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Original Research

Canine Pet Owners' Awareness on Zoonotic Soil Transmitted Helminths and Practices Facilitating their Spread in Andhra Pradesh, India

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Abstract

A questionnaire-based survey was designed to analyze the facts associated with soil-transmitted helminths of zoonotic potential in Andhra Pradesh, India. The survey intends to convene details about a. owner associated factors; b. animal-related factors; c. knowledge/awareness; d. dog management practices. Data was collected over a period of 10 months from January 2019 to October 2019. About 1047 pet owners were surveyed and a total of 366 (34.9%) responses were retrieved. Most pet owners in the study preferred adopting young (1-2 years) male dogs (61.74%) over females; pure breeds (78.4%) over local non-descriptive breeds. Owners lacking sound educational backdrop were poor in maintaining personal hygiene and more than half of the respondents (63.7%) were unaware of parasites being transmitted through soil. Pertaining to the child and pet animal association, 67.7% of individuals owning pet animals were having one or more children below 15 years of age. Data appertaining to dog's defecating sites and risk zones for children gaining access to soil revealed that the most contaminated sites were school playgrounds (40.9%) followed by backyards and under tree open areas. In the study, preferences of dog owners towards breed, sex, and age (young dogs) along with poor dog management and personal hygiene practices predispose them to a greater risk of zoonoses.

Keywords: Questionnaire survey, Factors, Soil-Transmitted Helminths, Zoonotic Potential

Introduction

India is witnessing a boom in Pet Industry. Andhra Pradesh (A.P.) being one of the most populous states of the country has experienced growing pet acceptance both in urban and rural local bodies in the recent past. As per 19th livestock census of India, A.P. is the second most populous state with an urban dog population of 2, 91,840 and seventh in place with 4, 96,687 dogs prevailing in rural areas of the state. Soil-transmitted helminths (STHs) come under the saprozoonotic category and infection to humans is by hand-to-mouth contact or by skin-penetration with parasitic forms (eggs/larvae) that are prevailing in soil (Parija, 1990). To date, much focus has been placed on human-specific STHs (*Ascaris lumbricoides*, *Ancylostoma duodenale*, *Necator Americanum* and *Trichuris trichiura*) and role of companion animals in the spread of zoonotic parasites (viz., *Toxocara canis*, *Toxocara cati*, *Ancylostoma caninum*, *A. brazeliense* and *A. ceylanicum*) through soil is quite neglected. Animal origin soil-transmitted helminths are known for establishing larval migrans in humans. Case reports of cutaneous larva migrans (Kaur *et al.*, 2015; Paul and Bhagirath, 2017) and visceral larva migrans (Laroia *et al.*, 2012; Kaur *et al.*, 2017) have been reported throughout India. Further, there is an increasing evidence of animal-specific parasites (*Ancylostoma ceylanicum*) being the cause of patent infections in humans (Choo Jia-Chi *et al.*, 2016; George *et al.*, 2016). The children are the potential risk group because of geophagia and playing habits (Worley *et al.*, 1984), followed by immunocompromised individuals (Robertson *et al.*, 2000).

Moreover, data pertaining to the prevalence of gastrointestinal parasites in stray and domicile dogs (Sharma *et al.*, 2006; Moudgil *et al.*, 2016) along with high rates of environmental contamination in urban and rural localities are available from India (Sudhakar *et al.*, 2013; Thomas and Jeyathilakan, 2014) and as well as from A.P (Charitha *et al.*, 2015; Swetha *et al.*, 2017). Nevertheless, there is a paucity of data on the risk perception of canine pet owners regarding zoonotic parasites that are transmitted through soil. Keeping these facts in view the current survey was designed to analyze the level of perception of dog owners on soil-transmitted helminths, zoonotic implications, knowledge on transmission pathways, and practices that are promoting their spread.

Materials and Methods

Survey Methodology

The survey was carried out over a period of 10 months from January 2019 to October 2019. A pilot online survey was designed and had been pretested to assess the suitability and responses from the owners (https://goo.gl/forms/lfXkJXVSLLpSSjml1). The final questionnaire comprised 13 multiple choice-based and 2 open-ended questions. The participants were pet dog owners who visited the clinics for treatment purposes in the 16 different veterinary clinics of A.P. The questionnaire hard copies were supplied to the clinics through intern students who were attending the clinics in the same calendar year. Owners who gave full consent regarding their participation in the survey were requested to fill out the forms during the waiting period of their consultation and filled-in forms were taken back at the time of providing treatment. Support from the concerned veterinarian along with internet students was taken to get back the responses. Further, responses from owners with basic education were also taken after translating the questions in the local vernacular language (Telugu).

The questionnaire intends to gather the information pertaining to the animal's age, sex, and breed and as well as owner-associated facts *viz.*, residence, educational status, personal hygiene, number of children in the household, and their play zones. Information on dog's management, association pattern with owners along with questions related to the deworming recommendations adopted, stool examination details, the extent of awareness on worm burden were posed to the pet owners. Their knowledge regarding zoonotic soil-transmitted parasites of animal origin & their transmission pathways, defecation pattern of the dogs, and other correlated factors that would enhance the chances of spread of STHs infections were assessed.

Statistical Analysis

Data obtained in hard copies were manually exported to Microsoft excel. Human errors in exporting the data to an excel sheet were cross-verified by taking the help of other colleagues. Later the whole data was transported to SPSS®23 software and each variable associated with the specific question was entered and frequencies and percentiles were calculated. The Chi-square test was used to relate different proportions, with a P-value < 0.05 regarded as statistically significant. Descriptive statistics were computed for certain significant variables like

educational status versus personal hygiene and awareness level and analyses was performed with SPSS®23 for Windows.

Results

Respondent Demographics/ Pet owners' related Factors

The questionnaire was posed to approximately 1047 individuals who took their dogs to veterinary clinics in 16 different towns of A.P state. Though 568 responses were retrieved back, only 366 (34.9%) responses were completely answered. Respondents from Kurnool (42) town showed higher interest in replying to the survey and the least was retrieved from Vishakapatnam (6) **(Fig 1)**.

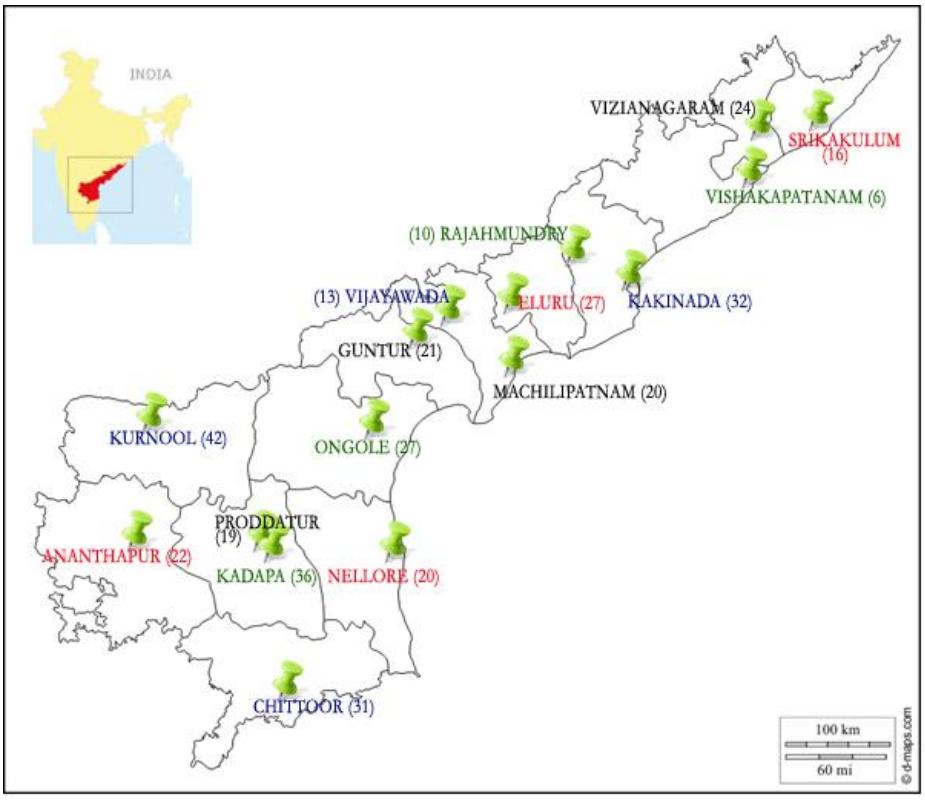

Fig 1: Map showing places from where questionnaire responses were retrieved in the study (Source: d.maps.com)

Concerning the educational status of the respondents, 124 (33.87%) were with basic education stating that they could read and write in the local language "*Telugu*" while 135 (36.88%) were with intermediate base and 107 (29.23%) individuals with sound educational backdrop up to academic level **(Table 1)**. Question-related to personal hygiene revealed that 35.2% (129/366) washed their hands quite often, 34.2% (125/366) washed some time, 21.3% (78/366) rarely washed, and 9.3% (34/366) stated they never washed their hands after contacting their companion animal. Descriptive static analysis between the educational status of the individual and personal hygiene revealed the values were statistically highly significant at $P< 0.0001$ ($x^2=36.27$, $df=6$). Individuals with a sound educational backdrop (Academicians) were keen on washing their hands every time they contacted the pet dog (54.2%) followed by intermediate (33.3%) and basic education groups (21.3%) **(Table 2)**.

Pertaining to the child and pet animal association, 67.7% (248/366) of individuals owning pet animals were having one or more children below 15 years of age and 32.2 % (118/366) stated none. When questioned about taking their dogs out for defecation, major proportions of respondents preferred side roads (48.9%) and play/school grounds (40.9%); while the others preferred parks (22.1%), neighborhood (16.1%), backyard (15.0%) and under tree open areas (10.65%). About 29.7 % replied that they were taking their dogs to other sites that were not mentioned in the questionnaire **(Table 1)**.

Table 1: Demographics of responded pet owners to the variables studied through questionnaire

S.No	Character/ Variable assessed	Category	Freq. (%) out of 366 responses	P Values	Chi-Square values
1	Educational status of owner (Q.N:2)	Basic Intermediate Academic	124 (33.9%) 135 (36.9%) 107 (29.2%)		
2	Dogs breed (Q.N:3)	ND Pure Breed	79[a*] (21.6%) 287 (78.4%)	$P<0.0001^a$	$^a x^2= 118.2, df=1$
3	Age of pet dogs (Q.N:4)	1-2 3-5 6-8 9-12	180[b*] (49.2%) 112 (30.6%) 49 (13.4%) 25 (6.83%)	$P<0.0001^b$	$^b x^2= 15.83, df=1$
4	Sex of pet dogs (Q.N:5)	Male Female	226 [c*](61.4%) 140 (35.25%)	$P<0.001^c$	$^c x^2= 20.28, df=1$
5	Management of pet dogs (Q.N:6)	Completely taken care Partially managed Freely roaming Stray dog	271[d*] (74%) 44 (12%) 39(10.6%) 12 (3.27%)	$P<0.0001^d$	$^d x^2= 163.58, df=1$
6	Washing hands after contact with pets (Hygiene) (Q.N:7)	Frequently Sometime Rarely Not at all	129 (35.2%) 125 (34.2%) 78 (21.3%) 34 (9.4%)		
7	Pet dogs Access to owners bed rooms (Q.N:8)	Regularly Occasionally Rarely Not at all	74 (20.2%) 49 (13.4%) 108 (29.5%) 135 (36.9%)		
8	Faecal stool examination (Q.N:9)	Regular checkup When recommended by Vet Pet was ill Not sure when it was done	57 (15.6%) 127[e*] (34.7%) 99 (27%) 83 (22.7%)	$P=0.0001^e$	$^e x^2= 26.63, df=1$
9	Noticed worms in Pet dog vomit/faeces (Q.N:10)	Yes No	87[f*] (23.8%) 279 (76.2%)	$P<0.0001^f$	$^f x^2= 100.7, df=1$
10	Children below 15 years age group in houses having pets (Q.N:11)	2-3yrs 4-6yrs 7-10yrs 11-15yrs None	66 (18.0%) 87 (23.7%) 84 (22.9%) 53 (14.5%) 118[g*] (32.2 %)	$P<0.0001^g$	$^g x^2= 46.17, df=1$
11	Children having access to soil (Q.N:12)	Back/front yard Public parks School/playgrounds Under tree/open areas Apartment play arena others	110 (30.0%) 105 (28.6%) 194 [h*](53.0%) 136 (37.1%) 65 (17.7%) 83 (22.6%)	$P<0.0001^h$	$^h x^2= 37.18, df=1$
12	Deworming dose to pet dogs (Q.N:13)	Twice yearly When recommended by Vet (four times yearly) Not on a regular basis Haven't done it yet	68 (18.6%) 107 (29.23%) 157[i*] (43%) 34 (9.3%)	$P=0.0021^i$	$^i x^2= 9.47, df=1$
13	Pet dogs are taken out for lowing down their feces (Q.N:14)	Back yard Walks in neighborhood Open places under trees Side roads Parks School playgrounds Others	55 (15.0%) 59 (16.1%) 39 (10.6%) 179[j*] (48.9%) 81 (22.1%) 150 (40.9%) 109 (29.7%)	$P<0.01^j$	$jx^2= 6.76, df=1$
14	Awareness about zoonotic parasites transmission through soil (Q.N:15)	Yes No	133[k*] (36.3%) 233 (63.7%)	$P<0.0001^k$	$^k x^2= 27.32, df=1$

***** Statistically significant with P value < 0.05. N =366 is static denominator. For Q.N: 11, 12 and 14 the respondents were allowed to choose more than one option so the total will not sum up to 100%. Q.N: 1 is not represented in table but given as Fig. 1

Table 2: Descriptive statistics between two variables educational status and Personal hygiene: Cross tabulation

			Personal hygiene				Total
			Frequently	Not at all	Rarely	Sometime	
Education	Basic	Count	26	18	30	50	124
		% within education	***21.0%***	***14.5%***	24.2%	40.3%	100.0%
		% within hygiene	20.2%	52.9%	38.5%	40.0%	33.9%
	Intermediate	Count	45	13	36	41	135
		% within education	***33.3%***	***9.6%***	26.7%	30.4%	100.0%
		% within hygiene	34.9%	38.2%	46.2%	32.8%	36.9%
	Academic	Count	58	3	12	34	107
		% within education	***54.2%***	***2.8%***	11.2%	31.8%	100.0%
		% within hygiene	45.0%	8.8%	15.4%	27.2%	29.2%
Total		Count	129	34	78	125	366
		% within education	35.2%	9.3%	21.3%	34.2%	100.0%
		% within hygiene	100.0%	100.0%	100.0%	100.0%	100.0%

Chi-Square Tests

	Value	Df	Asymptotic Significance (2-sided) P value
Pearson Chi-Square	36.276	6	0.0001
Likelihood Ratio	38.136	6	0.0001
N of Valid Cases	366		

In response to the question on children having access to soil, nearly half of the respondents answered that their children were having high access to soil in school/play grounds (53.0%) followed by under tree open areas (37.1%), backyard/front yard (30.1%), parks (28.6%), others (22.6%) and apartment play zones (17.8%). The two variables like dog's defecating sites and risk zones for children gaining access to soil when compared, the most contaminated sites were turned out to be school play grounds followed by backyards and under tree open areas **(Fig 2).**

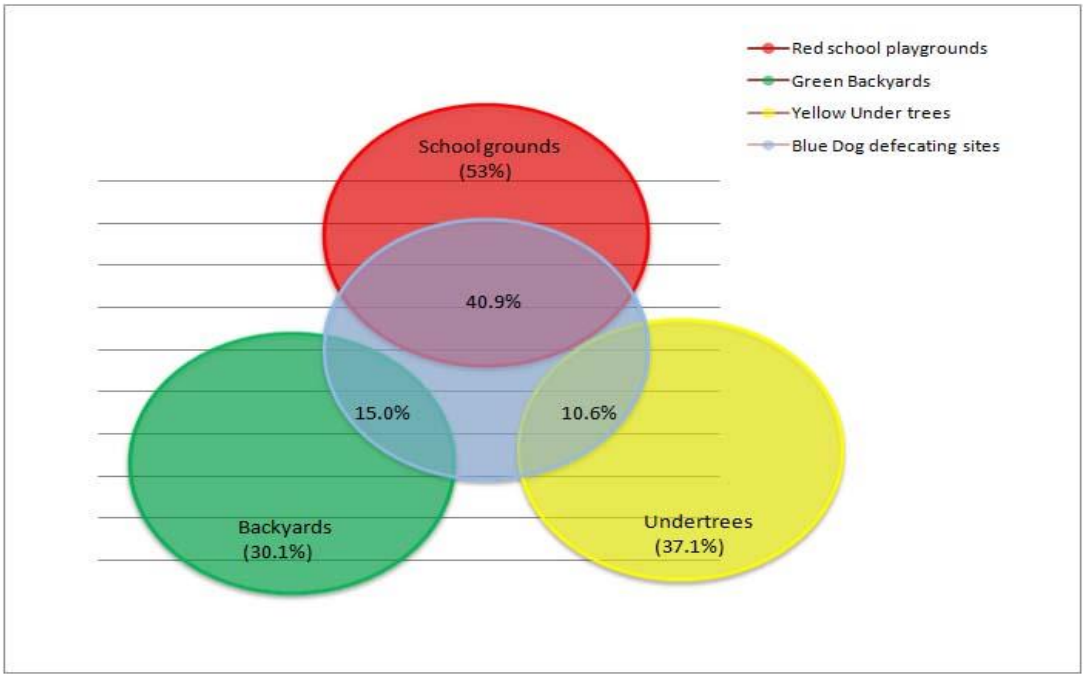

Fig 2: Venn diagram showing logical relationship between child play zones vs pet dog faecal voiding

Approximately one thirds (36.9%) of owners did not allow their pets to sleep in their beds and contrarily 20.2 % stated that their dogs were habituated to sleep along with them.

Animal-related Factors

Most of the dogs in the study were between 1-2 age groups (180/366) and it was found to be statistically highly significant (*P < 0.001)* as compared to 3-5 (112/366), 6-8 (49/366) and 9-12 (25/366) age groups**.** When the sex of the animal is taken into account, males represented 61.74% (226/366) and the value was statistically highly significant (*P < 0.001)* as compared to 35.25 % female dogs (140/366). When pet owners were asked about their dogs' breed, nearly three-fourths of respondents (78.4%) were petting pure breeds and only one-third (21.6 %) proportion was having non-descriptive local breed (ND) (Table 1).

Knowledge/Awareness on Zoonotic STHs

When questioned about the transmission of animal origin STHs through the soil, more than half of the respondents (63.7%) were unaware of the risk for humans from pet parasites. However, 36.3% of respondents stated that they were quite aware of the pet parasites being transmitted through soil. When compared with the "educational status" and "awareness about parasites being transmitted through soil", a statistical association (*P*< 0.05) was found between the categories. Most of the responders with basic (89/124) and intermediate education (85/135) replied that they don't know about parasites being transmitted through soil **(Table 3)**. Surprisingly, those with a good academic (59/107) backdrop were also unaware of STHs.

Table 3. Descriptive statistics between two variables Educational status and Awareness about soil-transmitted helminths

Educational Status * Awareness STH Cross tabulation					
			Awareness STH		
			NO	Yes	Total
Education	Basic	Count	**89**	35	124
		% within Education	71.8%	28.2%	100.0%
		% within AwarenessSTH	38.2%	26.3%	33.9%
	Intermediate	Count	**85**	50	135
		% within Education	63.0%	37.0%	100.0%
		% within AwaernessSTH	36.5%	37.6%	36.9%
	Academic	Count	**59**	48	107
		% within Education	55.1%	44.9%	100.0%
		% within AwarenessSTH	25.3%	36.1%	29.2%
Total		Count	**233**	**133**	366
		% within Education	63.7%	36.3%	100.0%
		% within Awareness STH	100.0%	100.0%	100.0%

Chi-Square Tests			
	Value	df	Asymptotic Significance (2-sided) P value
Pearson Chi-Square	6.915	2	0.032
Likelihood Ratio	6.961	2	0.031
Linear-by-Linear Association	6.887	1	0.009
N of Valid Cases	366		

Dog Management Practices

As far dog's management is concerned, 271 owners (74%) were completely taking care of their pet animals while 44 (12 %) respondents stated that they took partial care of their dogs and allowed to freely roam in neighborhood. But surprisingly, 51 (13.9%) individuals were sheltering free-roaming/stray dogs that often visit their houses.

Approximately twenty-three percent of pet owners reported detection of worms in their pet animals' feces and vomits. Regarding the control of internal parasites, 29.23% (107/366) owners followed a treatment regimen as suggested by a veterinarian (four times a year) whereas 18.6% (68/366) dewormed twice yearly, 42.9% (157/366) not on regular basis and 9.3% (34/366) had never treated their pets with dewormer (Table 1). Stool examination for parasitic stages was done when recommended by a veterinarian (34.7%) by most pet owners, 15.6% (57/366) owners got it done during the regular checkup of their pet dog, 27.0% (99/366) had done when the pet was showing signs of infection and 22.7% (83/366) had no idea about the fecal examination.

Discussion

Knowledge perception on zoonotic STHs revealed that more than half of the respondents were unaware of the parasites being transmitted from pet dogs. The awareness levels (36.3%) reported in the current survey were comparatively higher than the previous reports from India *i.e.,* 13.32 and 4.13 % obtained from pet owners of Pondicherry and Mathura (Das *et al.* 2007; Kumar *et al.* 2014). The differences regarding awareness level might be attributed to survey methodology, as the present one was a written questionnaire giving a high scope of liberty in expressing their opinions as compared to oral interview methodologies. Moreover, perception levels in any given community/region might rely on factors like educational status and socioeconomic standards. When "educational status" and "awareness about parasites being transmitted through soil" were compared, most of the responders with minimal education were unaware of STHs. As a matter of fact, the low educational level of pet owners has been considered as a predisposing factor for the prevalence of STHs parasites in companion animals (Pereira *et al.,* 2016; Balassiano *et al.,* 2009).

In the same line of thought, individuals with a sound educational backdrop (Academics) were keen on washing their hands every time they contacted the pet dog. Out of 34 individuals who never washed their hands, the majority were falling under the basic education group. Identical results were obtained when Pondicherry pet owners were surveyed wherein the tendency to use soap was more in graduate owners (Das *et al.* 2007).

Breed, age, sex, and management are some risk factors that predispose dogs to parasitism and thereby increase the risk of exposure to humans. About a quarter of respondents preferred rearing non-descriptive (N.D) local breeds. Studies by Panigrahi *et al.* (2014) and Sahu *et al.* (2014) reported a high prevalence of parasites in non-descriptive local breeds as compared to pure breeds. When the age of the animal is accounted for, most of them were between 1-2 (180/366) age group indicating recent adoptions and increased pet acceptance among Andhra people. Most pet owners in the study preferred male dogs over females; reasons might be high maintenance needs, problems of conception, whelping, and weaning management for female dogs as compared to males. Though sex was not a significant risk factor (Swai *et al.,* 2010), male dogs harbor more parasites due to a greater inclination to roam than females (Reynolds *et al.,* 2016).

Pet management is crucial in deciding the animal's health and indirectly influences the wellbeing of humans. In the current study, the unrestrained outside access (39.43% of owners allowed their pet dogs to freely roam) facilities the rampant excretion of infested dog excreta into the environment and thereby increasing the incidence of STHs infections in the regions (Otranto *et al.,* 2017). Further, the low percent of pets (29.23%) under effective prophylaxis in the study is worrying. However, this information could not be reliable as most of the pet owners were not clearly aware of the terms anthelminthic/dewormer and many mistook it for vaccination.

Query on pets having access to their owner's bedroom revealed that 20.2 % allowing them to share the beds and additionally, lack of care and attention towards pets is another factor that risks the exposure of the children in the households to the infections of zoonoses (Sharma *et al.,* 2017). Analyzing the data appertaining to dog's defecating sites and risk zones for children gaining access to soil, the most contaminated sites could be school playgrounds followed by backyards and under tree open areas. Correspondingly, Paller *et al.* (2014) assessed the prevalence and intensity of parasitic egg contamination in soils and revealed that empty lots (33%) followed by schools (29%) and backyards (25%) were the most contaminated sites. However, contaminated the soil/site may be, the most influential liable factor in deciding the persistence of STH within the community is their access to soil (by both children and pet animals). In a densely populated country like India, it is practically impossible to restrain access to soil due to a lack of robust monitoring programs.

Conclusion

As awareness about a disease is a prerequisite for the effective implementation of control strategies, the limited STHs knowledge recorded in the study is a concern. Given the dearth of infrastructure facilities and poor surveillance systems in India, signaling out STHs risk factors becomes an intricate process. This cannot be achieved alone and a multidisciplinary approach involving medical and veterinary professionals towards the review of animal-associated zoonoses with patients/clients is the need of the hour. The level of knowledge on zoonotic parasites transmitted through soil, water, and food varies among ethnic groups or communities. Hence, awareness surveys remain a reliable screening tool for identifying those groups that are in great need of additional education.

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Declarations

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Data availability statement

The data presented in this study is available as supplementary material provided at the end of the manuscript.

Authorship Policy

I being the corresponding authors declare that the names, addresses and affiliations of all authors are correct and in the right order and are as per the institutional approvals and that all authors have seen and agreed to a submission.

Consent to participate/publish

Owners who gave full consent to participate in the survey were included in the study

Conflict of Interests

There is no conflict of interest.

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