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PAMJ One Health

Research

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Received: 06 Nov 2024 - **Accepted:** 23 Feb 2025 - **Published:** 28 Mar 2025

Keywords: Rabies, dog vaccination, household practices, awareness, vaccination challenges

Cite this article: Fanice Kerubo Obara et al. Assessment of household head practices for the control of dog-mediated rabies in South Mugirango sub-County. PAMJ-One Health. 2025;16(9). 10.11604/pamj-oh.2025.16.9.45843

Available online at: https://www.one-health.panafrican-med-journal.com/content/article/16/9/full

Assessment of household head practices for the control of dog-mediated rabies in South Mugirango sub-County

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Abstract

Introduction: *rabies remains a critical public health issue in South Mugirango sub-County, Kenya, where dog-mediated rabies persists despite ongoing control efforts. This study evaluates household head practices related to dog-mediated rabies control and identifies key barriers to effective dog vaccination.* ***Methods:*** *a cross-sectional mixed-methods study was conducted, involving 422 household heads and 22 key informants. Data were collected through usage of structured questionnaires for the quantitative survey and key informant interviews for qualitative insights. Descriptive and inferential statistics, including chi-square tests, were employed to analyze data on vaccination knowledge, practices, and associated challenges.* ***Results:*** *the study found high awareness of rabies among residents, with 72.7% of key informants reporting general knowledge of the disease. However, adherence to dog vaccination was low, with 63.6% of key informants noting infrequent vaccination practices. Key barriers identified included low publicity (27.3%), inadequate funding (13.6%), and logistical issues such as weather conditions (11.2%) and poor infrastructure (7.8%). The role of the household breadwinner significantly influenced vaccination knowledge (chi-square value = 5.4, p-value = 0.029), with fathers being less informed than mothers.* ***Conclusion:*** *despite high awareness of rabies, practical vaccination adherence is hindered by several challenges, including limited public awareness, insufficient funding and infrastructural constraints. Addressing these barriers through targeted educational campaigns, improved funding and enhanced infrastructure could significantly boost vaccination rates and control rabies more effectively in South Mugirango sub-County.*

Introduction

Rabies remains a significant public health challenge in many countries, including Kenya, where it continues to contribute to a considerable burden of disease [1-3]. The disease is primarily transmitted through dog bites. It is fatal once clinical symptoms appear, making prevention and early intervention critical [4]. In Kenya, despite various control measures and vaccination efforts, rabies persists as a major concern, particularly in rural and underserved areas [1,5]. South Mugirango sub-County in Kisii County, Kenya a region characterized by a high density of dogs and limited access to veterinary services, exemplifies the ongoing struggle against this preventable disease [6].

In Kakamega County, Kenya previous studies have highlighted the substantial gap in dog vaccination rates, with only 35% of households having vaccinated their dogs within the past 12 months [7,8]. This low coverage is indicative of broader challenges in rabies control across Kenya. The relationship between knowledge of rabies and the practice of dog vaccination underscores the critical need for targeted educational and intervention strategies [1,9,10]. Despite these findings, there remains a lack of specific data from South Mugirango sub-County, a gap that this study aims to address.

The prevention and management of rabies involve a combination of primary and secondary measures. Primary prevention focuses on the vaccination of dogs, public awareness, and responsible dog ownership, particularly in endemic areas where cultural practices may impact intervention strategies [11-13]. The success of vaccination programs, as demonstrated in Latin America, highlights the importance of achieving high immunization coverage to break the transmission cycle [14]. However, recent increases in rabies cases in parts of Africa and Asia suggest a resurgence of the disease, emphasizing the need for continued and enhanced prevention efforts [2].

Secondary prevention through post-exposure prophylaxis (PEP) is crucial for those who have been bitten by potentially rabid animals [15]. Effective wound care and timely administration of

rabies vaccines and immunoglobulins can prevent the onset of clinical disease, which otherwise remains almost invariably fatal [14-16]. Despite the availability of preventive measures, the implementation of these practices in low- and middle- income countries faces numerous challenges, including inadequate funding, low public awareness and logistical constraints [1,17,18].

Studies have shown that effective rabies control is often hindered by factors such as inadequate awareness, limited access to veterinary services, and cultural beliefs [19,20]. In South Mugirango, the situation is compounded by economic constraints and varying levels of knowledge about rabies and its prevention [6]. To address these challenges, it is imperative to assess the current practices of household heads concerning dog management, vaccination, and response to dog bites.

Understanding the factors influencing household practices towards dog-mediated rabies control is essential for designing effective public health interventions [21,22]. Factors such as gender, age, education level, occupation, socioeconomic status, and cultural beliefs have been shown to affect rabies awareness and vaccination practices [23-26]. In South Mugirango sub-County, these factors may interact in unique ways, influencing both the level of public awareness and adherence to rabies vaccination practices.

This study seeks to fill the knowledge gap by assessing household head (HH) practices related to the control of dog-mediated rabies in South Mugirango sub-County. The findings will provide valuable insights into current practices, identify barriers to effective rabies control, and inform the development of targeted public health interventions. By addressing these gaps, the study aims to contribute to the reduction of rabies incidence, enhance the overall effectiveness of rabies prevention, and control strategies in the region.

Methods

Study site

This study was conducted in South Mugirango sub-County, located in Kisii County, Kenya. Geographically, it is situated at coordinates 0°49'60" S and 34°39'0" E (in Degrees Minutes Seconds) or -0.833333 and 34.65 (in decimal degrees) [27]. South Mugirango sub-County is bordered by Migori to the south, Trans Mara to the north, Bomachoge Borabu and Chache to the east and Bonchari to the west. The area has an estimated population of 196,768 as per the 2015 census and encompasses six administrative wards: Tabaka, Boikanga, Borabu/Chitago, Moticho, Getenga and Bogetenga [27-29]. It experiences an average annual rainfall of 1608 mm and temperatures ranging from 19.9°C to 20.3°C, with an altitude of 1598 meters above sea level. The primary economic activities include mining Tabaka soap stones and small-scale farming of crops such as maize and beans [27,30].

Study design

A cross-sectional study design was used. A mixed-methods approach was utilized, incorporating both quantitative and qualitative data collection methods. The study employed a descriptive cross-sectional survey for the quantitative component, utilizing a structured questionnaire to interview 422 household heads. For the qualitative component, key informant interviews were conducted with professionals from the Ministry of Health and the Ministry of Agriculture and Livestock Development and Marketing. The quantitative survey targeted household heads residing in South Mugirango sub-County. The qualitative component focused on 22 key informants who have specialized knowledge in rabies prevention and control, including public health officers and veterinary officers in the sub-county.

Inclusion criteria

Household heads with at least one dog who consented to participate. Key informants from the sub-county Ministry of Health and veterinary department with specialized knowledge on rabies control, who voluntarily agreed to participate.

Exclusion criteria

Household heads who did not consent or did not own a dog. Individuals without relevant expertise in rabies prevention and control or who declined to participate.

Sample size determination

A sample size of 422 households was computed using Fisher's equation (fisher *et al.* [31]) as shown below:

$$n = \frac{Z^2 p \, x \, q}{d^2}$$

Where, n = is the desired sample size (when the study target population is over 10,000). Z is the standard normal deviate= 1.96. (Corresponding to 95% Confidence Interval). p, proportion of the target population estimated to have the desired characteristics.

q = 1.0 - p

d= degree of accuracy required usually set as 0.05.

The proportion of HHs with dogs in South Mugirango sub-County is 29,300. In the absence of a reasonable estimate Fisher *et al.* [31] recommends a p of 50% (0.50).

p= 50/100 or 0.50

q = 1 - p = 1- 0.50 = 0.50

Hence, the desired sample size (n) was determined as follows.

$$n = \frac{1.96^2 \, x \, 0.050 \, x \, 0.50}{0.05^2}$$

n= 384.16 which is approximately 384 HHs. To account for non-responses and increase representativeness, 10% was added: 10% of 384= 38.4. Thus, the final sample size was: 384 + 38.4= 422 households.

For the qualitative component, 22 key informants were purposively sampled.

Sampling procedures and data collection tools

Sampling for the study was carried out in two stages. For the quantitative survey, proportionate sampling was utilized to determine the number of household heads to be sampled from each administrative ward in South Mugirango sub-County. This approach ensured that the sample represented the diverse wards within the sub-county proportionally. Subsequently, households were randomly selected from these wards, enhancing the representativeness of the sample. In the qualitative survey, key informants were purposively chosen based on their specialized knowledge and experience in rabies control, including public health officers and veterinary professionals. This targeted approach allowed for in-depth exploration of expert insights on rabies prevention and control practices.

Data collection tools included a pretested questionnaire for the quantitative survey and a key informant interview guide for the qualitative survey. The questionnaire was designed to collect comprehensive data on socio-demographic characteristics, awareness of rabies, adherence to dog immunization, and household practices regarding rabies control. Prior to the actual data collection, the questionnaire was pretested in a similar socio-demographic area, Bonchari sub-County, to ensure clarity and reliability. Reliability was assessed using Cronbach's alpha [31]. The qualitative data collection involved interviews with key informants using a structured guide, which facilitated the gathering of detailed and nuanced

information on rabies control practices. Village elders in identifying households with dogs, while trained research assistants conducted the interviews assisted the data collection process for the quantitative survey. For the qualitative component, interviews continued until thematic saturation was achieved, ensuring comprehensive coverage of the topic.

Data management and analysis

Ethical considerations

Ethical approval was obtained from the University of Eastern Africa Baraton (Ref. N°: UEAB/09/01/2019) and the National Commission for Science, Technology, and Innovation (NACOSTI) (Ref. N° NACOSTI/P/19/86707/29063). Informed consent was obtained from all participants, and confidentiality was assured. Village elders facilitated household access, and participants were assured of anonymity.

Data analysis and presentation

Quantitative data were analyzed using appropriate statistical techniques to provide a robust interpretation of the findings. The data were first entered, cleaned, and analyzed using SPSS Version 20 statistical software. Descriptive statistics were employed to summarize household practices characteristics and rabies control practices. Frequency distributions were calculated where appropriate, providing a clear understanding of the data. Chi-square analysis was conducted to identify associations between household practices and rabies vaccination with statistical significance set at $p < 0.05$, indicating a confidence level of 95%. For the qualitative data collection, in-depth key informant interviews were conducted to explore community perceptions and practices regarding rabies control. The interviews were semi-structured, which allowed for flexibility while maintaining focus on key research questions. This format ensured that the interviews provided both standardized responses and the opportunity to gather open-ended insights.

Results

The data on adherence to dog immunization in South Mugirango sub-County reveals insights into how various demographic factors correlate with vaccination practices. The chi-square test was used to examine associations between knowledge to immunization practices of dogs and several variables, including gender and household breadwinner. The results are in Table 1 below.

The chi-square test results in Table 1 show a chi-square value of 16.5 with a p-value of 0.285. The chi-square test results for household breadwinner reveal a chi-square value of 5.4 with a p-value of 0.029. Households where the father is the primary breadwinner show a non-adherence rate of 62.8%, while those where the mother is the primary breadwinner show a non-adherence rate of 17.3%.

Dog mediated rabies management strategies by households

The study assessed the management strategies employed by the households when a rabies-infected dog bites a member and the data obtained is presented in Figure 1. Most of household heads 360/422 (85.3%) took household members bitten by dogs to nearby health facility, 44/422 (10.4%) of the household heads took their household members bitten by dogs to traditional healers, 5/422 (1.2%) provided painkillers and let the wound to heal by itself. However, 13/422 (3.1%) of the household heads did not respond.

Knowledge and practices relating to rabies among residents of South Mugirango

A key informant interview was conducted to assess the level of awareness, level of adherence, challenges associated with adherence to immunization of dogs and actions taken in case of dog bites. Four thematic areas emerged, and these are: awareness of rabies, adherence to immunization of dogs, challenges with dog

immunization and proper seeking of medical assistance in case of dog bites.

A high level of awareness was observed based on the findings (Figure 2) from the key informants involved in this study. A majority (72.7%-16/22) of the key informant interview (KII) reported that people in South Mugirango were aware of rabies. They reported that the people knew that a bite from an infected dog could cause rabies.

The key informants also did indicate that the level of adherence to dog immunization was low with 14/22 (63.6%) of the key informants agreeing that people of South Mugirango hardly vaccinate their dogs (Figure 3).

Furthermore 6/22 (27.3%) of the KII agreed that the main challenge associated with dog immunization is low publicity on dog immunization, 3/22 (13.6%) KII agreed that inadequate funding on dog vaccination campaigns is a key challenge while another 3/22 KII agreed that unpredictable weather conditions and poor infrastructure to be key challenges associated with low level of adherence to dog immunization (Figure 4).

When asked about the actions taken in case of dog bites, 19 out of 22 key informants agreed that people are taken to the hospital when bitten by dogs (86,36%). Three (3) out of 22 informants agreed that dog bite victims are only given first aid (13,64%).

Discussion

The objective of this study was to assess the factors influencing adherence to dog immunization against rabies among household heads in South Mugirango sub-County, Kisii County - Kenya. Specifically, the study aimed to determine whether socio-demographic factors, such as gender and the role of the household breadwinner, were associated with adherence to dog vaccination practices. The chi-square analysis results indicate no significant difference in knowledge about dog immunization between male and female household heads (chi-square = 16.5, p= 0.285). This suggests that gender does not significantly influence the level of awareness or knowledge regarding dog vaccination in South Mugirango sub-County. Despite both genders showing some degree of awareness about dog immunization, the minimal impact of gender on knowledge implies that other factors, rather than gender, might be more critical in determining vaccination practices. Similar, findings were reported by Subedi *et al.* [2,32,33], who noted that community knowledge and practices towards rabies prevention were not significantly influenced by gender. This aligns with our results, indicating that interventions targeting rabies awareness and vaccination should not be gender-specific but should instead address broader community needs. Furthermore, studies like those by Iddi *et al.* [34] and Mbaipago *et al.* [35] highlight that various demographic factors, including marital status, occupation and educational level, play a more substantial role in influencing practices related to rabies and dog immunization.

The analysis of household breadwinner status shows a significant association with knowledge about dog immunization (chi-square= 5.4, p= 0.029). Households where the father is the primary breadwinner exhibit a higher proportion of non-knowledge (62.8%) compared to those where the mother is the primary breadwinner (17.3%). This suggests that the role of the household breadwinner may influence the level of awareness and knowledge about dog vaccination. Fathers, as primary breadwinners in most African communities, might face different challenges or prioritize health education differently compared to mothers, which could affect their knowledge and subsequent vaccination practices. This finding can be contextualized within broader gender and role-based research. Chesley and Flood [36] highlight how gender roles and time availability influence domestic work and childcare responsibilities. While their study focuses on domestic work, the broader implications for gender roles suggest that

traditional expectations of fathers as primary breadwinners might affect their engagement in health-related education and practices, such as dog vaccination. The pattern observed in our study reflects a similar dynamic where gender roles potentially influence knowledge and practices regarding dog immunization. Additionally, Raji *et al.* [37] report that in rural communities in Nigeria, fathers with poor knowledge of routine immunization (RI) often lack formal education, which correlates with lower uptake of immunization. This finding underscores the importance of targeted educational interventions for fathers, particularly in roles that influence household decisions. Their educational background might similarly influence the poor knowledge observed among fathers in our study and the prioritization of health education, reflecting the need for increased awareness and education tailored to their specific roles and responsibilities.

The majority of household heads (85.3%) take their family members to a nearby health facility when bitten by a dog. This indicates a strong reliance on formal medical services for managing dog bites, which aligns with recommended practices for rabies prevention. However, a notable minority (10.4%) seek traditional healers, and a small percentage (1.2%) opt for only pain relief without further medical intervention. The fact that 3.1% of respondents did not provide a response may indicate a lack of clarity or awareness about the appropriate actions to take, highlighting a potential area for improved public education on rabies management. These observations are consistent with broader research on rabies prevention and management. Dhakal *et al.* [38] for instance, found that while most respondents in rural Nepal would visit a health facility after a dog bite, a notable percentage also resorted to traditional healers, demonstrating variability in treatment-seeking behavior. Their study underscores the necessity of educating rural populations on effective rabies control practices and the importance of reporting dog bites and unusual animal behavior to local authorities. Ngugi *et al.* [3] further illustrated that appropriate management of dog bites, including timely PEP, is crucial for rabies prevention. Their research in Kenya indicates that improving public health education and encouraging early initiation of PEP can significantly reduce rabies cases. The high reliance on formal medical services observed in our study aligns with the need for timely and appropriate medical care as emphasized by Ngugi *et al.* [3]. Kisaka *et al.* [39] also emphasize the importance of compliance with pre-clinical management guidelines for dog bites, such as immediate washing of wounds and seeking medical care. Their findings highlight factors associated with poor compliance, including lower education levels and lack of awareness, which can contribute to inadequate management of dog bites and potential rabies risk.

According to key informant interviews, there is a high level of awareness about rabies among the residents of South Mugirango, with 72.7% of key informants reporting that people understand the risks associated with dog bites. This high level of awareness is crucial for effective rabies control, as it provides a foundation for encouraging preventive measures such as vaccination. However, despite this awareness, there are varying levels of knowledge and practice related to rabies management in different regions. For example, a study in Limpopo National Park, Mozambique, found that both community households and health practitioners had poor knowledge and practices regarding rabies. Only about 20% of households had good knowledge of rabies, and even fewer had appropriate practices, highlighting significant gaps in understanding and implementation of rabies control measures [3]. Similarly, research conducted in Laikipia County, Kenya, revealed that delays in seeking post-exposure prophylaxis (PEP) and challenges in accessing vaccines contributed to increased incidence of rabies. This situation underscores the need for improved public health infrastructure and access to timely medical care for effective rabies

prevention [39]. In addition, in Ethiopia, a study in Shone Town identified that while there was general awareness of rabies, significant gaps in knowledge about transmission routes and preventive measures remained. The study found that education level was strongly associated with better knowledge about rabies, emphasizing the role of education in improving public understanding and management of rabies [40].

Despite the high awareness, the level of adherence to dog immunization is reported to be low. Key informants indicate that 63.6% of the population does not regularly vaccinate their dogs. This discrepancy between awareness and practice suggests that while people may understand the importance of vaccination, barriers exist that prevent consistent adherence. These barriers could include cost, accessibility, or lack of immediate perceived need. In regions with high rabies awareness but low vaccination rates, cost and accessibility frequently emerge as significant barriers. For instance, in Mozambique, the Limpopo National Park area, both community members and health practitioners exhibited poor knowledge and practices concerning rabies control [3]. This gap suggests that even when awareness is high, practical challenges such as the cost of vaccines and access to veterinary services can impede the implementation of preventive measures. Similar issues are evident in rural areas of Kenya, where delays in receiving post-exposure prophylaxis (PEP) reflect the broader challenges of accessing timely medical care [39]. As it is the case in Mozambique and Kenya, in Shone Town, Ethiopia, educational interventions are needed to improve understanding and encourage action towards rabies prevention [40-42].

Key informants identified several challenges to dog immunization, including low publicity (27.3%), inadequate funding (13.6%), and issues related to weather conditions and infrastructure. These factors contribute to the low adherence rates and highlight areas where intervention could improve vaccination coverage. Increased public awareness campaigns, better funding for vaccination programs, and improvements in infrastructure could address these challenges and enhance adherence to immunization. Low publicity can result from a lack of effective communication strategies and insufficient community engagement, which can undermine efforts to promote vaccination and educate dog owners about its importance. Inadequate funding affects the ability to maintain consistent and widespread vaccination efforts, as seen in Tanzania, where high operational costs and a high turnover of the dog population present ongoing challenges [43]. Additionally, weather conditions and infrastructure issues complicate the logistics of vaccine delivery, particularly in remote areas where accessibility is limited. On the other hand, low numbers of KIIs is a clear indication that the study area could be lacking enough work force or low levels in numbers of the health centers. This could in turn affect management strategies especially amongst individuals who could be residing areas far away from the health centers. In rural communities in Mozambique, for instance, poor infrastructure and low levels of knowledge and practice regarding rabies control further highlight the need for better logistical support and education [40].

Enhanced public awareness campaigns can help overcome low publicity by increasing community knowledge and engagement, as demonstrated by the positive reception of the community-based continuous mass dog vaccination (CBC-MDV) approach in Tanzania, which successfully integrated community feedback and involvement [43]. Improved funding for vaccination programs is crucial to support sustained vaccination coverage and operational costs. Additionally, improving infrastructure and logistical support can help mitigate the effects of adverse weather conditions and ensure consistent vaccine delivery. Combining these strategies can enhance adherence to immunization programs and improve overall vaccination coverage, ultimately leading to more effective control of rabies. Most key informants (19 out of 22)

reported that people generally go to the hospital when bitten by dogs, reflecting appropriate actions for managing potential rabies exposure. However, the fact that three informants mentioned only administering first aid underscores the need for further education on the importance of comprehensive medical care following dog bites.

Study limitations

This study has several limitations that should be acknowledged. First, the cross-sectional design limits the ability to establish causality between socio-demographic factors and adherence to dog immunization; it can only identify associations. Second, the reliance on self-reported data may introduce recall bias or social desirability bias, where respondents may underreport non-adherence due to perceived social expectations. Third, the study was geographically confined to South Mugirango sub-County, which may limit the generalizability of the findings to other regions with different socio-economic, cultural, or infrastructural contexts. Additionally, the study did not account for seasonal variations that might influence dog vaccination rates, such as periods of increased rabies awareness due to recent outbreaks. Lastly, potential confounding factors, such as household income levels, access to veterinary services, and previous experiences with rabies, were not thoroughly explored, distances to health facilities and ability of such facilities to contain/keep vaccines safely at low temperatures could have provided a deeper understanding of adherence patterns and vaccines usage. Future research should consider these variables and adopt longitudinal designs to track changes over time and establish causal relationships.

Conclusion

The findings of this study highlight a complex relationship between knowledge, socio-demographic factors, and adherence to dog immunization practices in South Mugirango sub-County, Kisii County. Despite high levels of awareness about rabies and its associated risks, actual adherence to vaccination remains suboptimal. The results underscore that while gender does not significantly influence knowledge about dog immunization, the role of the household breadwinner plays a significant part in adherence levels, with households where fathers are the primary breadwinners showing higher rates of non-adherence compared to those led by mothers. These findings suggest that structural and socio-economic factors within households may shape immunization behavior, potentially linked to decision-making dynamics and prioritization of resources. Addressing these barriers through targeted interventions, such as community education programs, increased accessibility to vaccination services, and engagement with household decision-makers, could significantly enhance rabies prevention efforts. Strengthening awareness campaigns that focus not only on knowledge dissemination but also on encouraging practical adherence is essential to reduce the risk of rabies transmission in the community.

What is known about this topic

- *Rabies is a severe and fatal disease primarily transmitted through dog bites, and its prevention relies on widespread dog vaccination and post-exposure prophylaxis (PEP);*
- *Despite awareness campaigns and vaccination programs, rabies remains endemic in many rural areas of Kenya due to logistical, financial, and infrastructural challenges;*
- *Studies have shown that socio-demographic factors, such as education level and economic status, influence adherence to dog vaccination programs.*

What this study adds

- *This study provides region-specific data from South Mugirango sub-County, highlighting the low adherence to dog vaccination despite high awareness of rabies;*
- *It identifies household breadwinner status as a significant factor, showing that households where fathers are primary earners have higher non-adherence rates to dog vaccination compared to those where mothers are primary earners;*
- *The study highlights key barriers to rabies control, including low publicity, inadequate funding, and poor infrastructure, offering targeted recommendations for improving vaccination coverage.*

Competing interests

The authors declare no competing interests.

Authors' contributions

All authors contributed to this study and have read and agreed to the final manuscript.

Table and figures

Table 1: knowledge on immunization of dogs by gender and household head

Figure 1: action taken when a household member is bitten by a dog

Figure 2: awareness of rabies

Figure 3: adherence to immunization

Figure 4: challenges associated with adherence to immunization of dogs

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Table 1: knowledge on immunization of dogs by gender and household head

Variable	**Knowledge on immunization of dogs**			
	No F (%)	**Yes F (%)**	**Chi-square**	**P value**
Gender				
Male	155 (36.7%%)	34 (8.1%)	16.5	0.285
Female	200 (47.4)	33 (7.8%)		
Household breadwinner				
Father	265 (62.8%%)	56 (13.3%)	5.4	0.029
Mother	73 (17.3%)	11 (2.6%)		
Children over 18 years	17 (4.0%)	0 (0%)		

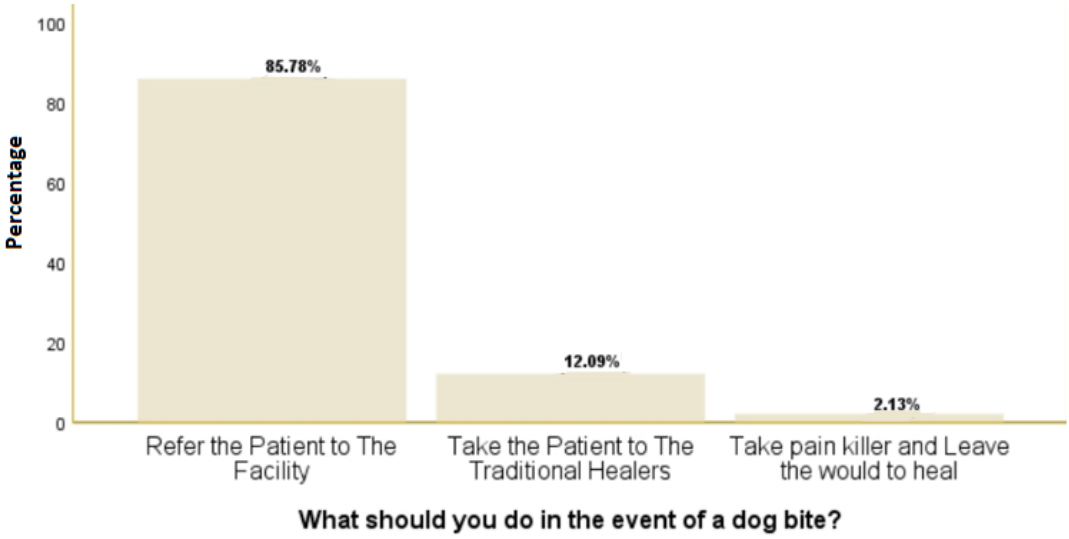

Figure 1: action taken when a household member is bitten by a dog

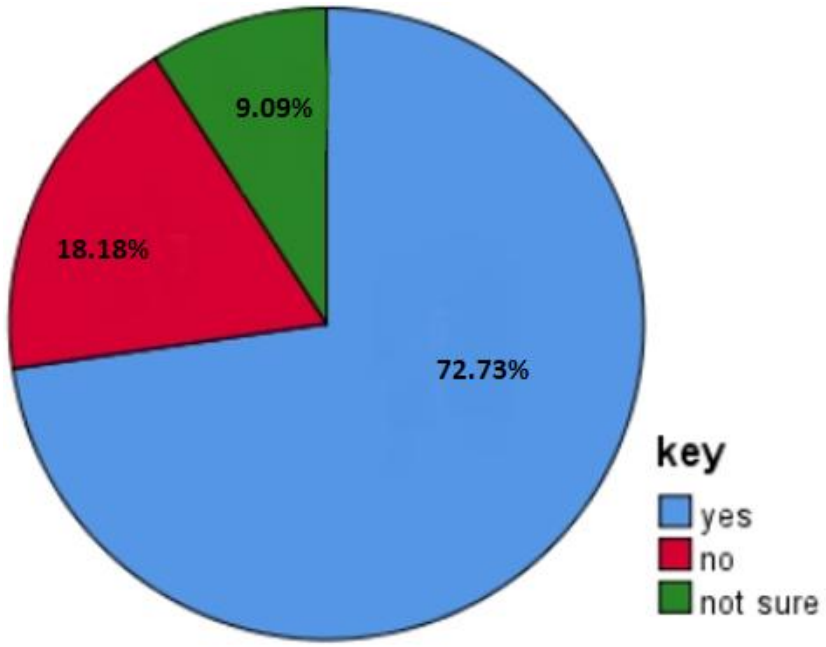

Figure 2: awareness of rabies

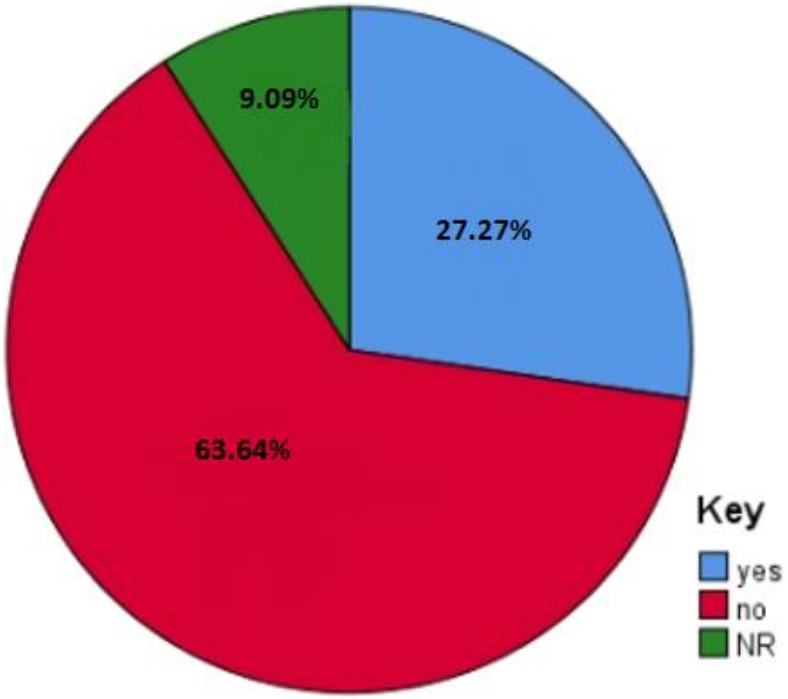

Figure 3: adherence to immunization

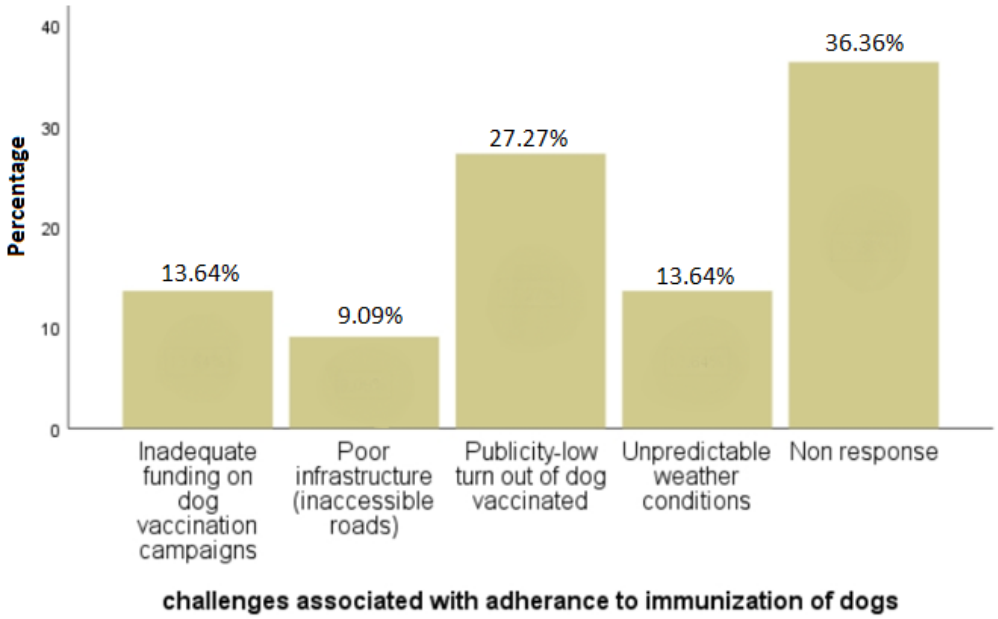

Figure 4: challenges associated with adherence to immunization of dogs