2020; Alkishe et al., 2021)

Vector-borne diseases can expand due to negligence due to the lack of knowledge, poor health conditions, lack of health insurance, a non-well-focused health system, and poor vector control. The promotions on protection practices about ticks and tick-borne diseases and the implementation via education informational resources as flyers and videos could become very beneficial to reach out to the residents of the transboundary region of U.S.-Mexico.

Our findings could help implement English and Spanish flyers, videos, and other materials to help prevent tick-borne diseases by using information promoted by the CDC against tick-bites and tick-borne diseases. Our video, example: https://youtu.be/_vzWLUEgymE

A limitation in our survey was excluding some questions such as *Do you know how a tick looks like? Do you live in a rural or an urban area? Have you encountered a tick-bite?* If yes, *what did you do? Have you heard about tick bite prevention?* If yes, *Where?* The addition of these questions could probably enhance findings in a future similar project.

We acknowledge that research like this could only be possible by combining all the needed components such as a sound strategy, research institutions, public health help programs, experts (entomology, biology, ecology, statisticians, and the community engagement), and funding. Teamwork is needed in a synergistic way to prevent tick-borne disease.

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APPENDIX A

APPENDIX A

VALIDATION OF THE PILOT STUDY

For the validation of the pilot survey, we uploaded the data to IBM SPSS software for validation, Exploratory Factor Analysis, followed to KMO and Bartlett's Test. The results were as follows: Factor 1: Q 13, 14, 15, 16 with alpha .778., Factor 2: Q 7, 20, 21, 22 with alpha .6., Factor 3: Q 5, 17, 18 and 19 with alpha .585., Factor 4: Q 9, 10, 11, 12 with alpha .640., Factor 5: Q 23 and 24 with alpha .775., Factor 6: Q 1, 2, 3, 8 with alpha .3. With the information from the questions' factors, we could construct the original final questionnaire to predict a correlation between variables for an effective analysis.

APPENDIX B

APPENDIX B

THE SURVEY

INTRODUCTION AND CONSENT

Ticks and Their Possible Transmitted Diseases (Survey)

This survey is being conducted by Consuelo Aguilar, a biology graduate student, at The University of Texas Rio Grande Valley (UTRGV).

The purpose of this study is to assess the knowledge of ticks and tick-borne diseases among residents in the transboundary region of Mexico-USA. The study area includes the Rio Grande Valley Counties (Hidalgo, Cameron, Willacy, and Starr), Texas, and the northern region of Tamaulipas, Mexico.

This survey should take about ten minutes to complete.

Participation in this research is completely voluntary. If there are any questions that you are uncomfortable with answering, feel free to skip that question, and leave the answer blank. Also, please be aware that you are entitled to withdraw from the study and terminate your participation at any time without question or comment.

Choosing not to participate will not adversely affect your grade or standing in the class if you are a student.

You must be at least 18 years old to participate. If you are not 18 or older, please do not complete the survey.

All survey responses received will be treated confidentially and stored on a secure server. However, given that the surveys can be completed from any computer (e.g., personal, work, school), there is no guarantee of the security of the computer on which you choose to enter your responses. As a participant in this study, please be aware that certain technologies exist that can be used to monitor or record data and/or websites that are visited.

Any individually identifiable responses will be securely stored and will only be available to those directly involved in this study. De-identified data may be shared with other researchers in the future but will not contain information about any specific individual identity.

This research has been reviewed and approved by the University of Texas Rio Grande Valley
Institutional Review Board for Human Subjects Protection (IRB). If you have any questions about your rights as a participant, or if you feel that your rights as a participant were not adequately met by the researcher, please contact the IRB at (956) 665-3598 or irb@utrgv.edu.

Do you accept to participate in this survey?

Yes, I accept. No, I do not accept.

By selecting "Yes, I accept," I am declaring I am 18 years old or older, and I accept to participate in the survey.

TICKS AND THE DISEASES THEY TRANSMIT

Do you know what diseases can be transmitted by ticks to humans and animals?

Yes

No

How many diseases do you know that are transmitted by ticks?

One disease

Two diseases

Three diseases or more

I do not know

Do diseases transmitted by ticks have a cure?

Yes

No

I do not know

Do you frequently see ticks in the area where you live?

Yes

No

I do not know.

PROTECTION STRATEGIES FOR CHILDREN AGAINST TICK BITES

Are there any children living in your household?

Yes

No

I prefer not to answer this question.

Please answer questions "a" through "e".

	Please select one for each question.				
	Never	Rarely	Sometimes	Frequently	Always
a. Do you tuck children's pants into their socks when going outside?	O	O	O	O	O
b. Do you dress the children in clear colors so you can easily check for ticks?	O	O	O	O	O
c. Do you apply any type of tick repellent to the children when going outside?	O	O	O	O	O
d. Do you have the children shower right after returning indoors?	O	O	O	O	O
e. Do you check the children for ticks after returning indoors?	O	O	O	O	O

Please select one for each of the following statements from "a" through "d".

	Please select one for each statement.				
	Protects very well	Protects well	Does not protect well	Does not protect at all.	I do not know

a. The wear of long sleeves and long pants when going outdoors.	○	○	○	○	○
b. The wear of ankle-high shoes when going outdoors.	○	○	○	○	○
c. The application of anti-tick agents or bug repellents when going outdoors.	○	○	○	○	○
d. The search for ticks on the body when returning from being outdoors.	○	○	○	○	○

PREVENTION STRATEGIES AGAINST TICK BITES

Please select one for each of the following statements from "a" through "d".

HOW WELL YOU SEARCH FOR TICKS

Do you conduct a full body check up for ticks on yourself after being outdoors or in areas where ticks can be found?

Yes

No

What areas of your body do you normally check when searching for ticks after being outdoors or in areas that ticks can be found?

I conduct a full check-up.

I check only a few areas.

I do not check at all.

If you have pets, do you conduct a full body check-up for ticks on your pets' bodies after being outdoors or in areas that ticks can be found?

Yes

No

I do not have any pets.

What areas of your pets' bodies do you normally check when searching for ticks after being outdoors or in areas that ticks can be found?

I conduct a full check.

I check only a few areas.

I do not check at all

TICK'S INFORMATION

Please read carefully the following images that provide information on how to prevent and protect yourself, your children, and your pets from tick bites that may cause transmitted diseases. You will use this information to answer the next two questions. After reading this, please proceed to the next questions you will need to answer.

The images below show where ticks live.

Ticks live in grassy, brushy, wooded areas, and in animals.

Content source: Centers for Disease Control and Prevention, National Center for Emerging and Zoonotic Infectious Diseases (NCEZID), Division of Vector-Borne Diseases (DVBD). Photos by Consuelo Aguilar and Google images

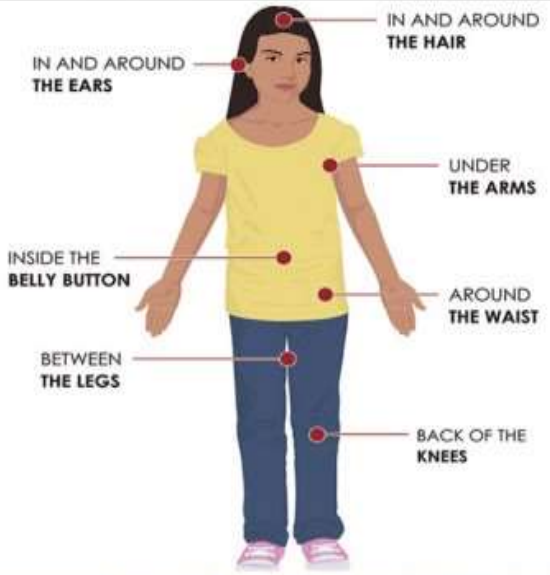
The images below show how to prevent tick bites.

Use the right gear when going outdoors, light colored clothes, and tuck in pants into socks.

For repellents and insecticide products visit: The Environmental Protection Agency (EPA) webpage.

Content source: Centers for Disease Control and Prevention, National Center for Emerging and Zoonotic Infectious Diseases (NCEZID), Division of Vector-Borne Diseases (DVBD). Photos by Consuelo Aguilar and Nancy Sandoval

The image below shows what areas of the body to check for ticks.

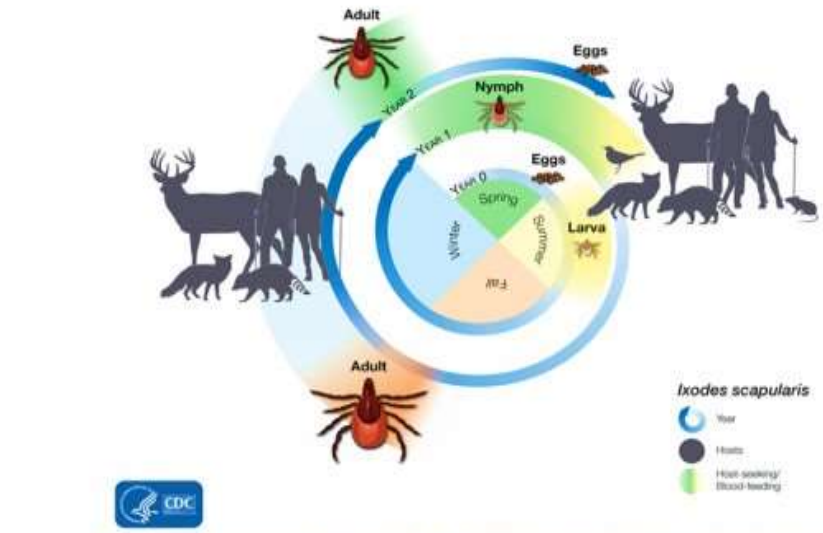


Content source: Centers for Disease Control and Prevention, National Center for Emerging and Zoonotic Infectious Diseases (NCEZID), Division of Vector-Borne Diseases (DVBD)

The image below show the areas where to check your pet for ticks.

Content source: Centers for Disease Control and Prevention, National Center for Emerging and Zoonotic Infectious Diseases (NCEZID), Division of Vector-Borne Diseases (DVBD)

The image below shows how ticks spread diseases.



Content source: Centers for Disease Control and Prevention, National Center for Emerging and Zoonotic Infectious Diseases (NCEZID), Division of Vector-Borne Diseases (DVBD)

For more information visit:

https://www.cdc.gov/ticks/index.html

SELF EFFICACY

After reviewing the previous information about ticks, please answer the questions "a" and "b".

	Please select one for each question.				
	A lot	Enough	A little	Nothing	I am not sure
a. How much do you think you know about how to protect yourself, your family, and/or your pets from tick bites?	○	○	○	○	○
b. How much do you think you know about how ticks can transmit diseases?	○	○	○	○	○

DEMOGRAPHIC INFORMATION

What is your race?

Asian

White

Black

Hispanic/Latino

Native American

Pacific Islander

Mix Race

Other

Prefer not to answer.

In what year were you born?

	Year
Please click on the arrow to select the year	

What is your gender?

Male

Female

Other not described in here.

I prefer not to say.

What is your highest level of education?

No School
Elementary
Middle School
I did not complete High School.
High School Diploma or (GED)
I have some college hours, no diploma.
Technical or Vocational Training/Certificate
Associate's degree
Bachelor's degree
Master's degree
Doctoral degree

Please enter your zip code

UTRGV The University of Texas Rio Grande Valley

INTRODUCCIÓN Y CONSENTIMIENTO

Las garrapatas y sus posibles enfermedades de transmisión

(encuesta)

Esta encuesta está siendo realizada por Consuelo Aguilar, una estudiante de maestría en biología, en La Universidad de Texas del Valle del Río Grande (UTRGV).

El propósito de este estudio es evaluar el conocimiento sobre las garrapatas y las enfermedades transmitidas por estas mismas entre los residentes que viven en la región transfronteriza de México y los Estados Unidos. El área de estudio incluye los cuatro condados del Valle del Río Grande (Hidalgo, Cameron, Willacy, y Starr) en Texas y la parte norte de Tamaulipas, México.

Esta encuesta toma aproximadamente 10 minutos en completarse.

Su participación en esta investigación es completamente voluntaria. Si hay alguna pregunta que usted desee no responder, déjela en blanco y proceda a la siguiente. Usted tiene derecho a retirarse del estudio y finalizar su participación en cualquier momento que desee. Si usted es estudiante, elegir no participar en esta encuesta no afectara negativamente la calificación o posición en la clase.

Debe tener al menos 18 años para participar. Si no tiene 18 años o más, no complete la encuesta.

Todas las respuestas de la encuesta recibidas serán procesadas de forma confidencial y almacenadas en un servidor seguro. Sin embargo, dado que las encuestas se pueden completar desde cualquier computadora (p. ej., personal, laboral, escolar), no hay garantía de la seguridad de la computadora en la que usted elija usar para ingresar sus respuestas. Como participante en este estudio, tenga en cuenta que no garantizamos la seguridad de su información si usted usa una computadora o cualquier otro electrónico compartido o público.

Cualquier información personal que nos provea se almacenará de forma segura y solo estará disponible para aquellos directamente involucrados en este estudio. Los datos colectados pueden compartirse con otros investigadores en el futuro, pero no contendrán información sobre ninguna identidad individual específica.

Esta investigación ha sido revisada y aprobada por la Junta Directiva del Centro de Investigaciones de la
Universidad de Texas del Valle del Río Grande para la Protección de la Investigación con Sujetos Humanos (IRB). Si tiene alguna pregunta sobre sus derechos como participante, o si considera que el investigador no cumplió adecuadamente con sus derechos como participante, comuníquese con el IRB al (956) 665-3598 o irb@utrgv.edu.

¿Acepta participar en esta encuesta?

Sí, acepto.
Al seleccionar "Sí, acepto," declaro que tengo 18 años o más, y acepto participar en la encuesta.

No, no acepto.

LAS GARRAPATAS Y LAS ENFERMEDADES QUE TRANSMITEN

¿Sabe qué enfermedades pueden transmitir las garrapatas a humanos y animales?

Si

No

¿Cuántas enfermedades sabe que transmiten las garrapatas?

Una enfermedad

Dos enfermedades

Tres enfermedades o más

No sé

¿Tienen cura las enfermedades transmitidas por las garrapatas?

Si

No

No sé

¿Ve garrapatas frecuentemente en el área donde vive?

Si

No

No sé

ESTRATEGIAS DE PROTECCIÓN PARA NIÑOS CONTRA LAS PICADURAS DEGARRAPATAS

¿Viven niños en su hogar?

Si

No

Prefiero no contestar esta pregunta

Por favor responda las preguntas "a" a la "e".

Por favor seleccione uno para cada pregunta.

	Nunca	Raramente	A veces	Con Frecuencia	Siempre
a. ¿Mete la bastilla de los pantalones de sus hijos en los calcetines cuando sale?	O	O	O	O	O
b. ¿Viste a sus hijos con colores claros para que pueda verificar fácilmente si hay garrapatas?	O	O	O	O	O
c. ¿Aplica algún tipo de repelente de garrapatas a sus hijos cuando sale?	O	O	O	O	O
d. ¿Hace que sus hijos se duchen justo después de regresar al interior de la casa?	O	O	O	O	O
e. ¿Revisa a sus niños por garrapatas justo después de regresar al interior de la casa?	O	O	O	O	O

ESTRATEGIAS DE PREVENCIÓN CONTRA LAS PICADURAS DE GARRAPATAS

Por favor seleccione una respuesta para cada una de las siguientes afirmaciones de la "a" a la "d".

Por favor seleccione uno para cada una de las afirmaciones.

	Protege muy bien	Protege bien	No protege bien	No protege en absoluto	No sé
a. El uso de mangas y pantalones largos al salir al aire libre.	O	O	O	O	O
b. El uso de zapatos hasta los tobillos cuando sale al aire libre.	O	O	O	O	O

	Por favor seleccione uno para cada una de las afirmaciones.				
	Protege muy bien	Protege bien	No protege bien	No protege en absoluto	No sé
c. La aplicación de agentes anti-garrapatas o repelentes de insectos al salir al aire libre.	O	O	O	O	O
d. La búsqueda de garrapatas en el cuerpo al regresar de estar al aire libre.	O	O	O	O	O

¿QUE TAN BIEN BUSCA LAS GARRAPATAS?

Después de estar al aire libre o en áreas donde se pueden encontrar garrapatas, ¿realiza usted una revisión corporal para detectar garrapatas?

Si

No

Después de estar al aire libre o en áreas donde se pueden encontrar garrapatas, ¿qué áreas de su cuerpo normalmente revisa para detectar garrapatas?

Realizo un chequeo completo

Reviso solo algunas áreas

No reviso en absoluto

Después de estar al aire libre o en áreas donde se pueden encontrar garrapatas con su mascota, ¿realiza una revisión de todo el cuerpo de su mascota para detectar garrapatas?

Si

No

Yo no tengo ninguna mascota

¿Qué áreas del cuerpo de sus mascotas normalmente revisa cuando busca garrapatas después de estar al aire libre o en áreas donde se pueden encontrar garrapatas?

Realizo un chequeo completo

Reviso solo algunas áreas

No reviso en absoluto

INFORMACIÓN SOBRE GARRAPATAS

Lea atentamente la información en las siguientes imágenes sobre cómo prevenir y protegerse a sí mismo, a sus hijos y a sus mascotas de las picaduras de garrapatas que pueden transmitirnos enfermedades infecciosas.

Esta información se utilizará para responder las siguientes dos preguntas.

Después de leer esto, por favor continúe y responda las siguientes preguntas.

Estas imágenes muestran donde viven las garrapatas.

Las garrapatas viven en el zacate, en áreas boscosas, arbustos, y en los animales.

Content source: Centers for Disease Control and Prevention, National Center for Emerging and Zoonotic Infectious Diseases (NCEZID), Division of Vector-Borne Diseases (DVBD). Imagenes por Consuelo Aguilar and Google Images

Estas imágenes muestran cómo prevenir las picaduras de las garrapatas.

Use el vestuario adecuado cuando salga al aire libre, ropa de colores claros, y meta la bastilla de los pantalones dentro de los calcetines.
Para productos repelentes e insecticidas, visite: La página web de la Agencia de Protección Ambiental (EPA).

Content source: Centers for Disease Control and Prevention, National Center for Emerging and Zoonotic Infectious Diseases (NCEZID), Division of Vector-Borne Diseases (DVBD). Imagenes por Consuelo Aguilar y Nancy Sandoval

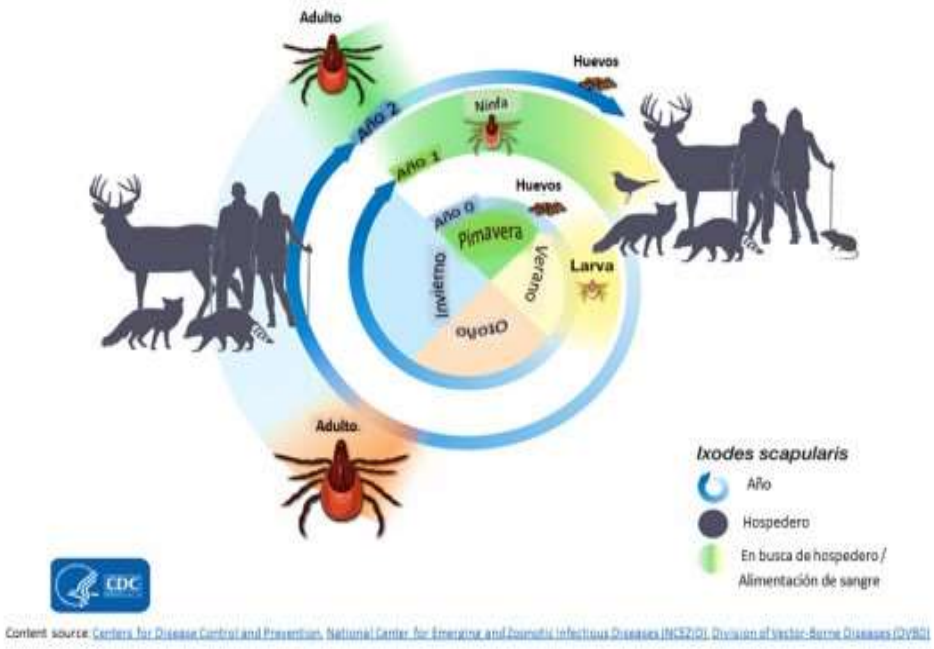
Esta imagen muestra las áreas del cuerpo que debe revisar para buscar garrapatas.

Content source: Centers for Disease Control and Prevention, National Center for Emerging and Zoonotic Infectious Diseases (NCEZID), Division of Vector-Borne Diseases (DVBD)

Esta imagen muestra las áreas del cuerpo de su mascota para ver si no hay garrapatas.

Content source: Centers for Disease Control and Prevention, National Center for Emerging and Zoonotic Infectious Diseases (NCEZID), Division of Vector-Borne Diseases (DVBD)

Esta imagen muestra como las garrapatas transmiten las enfermedades.



Content source: Centers for Disease Control and Prevention, National Center for Emerging and Zoonotic Infectious Diseases (NCEZID), Division of Vector-Borne Diseases (DVBD)

Para más información visite:

https://www.cdc.gov/ticks/index.html

AUTOEFICACIA

Después de revisar la información anterior sobre las garrapatas, conteste las preguntas "a" y "b".

	Por favor seleccione uno para cada pregunta.				
	Mucho	Lo suficiente	Poco	Nada	No estoy seguro
a. ¿Cuánto cree que sabe sobre cómo proteger a usted, a su familia o a sus mascotas de las picaduras de garrapatas?	○	○	○	○	○
b. ¿Cuánto cree que sabe usted sobre como las garrapatas pueden trasmitir enfermedades?	○	○	○	○	○

INFORMACIÓN DEMOGRÁFICA

¿Con cuál grupo racial se identifica usted?

Asiático

Blanco

Negro

Hispano / Latino

Nativo americano

Isleño del Pacífico

Raza mixta

Otro

Prefiero no responder

¿En qué año nació?

	Año
Haga clic en la flecha para seleccionar el año.	

¿Cuál es su género?

Masculino

Femenino

Otro género no descrito aquí

Prefiero no contestar

¿Cuál es su nivel más alto de educación?

No fui a la escuela
Primaria / Elemental
Escuela intermedia / Secundaria
No completé la secundaria
Diploma de preparatoria
Tengo algunas horas de colegio, no tengo diploma
Escuela técnica / Certificado
Asociado
Licenciatura
Maestría
Doctorado

Por favor ingrese su código postal.

BIOGRAPHICAL SKETCH

Consuelo Aguilar graduated from South Texas College with an Associate's degree in Biology in December 2014. She transferred to The University of Texas Rio Grande Valley in 2015 and earned a Bachelor's degree in Biology and a minor in Rehabilitation Services in the Fall of 2017. Her passion for public health took her to participate in a bi-national project conducting mosquito surveillance in U.S.-Mexico transboundary region. She received mosquito identification training by Texas A&M AgriLife Extension and certification by UTEP. She was a co-author in the publication of the mosquito surveillance project.

She started the Master degree in Science in the Spring of 2018. Her concentration was on ticks and tick-borne diseases under the supervision of Dr. Teresa Feria-Arroyo. She received two scholarships from the Global Change Studies (Project number 31000191) and Fred W. and Frances H. Rusteberg Faculty Fellowship in Science and Technology Endowment position, both granted to Dr. Teresa Patricia Feria-Arroyo. She received tick identification training and in laboratory work searching for tick-pathogen with the ticks collected in the Rio Grande Valley (RGV). She volunteered with a CDC project under Dr. Vitek at UTRGV to collect ticks from veterinary hospitals along the RGV. As part of her thesis project, she surveyed the transboundary region of U.S.-Mexico residents to assess the level of perception of knowledge about ticks and tick-borne diseases. She was trained to conduct statistical data analysis using IBM SPSS. She earned her Master of Science degree in Biology in May 2021.

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