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RESEARCH ARTICLE

Perceptions regarding rabies prevention and control in two different community settings in Vietnam using a Q-sorting approach

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ABSTRACT

Background and Aim: Rabies remains a critical public health threat in Vietnam, particularly in areas where dog-mediated transmission persists. Despite national control strategies, vaccination coverage in dogs remains suboptimal. This study aimed to investigate the perceptions of dog owners toward rabies prevention and control in distinct urban and rural settings of Long An Province, using a Q-sorting methodology to explore sociobehavioral and socioeconomic drivers influencing compliance with vaccination programs.

Materials and Methods: A cross-sectional study was conducted among 109 dog owners – 60 from urban Tan An City and 49 from rural Duc Hue District – between March and June 2023. Participants performed Q-sorting with 46 validated statements across four domains: Knowledge, attitudes, practices, and cost perceptions regarding rabies prevention. Principal component analysis was applied separately for each setting to identify latent discourses. Socioeconomic factors were assessed in relation to discourse membership using descriptive and inferential statistics.

Results: Two discourses were identified in the urban setting ("Obstructed Adherents" and "Casual Observers") and three in the rural setting ("Identified Awareness," "Independent Owners," and "Close Adherence"). While all participants demonstrated baseline knowledge of rabies severity, barriers such as limited vaccine accessibility and inadequate veterinary support impeded proactive vaccination. Vaccine cost was not perceived as a major deterrent. Educational attainment was significantly associated with proactive health-seeking behavior in the rural setting ($p = 0.017$).

Conclusion: This study elucidates community-specific perceptions that influence rabies prevention behavior. Although awareness of rabies is high, structural limitations – particularly inadequate access to veterinary services – hinder effective control. Tailored community engagement, veterinary outreach, and education campaigns, especially in low-resource settings, are recommended to enhance vaccination uptake and achieve national rabies elimination goals by 2030.

Keywords: community perceptions, One Health, Q-sorting, rabies prevention, vaccination barriers, Vietnam.

INTRODUCTION

Rabies virus (RABV) is a single-stranded RNA virus that infects various animal species and is primarily transmitted through zoonotic pathways [1]. Humans are most commonly infected through exposure to rabid dogs [2]. RABV causes acute and invariably fatal neurological disease in both humans and other mammals, typically transmitted through the saliva of infected animals through bites or scratches [3]. In nearly all untreated human cases, the disease results in death, with a case fatality rate approaching 100% [4]. Globally, the economic burden attributed to rabies is estimated at approximately USD 8.6 billion annually, largely driven by the costs of post-exposure prophylaxis (PEP) and treatment. Rabies is also responsible for an estimated 59,000 human deaths each year [5]. Despite its severity, rabies is entirely preventable through vaccination. The World Health Organization (WHO) recommends

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maintaining at least 70% annual vaccination coverage of the dog population as a critical measure to eliminate canine rabies and prevent human cases worldwide [6].

While many high-income countries have successfully implemented comprehensive rabies control programs [7, 8], the disease remains endemic in several low- and middle-income countries (LMICs), primarily due to the absence of integrated control strategies and limited public awareness [9–11]. In Vietnam, rabies continues to pose a significant public health concern, with an increasing number of rabies-related deaths reported in recent years. In 2021, rabies resulted in 66 human deaths across 11 of the country's 63 provinces and cities [12], rising to 70 deaths in 2022 and remaining high at 63 deaths in 2023 [13]. In addition, canine rabies remains prevalent, with 347 confirmed cases in dogs reported across 31 provinces in 2023 [14]. Although the government has adopted several preventive strategies – including mass dog vaccination, diagnostic testing of suspected rabid dogs, post-vaccination surveillance, and public education – vaccination coverage remains below target. Between 2017 and 2022, the national dog vaccination rate averaged 50%, with only 13 out of 63 provinces (20.6%) meeting the 70% coverage goal in 2022 [13, 14].

Long An Province, located in southern Vietnam, has been identified as a rabies hotspot, with seven human fatalities reported between 2017 and 2021 [15]. The average dog vaccination coverage in the province over this period was 68% (unpublished data), below the recommended threshold of 70% [16]. Insufficient public awareness has been recognized as a major contributing factor to the persistent rabies burden [17]. Castillo-Neyra *et al*. [18] have indicated that urban residents tend to prioritize their pets' health more than rural residents, suggesting that rabies control interventions may need to be adapted to different community contexts. The Q-sorting methodology, a widely used approach in social science and public health, is effective for capturing the diversity of individual perceptions by grouping participants into discourses based on their shared views [19, 20].

Despite ongoing national efforts to eliminate rabies in Vietnam, including mass vaccination campaigns and public health interventions, vaccination coverage among domestic dogs remains below the WHO-recommended threshold. Prior studies have largely focused on knowledge, attitudes, and practices (KAP) using quantitative survey tools, which may not fully capture the sociocultural and contextual nuances underlying vaccine hesitancy or non-compliance. There remains a lack of in-depth, community-specific understanding of the behavioral, structural, and socioeconomic barriers influencing rabies prevention in Vietnam, particularly across contrasting rural and urban settings. Furthermore, no published studies have employed the Q-sorting methodology to explore latent discourses and stakeholder perceptions related to rabies control in Vietnamese communities. This methodological gap limits the capacity of public health authorities to design context-sensitive interventions that resonate with local beliefs and practices.

This study aimed to investigate the perceptions and underlying belief systems of dog owners regarding rabies prevention and control in two distinct community settings – urban Tan An City and rural Duc Hue District – in Long An Province, Vietnam. Utilizing a Q-sorting approach, the study sought to identify shared opinion discourses and examine how socioeconomic factors shape attitudes toward animal vaccination and rabies risk mitigation. The findings are intended to inform the development of tailored, evidence-based public health strategies that enhance rabies control efforts within local contexts and contribute to achieving Vietnam's national rabies elimination goals by 2030.

MATERIALS AND METHODS

Ethical approval

This study received ethical approval from the Sub-Department of Animal Health of Long An Province (SDAH-LA) (SubDAH_approval_001). The approval confirmed that all methodologies adhered to traditional cultural norms and ethical standards of the local communities, and that the collected data were suitable for publication. Before participation, all participants were provided with a detailed explanation of the study objectives, and written informed consent was obtained.

Study period and location

The study was conducted from March to June 2023 in Long An Province, southern Vietnam, encompassing two distinct community settings: Urban (Tan An City) and rural (Duc Hue District). Tan An, the provincial capital, has an estimated population of 6,100 dogs and cats across 5,100 households. Duc Hue District, a remote area near the Cambodian border, hosts approximately 8,700 dogs and cats in nearly 4,000 households. Both Tan An City and Duc Hue District are designated as high-priority areas for rabies control. The geographical locations of the study sites are illustrated in Figure 1.

Sample size

The study participants consisted of dog owners residing in Tan An City (n = 60) and Duc Hue District (n = 49), who were randomly selected from household records maintained by the SDAH-LA. The sample size and participant selection for the Q-sorting methodology followed the criteria outlined by Brown *et al*. [21].

Conceptual framework for study

A conceptual framework (Figure 2) was adopted to guide the study design, depicting the expected relationships between socioeconomic variables (independent variables), mediating factors (moderators), and behavioral outcomes (dependent variables). This framework informed the formulation of hypotheses and the analytical approach.

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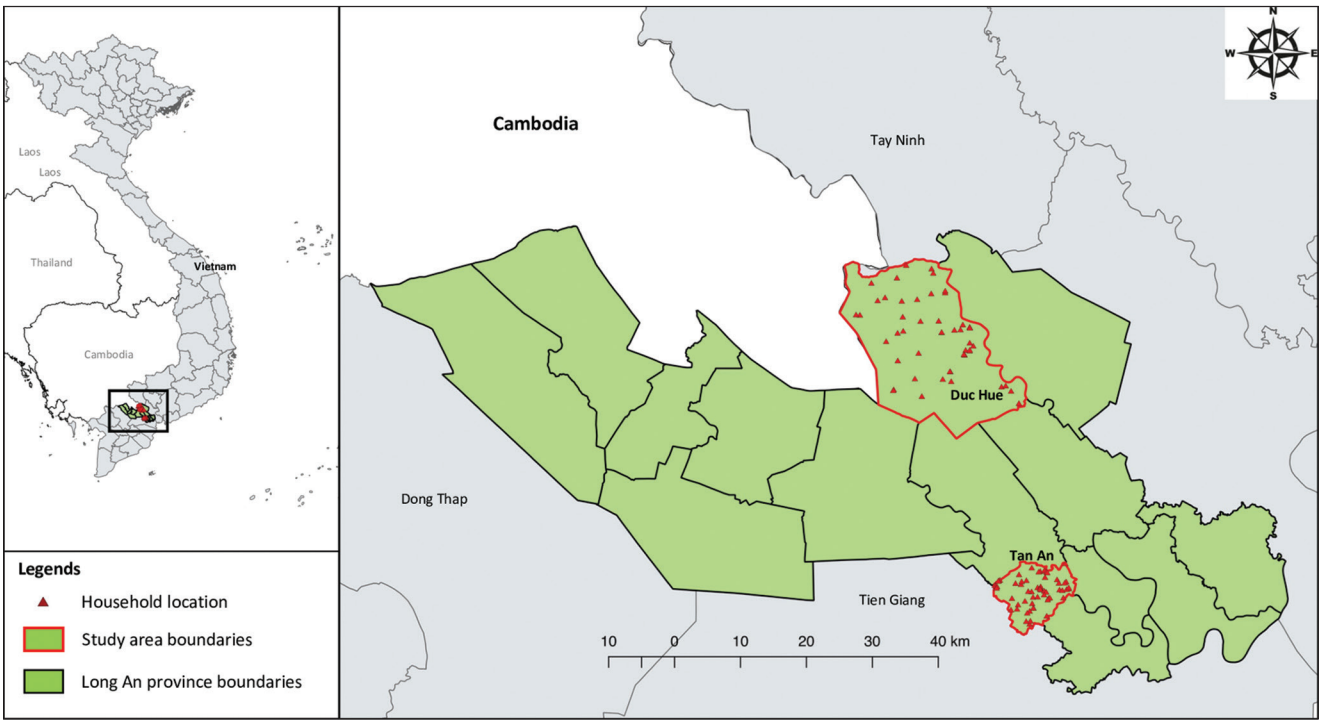

Figure 1: Geographical locations of the sampling site [Source: The map wss designed by first author using QGIS 2.18.1].

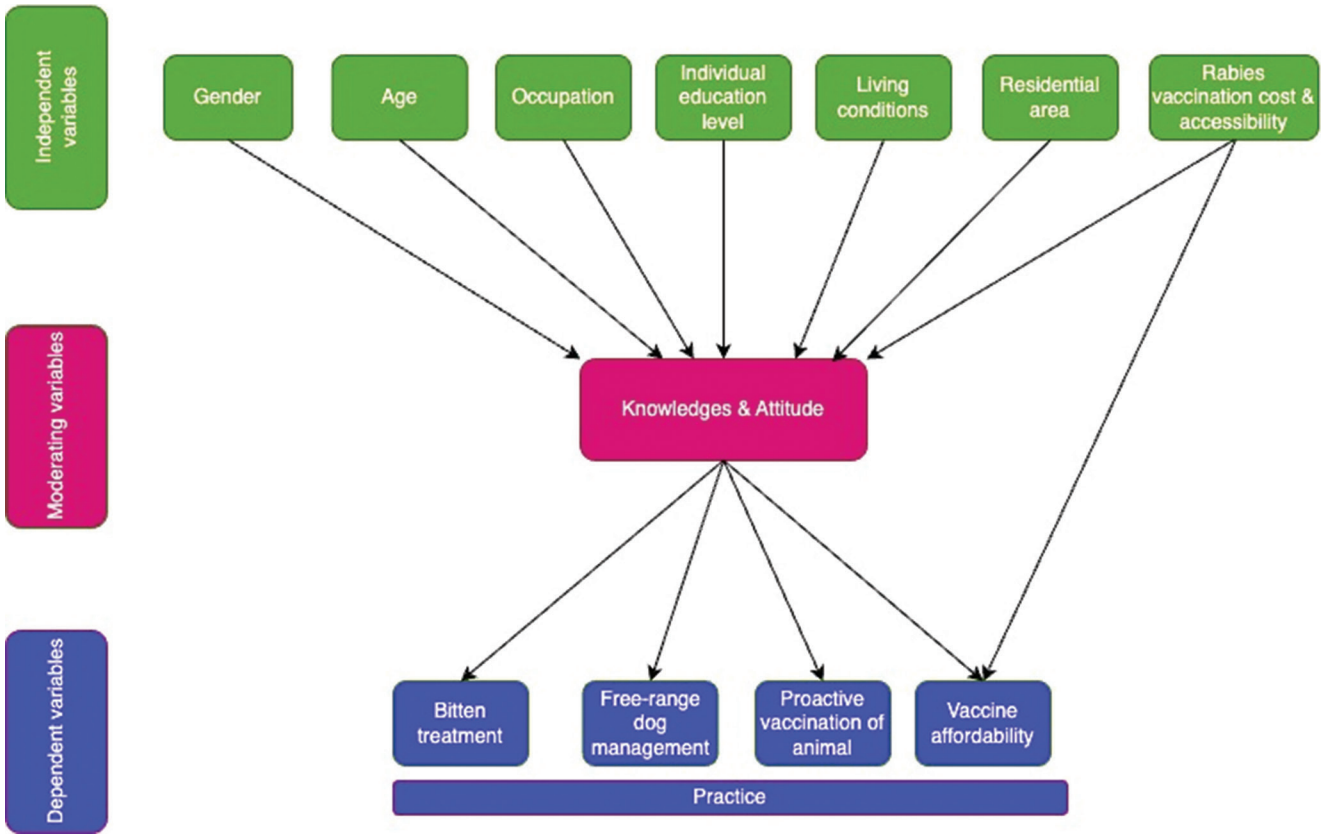

Figure 2: Conceptual framework representing the relationship between socioeconomic variables and rabies prevention practices.

Q-sorting procedure and in-depth interviews

The Q-sorting process was conducted in accordance with the methodology described by Truong *et al*. [22]. Briefly, participants were asked to read, evaluate, and sort 46 statements into a quasi-normal distribution grid based on their level of agreement. Responses were recorded using a seven-point scale ranging from −3 (extremely disagree) to +3 (extremely agree), with 0 indicating neutrality. These 46 statements captured a wide range of opinions on rabies prevention

and control, categorized into four thematic domains: (1) Knowledge, (2) attitudes, (3) practices, and (4) cost-related factors.

Each Q-sorting interview lasted approximately 40 min. Following the sorting activity, in-depth interviews were conducted to explore participants' rationale behind extreme statement placements. Qualitative data were collected through written notes and photographs.

Prior to data collection, the statement set was reviewed and validated by three subject matter experts – a veterinarian, a medical doctor, and a local official from the Sub-Department of Animal Health – who assessed the content for clarity and relevance. The index of statement-objective congruence averaged 0.85, with all items scoring above the minimum threshold of 0.75, indicating strong content validity in accordance with Turner and Carlson [23]. After incorporating the experts' feedback, the finalized 46-statement set was used for Q-sorting (Supplementary data).

Statistical analysis

Q-sorting data were analyzed separately for each community setting using distinct matrices. For Tan An City, a 46 × 60 matrix was constructed, treating statements (n = 46) as observations and participants (n = 60) as variables. Similarly, a 46 × 49 matrix was used for Duc Hue District. In line with the Q-methodology framework, the roles of variables and observations were transposed during analysis, as described by Brown *et al*. [21].

Principal component analysis (PCA) was performed to identify key factors (discourses). Factors were retained based on their ability to cumulatively explain 50%–70% of the variance and eigenvalues greater than 1, consistent with the Kaiser criterion [24] and previous applications in Q methodology [20].

Each statement's relative position within a discourse was recalculated through factor loading scores, resulting in k discourses derived from the selected PCA components. A discourse was retained if it included more than 5% of the total participants. These discourses were interpreted as hypothetical Q-sorts reconstructed from the factor scores. Consensus and distinguishing statements were identified based on correlation coefficients and standard error (SE) differences between factors, with statistical significance set at $p < 0.05$.

Descriptive statistics – including proportions, means, SEs, medians, and interquartile ranges (IQRs) – were used to characterize participants' demographics. A proportion test was used to explore associations between demographic variables and discourse membership. The demographic variables included: (1) Age (years); (2) gender (male/female); (3) occupation (student, farmer, government officer, private officer, manual laborer, freelancer, and pensioner); (4) education level (primary, secondary, high school, or bachelor degree); and (5) living condition (low, standard, or high).

All statistical analyses were conducted using R software version 4.3.2 (R Core Team, 2023) [25], employing the "FactorMineR" and "qmethod" packages for PCA, Q-sorting, and bootstrapping (resampled 100 times) analyses.

RESULTS

Descriptive characteristics of the study participants

Of the 109 participants included in the study, 60 resided in Tan An City and 49 in Duc Hue District. The overall median age was 51 years (IQR: 41–57); the median age in Tan An City was higher at 55 years (IQR: 45–59), compared to 48 years (IQR: 36–54) in Duc Hue District. Males represented the majority in both locations, accounting for 57.8% of the total sample. The most common education levels were secondary school (40.4%) and high school (35.8%), while only 16.5% of participants held an associate or bachelor degree. Participants' occupations were diverse, with farmers comprising the largest group (32.1%), followed by private sector employees (21.1%), freelancers (18.3%), government officers (12.8%), pensioners (8.3%), manual laborers (6.4%), and students (0.9%). In terms of living standards, 61.5% of participants reported living under standard conditions, 22.9% under high living conditions, and 15.6% under low living conditions. Comprehensive demographic data across the two community settings are presented in Table 1.

Description of PCA and factor analysis

In Tan An City, two distinct participant discourses (F1 and F2) were identified among the 60 participants (Figure 3). These two factors collectively explained 63.3% of the total variance, with eigenvalues for both factors exceeding 2. The analysis revealed that 31 participants aligned with discourse F1 and 29 with discourse F2. The proportion of explained variance for F1 and F2 was 34.1% and 29.2%, respectively. Composite reliability for both discourses exceeded 99.0%. Bootstrapping results indicated high stability for both factors, with Factor Stability Indices (FSI) of 1.39 for each, suggesting these results are robust and replicable across different samples.

In Duc Hue District, PCA identified three discourses (F1, F2, and F3) among the 49 participants (Figure 3), accounting for a cumulative variance of 61.1%. Each factor had eigenvalues >2. The discourses included 22, 14, and 4 participants, respectively. Nine participants were excluded from discourse assignment due to falling below the 5% threshold set for minimum group size. The explained variance for discourses F1, F2, and F3 was 27.4%, 22.4%, and 11.3%, respectively, with corresponding composite reliability scores of 99%, 98%, and 94%. Bootstrapping results confirmed high stability for all three factors, with FSIs of 1.60, 1.60, and 2.17, respectively.

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Table 1: Characteristics of study participants in 2two different community settings.

Characteristics	Tan An city (n = 60) (%)	Duc Hue district (n = 49) (%)	Total (n = 109) (%)
Age (median, IQR)	55 [45-59]	48 [36-54]	51 [41-57]
Gender (%)			
Male	35 (58.3)	28 (57.1)	63 (57.8)
Female	25 (41.7)	21 (42.9)	46 (42.2)
Education status (%)			
Primary school	1 (1.7)	7 (14.3)	8 (7.3)
Secondary school	23 (38.3)	21 (42.9)	44 (40.4)
High school	28 (46.7)	11 (22.4)	39 (35.8)
Associate/Bachelor degree	8 (13.3)	10 (20.4)	18 (16.5)
Occupation (%)			
Students	0 (0.0)	1 (2.0)	1 (0.9)
Farmers	10 (16.7)	25 (51.0)	35 (32.1)
Government officers	10 (16.7)	4 (8.2)	14 (12.8)
Private officers	16 (31.7)	7 (14.3)	23 (21.1)
Manual labors	6 (10.0)	1 (2.0)	7 (6.4)
Freelancers	12 (20.0)	8 (16.3)	20 (18.3)
Pensioners	6 (10.0)	3 (6.1)	9 (8.3)
Living condition (%)			
Low	5 (8.3)	12 (24.5)	17 (15.6)
Standard	35 (58.3)	32 (65.3)	67 (61.5)
High	20 (33.3)	5 (10.2)	25 (22.9)

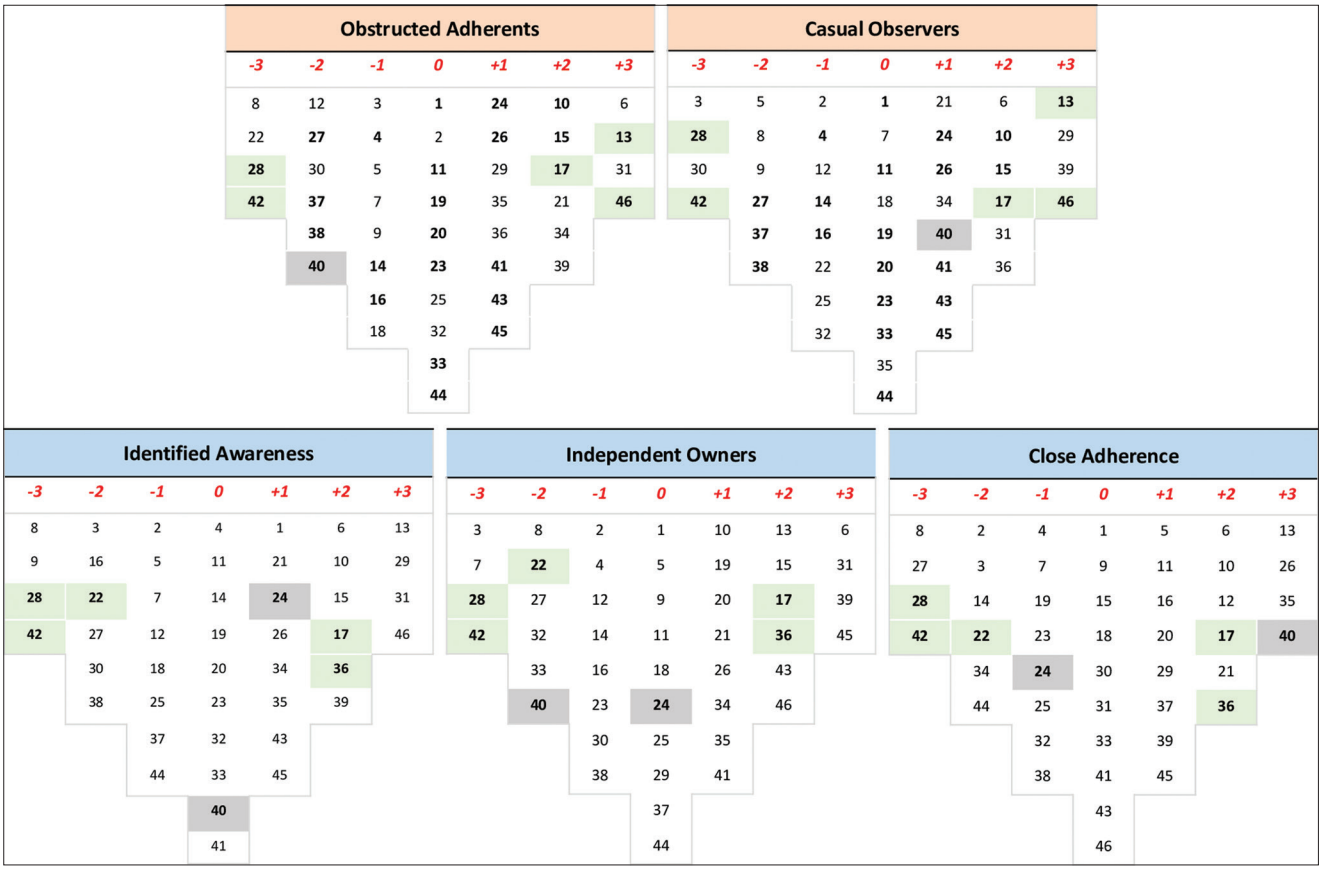

Figure 3: Discourses identified from urban (Two on top) and rural (Three below) community settings.

Description of participant discourses

Urban Tan An City – discourse F1: "Obstructed adherents"

This discourse includes 31 participants who demonstrated basic knowledge of rabies and expressed a strong commitment to rabies prevention and control. However, they identified significant barriers to action. Although the cost of vaccination was not perceived as prohibitive (stat. 46, score −3), the main obstacles cited were limited vaccine accessibility (stat. 31, score +3; stat. 17, score +2) and insufficient veterinary support (stat. 39, score +2). Participants recognized the

importance of annual rabies vaccination (stat. 6, score +3) and rejected traditional remedies for dog bites (stat. 13, score +3). They also strongly disagreed with disinfecting dog scratches using only alcohol or iodine (stat. 8, score −3). Notably, they believed that stray dogs posed no threat and opposed their capture and culling as a rabies control measure (stat. 28, score −3).

Urban Tan An City – discourse F2: "Casual observers"

Comprising 29 participants, this group acknowledged rabies but did not actively engage in prevention measures, perceiving their personal risk to be low. They were confident that rabies did not pose a threat to their families (stat. 46, score +3). Their reluctance to vaccinate was attributed to aggressive pet behavior and lack of veterinary support (stat. 29, score +3; stat. 39, score +3), rather than cost concerns (stat. 42, score −3). Participants recognized rabies as a fatal, transmissible disease (stat. 5, score −2) and rejected traditional medicine for rabies treatment (stat. 13, score +3). Their decisions regarding PEP were influenced by the vaccination status and clinical signs of the biting dog (stat. 3, score −3).

Rural Duc Hue District – discourse F1: "Identified awareness"

This discourse group includes 22 participants who were knowledgeable about rabies prevention but whose decision to vaccinate pets was influenced by external constraints. They acknowledged the health risks of rabies (stat. 8, score −3; and stat. 9, score −3) and emphasized the role of vaccination in both animal and human protection (stat. 6, score +2; stat. 31, score +3; stat. 16, score −2; and stat. 27, score −2). They also recognized that the cost of PEP was higher than that of preventive vaccination (stat. 46, score +3; stat. 42, score −3). However, the accessibility of veterinary and healthcare services played a critical role in their decision to vaccinate (stat. 31, score +3; and stat. 17, score +2).

Rural Duc Hue District – discourse F2: "Independent owners"

This group of 14 participants acknowledged the essential role of animal vaccination in preventing human rabies (stat. 6, score +3). They understood that PEP for humans was more expensive than preventive pet vaccination. Despite limitations in vaccine availability and veterinary services (stat. 31, score +3; stat. 17, score +2; and stat. 39, score +3), they ensured that their pets were vaccinated. Their response to dog bites was guided by personal assessment of wounds and the behavior of the biting dog, rather than exclusive reliance on medical advice (stat. 7, score −3; stat. 22, score −2).

Rural Duc Hue District – discourse F3: "Close adherence"

This discourse, comprising four participants, demonstrated a highly proactive approach to rabies prevention. Members strongly supported annual vaccination of animals (stat. 35, score +3; and stat. 6, score +2). Regardless of the severity of dog bites or scratches, they sought prompt medical consultation (stat. 40, score +3) and recognized rabies as untreatable (stat. 13, score +3). They favored community-level propaganda campaigns for rabies control (stat. 26, score +3) and opposed the culling of stray dogs (stat. 28, score −3). Vaccination cost was not considered a barrier (stat. 42, score −3).

Consensus and distinguishing statements from Q-sorting analysis

Consensus across participants from both settings was observed on key issues related to rabies treatment, cost, and prevention. Most agreed that rabies is untreatable (stat. 13, score +3) and that vaccination cost does not constitute a significant barrier (stat. 46, score +3; and stat. 42, score −3). In addition, there was unanimous opposition to culling stray dogs as a control strategy (stat. 28, score −3). Although vaccination was widely accepted as the primary control measure, all groups agreed that limited access to vaccination services remained the principal barrier (stat. 17, score +2).

Divergent views were observed for statements 24 and 40. In statement 24 – asserting that pet owners need not be vaccinated to prevent rabies – the "Identified Awareness" group agreed (score +1), the "Close Adherence" group disagreed (score −1), and the "Independent Owners" remained neutral (score 0). For statement 40 – proposing that the nearest medical center should be the first recourse following a dog bite – participants in the "Close Adherence" and "Casual Observers" groups agreed (scores +3 and +1, respectively), while "Obstructed Adherents" and "Independent Owners" disagreed (both scored −2). Follow-up interviews revealed that the latter two groups preferred to observe the dog's behavior and self-treat the wound before seeking professional care.

Socio-economic factors associated with awareness of rabies prevention and control

A detailed overview of the socio-economic variables associated with the various discourses in both community settings is presented in Table 2. Among these variables, a statistically significant association was found only between educational status and discourse membership in Duc Hue District ($p = 0.017$). Participants in discourse F2 ("Independent Owners") generally had higher educational attainment, with 7 out of 14 holding associate or bachelor degrees. Conversely, in discourse F1 ("Identified Awareness"), 13 of 22 participants had attained no more than secondary school education.

DISCUSSION

The national rabies prevention and control program of the Vietnamese Government (2022–2030) aims to eliminate rabies-related human fatalities and control rabies among dogs and cats by 2030 [15]. Achieving this goal requires a thorough understanding

Table 2. Socio-economic factors associated with different discourses among study participants

Characteristics	Tan An City (n = 60) (100%)			Duc Hue District (n = 49) (100%)				
	F1 (n = 31) (51.7)	F2 (n = 29) (48.3)	Proportion test (p-value)	F1 (n = 22) (44.9)	F2 (n = 14) (28.6)	F3 (n = 4) (8.2)	Other (n = 9) (18.4)	Proportion test (p-value)
Age								
≤ median age*	18 (30.0)	13 (21.7)	0.443	8 (16.3)	8 (16.3)	2 (4.1)	6 (12.2)	0.406
> median age	13 (21.7)	16 (26.7)		14 (28.6)	6 (12.2)	2 (4.1)	3 (6.1)	
Gender								
Male	19 (31.7)	16 (26.7)	0.827	12 (24.5)	7 (14.3)	2 (4.1)	7 (14.3)	0.567
Female	12 (20.0)	13 (21.7)		10 (20.4)	7 (14.3)	2 (4.1)	2 (4.1)	
Education status								
Primary school	1 (1.7)	-	0.051	5 (10.2)	1 (2.0)	-	1 (2.0)	0.017
Secondary school	16 (26.7)	7 (11.7)		13 (%)	4 (8.2)	2 (4.1)	2 (4.1)	
High school	12 (20.0)	16 (26.7)		3 (6.1)	2 (4.1)	1 (2.0)	5 (10.2)	
Associate/Bachelor degree	2 (3.3)	6 (10.0)		1 (2.0)	7 (14.3)	1 (2.0)	1 (2.0)	
Occupation								
Students	-	-	0.366	-	-	-	1 (2.0)	0.065
Farmers	4 (6.7)	6 (10.0)		14 (28.6)	3 (6.1)	3 (6.1)	5 (10.2)	
Government officers	3 (5.0)	7 (11.7)		-	3 (6.1)	-	1 (2.0)	
Private officers	10 (16.7)	6 (10.0)		3 (6.1)	3 (6.1)	-	1 (2.0)	
Manual labors	4 (6.7)	2 (3.3)		-	-	1 (2.0)	-	
Freelancers	8 (13.3)	4 (6.7)		4 (8.2)	4 (8.2)	-	-	
Pensioners	2 (3.3)	4 (6.7)		1 (2.0)	1 (2.0)	-	1 (2.0)	
Living condition								
Low	1 (1.7)	4 (6.7)	0.333	6 (12.2)	2 (4.1)	2 (4.1)	2 (4.1)	0.170
Standard	20 (33.3)	15 (25.0)		11 (22.4)	12 (24.5)	2 (4.1)	7 (14.3)	
High	10 (16.7)	10 (16.7)		5 (10.2)	-	-	-	

*Median age of participants in Tan An City iswas 55 years, and in Duc Hue District iswas 48 years.

of the awareness, perceptions, and socio-economic factors that influence pet owners' compliance with vaccination programs. While previous studies have reported low vaccination coverage, the present study provides novel evidence linking these low rates to specific socio-economic and infrastructural barriers unique to Long An Province, Vietnam.

The Health Belief Model [26] offers a theoretical lens to interpret the behavioral dynamics observed in this study. Although most participants recognized that untreated rabies is nearly always fatal, the degree of perceived susceptibility varied among groups. Participants with higher education levels tended to assess the severity of bite wounds before seeking medical care, whereas those with lower education levels were more likely to pursue immediate treatment – highlighting differing risk perception strategies. Although the benefits of vaccination were widely acknowledged and preferred over other control strategies, such as stray dog management, the primary barriers identified were poor awareness of vaccine accessibility and limited veterinary support, rather than cost constraints. Furthermore, no significant differences in vaccination-seeking behavior were observed between urban and rural participants, indicating that geographic location was not a principal determinant in this context. These findings underscore the critical role of cognitive factors in shaping vaccination decisions and suggest that improving access to accurate information could substantially increase compliance.

Participants' understanding of the fatal nature of rabies aligns with findings from Tanzania and Sri Lanka [27, 28], but contrasts with data from Rwanda [29]. Unlike previous research by Tandon *et al*. [30] in India, which reported that urban residents possessed greater knowledge and more favorable attitudes than rural residents, our findings indicate no such disparity between the two settings. Moreover, in contrast to recent studies from Bhutan, Morocco, and Pakistan – which highlighted misconceptions such as using antibiotics, wound dressing, or consulting traditional healers as prevention strategies [31–33] – our study demonstrated generally accurate attitudes regarding rabies prevention. Notably, the divergence in first aid and healthcare-seeking behavior based on educational attainment in our study mirrors previous findings from Nepal [34].

Both communities – Tan An City and Duc Hue District – exhibited increased public awareness of rabies vaccination, likely influenced by targeted action programs implemented in Long An Province, a known rabies hotspot in the Mekong Delta. In recent years, local authorities have intensified outreach and awareness initiatives in collaboration with the national rabies prevention program. In addition, the COVID-19 pandemic may have contributed to greater public consciousness about the importance of vaccination in controlling infectious diseases [35]. A collaborative initiative between Long An Province and a university in southern Vietnam has further strengthened outreach

by deploying veterinary student volunteers to assist in vaccination campaigns and public education. These efforts have helped promote preventive behaviors not only for rabies but also for other zoonotic diseases [36].

Our findings also indicate that the main barrier to pet vaccination is not cost, but rather the lack of information about where to obtain vaccines and insufficient veterinary support. A parallel study by Yoak *et al*. [37] in Ethiopia similarly identified inadequate awareness of the importance and accessibility of rabies vaccines as major impediments to successful vaccination campaigns. Barbosa Costa *et al*. [38] reinforce the view that cost is not a substantial deterrent, which is consistent with other research examining dog owners' willingness to pay for vaccination and their willingness to travel for access. Participants in our study understood that the financial burden of PEP is far greater than that of preventive vaccination. Indeed, one report estimated that the cost of rabies control in Vietnam from 2017 to 2021 totaled 3,863 billion VND, with 99.4% of expenditures directed toward PEP – primarily funded by the private sector [12].

The implications of these findings are significant. They can inform evidence-based policy development aimed at improving equitable access to veterinary services, particularly in underserved areas. Many pet owners reported being unaware of where to obtain vaccinations and emphasized the need for veterinary assistance during the vaccination process. We recommend that future rabies vaccination campaigns be coordinated at the regional level under government supervision, with vaccine distribution supported by veterinary professionals. Pet owners should be responsible for covering veterinary labor and vaccine costs. This approach could improve vaccine coverage, increase compliance, enhance rabies control efforts, and contribute to One Health goals – bringing Vietnam closer to its target of disease elimination by 2030.

No significant differences were found in rabies-related knowledge and attitudes between the two communities studied. This consistency likely reflects similar demographic and socio-economic conditions across both areas. However, a more complex relationship between education level and rabies prevention behavior was evident. Participants with higher education demonstrated a more accurate understanding of rabies transmission and prevention, highlighting the need for tailored educational programs to address gaps among less-educated groups. For example, some individuals relied on their own observations of the biting dog's behavior rather than seeking immediate medical attention. Even among well-educated individuals who trust their judgment, it is critical to emphasize the necessity of professional medical evaluation following potential rabies exposure. Promoting a balanced approach that integrates personal awareness with expert guidance will be essential for effective rabies control.

CONCLUSION

This study provides novel insights into the perceptions and behavioral drivers influencing rabies prevention and control among pet owners in two demographically distinct settings – urban Tan An City and rural Duc Hue District – within Long An Province, Vietnam. Using the Q-sorting methodology, we identified five distinct discourses reflecting varying degrees of awareness, risk perception, and structural barriers related to rabies vaccination. Participants across both communities generally acknowledged the fatal nature of rabies and recognized the importance of animal vaccination as a preventive measure. Importantly, vaccine cost was not widely perceived as a deterrent; instead, key barriers included limited access to vaccination services, insufficient veterinary support, and a lack of awareness about where and how to obtain these services. Educational attainment was a significant factor shaping health-seeking behaviors, with more educated individuals displaying greater confidence in assessing bite risks and navigating treatment options.

A major strength of this study lies in its application of the Q-sorting technique, which enabled the identification of latent discourse patterns not easily captured by conventional KAP surveys. This allowed for a more nuanced understanding of community-level perspectives and underscored the heterogeneity in beliefs even within the same geographic region. The study also benefits from its dual focus on both rural and urban populations, contributing to a more comprehensive picture of rabies prevention challenges in Vietnam.

However, several limitations should be noted. First, although the Q-sorting statements were validated by field experts, they were not informed by an initial qualitative phase, which may have limited their cultural specificity and comprehensiveness. Second, the study's findings are geographically restricted to one province and may not reflect the broader context of rabies prevention in other regions of Vietnam with different socio-economic profiles. Third, critical service-related limitations – such as the irregular availability of vaccines, poorly coordinated mass vaccination campaigns, and the understaffing of veterinary services – may have further influenced pet owner compliance but were not systematically measured. In many areas, rabies vaccination campaigns are sporadic and inadequately promoted, leading to missed opportunities for outreach. Moreover, the lack of follow-up support from veterinary staff during community vaccination drives undermines public confidence and continuity of practice. These logistical deficiencies, coupled with the absence of ongoing education and awareness efforts, contribute to persistent gaps in prevention.

To address these issues, a multifaceted strategy is required. Future interventions should prioritize strengthening the infrastructure for rabies vaccine distribution and veterinary services, particularly in remote and underserved communities. Education campaigns tailored to varying literacy levels and delivered through community-based platforms, schools, and local media could significantly improve public understanding and engagement. Integrating rabies education into existing One Health programs and training local volunteers or veterinary students to assist in vaccination drives may further enhance outreach and sustainability. Future research should incorporate a mixed-methods design across multiple provinces to capture a broader range of cultural, logistical, and systemic factors influencing rabies prevention.

In conclusion, rabies prevention in Vietnam must extend beyond biomedical solutions to include community-specific, socio-behavioral interventions that address both awareness and accessibility. The evidence generated by this study underscores the need for contextually informed public health planning, enhanced veterinary infrastructure, and robust educational campaigns. These efforts are essential not only for improving vaccine uptake but also for supporting Vietnam's national objective of eliminating rabies-related human deaths by 2030 and contributing to the broader global One Health agenda.

AUTHORS' CONTRIBUTIONS

DBT, DHP, and PP: Conceived and designed the study. TPT, DNTT, MDT, and TNTP: Conducted field surveys and designed and aided data collection. TPT, DHP, DNTT, DBT, and PP: Data analysis and drafted the manuscript. MDT and TNTP: Interpreted the results. DHP, DBT, TPT, MDT, TNTP, and PP: Edited and revised the manuscript. All authors have read and approved the manuscript.

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COMPETING INTERESTS

The authors declare that they have no competing interests.

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