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Knowledge, Attitudes, and Practices of Dog Owners Regarding Dog-Related Diseases in Mvomero and Morogoro Districts, Tanzania

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ABSTRACT

Background: Dogs were the earliest animals domesticated by humans for various purposes, but receive little attention from the community and may be sources of diseases in humans and other animals. In Tanzania, most dogs are Mongrels and are primarily found in rural areas where they receive limited veterinary care. Therefore, the study aimed to assess the knowledge, attitudes, and practices of dog keepers regarding dog management, and their awareness of zoonoses, to develop effective disease prevention and control programs.
Subjects and Method: A cross-sectional study was conducted between October 2017 and January 2018 in the Mvomero and Morogoro districts of Tanzania. The study used a simple random sampling method, whereas a structured questionnaire was administered to 200 dog keepers. Statistical Package for Social Sciences (SPSS) version 20 was used for data analysis. The independent variables were demographic characteristics of dog keepers (age, gender, education, and location), while dependent variables included knowledge of dog management, attitudes toward dogs, and practices.
Results: The study found that 59% of respondents had fair to good knowledge of dog management, though practices were generally poor, with most dog keepers owning dogs for security purposes. While 87% were aware of zoonotic diseases, particularly rabies, vaccination rates were higher in Morogoro than in Mvomero ($p<0.05$). Negative experiences with dogs were reported by 78% of respondents, and attitudes towards dogs were more negative in Mvomero than in Morogoro ($p=0.007$).
Conclusion: The study concludes that dogs in Morogoro are poorly managed, live-in unhygienic conditions, rarely receive veterinary services, and experiences suffering of different kinds, which is contrary to animal welfare principles. Therefore, integrative approaches to raising public awareness about dog management practices in the study areas and other regions of Tanzania are recommended to safeguard the health of both dogs and humans.

Keywords: dog management, zoonotic diseases, knowledge, attitudes, practices

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BACKGROUND

Dogs are the earliest animals to be domesticated by humans. In most countries of Africa, dogs are kept for security, hunting, herding livestock, alert of dangers and occasionally as pets (Whitfield and Smith, 2014). In Tanzania, the majority of domesticated dogs are Mongrels, which are kept mostly in rural areas with poor veterinary attention (Knobel et al., 2008). Some pastoral and agropastoral societies in Tanzania like Maasai, Sukuma, Gogo, Barabaig, and Wambulu keep large groups of dogs for home security and assist in herding livestock. It is also the custom of many people living in urban areas to keep guard dogs (Knobel et al., 2008). Boys around 10 to 15 years old are mostly involved in dog management in most households (Ernest et al., 2013).

In many areas of Tanzania, dogs are seldom protected from diseases, making them potential reservoirs and vectors of pathogens transmissible to humans and livestock (Ernest et al., 2013). Morogoro is one of the regions in Tanzania with a significant number of pastoralists and agropastoralists who own large herds of livestock and dogs. These dogs are often considered part of the family, as it is customary for livestock keepers to own them. In areas where livestock keepers reside at the wildlife–livestock–human interface, dogs frequently interact with wild animals, increasing their risk of infection.

For instance, the Mvomero district contains several wildlife areas, including the Wami Mbiki Wildlife Management Area, Mikumi National Park, and the Wami Sub-basin with its forests and woodlands. These regions serve as interaction points between dogs and wild animals, facilitating the transmission of infectious agents between the wild and domestic environments. Despite this, there have been no studies to assess the management practices of dogs or the awareness of dog keepers on the health of their animals. The purpose of the current study was to evaluate dog keepers' knowledge, attitudes, and practices regarding dog management, as well as their awareness of dog diseases that pose significant public health risks in Mvomero and Morogoro Municipality. This study is crucial because understanding dog keepers' perceptions of dog management practices and their knowledge of zoonotic diseases is an essential step toward developing appropriate disease prevention and control programs for dogs.

SUBJECTS AND METHOD

1. Study Design

A cross-sectional study was carried out to evaluate the knowledge, attitudes, practices, and awareness of dog keepers regarding zoonoses in each study district. The study population comprised all households that keep dogs and all dogs in the Mvomero district and Morogoro Municipality. The inclusion criteria were adult dog keepers (aged 18 years and above), willing to participate in the study, capable of providing information, and accessible during the data collection period. A total of 200 dog keepers participated in the study as respondents to the questionnaire.

2. Population and Sample

This study was conducted in Mvomero district (regarded as a rural area) and Morogoro Municipality (urban area) in Tanzania. Mvomero district was selected because it has a large number of pastoralists and agro-pastoralists who keep many dogs. Mvomero district is found at latitudes 06° 26' S and longitude 37° 32' E (Figure 1). It is administratively divided into 30 wards, and 115 villages and the human population is 312,109 (Tanzania Ministry of Finance, 2013).

Morogoro Municipality was involved in the study for comparison of dogs' husbandry practices between urban versus rural areas. Morogoro Municipality lies at latitude 5.7 to 10 °S and longitude 35.6 to 39.5°E and is situated on the lower slopes of Uluguru Mountain whose peak is about 500 to 600 meters above sea level (Figure 1). It is located about 195 km to the West of Dar es Salaam City. It is divided into 29 administrative wards and 272 streets with an estimated human population of 315,866 (Tanzania Ministry of Finance, 2013).

The sampling frame for the Mvomero district included 15 wards where most pastoralists and agro-pastoralists reside, while for Morogoro Municipality, it encompassed 29 wards. The selection of wards and villages/ streets was deliberately based on the presence of dog keepers, the accessibility of the area, and compliance. In each district, five wards were chosen. In Mvomero district, the selected wards were Dakawa, Mangae, Melela, Doma, and Hembeti, whereas in Morogoro Municipality, the wards were Magadu, Lukobe, Kihonda Magorofani, Mafisa, and Mazimbu. The selection of study households was conducted through simple random sampling from a list of all dog keepers in a given village or street. In total, the study involved 12 villages and 100 households in Mvomero district. In Morogoro Municipality, 27 streets were included, and interviews were conducted with the heads of 100 households.

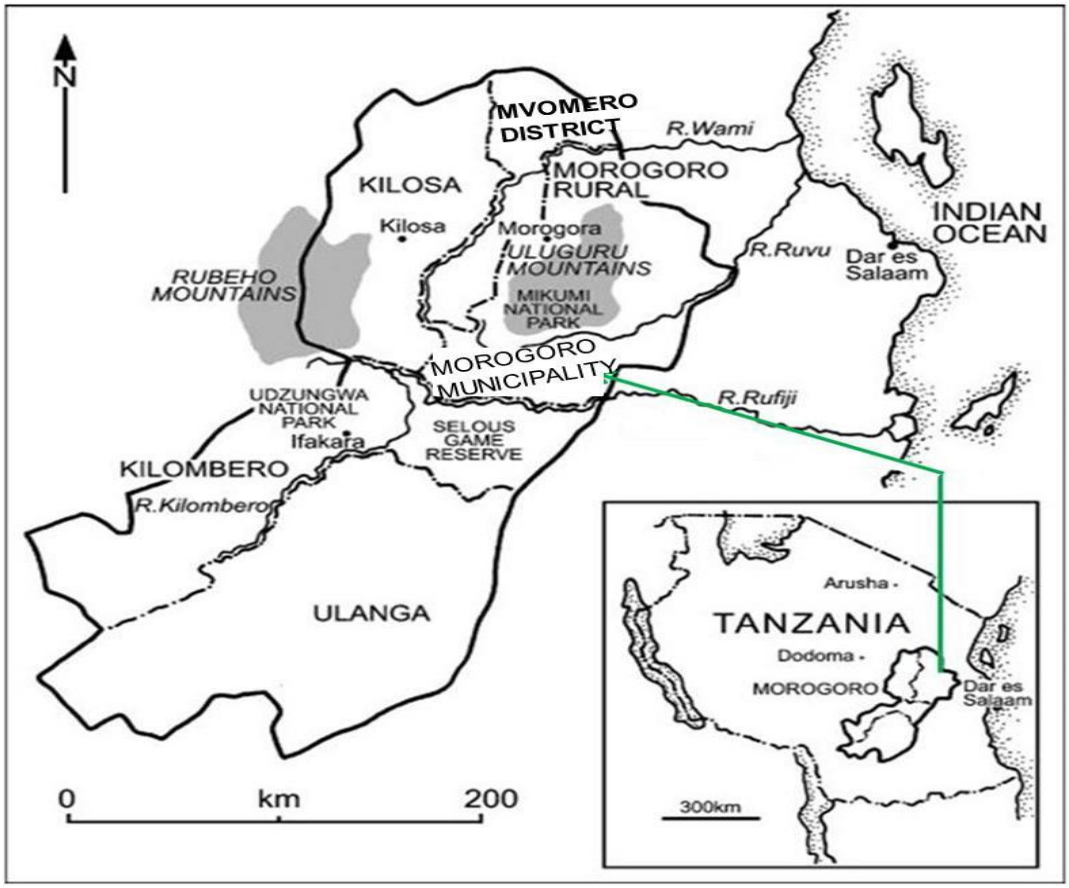

Figure 1. A map showing the location of the Morogoro region where the Mvomero district and Morogoro Municipality are found

3. Study Variables

In this study assessing the knowledge, attitudes, and practices (KAP) of dog keepers on dog management and the risks of zoonoses in Mvomero and Morogoro Municipality, the independent variables included the demographic characteristics of dog keepers (such as age, gender, education level, and location), dog management practices, awareness of diseases and zoonoses, and respondents' experiences with dogs. The dependent variables were the levels of knowledge regarding dog parasitic infestations, attitudes toward dogs, and actual dog management practices, which were measured using a structured questionnaire. These dependent variables were assessed by comparing respondents' scores to the mean, categorizing their knowledge, attitude, and practice levels as high, medium, or low, and further classifying attitudes as positive or negative based on their responses to Likert scale questions.

4. Operational Definition of Variables

The study on dog management practices and diseases measured several key variables, including knowledge, attitudes, practices, and overall KAP (knowledge, attitude, and practice) scores, using a structured approach.

Knowledge of dog management and diseases: The variable assessing respondents' knowledge focused on dog management practices and zoonotic diseases associated with keeping dogs. This was measured using 22 questions from the knowledge module in the questionnaire. Based on their responses, participants were categorized according to their score relative to the mean knowledge score. Respondents with scores above the mean were categorized as having "high knowledge," those with scores equal to the mean as having "medium knowledge," and those with scores below the mean as having "low knowledge."

Attitudes toward dogs: The variable for attitudes measured respondents' perceptions and feelings toward dogs and dog management. Attitudes were evaluated using 8 Likert-scale questions where responses ranged from "strongly agree" to "strongly disagree" on a 5-point scale (Allen and Seaman, 2007). Respondents with scores above the mean were considered to have a "high attitude," those with scores equal to the mean were categorized as having a "positive attitude," and those with scores below the mean fell into the "negative attitude" category. Additionally, responses were classified as either "positive" (strongly agree/agree) or "negative" (neutral/ disagree/strongly disagree).

Practices related to dog management: This variable assessed the practices respondents engaged in regarding dog management. A series of questions captured their behaviors and experiences, which were then scored. Respondents with scores above the mean were classified as having "high practice," those with scores equal to the mean as "medium practice," and those scoring below the mean as "low practice."

Overall KAP score: The overall KAP score was determined by averaging the individual scores for knowledge, attitudes, and practices. Respondents were categorized based on how their overall score compared to the mean. Scores above the mean were classified as "high KAP," those equal to the mean as "medium KAP," and those below the mean as "low KAP (Memon et al., 2015). The study used various types of response formats to collect data, including yes/no questions, multiple-choice options, listing, and Likert scale questions (ranging from 1 to 5). This range of question types ensured a comprehensive assessment of dog management and attitudes toward dog keeping.

5. Study Instrument

The questionnaire tool was used to assess knowledge, attitudes, and practices regarding the dogs' management among dog keep-

ers. The questionnaire tool collected data on the demographic characteristics of dog keepers, their awareness of dog management practices, and their understanding of diseases and zoonoses related to keeping dogs. To evaluate both knowledge and practices, 22 questions were administered. Attitudes toward dogs were assessed using a set of 8 brief questions, while 11 additional questions focused on experiences and behavioral responses. In total, the questionnaire comprised 40 questions.

6. Data Analysis

Quantitative data from the questionnaire tool were recorded, edited, coded, and analyzed using the Statistical Package for Social Sciences (SPSS) version 20. The analysis in the SPSS involved means, frequencies, standard deviation, and cross-tabulation. Comparison between categorical variables was done by using the Chi-Square test at a 5% level of significance ($p < 0.05$). The analysis of the questionnaire was done by coding the responses of respondents and results presented in percentages. Analysis of individual attitudes was done by grouping responses into positive and negative whereby strongly agree/agree was considered as positive while neutral, disagree and strongly disagree were considered as negative.

7. Research Ethics

A research permit was granted by the Vice Chancellor of Sokoine University of Agriculture (SUA/DRPSG/R/126/3/93), and a permission letter was secured from the Executive Director of Morogoro Municipality and Mvomero district (MVDC/D.30/-15/VOL.IV/54). Additionally, verbal permissions were sought from the Ward Executive Officers (WEO) and Village/Street Executive Officers in the respective wards, villages, and streets. Verbal consent was obtained from the heads of households in the study villages and streets after explaining the purpose and significance of the study before the commencement of interviews and subsequent sampling of dogs. Participation in the study was voluntary. All information collected from the participants was treated as confidential and was kept securely by the researcher. The identities of the study participants were anonymized.

RESULTS

1. Demographic characteristics of respondents

A total of 200 respondents were interviewed, with demographic characteristics detailed in Table 1. The respondents' ages ranged between 18 and 71 years in both Mvomero district and Morogoro Municipality, with the majority having primary education. The majority were male with primary levels of education.

Table 1. Demographic characteristics of respondents based on in the study districts

Demographic information	Category	Number and percentage of respondents					
		Mvomero (N=100)		Morogoro Municipality (N=100)		Total (N=200)	
		N	%	N	%	N	%
Sex	Male	72	72.0	54	54.0	126	63.0
	Female	28	28.0	46	46.0	74	37.0
Age (years)	15-25 years	30	30.0	23	23.0	53	26.5
	Above 25 years	70	70.0	77	77.0	147	73.5
Level of education	No formal education	25	25.0	6	6.0	31	15.5
	Primary school	59	59.0	46	46.0	105	52.5
	Secondary school	12	12.0	33	33.0	45	22.5

Demographic information	Category	Number and percentage of respondents					
		Mvomero (N=100)		Morogoro Municipality (N=100)		Total (N=200)	
		N	%	N	%	N	%
Sources of income	College Education	4	4.0	15	15.0	19	9.5
	Crop farming	71	71.0	27	27.0	98	49.0
	Livestock and poultry-keeping	28	28.0	22	22.0	50	25.0
	Trading in livestock and livestock products	7	7.0	3	3.0	10	5.0
	Trading in crops and crop products	8	8.0	22	22.0	30	15.0
	Formal salaried employee	5	5.0	39	39.0	44	22.0
	Shopkeeper	4	4.0	25	25.0	29	14.5
Annual income in Tanzania shilling	Below one million	45	45.0	4	4.0	49	24.5
	Between 1 and 10 million	53	53.0	87	87.0	140	70.0
	Above 10 million	2	2.0	9	9.0	11	5.5

2. General knowledge of dog management practices

The results (Table 2) found that, most respondents (80.5%) keep 1 to 3 dogs, with a significant majority (64.5%) having kept dogs for over three years, indicating a relatively stable pet ownership culture. The primary purpose for keeping dogs is for home security (99.5%), reflecting a reliance on dogs for protective measures rather than companionship or herding. However, concerns regarding dog management are prevalent, with 85% of respondents citing the risks of bites and rabies spread as significant disadvantages. Interestingly, while housing and tethering practices vary, a majority (42%) allow dogs to roam freely, which could exacerbate health risks and community concerns. The predominant feeding method is homemade diets (90.5%), suggesting a need for awareness on nutritional needs and feeding practices. The data indicates a lack of dedicated care for dogs, with 40% of respondents reporting that family members do not care for them. This finding underscores a potential gap in responsible pet ownership education, emphasizing the need for targeted interventions to improve dog welfare and management practices in these communities.

Table 2. General knowledge of dog management practices in Mvomero district and Morogoro Municipality (n=200)

Parameter	Category	The number and percentage of respondents in the study districts					
		Mvomero (N=100)		Morogoro Municipality (N=100)		Total (N= 200)	
		N	%	N	%	N	%
Number of dogs kept	1 - 3	79	79.0	82	82.0	161	80.5
	> 3	21	21.0	18	18.0	39	19.5
Duration of keeping dogs (years)	1 - 3	42	42.0	29	29.0	71	35.5
	> 3	58	58.0	71	71.0	129	64.5
Source of dogs	Friends	21	21.0	28	28.0	49	24.5
	Neighbors	45	45.0	43	43.0	88	44.0
	Commercial breeders	34	34.0	29	29.0	63	31.5
Purpose of keeping dogs	Herding	20	20.0	0	0.0	20	10.0

Parameter	Category	The number and percentage of respondents in the study districts					
		Mvomero (N=100)		Morogoro Municipality (N=100)		Total (N= 200)	
		N	%	N	%	N	%
Disadvantage of keeping dogs	Hunting	13	13.0	2	2.0	15	7.5
	Home security	99	99.0	100	100.0	199	99.5
	Companionship	1	1.0	9	9.0	10	5.0
	Bites and spread rabies	80	80.0	90	90.0	170	85.0
	Spread ectoparasites	13	13.0	9	9.0	21	11.0
	Preying on livestock	7	7.0	1	1.0	8	4.0
Dog housing and tethering	Housing/tethering of dogs	39	39.0	77	77.0	116	58.0
	Free roaming	61	61.0	23	23.0	84	42.0
Type of food for dogs	Cooked meat	1	1.0	6	6.0	7	3.5
	Homemade diet	96	96.0	85	85.0	181	90.5
	Commercial feed	1	1.0	7	7.0	8	4.0
	Homemade and Commercial Feed	1	1.0	7	7.0	8	4.0
How do you feed your dogs?	In utensils	29	29.0	58	58.0	87	43.5
	On bare ground	56	56.0	23	23.0	79	39.5
	Both of the above	15	15.0	19	19.0	34	17.0
Family members who care dogs	Don't care	60	60.0	20	20.0	80	40.0
	Son	21	21.0	47	47.0	68	34.0
	Attendants	5	5.0	16	16.0	21	10.5
	Anybody	13	13.0	18	18.0	31	15.5

Figure 2. Some of the dog houses encountered during the study

3. Dog health, zoonotic diseases, and access to veterinary services

The study revealed that 86.5% of respondents believed that dogs spread diseases, with ectoparasite infestations being the most commonly reported issue (55.5%) (Table 3). Rabies was recognized as the most significant zoonotic disease, with 85.5% acknowledging its impact on both dogs and humans. Access to veterinary services was higher in Morogoro Municipality (80%) compared to Mvomero district (61%), and services like vaccination (66%) and deworming (25.5%) were commonly provided. However, 28% of respondents indicated that no treatment was provided to their dogs (Table 3). Precautionary measures such as cleaning the home environment (59.5%) and regular dipping (40.5%) were employed, but only 13% cleaned and disinfected dog houses. Additionally, a concerning 44.5% of respondents did not wash their hands after handling dogs, increasing the risk of disease transmission (Table 3). These findings imply a need for improved public awareness of the importance of veterinary care, hygiene practices, and preventive measures to control zoonotic diseases, particularly rabies, and parasite infestations. Enhanced access to veterinary services, along with community education on sanitation, could significantly reduce the health risks associated with dog ownership in these regions.

Table 3. Dog health, zoonoses, and access to veterinary services

Parameter	Category	The number and percentage of respondents in the study districts					
		Mvomero district (N= 100)		Morogoro Municipality (N= 100)		Total (N=200)	
		N	%	N	%	N	%
Dogs spread diseases	Yes	82	82 0	91	91.0	173	86.5
	No	18	18.0	9	9.0	27	13.5
Common dog diseases	Mange	23	23.0	16	16.0	39	19.5
	Helminthiasis	19	19.0	32	23.0	51	25.5
	Ectoparasite infestation	48	48.0	63	63.0	111	55.5
Zoonotic dog diseases	Mange	3	3.0	8	8.0	11	5.5
	Helminthiasis	6	6.0	10	10.0	16	8.0
	Allergic dermatitis	11	11.0	13	13.0	24	12.0
	Rabies	80	80.0	91	91.0	171	85.5
Veterinary service accessibility	Yes	61	61.0	80	80.0	141	70.5
	No	39	39.0	20	10.0	59	29.5
Types of veterinary services	Vaccination	55	55.0	77	77.0	66	66.0
	Dipping/spraying	5	5.0	24	24.0	29	14.5
	Deworming	19	19.0	32	32.0	51	25.5
Veterinary service providers	Veterinary and or Livestock Officers	0	0.0	22	22.0	22	11.0
	Livestock field officer	61	61.0	56	56.0	117	58.5
	Father and son	3	3.0	5	5.0	8	3.5
	No treatment	36	36.0	20	20.0	56	28.0
Preventive measures for dogs	Clean & disinfect dog houses	10	10.0	16	16.0	26	13.0
	Cleaning home environment	42	42.0	77	77.0	119	59.5

Parameter	Category	The number and percentage of respondents in the study districts					
		Mvomero district (N= 100)		Morogoro Municipality (N= 100)		Total (N=200)	
		N	%	N	%	N	%
	Regular deworming every 3 months	11	11.0	39	39.0	25	25.0
	Feeding dogs cooked meat	3	3.0	7	7.0	10	5.0
	Regular dipping every week	20	20.0	61	61.0	81	40.5
	Burning affected areas	0	0.0	0	0.0	0	0.0
Post-handling sanitation practices	Do not wash hands	43	43.0	46	46.0	89	44.5
	Wash hands with water only	13	13.0	8	8.0	21	10.5
	Wash hands with water & soap	44	44.0	46	46.0	90	45.0

4. Respondents' attitudes towards dogs

The study revealed that most respondents in both Mvomero district and Morogoro Municipality had a generally positive attitude toward dogs, with over 90% expressing that they like dogs (Table 4). However, feelings of safety around dogs were low, as only 29.0% in Mvomero and 33.0% in Morogoro felt safe when surrounded by dogs, reflecting concerns about dogs being dangerous (63.0% in Mvomero and 51.0% in Morogoro agreed). Sympathy for stray dogs was common, with over 78% in both areas feeling sorry for them. The majority of respondents rejected the use of violence against dogs (71.0)% in Mvomero and 81.0% in Morogoro), indicating a prevailing stance against cruelty. On the other hand, many respondents, particularly in Mvomero (77.0%), considered dogs a nuisance. Additionally, a significant number disagreed with the idea of dogs scavenging for food from garbage (83.0% in Mvomero and 91.0% in Morogoro) (Table 4). These findings suggest that while people have a generally positive attitude towards dogs, there are concerns about their safety and nuisance behavior, pointing to the need for better dog management practices and public education on responsible dog care, as well as addressing stray dog issues to reduce risks and nuisances.

Table 4. Distribution of respondents' responses on attitude towards dogs (n=200)

Study area	Variable	Number and percentage of respondents' responses									
	Statement asked	Strongly agree		Agree		Neutral		Disagree		Strongly disagree	
		N	%	N	%	N	%	N	%	N	%
Mvomero district	I like dogs	49	49.0	45	45.0	4	4.0	2	2.0	0	0.0
	I feel sorry for stray dogs	20	20.0	58	58.0	18	18.0	4	4.0	0	0.0
	I feel safe when surrounded by dogs	4	4.0	25	25.0	10	10.0	53	53.0	8	8.0

Study area	Variable	Number and percentage of respondents' responses									
	Statement asked	Strongly agree		Agree		Neutral		Disagree		Strongly disagree	
		N	%	N	%	N	%	N	%	N	%
Morogoro Municipality	I feel happy purchasing food for dogs	18	18.0	69	69.0	9	9.0	3	3.0	1	1.0
	The use of violence against dogs is acceptable	3	3.0	12	12.0	14	14.0	62	62.0	9	9.0
	Dogs are dangerous animals	7	7.0	56	56.0	16	16.0	17	17.0	4	4.0
	Dogs are nuisance	27	27.0	50	50.0	10	10.0	9	9.0	4	4.0
	Dogs need to scavenge for food from garbage	2	2.0	10	10.0	5	5.0	74	74.0	9	9.0
	I like dogs	35	35.0	61	61.0	1	1.0	3	3.0	0	0.0
	I feel sorry for stray dogs	21	21.0	62	62.0	3	3.0	14	14.0	0	0.0
	I feel safe when surrounded by dogs	7	7.0	26	26.0	1	1.0	66	66.0	0	0.0
	I feel happy purchasing food for dogs	22	22.0	66	66.0	6	6.0	6	6.0	0	0.0
	The use of violence against dogs is acceptable	1	1.0	13	13.0	5	5.0	77	77.0	4	4.0
	Dogs are dangerous animals	6	6.0	45	45.0	7	7.0	39	39.0	3	3.0
	Dogs are nuisance	2	2.0	29	29.0	11	11.0	56	56.0	2	2.0
	Dogs need to scavenge for food from garbage	0	0.0	7	7.0	2	2.0	87	87.0	4	4.0

5. The experience and behavior of respondents toward husbandry dogs

The findings show that the majority of respondents in both Mvomero district and Morogoro Municipality have seen free-roaming dogs, with 88% in Mvomero and 92% in Morogoro reporting this issue (Table 5). A significant number of respondents in both areas avoid contact with dogs, with 42% in Mvomero and 48% in Morogoro expressing this behavior, indicating potential concerns about safety or health risks. Many respondents in Mvomero (40%) and Morogoro (49%) do not consider dogs to be friendly, and a substantial proportion believe that dogs are frightened and avoid human contact (Table 5). Feeding practices are high, with 76% in Mvomero and 83% in Morogoro feeding dogs, but scavenging is also prevalent, with 40% in Mvomero and 42% in Morogoro noting that dogs scavenge for food. Health concerns are notable, as only 2% in Mvomero and 3% in Morogoro believe dogs are healthy, and similarly low percentages think dogs are well-fed. Stray dogs are considered a problem, with 77% in Mvomero and 48% in Morogoro reporting too many strays in their areas (Table

5). These findings imply a need for improved dog population control measures, better public education on dog management, and enhanced community initiatives to address stray dog issues. Additionally, public health and safety concerns around dog behavior and disease spread may be alleviated through targeted interventions such as vaccination campaigns, commuinity outreach, and the promotion of responsible pet ownership.

Table 5. Distribution of respondents on experience and behavioral questions based on study area (n=200)

Study Area	Variables	Number and percentage of respondents' responses									
	Parameters	Yes		Always		Sometimes		No		Not at all	
		N	%	N	%	N	%	N	%	N	%
Mvomero district	Presence of free-roaming dogs	24	24.0	64	64.0	8	8.0	4	4.0	0	0.0
	Avoidance of dog contact	34	34.0	6	6.0	16	16.0	42	42.0	2	2.0
	Dogs are friendly	19	19.0	2	2.0	34	34.0	40	40.0	5	5.0
	Dog frightened and avoid human	12	12.0	3	3.0	44	44.0	36	36.0	5	5.0
	Feed dogs	21	21.0	76	76.0	3	3.0	0	0.0	0	0.0
	Presence of scavenging dogs	40	40.0	21	21.0	24	24.0	14	14.0	1	1.0
	Feel threatened by dogs	41	41.0	5	5.0	15	15.0	35	35.0	4	4.0
	Witnessing inappropriate behavior against dogs	42	42.0	23	23.0	9	9.0	23	23.0	3	3.0
	, Dogs appear healthy	2	2.0	29	29.0	48	48.0	19	19.0	2	2.0
	Dogs are well-fed	1	1.0	30	30.0	49	49.0	19	19.0	1	1.0
	Presence of stray dogs	27	27.0	50	50.0	10	10.0	9	9.0	4	4.0
Morogoro Municipality	Presence of free-roaming dogs	22	22.0	70	70.0	3	3.0	4	4.0	1	1.0
	Avoidance of dog contact	48	48.0	17	17.0	8	8.0	26	26.0	1	1.0
	Dogs are friendly	30	30.0	3	3.0	18	18.0	49	49.0	0	0.0
	Dog frightened and avoid human	21	21.0	2	2.0	31	31.0	46	46.0	0	0.0
	Feed dogs	15	16.0	83	83.0	1	1.0	1	1.0	0	0.0
	Presence of scavenging dogs	42	42.0	18	18.0	16	16.0	23	23.0	1	1.0
	Feel threatened by dogs	35	35.0	28	28.0	14	14.0	23	23.0	0	0.0
	Witnessed inappropriate behavior against dogs	30	30.0	31	31.0	12	12.0	27	27.0	0	0.0
	Dogs appear healthy	3	3.0	38	38.0	24	24.0	32	32.0	3	3.0
	Dogs are well-fed	4	4.0	37	37.0	24	24.0	33	33.0	2	2.0
	Presence of stray dogs	3	3.0	45	45.0	15	15.0	35	35.0	2	2.0

6. Understanding the general knowledge, attitudes, and experiences of respondents regarding dog management

The key findings from Table 6 indicate that in Mvomero district, a majority of respondents (61%) have poor knowledge about dog management and health, while in Morogoro Municipality, a higher percentage (65%) exhibit good knowledge. Overall, 45.5% of respondents have good knowledge across both districts. In terms of attitude, 59% of

respondents in Mvomero show a negative attitude toward dogs, while 60% in Morogoro have a positive attitude, resulting in a nearly even split in attitude overall (49.5% negative and 50.5% positive). Regarding practice, a larger proportion of respondents in Mvomero (76%) engage in bad practices related to dog care compared to Morogoro (40%), with 58% of respondents overall demonstrating bad practices. The general experience with dogs is predominantly negative in both districts, with 79% in Mvomero and 77% in Morogoro reporting bad experiences, resulting in 78% of respondents overall with negative experiences (Table 6). The implications of these findings suggest a need for targeted educational interventions in Mvomero to improve knowledge and practices regarding dog management. In both districts, the high percentage of negative experiences and bad practices highlights the importance of community outreach and support programs to promote better dog care, which could foster more positive attitudes and experiences, ultimately reducing issues related to stray dogs and associated public health risks.

Table 6. General knowledge, attitude and practices of respondents towards dog management according to the study areas (n=200)

Parameter	Category	The number and percentage of respondents in the study districts					
		Mvomero district (n=100)		Morogoro Municipality (n=100)		Total (N=200)	
		N	%	N	%	N	%
General knowledge	Poor knowledge	61	61.0	29	29.0	90	45.0
	Fair knowledge	13	13.0	6	6.0	19	9.5
	Good knowledge	26	26.0	65	65.0	91	45.5
General attitude	Negative attitude	59	59.0	40	40.0	99	49.5
	Positive attitude	41	41.0	60	60.0	101	50.5
General practice	Good practice	24	24.0	60	60.0	84	42.0
	Bad practice	76	76.0	40	40.0	116	58.0
General experience	Bad experience	79	79.0	77	77.0	156	78.0
	Good experience	21	21.0	23	23.0	44	22.0

7. Comparison of general knowledge, attitude, and practices of respondents towards dog management

The analysis of general knowledge, attitude, practice, and experience regarding dog management in Mvomero district and Morogoro Municipality reveals significant disparities (Table 7). In Mvomero, a substantial majority (61.0%) exhibit poor knowledge of dog management compared to only 29.0% in Morogoro Municipality, indicating a critical need for educational interventions (p= 0.001). Furthermore, negative attitudes towards dog management are more prevalent in Mvomero (59.0%) than in Morogoro (40.0%), suggesting a significant difference in perception (p= 0.007). In terms of practice, only 24.0% of respondents in Mvomero demonstrate good practices, in stark contrast to 60.0% in Morogoro (p =0.001). Experience levels are similar across both districts, with both reporting comparable instances of good (21.0% in Mvomero and 23.0% in Morogoro) and bad experiences (79.0% in Mvomero and 77.0% in Morogoro) (p = 0.733). These findings

underscore the urgent need for targeted educational initiatives in Mvomero to enhance knowledge and foster positive attitudes toward dog management, ultimately leading to improved practices, dog welfare, and public health outcomes in both regions.

Table 7. Comparison of general knowledge, attitude and practices of respondents towards dog management according to the study areas (n=200)

Parameter	Category	The number and percentage of respondents in the study districts				OR	p
		Mvomero district		Morogoro Municipality			
		N	%	N	%		
General knowledge	Poor knowledge	61	61.0	29	29.0	30.67	<0.001*
	Fair knowledge	13	13.0	6	6.0		
	Good knowledge	26	26.0	65	65.0		
General attitude	Negative attitude	59	59.0	40	40.0	7.22	0.007*
	Positive attitude	41	41.0	60	60.0		
General practice	Good practice	24	24.0	60	60.0	26.07	>0.001*
	Bad practice	76	76.0	40	40.0		
General experience	Bad experience	79	79.0	77	77.0	0.11	0.733
	Good experience	21	21.0	23	23.0		

DISCUSSION

This study aimed to evaluate the knowledge, attitudes, and practices of dog keepers regarding dog management and community awareness of dog zoonotic diseases in Mvomero district and Morogoro Municipality. The findings revealed that a majority (59%) of dog keepers had fair to good knowledge of dog management, and 50.5% demonstrated a positive attitude towards dogs. However, most dogs were managed under poor conditions, and a significant number of respondents (78%) reported negative experiences with dogs. Many respondents observed free-roaming dogs with poor body conditions and witnessed mistreatments, such as beating and inhumane killing. These results underscore the need for integrative approaches to raise public awareness about proper dog management practices in Mvomero district, Morogoro Municipality, and other areas in Tanzania to protect the health of both dogs and humans (Ernest et al., 2013). Without such efforts, dogs will continue to be mismanaged, undervalued, neglected, and suffer from various diseases, some of which can be transmitted to humans.

This study found that most dog keepers were male, had primary education, and had over three years of experience with dogs. The average number of dogs kept ranged from one to three, primarily local breeds (mongrels). Despite many dog keepers reporting that they confined or tethered their dogs, the conditions of the dog houses were poor, leading to significant animal suffering and violating animal welfare standards. In the Mvomero district, dogs were more often managed under a free-range system compared to Morogoro Municipality (p=0.000). This difference is attributed to the poor knowledge of dog husbandry and the poverty among dog keepers in the Mvomero district, as shown in Table 1. Additionally, many dog keepers in Mvomero are pastoralists who keep large numbers of dogs for herding and guarding livestock, contributing to the prevalence of stray dogs. In contrast, in Morogoro Municipality, dogs are primarily kept for security and companionship, with most being con-

fined. Similar patterns have been observed in various studies worldwide (Ernest et al., 2009; Bitsu-Kiflu et al., 2016; Iddi et al., 2023).

The study found that boys aged 10 to 15 were primarily responsible for dog care, including feeding, cleaning, tethering, and other services. Entrusting dog care to children increases their risk of dog bites, scratches, and zoonotic diseases. While it is unclear why sons take on this role, it may be a tradition in many African communities. Most respondents reported washing their hands after handling dogs, but they barely used water, which may not be adequate to cleanse and disinfect contaminated hands. This aligns with Kiflu et al. (2016) in Ethiopia, where most dog keepers also wash their hands after contact with dogs. However, it contrasts with studies by Westgath et al. (2008) and Dawit Gebremichael et al. (2013), which found that most dog owners do not wash their hands after direct contact with dogs. The study suggests that sanitary education for dog keepers is essential for public health.

It was further discovered that cleaning and disinfecting dog houses and related equipment are uncommon practices among dog keepers. This negligence may contribute to the presence of infectious agents in the environment, increasing the risk of infection for both dogs and humans. The lack of disinfectant, unawareness of cleaning dog houses, negligence, poverty, negative attitudes towards dogs, and illiteracy among the dog keepers in the study areas may be among the reasons for these results. This finding is consistent with other studies conducted in different regions (Dawit Gebremichael et al., 2013; Asmare and Mekuria, 2013; Bitsu-Kiflu et al., 2016), which also reported poor hygienic practices in households that keep dogs.

Moreover, the majority (90.5%) of dog keepers feed their dogs with homemade feed, particularly kitchen scraps, a mixture of maize bran and sardines, and the feeding process involves dropping the feed on bare ground. This method of feeding dogs with homemade feed is closely linked to the economic status of most visited households, as the majority of dog keepers cannot afford to purchase meat or commercial feeds. The study revealed that only 5.5% of respondents had an average annual income exceeding ten million Tanzanian shillings (USD 4,167), indicating that only a few individuals can afford to buy commercial feeds for their dogs. However, freely roaming dogs were not provided with feed; instead, they scavenged for food from waste disposal areas such as dumps, collected food leftovers from homestead areas, and sometimes hunting of small mammals like rodents and hares. This observation on dog feeding contradicts findings from other studies (Asmare and Mekuria, 2013; Bitsu Kiflu et al., 2016), which reported that some dog owners feed their dogs raw or cooked meat/offal.

Furthermore, the results indicated that most respondents were aware of transmissible diseases between dogs and humans, particularly rabies, but very few reported helminthiasis and mange infestations. This limited awareness may be attributed to the lack of educational programs focusing on dog zoonotic diseases, except for rabies, which is targeted by numerous vaccination campaigns conducted by the Tanzanian Ministry of Livestock and Fisheries. This finding is consistent with studies conducted by Bitsu Kiflu et al. (2016), Asmare, and Mekuria (2013), and Iddi et al. (2023) which also noted that most dog owners were knowledgeable about rabies compared to other zoonotic diseases. Nonetheless, from the findings of the study, the majority of the respondents knew that veterinary services

are rabies vaccination and this evidently shows that dogs in the study areas rarely get routine health management. In general, there is a pressing need to develop a national disease control program and raise public awareness regarding zoonotic diseases of dogs.

The present study revealed that most dog keepers reported various health issues in their dogs, particularly ectoparasite infestations and rabies. However, the majority of dogs did not receive routine veterinary services, except for rabies vaccination, which was administered solely during rabies campaigns. Controlled breeding of dogs was not practiced; mating occurred haphazardly, and in many cases, the resulting puppies had no owners, especially in the Mvomero district. Several factors may contribute to this, such as a lack of awareness regarding routine care for dog diseases other than rabies, negative attitudes toward dogs, and some respondents admitting to simply disliking dogs. Additionally, certain communities, such as the Maasai in Mvomero district, do not believe that dogs can suffer from diseases like other animals (Researchers' observation)). This mirrors findings from other studies that have documented inadequate veterinary services provided to dogs by their owners (Ugbomoiko et al., 2008; Bitsu Kiflu et al., 2016). Therefore, there is a pressing need to raise public awareness of proper dog husbandry to control dog diseases.

Furthermore, the study found a significant difference ($P<0.005$) in the accessibility of veterinary services between Mvomero district and Morogoro Municipality. This disparity is primarily due to Morogoro Municipality being an urban area where veterinary shops, clinics, dog dips, and other veterinary services are readily available compared to the predominantly rural Mvomero district. These findings are consistent with other studies conducted in various locations (Ugbomoiko et al., 2008; Kiflu et al., 2016), which reported that veterinary services are more accessible in urban areas compared to rural areas.

Remarkably, the majority (59%) of participants in the current study demonstrated fair to good knowledge regarding dog management and its significance. Practices such as dog housing, feeding, ectoparasite control, and regular deworming were reported, particularly in Morogoro Municipality. Most participants stated that dogs are primarily used as guard animals; however, some also mentioned negative aspects such as bite wounds, disease transmission, and predation of livestock. Additionally, the study found that 58% of participants inadequately managed their dogs, with better husbandry practices observed in Morogoro Municipality compared to Mvomero district ($p<0.05$). This difference is associated with the level of education, as the majority of participants from the Mvomero district were illiterate compared to those from Morogoro Municipality (Table 1). This finding is consistent with previous studies conducted in various regions (Dawit Gebremichael et al., 2013; Bitsu Kiflu et al., 2016). Therefore, raising community awareness of dog management, especially in rural areas, is crucial for both the well-being of dogs and public health.

Moreover, half of the respondents exhibited a positive attitude towards dogs. Dog keepers from Morogoro Municipality displayed a more positive attitude towards dogs compared to those from Mvomero district ($p=0.007$). In Mvomero district, negative attitudes towards dogs were reported, stemming from a natural aversion, especially towards free-roaming dogs often found in poor physical condition. Some respondents reported witnessing inappropriate behavior towards dogs, such as beating and killing. This negative perception is

likely influenced by stray dogs that prey on livestock (goats and sheep), cause dog bites, and spread rabies, as reported by the majority of respondents (61.0%) from Mvomero district. Consequently, free-roaming dogs were considered nuisances and hazardous animals in society, particularly for children. This negative attitude towards dogs observed during the study may be further exacerbated by the aforementioned factors. Education on dog husbandry is essential in both study areas, but more emphasis is needed in rural communities.

Based on the findings of this study, it is concluded that dogs in the Mvomero district are predominantly managed under a free-range system compared to those in Morogoro Municipality. Schoolboys are primarily responsible for caring for dogs in most households, and poor hygienic husbandry practices were observed in some dog keepers. The majority of dog keepers feed their dogs homemade food on bare ground. Additionally, the dog keepers were aware of transmissible diseases between dogs and humans, particularly rabies, and most dogs did not receive routine veterinary care. Respondents in Morogoro Municipality demonstrated good knowledge of dog management and exhibited a positive attitude towards dogs. Integrative approaches to creating public awareness of dog management practices, zoonoses, and other dangers associated with dogs in Mvomero district, Morogoro Municipality, and other areas in Tanzania using a One Health approach are recommended to safeguard the health of both dogs and humans).

AUTHOR CONTRIBUTION

All authors contributed significantly in this work, where ARI collected data, analyzed and wrote the initial draft of the manuscript. HEN reviewed and edited the manuscript.

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CONFLICT OF INTEREST

The authors declare no conflict of interest in this work.

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