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Predicting preventive behaviors on dog-borne zoonoses using the health belief model

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ABSTRACT

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Due to the risks posed by dog-borne zoonotic diseases, a cross-sectional survey was carried out on: (1) respondents' socio-demographic characteristics and prior exposure to dog-borne risks; (2) respondents' knowledge, risk perceptions and preventive behavior towards dog-borne zoonotic diseases; and (3) relationships between respondents' information exposure, knowledge, risk perceptions, and preventive behavior towards dog-borne zoonotic diseases. Since health behavior is dependent on multiple factors within a social context, this study used the Health Belief Model to achieve the study objectives.

A randomly selected sample of 147 residents of the City of Baybay (aged 20-77 years (mean=47.29, SD=13.27)) perceived dog-borne zoonoses to be highly severe types of diseases. Structural equation modelling based on the Health Belief Model showed that dog ownership, perceptions on severity and susceptibility, and perceptions on benefits and barriers directly predicted the likelihood of adopting dog-borne zoonotic disease preventive measures. In addition, there were significant indirect effects of knowledge on dog-borne zoonoses, demographic factors including prior exposure to dog-borne zoonoses, membership of community organizations, and barangay (village) residence zone. Information exposure to dog-borne zoonoses (cues to action) also had a significant indirect effect on behavior. All these denote that the health belief model (HBM) is effective in predicting preventive behaviors on dog-borne zoonotic diseases. However, to maintain these levels of prevention behavior, there is a need for sustained exposure to information on dog-borne zoonoses, and the institutionalization of a community-based dog-borne zoonotic disease prevention initiative.

Keywords: Dog-borne zoonoses, health belief model, preventive

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INTRODUCTION

In Philippine cities and barangays, the increasing population of dogs, whether as pets or as strays in the community, increases the likelihood of contacts between these animals as well as between dogs and man. Since dog-borne zoonoses can be transmitted naturally between dogs and humans (Beck 2000), the likelihood of transmission of these diseases is also increased. One such disease is rabies, where the number of human deaths worldwide attributed to this disease annually is estimated to be between 40,000 and 60,000 (Meslin 2000), and 98% of these deaths are attributable to the bite of a rabid dog (Fekadu 1991). In the Philippines, rabies is regarded as a significant public health problem because it is one of the most acutely fatal infections and it is responsible for the death of 200-250 Filipinos annually (Department of Health [DOH] 2011). Unfortunately, Beck (2000) observed that with the exception of rabies, most of the diseases transmitted from dogs do not attract much public attention, despite the widespread economic and public health consequences associated with their occurrences.

Due to the risks of these diseases, there are Philippine Government programs to control or eradicate these and the participation of the community is critical. In the City of Baybay, there is currently a rabies eradication program jointly implemented by the Department of Health (DOH) and Department of Agriculture (DA) together with the Local Government Unit (LGU). The College of Veterinary Medicine (CVM) in the Visayas State University (VSU) is providing technical expertise for the city. However, other zoonotic diseases transmitted by dogs, such as toxocariasis (visceral larva migrans) and dermatophytosis (ringworm), and others, are not given much attention despite their known public health effects.

Dog-Borne Zoonoses and the Health Belief Model

Given the worldwide challenges posed by major threats, health communication scholars and experts acknowledge the significance of prevention and, with it, the need to understand human behavior through the prism of theory (Rimal and Lapinski 2009). This study is thus anchored on the health belief model (HBM). HBM relates a socio-psychological theory of making decisions to individual behaviors that are related to health (Harrison et al 1992). It is a value-expectancy theory. According to Stretcher and Rosenstock (1997), when value-expectancy concepts were gradually reformulated in the context of health-related behavior, the translations were as follows: the desire to avoid illness or to get well (value) and the belief that a specific health action available to a person would prevent illness (expectation). The expectation was further categorized in terms of the person's estimate of his/her susceptibility to and severity of an illness, and of the likelihood of being able to reduce that threat through personal action (Stretcher and Rosenstock 1997).

HBM is based on the areas of perceived susceptibility (to disease), perceived severity, perceived threat, perceived barriers, perceived benefits, cues to action and health action (Becker 1974). Knowledge of all of these factors is believed to be vital to the planning process for successful educational interventions. The model affirms that to plan a successful educational intervention, the individual or group's perceived susceptibility (eg, to dog-borne zoonotic diseases); perceived severity of the condition and its consequences; perceived benefits in taking certain actions to reduce risk; perceived barriers (eg, costs of the advised action) and cues to action (strategies for activating the “readiness” to undertake health actions) are required. An additional construct (self-efficacy) was later added to address entry points which will provide for potentially effective interventions directed at behavioral modifications (Rosenstock et al 1988). The use of this model has resulted in effective programs in which individuals experienced changes in beliefs that led to an increase in healthy behaviors (Heidarinia 2002).

In the area of health communication campaigns, exposure to a campaign has been found to affect change in people's behaviors (Hornik 2002). Public health communication campaigns have helped increase awareness of the risk from chronic illness and new infectious diseases and promoted the adoption of recommended treatment regimens (Guttman and Salmon 2004). In addition, modifying factors that include prior exposure to the risk under consideration, sociodemographic variables, such as age, sex, race, education level, income level, organizational affiliation and others influence an individual's perception of risk. These also indirectly influence health related behaviors (Cioe 2012). The health belief model (HBM), which provides a theoretical structure for this study, proposed that a repertoire of healthy actions is more accessible to the individual when the magnitude of perceived threat, benefits and self-efficacy exceed his/her perceived barriers to behavioral performance. Provided that the person is exposed to messages that are able to tap into these behavioral determinants and that a regular dose of cues or triggers for good behavior are available, individuals can be influenced to adhere to healthy practices (Champion and Skinner 2008).

Thus, to guide the design and implementation of programs on zoonotic diseases, there is a need to gather data on the target clientele's risk perceptions (perceived severity, threat, benefits, barriers), knowledge, and the practice of prevention and control measures of these diseases and how they are influenced by information exposure, socio-demographic characteristics and prior experience with dog-borne risks. Understanding of risk perception is crucial as a foundation of an effective risk or health communication intervention. In addition, Adhikarya (1994) pointed out that the KAP (knowledge, attitude and practices) of the clients should form a substantial part of the information base in health education campaigns. It is within these contexts that this study was carried out.

Figure 1 shows the hypothesized relationships of variables based on the Health Belief Model (Stretcher and Rosenstock 1997). This framework was the basis used in this study for the structural equation modelling of causal pathways toward adoption of preventive measures against dog-borne zoonotic diseases by the community.

Objectives

Specifically, this study aimed to: (1) determine knowledge, risk perceptions and preventive behavior of City of Baybay residents towards dog-borne zoonotic diseases (focusing mainly on 3 diseases: rabies, toxocariasis, and dermatophytosis); and (2) ascertain relationships between the respondents' socio–demographic characteristics, prior exposure to dog-borne risks, knowledge, risk perceptions, and preventive behavior towards dog-borne zoonotic diseases using structural equation modeling based on the HBM framework.

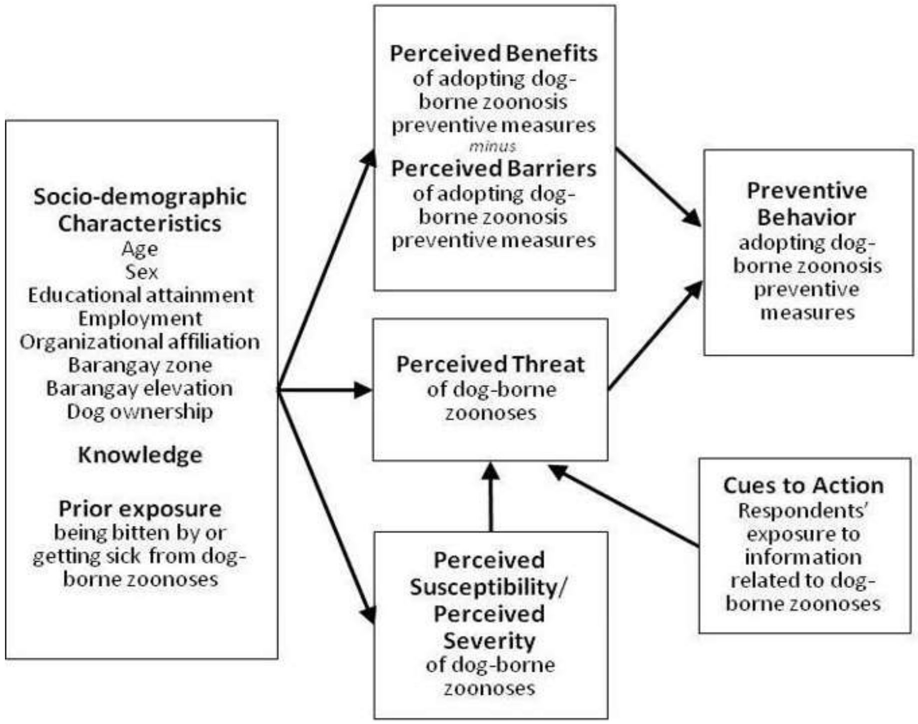

Figure 1. The hypothesized relationships of variables based on the Health Belief Model (Stretcher and Rosenstock, 1997).

METHODOLOGY

Location and Selection of Participants

We conducted this study in the City of Baybay, which is situated on the western coast of the province of Leyte (coordinates 10°41'N, 124°48'E) on the island of Leyte in central Philippines. The City of Baybay has 68 rural and 24 urban minor administrative divisions, referred to as barangays. The area has a tropical climate with an average annual rainfall of 2421 mm and an ambient temperature of 27°C (SD ±1.9°C). The whole city covers an area of 46,050 hectares (46.05km^2). Of the 92 barangays, 59 are considered lowland and 33 upland. Sixty-one percent of the residents owned dogs, with 72% of these dog owners residing in urban barangays, with each having an average of 1.74 dogs owned (Lañada et al 2019).

Using an online multistage cluster sampling procedure (Rollins School of Public Health, Emory University (www.sph.emory.edu)), 10% of the city barangays were selected at random, which resulted in undertaking a cross-sectional survey with the use of an interview schedule in nine barangays. From these barangays, an estimated 5% of the target population of interest was considered for sampling. Clusters of respondents from each of the nine barangays (proportional to the barangay population) were drawn, with the sampling done at a confidence interval width of ±(5)%, an estimated design effect of 1.0, and 95% expected participation rate.

A list of names of the occupants of households in the selected barangays was obtained from the official records of the City of Baybay (BMIS 2014). From this list, the sampled households from each barangay were drawn randomly using a table of random numbers. A total of 147 households from lowland (78) and upland (69) barangays in Baybay were included in the survey. The participation in the survey was totally voluntary, and the respondents understood that their replies to the survey questions were given with their full consent.

Demographics and Relevant Participant Characteristics

Demographic characteristics including age (considered as a continuous variable in this study), educational attainment (scaled: 1-none, 2-elementary, 3-high school, 4-college, 5-post-graduate), employment (employed or not), affiliation in community organizations (yes/no), and dog ownership (yes/no) were included in the survey. In addition, specific barangay characteristics, including urbanization category (urban/rural) and elevation (lowland/upland) were taken.

The participants' prior exposure to an episode of a zoonotic event from dogs, whether from a direct experience or risky encounter (they were bitten or sick from dog transmitted diseases before) and indirect experience or risky encounter (they have had relatives, friends or neighbors bitten or sick from dog transmitted diseases before) with dogs prior to this study were also recorded. Respondents were asked if they had any direct experience or risky encounter and indirect experience of dogs or diseases transmitted from them prior to this study. The scores from each item were totaled to get the prior exposure score.

Current knowledge of respondents regarding dogs as carriers of diseases which could be transmitted to humans was measured using a knowledge test which had highest possible score of 11. The scores from each item were totaled to come up with the knowledge score.

HBM Constructions

Perceptions of severity of the threat of dog-borne zoonoses were obtained through questions on the following six topics: death of dogs from rabies, death of humans from rabies, transmission of rabies through dog bites, effect of dog helminths on people, effect of dog fur and skin infections on people, and consumption of dog meat. In addition, a 3-item measurement asking the respondent to rate the severity of three common dog-borne zoonotic diseases (rabies, toxocariasis and dermatophytosis) was included in this construct. The scores from each item were totaled to come up with the perceived severity score. Perceptions on susceptibility were obtained through questions on nine topics: acquiring rabies from a dog bite, acquiring diseases other than rabies through bites, possibility of acquiring diseases through physical contact with dogs, safety from dog-borne diseases when dogs sleep on people's beds, diseases from dog licks, dog fur as a source of infection, children's safety when a playground is frequented by dogs, whether handling and stepping on dog waste results in the acquisition of disease from dogs, and aside from rabies, whether people can/cannot acquire other diseases from dogs. In addition, this construct includes a 3-item measurement asking the respondent to rate his/her susceptibility to three common dog-borne zoonotic diseases (rabies, toxocariasis, and dermatophytosis). The scores from each item were totaled to come up with the perceived susceptibility score. Scores from perceptions on severity and perceptions on susceptibility were added together and divided by two to obtain mean severity/susceptibility scores for use as an HBM construct.

Perceptions on benefits were obtained through four topics: effects of protection for people against rabies when dogs are vaccinated against the disease, effects of dog deworming, effects of regular visits to the veterinarian on the probability of zoonoses occurrences transmitted from dogs, and the effects of confinement or leashing on the acquisition and transmission of disease agents. The scores from each item were totaled to come up with the perceived benefits score. Perceptions of barriers were obtained through five topics: irregular availability of rabies vaccination in the community, expenses involved in rabies vaccination, availability and expenses involved in dog deworming, and absence/presence of veterinary services in the community, and absence/presence of anti-rabies and dog population control ordinance in place in the community. The scores from each item were totaled to come up with the perceived barriers score. Scores from perceptions of barriers were subtracted from scores from perceptions of benefits to obtain the final benefits minus barriers scores for use as an HBM construct.

Perceptions of self-efficacy were obtained from questions on the following six topics: ability to bring dogs to a veterinarian for health issues, ability to have dogs vaccinated against rabies for protection, ability to do the recommended actions to protect dogs from other diseases (other than rabies), capability to regularly have dogs dewormed, and efforts required to keep dogs outside the house or in a kennel. The scores from each item were totaled to come up with the perceived self-efficacy score.

Cues to action (Information exposure on dog-borne zoonoses), as defined in this study, referred to the participants' exposure to information on dog-borne zoonotic diseases through media and interpersonal sources. Media included radio, TV, newspaper and magazines, and the internet. Interpersonal sources included family members, community leaders, health providers and friends. Scores were totaled to obtain the information exposure score.

Behavioral change regarding prevention of zoonoses from dogs was measured using actions that could be implemented by the respondents. Participants were asked if they had taken the necessary actions to prevent dog-borne diseases. This construct included six questions on taking personal action to prevent oneself from contracting diseases from dogs, dog vaccination, not allowing the dogs to stay inside the house, prohibition of dogs sleeping on owner's bed or couch, avoidance of dogs licking the owner's face, and putting dogs on a leash. The scores from each item were totaled to come up with the preventive behavior scores.

Each HBM construct was measured in the context of preventive actions against dog-borne zoonoses. For risk perceptions, a 5-point Likert scale (5=strongly agree; 1=strongly disagree) was used to measure the respondents' perceptions. The dependent variable was assessed using a 5-point Likert scale (5=always; 1=never at all). Items stated negatively were reverse scored. The highest possible scores were determined by multiplying the highest achievable score for the items by the number of items for each construct. The scores from each item were totaled to come up with the construct index. The highest possible score from these items was determined and categorized into three groups of high, medium, and low. Scores falling into the top third were classified as high, those in the middle third were classified as medium, and those in the lowest third were classified as low.

Since the HBM constructs were each comprised of several Likert items to create Likert scales, parametric data analytic procedures were used in this study, as recommended, in the structural equation modelling (Carifio and Perla 2008, Lovelace and Brickman 2013, and Subedi 2016). The unidimensionality of each HBM construct was assessed by calculating the mean interitem correlation for each scale, wherein mean values should fall within 0.15 to 0.50 (Clark and Watson 1995). This is to maximize unidimensionality (correlations <0.15) and avoid repetitive measurements for the targeted construct (correlations >0.50).

Structural Equation Modelling (SEM) of Causal Pathways

Pearson's correlation coefficients among the demographic variables (exogenous) and the HBM constructs (endogenous), as well as among the HBM constructs (exogenous or endogenous) were determined prior to further analysis (Tables 1 and 2). Variables with significant correlations were identified for modelling in SEM.

Based on the calculated correlations among the exogenous and endogenous variables, structural equation modeling was used to perform path analyses to examine the hypothesized relationships between variables. Variables with significant correlations were used in modelling causal pathways for adoption of preventive measures against dog-borne zoonoses via maximum likelihood estimation using SEM Builder module in Stata 13® (StataCorp, 4905 Lakeway Drive, College Station, Texas 77845 USA). Variables were laid out in the logical causal pathways suggested by HBM. Initial estimation by the SEM module resulted in a full model, which was reconfigured to improve overall model fit. Model trimming was carried out by removing the non-significant variables individually in the casual pathways, starting with the least significant. Then the model was run again and the p-values checked. The process was repeated for the remaining variables in the model until all the variables left among the causal pathways in the model remained significant ($P<0.05$).

Regression coefficients for the causal pathways were calculated as standardized values. The overall model fit was then evaluated using the chi square goodness of fit test, and root mean squared error of approximation (RMSEA). Results with $P>.05$ in the chi-square test indicate good model fit. Values below .08 in RMSEA also indicate good model adequacy (Kline 2016, Huber 2019).

RESULTS

Participant Characteristics

The 147 participants selected for the study aged from 20 to 77 years, with an average of 47.29 (SD, 13.27). Most (68.7%) were female; the big difference between the number of female and male respondents was due to the fact that most male household heads were at work during the survey. Nearly half of the respondents (46.3%) had elementary education, and more than one-third (38.8%) reached high school or were high school graduates. Only 15% of them reached college level; there were none who had postgraduate qualifications.

Table 1. Bivariate correlations between demographic and Health Belief Model constructs.

Variable	Age	Sex	Education	Employed?	Barangay zone	Org	Knowledge	Prior exposure	Dog ownership	Barangay elevation
Perceived Benefits – Perceived Barriers	.025	.113	.022	.005	.152	.059	.035	-.228**	-.081	.144
Perceived Severity/ Perceived Susceptibility	.064	-.099	.099	-.048	.127	.212*	.482***	.057	-.089	.005
Cues to action: Information exposure	-.114	.037	.161	.130	.196*	.291***	.252**	.117	.014	-.096
Self-Efficacy	-.003	-.083	.061	.086	-.084	.154	.127	.196*	-.317***	.188*
Preventive Behavior	.144	.029	.002	.061	.207*	.040	.054	-.140	-.284***	-.051

Table 2. Bivariate correlations between endogenous variables (Health Belief Model constructs)

Variable	Perceived Benefits – Perceived Barriers	Perceived Severity/ Perceived Susceptibility	Cues to action: Information exposure	Self-Efficacy
Perceived Severity/ Perceived Susceptibility	.133			
Cues to action: Information exposure	.186*	.216**		
Self-Efficacy	.152	.112	.088	
Preventive Behavior	.226**	.256**	.130	.238**

More than two thirds (68.7%) of the respondents were employed, and more than half of the participants (52.4%) were members of a community organization; most of the affiliations (52.4%) were with the community women's group. More than half of the respondents (52.4%) were dog owners. The respondents owned on average one dog. Seventy-eight (53.1%) had their residences situated in lowland areas of the city. In addition, 32.7% of the participants were from urbanized sections.

The average knowledge score of the participants was 6.53 (range, 0-11; SD, 2.64). More than half (55.8%) had moderate knowledge scores. High knowledge scores on dog-borne zoonoses were recorded for 23.1% of participants while 17.0% had low knowledge scores; 4.1% had no knowledge at all. Interestingly, combining the percentage of those who had no knowledge of dog-borne zoonotic diseases and those who had low knowledge would yield a proportion (21%), which almost equals to the percentage of those who had high knowledge of dog-borne zoonotic diseases. This implies that the majority of the respondents need more educational interventions regarding this health issue. These findings are similar to study results elsewhere (Bingham et al 2009) where it was demonstrated that many people surveyed had deficient knowledge on dog-associated zoonotic diseases, which could seriously impact their health and the health of their families.

The participants had an average score of 5.94 (range, 0-23; SD, 4.68) for exposure to information on dog-borne zoonoses. The majority (70.1%) of the participants had low exposure to information about dog-borne zoonotic diseases. Only (10.9%) had moderate information exposure while (19.0%) had no exposure to information at all. The proportion of respondents who were not exposed to information on the health issue was slightly higher in the uplands (21.7%) than in the lowlands (16.7%). The proportion of respondents who had low exposure to such information was more or less the same in the lowlands and the uplands (lowland = 71%, upland=69.2%).

Unidimensionality of HBM Constructs

Pilot testing of the HBM constructs was carried out on 30 randomly selected participants coming from a barangay outside the study area. Using the test for interitem correlation within each construct (Clark and Watson 1995), all were calculated to fall within the recommended limits (0.15 to 0.50): perceived severity (.246), perceived susceptibility (.337), perceived self-efficacy (.381), perceived benefits (.296), perceived barriers (.222), and behavior towards prevention of dog-borne zoonoses (.452).

Risk Perceptions on Dog-Borne Zoonotic Diseases

We found that the respondents perceived dog-borne zoonoses to be highly severe types of diseases, where 83.0% had high perceived severity. Furthermore, when asked to assess the perceived severity of dog-borne zoonotic diseases using a scale of 1 to 5 where 1 stood for least severe and 5 stood for most severe, 76.9% rated rabies as the most severe, 38% rated toxocariasis as most severe, and 53% rated dermatophytosis as most severe. This high subjective assessment of severity was consistent with the overall perceived severity trend. However, this result also revealed an ordered subjective assessment of the three dog-borne zoonotic diseases where rabies was assessed by most to be highly severe, followed by dermatophytosis and toxocariasis. As to perceptions on susceptibility, results showed that 61.2% of the respondents had high perceived susceptibility of threat towards dog-borne zoonotic diseases. More than one-third (38.8%) of them had moderate perceived susceptibility. When asked to give their subjective assessment of susceptibility to dog zoonotic diseases, 52.4% of the respondents assessed themselves to be most susceptible to rabies, 30.6% to toxocariasis and 46.3% to dermatophytosis. Participants had a mean severity/susceptibility score of 39.0 (range, 24.5-52.5; SD, 6.32).

Regarding perceptions on benefits, most of the respondents (93.9%) had high scores for perceived benefits while a small percentage (6.1%) had moderate scores for perceived benefits. Perceptions on barriers showed that about three-quarters (70.7%) of the randomly selected respondents had moderate perceived barriers on adhering to the measures against dog-borne zoonotic diseases. Nearly one-third of them (27.2%) had high perceived barriers. Only 2.0%, however, had low perceived barriers based on the results of the survey. Perceived barriers included the cost of anti-rabies vaccination and deworming, and the scantiness and high expense of veterinary services in the City of Baybay. Participants had a mean benefits *minus* barriers score of 2.55 (range, -4.0-11; SD, 3.61).

Among the randomly selected respondents, 83.0% had high perceived self-efficacy to do the recommended responses to dog-borne zoonotic diseases. In contrast, only 0.7% had low perceived self-efficacy while the remaining 16.3% had only moderate perceived self-efficacy. This means that the majority of the respondents perceived themselves to be highly efficacious to have their dogs vaccinated, dewormed, leashed, and kept outdoors. Those who did not own dogs still felt themselves to be highly efficacious in adhering to these recommendations if they were to own one in the future. Participants had a mean self-efficacy score of 24.17 (range, 9.0-30.0; SD, 3.89).

More than half (60.5%) of the respondents had high levels of dog-borne zoonoses prevention behavior. However, more than one-third (35.4%) had moderate and 4.1% had low preventive behavior scores. Participants had a mean preventive behavior score of 21.54 (range, 6.0-30.0; SD, 5.52).

Modeling Preventive Behavior

The initial full model, which included all significantly correlated variables (Tables 1 and 2) did not fit the data very well: χ^2 (*df*)=36.04 (24), Prob > chi2=0.0544; and root mean squared error of approximation (RMSEA)=0.058. The model was thus trimmed by removing all non-significant pathways in the model diagram, and the estimation run again. The trimmed model (Figure 2) showed that preventive behavior against dog-borne zoonoses was directly associated with 2 HBM variables and 1 modifying variable: perceived benefits minus perceived barriers (*b*=.182, P=.019) and perceived severity/perceived susceptibility (*b*=.215, P=.005), and dog ownership (*b*=-.255, P=.001). We observed indirect associations to preventive behavior among several variables. Prior exposure was indirectly associated (*b*=-.251, P=.001) with preventive behavior, mediated by perceived benefits minus perceived barriers. Cues to action was also indirectly associated with preventive behavior, also mediated by perceived benefits minus perceived barriers. The modifying variables organization membership (*b*=.224, P=.003), barangay zone (*b*=.208, P=.005) and knowledge on dog-borne zoonoses (*b*=.230, P=.002) were also indirectly associated with preventive behavior, mediated by cues to action. Through mediation by perceived severity/perceived susceptibility, knowledge (*b*=.482, P=.000) also had indirect association with preventive behavior. These associations and their coefficients are shown in Table 3.

The model (Figure 2) showed good data fit: χ^2 (*df*) = 22.60 (17), Prob > chi2 = 0.1628; and root mean squared error of approximation (RMSEA) = 0.047. The variables in the model explained 43.4% of the variability in preventive behavior against dog-borne zoonoses in the community.

Table 3. Direct and indirect effects on preventive behavior towards dog-borne zoonoses.

Dependent Variable		Independent Variable	Standardized b	95% CI Lower limit	95% CI Upper limit	P-value
Direct Effect						
Preventive behavior against dog-borne zoonoses	▲	Dog ownership	-.255	-.399	-.110	0.001
	▲	Perceived severity/susceptibility	.213	.064	.363	0.005
	▲	Perceived benefits – Perceived barriers	.182	.030	.333	0.019
Indirect Effect						
Perceived benefits – Perceived barriers	▲	Prior exposure	-.251	-.396	-.106	0.001
	▲	Cues to action	.214	.065	.363	0.005
Perceived severity/perceived susceptibility	▲	Knowledge	.482	.365	.598	0.000
Cues to action	▲	Organization membership	.224	.077	.372	0.003
	▲	Barangay zone	.208	.062	.353	0.005
	▲	Knowledge	.230	.082	.378	0.002

DISCUSSION

We examined the applicability of an HBM model for explaining behavioral change in relation to the dog-borne zoonoses in this study. The model shows that among the HBM constructs, the keys to driving preventive behaviors against dog-borne zoonoses are the individuals' perceptions on the severity of, and their susceptibility to, these diseases, and their perceptions of benefits that they may get if they do preventive actions. Although it has been suggested that preventive behavior may only be acted upon if the following sequential order is followed: evaluation of the threat at hand through perceived severity of the disease, followed by preventive action evaluation (perceived benefits) (Werle 2011), we were able to show that preventive action could be taken without perceptions of benefits mediating perceptions of susceptibility and severity.

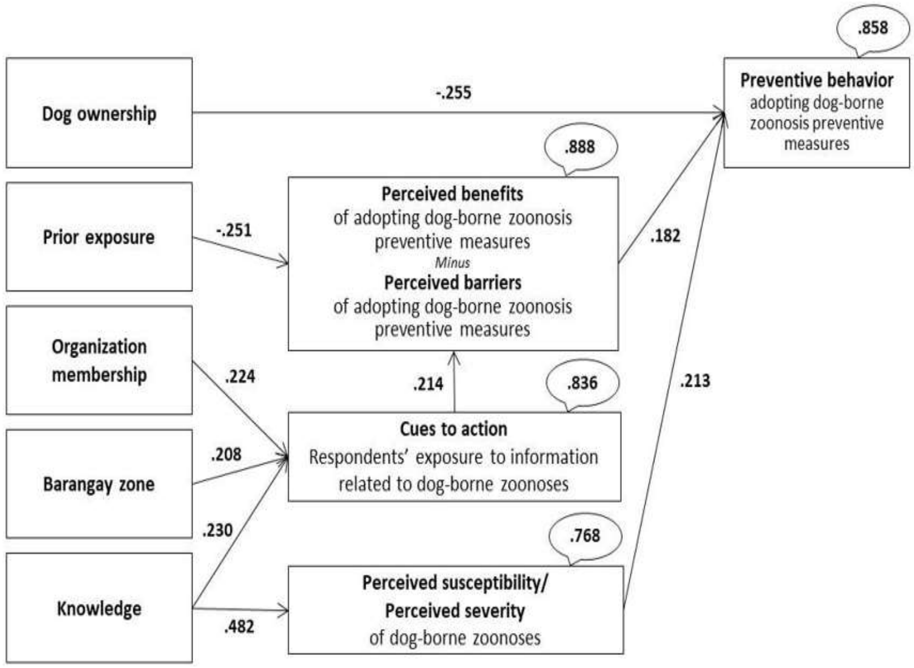

Figure 2. Estimated coefficients of the final trimmed health belief model of preventive behavior towards dog-borne zoonoses. Non-significant paths were removed in this model. $\chi 2$ (df)=22.60 (17), Prob > $\chi 2$=0.1628; and root mean squared error of approximation (RMSEA)=0.047.

The main HBM limit is the assumption that beliefs will directly impact behavior (Werle 2011). However, other research has proven that attitude mediates this relation and is the best predictor of behavior (Oliver and Berger 1979). The measurement of the attitudes of the individuals who participated in this study towards doing preventive measures were not clearly defined; the addition of attitudinal questions could have improved model fit.

High scores in the HBM constructs generally indicate positive behavioral change towards disease prevention. More than half of the respondents, however, had only moderate knowledge on dog-borne zoonoses, due to the community's low exposure to dog-borne zoonoses information other than that on rabies. This dilution of knowledge scores could have contributed to some negative coefficients in the models, which are contrary to the reasoning that a person is supposed to have higher likelihood of adopting preventive measures against dog-borne zoonotic diseases if the HBM scores are rated high. In addition, the perception that dog-borne zoonoses pose very high risks to health and tend to scare people away from adopting preventive measures (Lundgren and McMakin 2009), could further explain the modeling results.

The general lack of community knowledge on dog-borne zoonotic diseases could pose a serious risk to community members and their families (Bingham et al 2010), and must be rectified. It is necessary therefore to introduce knowledge on dog-borne zoonoses in the educational system, because of the dangers brought about by ignorance and misinformation to both animals and man. Information and education campaigns should be carried out through various approaches, such as television spots, leaflets in veterinary clinics, pet shops and physicians' offices. The aim being to inform individuals about zoonoses with specific information about which diseases are considered zoonoses, their transmission, risk factors and necessary preventive measures in order to eliminate the spread without causing panic and mistreatment towards animals (Kantarakia et al 2020). It should also be recognized that health communication is only one of the numerous factors needed to make health behavior permanent. When combined with community, political, cultural and economic infrastructures, changes in individual health behaviors are more likely to occur.

Dog ownership played a prominent role in preventive behavior against dog-borne zoonoses. It was a directly influencing behavior, without mediation (b=-.225, P=.001). The negative coefficient may be an indication of the already embedded confidence of dog owners to protect themselves against dog-borne zoonoses. An additional argument for this is found in previous research which showed that there was significantly less concern among dog-owning households for pet-associated disease for themselves and household children, where 83% were either "minimally concerned or not at all" about catching a disease from pets or pets of friends or family (Stull et al 2012). In this present study, we examined the preventive behavior scores of dog owners versus non-dog owners and we found out that dog owners had an average score of 20.05, while non-dog owners had a score of 23.19. Details showed that generally, for the individual items in the scale, the scores of non-dog owners were all higher compared with the scores of the dog-owners, except in question 3, on "allowing the dogs to stay inside the house", a situation very commonly observed among dog owners. In addition, the predictive power demonstrated by dog-ownership in this study also implies that aside from building on people's perceived susceptibility and perceived self-efficacy, any health intervention aimed to promote dog-borne zoonotic disease prevention among the respondents must also take into consideration ownership or non-ownership of dogs. Dog owners may need another type of information about dog-borne zoonotic diseases; non-dog owners may need another type of information and another way of framing the message.

Owning dogs brings major well-being support and the risk of zoonoses is limited when good animal care and appropriate preventive measures are applied in the human environment. This has been shown to increase self-efficacy (Olesky 2018). However, the risks are not null and some behaviors (kissing, sleeping, being licked, or sharing food or kitchen utensils) or exposure of high-risk group persons may lead to disease spread by companion animals (Chomel 2014). Reducing the risk of transmission of zoonoses should not, however, be approached by advising against pet ownership but by informing dog owners about the risks of different intensities of dog–owner interactions and hygienic precautions (Joosten et al 2020).

We also found in this study that communication cues were greatly influenced by external factors such as: knowledge on dog-borne zoonoses, membership of a community organization, and having residence in an urban zone. Cues to action are supposed to influence behavior directly, but not in this case; it influenced behavior through perceptions of benefits derived from adopting preventive measures against these diseases minus perceptions of barriers to adoption of preventive measures. This result shows that when attitudes are relevant to behavior, these are able to predict behavior better than attitudes based on low relevance knowledge (Fabrigar et al 2006). Thus, cues to action designed to influence adoption of preventive measures against dog-borne zoonoses do not influence behavior directly, unlike in the case of dengue in the Philippines (Lennon 2005), and in the case of MERS-CoV in Saudi Arabia (Alsulaiman and Rentner 2018).

Even when information exposure is shown not to have a direct effect on preventive behavior, efforts aimed at promoting preventive behavior against dog-borne zoonotic diseases should not discount the importance of this factor. Hornik (2002) observed that despite the amount of health education programs available, the effect on people's health attitudes, beliefs and behaviors have contradictory evidence because the requirement of a steady and wider amount of exposure, which is a requirement for public health education programs to be effective, has not been satisfied. Health education on the issue is crucial so that people will understand and develop risk estimates of dog-borne zoonotic diseases that are comparable to evidence-based risk estimates so that false higher risk estimates will not scare people away from prevention and false lower risk estimates will not influence people into non-prevention (Lundgren and McMakin 2009).

CONCLUSIONS AND RECOMMENDATIONS

Community knowledge on dog-borne zoonoses was found to be mostly on the moderate to low levels, coupled with low exposure to information on dog-borne zoonoses. The majority of the respondents need more educational interventions regarding the health issue. These findings are similar to results elsewhere (Bingham et al 2009) where it was demonstrated that many people surveyed had deficient knowledge of dog-associated zoonotic diseases, which could seriously impact their health and the health of their families.

Among the demographic variables, dog ownership was shown to have the highest effect on behavioral changes in the community. Knowledge of dog-borne zoonoses also had a high effect, but only after mediation by perceptions on severity and susceptibility, which, in turn, had the highest direct effect on behavioral change among the perception variables. Significant indirect effects on behavior of prior exposure to dog-borne zoonoses, membership in community organizations, barangay residence zone as well as information exposure on dog-borne zoonoses were also shown by the model. Overall, the path model constructed was shown to be statistically significant and demonstrated the suitability of the Health Belief Model for predicting the likelihood of adopting dog-borne zoonotic disease preventive measures.

Perceptions of risks posed by dog-borne zoonoses in the community were generally high and were considered as indicators of positive effects on behavioral change. Given this, the likelihood of behavioral change towards preventing dog-borne zoonoses must be supplemented with high levels of knowledge about these diseases to achieve positive effects. This is needed to sustain these perception levels; this should be reinforced further by sustained exposure to information on dog-borne zoonoses. In addition, these community health messages should be able to address the right combination of perceived susceptibility and perceived self-efficacy to develop stable levels of prevention behavior. This communication intervention would also be more effective when institutionalized as a community-based project for dog-borne zoonotic disease prevention.

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