Zoonotic Disease Knowledge, Attitudes, and Practices in Chuquisaca, Bolivia

Conocimientos, actitudes y prácticas sobre enfermedades zoonóticas en Chuquisaca, Bolivia

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Abstract

Introduction. About 60% of emerging infectious diseases are zoonotic, originating mainly from wildlife. **Objective.** To identify the knowledge, attitudes, and practices associated with zoonotic transmission risks in communities from urban, rural, and protected areas. **Methods.** A cross-sectional study in a representative sample stratified by areas (urban, rural and protected areas) and age groups. A standardized survey in Spanish and Quechua, adapted to the local context, was applied to explore sociodemographic data, contact with animals, attitudes towards wildlife, its trade and consumption, and knowledge about zoonotic diseases and sources of information. Trained local interviewers visited households and recorded information using the ODK application on electronic tablets. Frequencies were described and the chi-square test was used to compare the distribution by area. **Results.** A total of 922 people took part in the study. The most recognized diseases were rabies (57.3%), Chagas disease (36.1%) and yellow fever (11.5%). Few respondents had previous training on zoonosis (8.9%), higher in the protected area (13.5%). In addition, there was concern about zoonosis outbreaks (70.7%), and (70.7%) indicated that wild animals should be protected, with significant differences across study areas. (76.4%) have close contact with animals; (62.5%) handled slaughtered animals and their parts; (35.2%) noted the presence of animal feces in or near food; (13.3%) indicated selling, ingesting or sharing dead animals that had died from unknown causes. **Conclusions.** Low knowledge, perceptions and practices of high zoonotic risk in human-animal interactions were identified, with significant differences according to the area of residence.
Keywords: Zoonoses; Domestic Animals Rearing; Wild Animals; Human-Animal Bond; Bolivia (source: DeCS BIREME).

Resumen

Introducción. Alrededor del 60% de las enfermedades infecciosas emergentes son zoonóticas y provienen principalmente de la fauna silvestre. **Objetivo.** Identificar conocimientos, actitudes y prácticas asociadas a riesgos de transmisión zoonótica en comunidades de áreas urbanas, rurales y protegida, para prevenir potenciales brotes zoonóticos. **Métodos.** Estudio transversal en una muestra representativa estratificada por zonas (urbana, rural y área protegida) y grupos de edad. Se aplicó un cuestionario estandarizado en español y quechua, adaptado al contexto local, para explorar datos sociodemográficos, contacto con animales, actitudes hacia la fauna silvestre, su comercio y consumo, y conocimientos sobre enfermedades zoonóticas y fuentes de información. Entrevistadores locales formados visitaron los hogares y registraron la información utilizando la aplicación ODK en tabletas electrónicas. Se describieron las frecuencias y se utilizó la prueba de Chi-cuadrado para comparar la distribución por zonas. **Resultados.** En total participaron 922 personas. Las enfermedades más reconocidas fueron: La Rabia (57,3%), Chagas (36,1%) y Fiebre Amarilla (11,5%). Se revela bajo porcentaje de formación en zoonosis: 8,9% (mayor en área protegida, 13,5%). Asimismo, la preocupación por brotes zoonóticos es del (70,7%). Mientras que otro (70,7%) indicaron que la fauna silvestre debe estar protegida, con diferencias significativas entre zonas de estudio. Tienen contacto con animales (76,4%); manipulación de animales sacrificados y sus partes (62,5%); señalaron heces en alimentos o cerca (35,2%); consumo o venta de animales muertos por causas desconocidas (13,3%). **Conclusiones.** Se identificaron bajos conocimientos, percepciones y prácticas de alto riesgo zoonótico en las interacciones hombre-animal, significativamente diferentes entre áreas de residencia.
Palabras clave: Zoonosis; Crianza de Animales Domésticos; Animales Salvajes; Vínculo Ser Humano-Animal; Bolivia (fuente: DeCS BIREME).

INTRODUCTION

Zoonotic diseases are infections naturally transmitted from vertebrates to humans and they have a significant public health and animal health concern worldwide [1,2]; transmission of zoonoses can be done through direct contact with domestic animal (farm animals and pets), or wild animals (those living freely in their natural habitat without having generational management), or indirect contact through vectors, the environment, or contaminated food [2]. More than 60% of pathogenic microorganisms in humans have a zoonotic origin, and about 25% come from domestic animals, while 75% from wildlife [2-4].

The risk of zoonotic diseases is linked to knowledge, attitudes, and practices (KAP) related to human-animal interactions and direct contact with animals, as well as with their products or by-products during trade, consumption, and traditional use activities [4–7]. Likewise, lack of access to basic services, poverty, and low education levels are considered risk factors that facilitate the transmission of zoonotic diseases or other common infections, which are common in Latin American countries [8,9]. In 2022, poverty in Latin America affected 26.1%, of the urban population and 41.0% of the rural population. In Bolivia, in 2021, 66.1% of the population lives in poverty, 23.3% in urban areas, and 42.8% in rural areas [9], The most common zoonotic diseases in Latin America include brucellosis, campylobacter, anthrax, avian chlamydiosis, colibacillosis, cryptococcosis, dermatophytosis, tuberculosis, leptospirosis, listeriosis, salmonellosis, rabies, Chagas disease, cysticercosis, fascioliasis, hydatidosis, leishmaniasis, toxoplasmosis, trichinellosis, tungiasis (Chigger) [10,11].

Previous studies in China, Africa, and Irán on Knowledge, Attitudes, and Practices (KAP studies) have identified risk-related attitudes and practices associated with zoonotic disease transmission [4–7]. These studies serve as valuable tools for assessing health risks and identifying opportunities for behavior change aimed at disease prevention. However, no KAP studies on zoonotic disease risks have been conducted in Bolivia, and the existing information is limited to specific zoonotic diseases [12,13]; therefore, conducting KAP studies focused on prevention strategies adapted to the local context is considered relevant.

Considering this, our study aimed to identify the KAPs regarding the risks of zoonotic diseases in Urban and Rural communities and within a Protected Area in the municipality of Presto, Bolivia. This study will provide information to strengthen health programs, by considering the interaction between people, animals, and the environment, reducing the risk of zoonotic disease transmission through improved preventive measures.

METHODS

Study design and study area

A cross-sectional study was conducted between August 2022 and December 2023 in the municipality of Presto, Chuquisaca-Bolivia, which has an area of approximately 1443,8 km_2 and has an estimated population of 12385 inhabitants [14]. They are distributed in communities located in Urban areas (urban center with more than 2000 inhabitants), Rural (Population center with less than 2000 inhabitants), and within the Protected Area (Figure 1) The latter are cultural and environmental conservation areas managed by the national government, where both wildlife and people coexist, with each community having fewer than 2000 inhabitants [15,16]. The municipality brings together 36 communities (1 Urban, 26 Rural, and 9 within the Protected Area) where the predominant language spoken is Quechua [14,17]. The Integrated Management Natural Area (IMNA) "El Palmar" is one of the nine Protected Areas of Chuquisaca [18]. It was founded as an IMNA by the National Government in 1997, allowing the establishment of communities and sustainable rural development within the framework of biodiversity conservation [16].

The Protected Area IMNA “El Palmar" has 594,8 km_2. It occupies dry mesothermal valleys with humid mountainous forests and semi-arid valleys. In this area, several species of wildlife were recorded: 173 vertebrates species, 30 large and medium-sized mammals, 115 birds species, 17 reptiles species, 6 amphibians species, and 3 fish species [16,19]. Three threatened species of conservation interest are registered: the Jucumari bear (*Tremarctos ornatus*) and two bird species, the Red-fronted Macaw (*Ara rubrogenys*) and the Andean Condor (*Vultur gryphus*) [16,20].

On the other hand, rural and urban communities are distributed in 849,0 km_2 outside the limits of the Protected Area, where land use is primarily dedicated to agricultural production, farm animal rearing, and monocultures mainly of pine and eucalyptus [17,21].

Study population and sample

The study population consisted of households in the municipality of Presto, considering 8 communities out of a total of 36 randomly selected: 1 in the Urban area (Presto), 2 in the Rural area (Tomoroco and Pasopaya), and 5 in the Protected Area (Aramasi, Loman, Rodeo El Palmar, Molani, Joya Charal). Communities with difficult geographical access were excluded from the sampling framework [14,16].

For each community, a random sampling of blocks (areas that group several homes delimited by streets) was performed, and all households were included in each block. In each household, all individuals aged 10 years and older were interviewed. The StatCalc module of Epi Info™ Version 7.2 was used to calculate the sample size, following population survey and descriptive study criteria recommended in previous research [22] The sample size was estimated based on an expected prevalence of 50% (maximum possible proportion for the main categorical study variables), with a 5% margin of error, adjusted for the total population size. The final sample size was 300 respondents per study area (urban, rural, and protected area), resulting in a total of 900 respondents.

Definitions of instruments and variables

To measure knowledge, attitude and practice on zoonotic risk in wildlife trade and consumption, we used an adapted version of the surveys proposed in studies conducted in China among adult Internet users aged ≥ 18 years, residing in three provinces (Yunnan, Guangxi, and Guangdong), and another study carried out in Africa among vendors, butchers, market managers, cleaners, hunters, middlemen/transporters and hospitals patients. in three locations: Meyomessala,

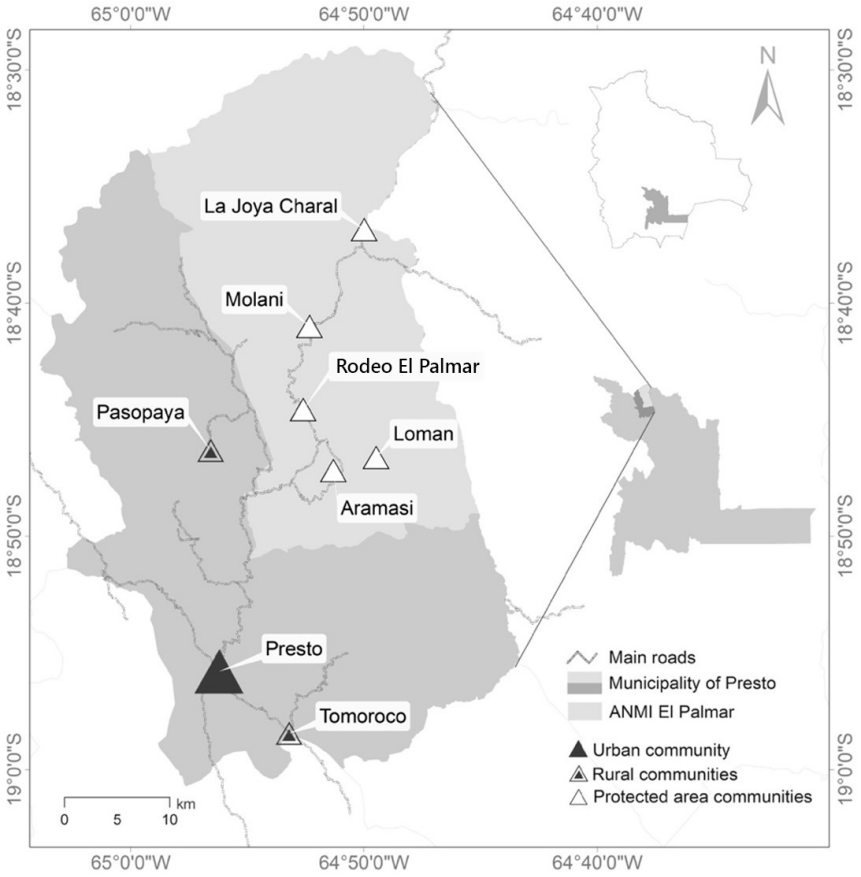

Figure 1. Municipality of Presto, Bolivia. The communities where the study was carried out are indicated.

Sangmelima and Ebolowa) [6,7], due to the absence of a validated instrument for Bolivia. The survey was translated into Spanish and Quechua and adapted to the local context (Supplementary Material 1).

The survey was administered in households by trained local enumerators, with data collected directly on electronic tablets using the ODK application [23]. The survey was available in Spanish and Quechua, using the respondents' preferred language. The survey included six sections: (1) demographics; (2) education and employment ; (3) health history; (4) experience with animals contact; (5) attitudes towards wildlife, its trade and consumption; and (6) knowledge of zoonotic diseases and sources of information. The survey contained 96 questions with several response formats, including dichotomous, multiple choice, open-ended responses, and Likert scale (yes, unsure, no). The approximate time to complete the survey was 60 minutes.

Sociodemographic data included age (categorized as ≤ 18; 19 – 39; 40-59 >60 years old), sex (male, female), education level (none, primary and secondary or higher), ethnic identification (yes, no), any religious identification (yes, no), current employment (yes, no), length of residence in the community (≤ 10, > 10 years). Monthly income was analyzed as a continuous variable, and it was categorized based on the National Minimum Wage (NMW) in Bolivia for 2022 (≤ USD 350: less than the NMW, and > USD 350: more than the NMW). Finally, healthcare was considered where the people go when they are sick (conventional medicine only: hospital, primary care; traditional medicine only: traditional healers and herbal medicine; and both conventional and traditional medicine).

Knowledge of zoonotic diseases was assessed using 21 questions, considering the following variables: prior training on zoonoses (yes, no), perceived likelihood of disease transmission from animals to humans (yes: "I guess yes"/"I am certain"; no: "I guess not"/"certainly not and "I don't know"), perceived likelihood of disease transmission through wildlife trade animals (yes: I guess yes/ I'm sure so; no: I guess not/certainly not; and "I don't know") and recognition of specific zoonotic diseases (yes or no for the following diseases: rabies, Chagas disease, yellow fever, hantavirus infection, COVID-19, chikungunya, tuberculosis, brucellosis, salmonellosis, leptospirosis).

Attitudes toward wildlife, its trade, and consumption were assessed using 21 questions, consisting of a series of statements designed to measure attitudes regarding concern about zoonotic disease outbreaks and perceptions toward wildlife, its trade and consumption. All responses followed three categories (yes, I don't know, and no) and were subsequently coded in (yes and no/I don't know).

Practices related to zoonotic diseases risk were explored through 24 questions, inquiring about specific behaviors during the last 12 months, including: keeping animals as pets; breeding animals; presence of animal feces in or near food; handling freshly slaughtered animals or their parts; fresh consumption of animals or their organs; selling, eating, or sharing dead animals found; being bitten or scratched by animals; and hunted or trapped an animal. Each question was was formulated as dichotomous (yes, no). If the answer was positive, the type of animal was specified.

Considering the biodiversity of the area, the animals were classified into three groups: farm animals, (horses, poultry, pigs, cows, and bees); pets (dogs and cats); and wild animals, (wild rodents, rabbits, wild birds, carnivores, anteaters, tatus, deer, peccaries, iguanas, amphibians and fish).

Additionally, we asked about where animal meat is obtained for consumption (local markets, supermarkets/butcher, open-air markets, warehouses/grocery stores, and self-supply or family provision); conditions of sale (live animal, dead in whole body and dead dismembered (in parts); and whether they produce or apply any medicinal substance derived from wild animals (yes, no).

Data analysis

Data were collected online using Microsoft Excel through the ODK© software [23] Statistical analyses were conducted using IBM SPSS Statistics, version 29.0 (IBM Corp., 2022). Absolute and relative values for each variable were reported. A two-sided Chi-square test was used to compare their distribution of KAP according to the study areas (urban, rural, and the ANMI "El Palmar" communities).

Ethical considerations

The study followed the recommendations of the Declaration of Helsinki for research in humans beings. The study proposal was approved by the Bioethics Committee of the Faculty of Medicine of the Universidad Mayor of San Simón in Cochabamba, Bolivia. Additionally, authorization was obtained from local authorities and the National Protected Areas Service (SERNAP) of Presto. Prior to obtaining written informed consent, all respondents were provided with a clear explanation of the study objectives and procedures. For underage respondents, written parental consent and assent of the respondents were required. The survey was anonymous. Voluntary participation in the study was respected.

RESULTS

A total of 922 people participated in the surveys, the majority were women (57. 6%). (66.6%) of the respondents were between 19 and 60 years old, (42.4%) had primary education and (85.3%), had lived in the community for more than 10 years. Additionally, 90% self-identified as indigenous (with the highest proportion in the Protected Area), 80% were unemployed and 90% reported an income of less than 350 USD per month. 76.3% used conventional medicine, while 20.9% combined traditional and conventional medicine. Lower levels of education were observed in rural areas, while religious identification was more prevalent in urban areas (Table 1).

Knowledge of zoonotic diseases

Only (8.9%) of respondents had received training on zoonosis (Table 2), 60.4% considered animal-to-human

Table 1. Sociodemographic information of the study population by area.

Variable	Total (N = 922) n (%)	Urban (n = 300) n (%)	Rural (n = 304) n (%)	Protected area (n = 318) n (%)	p[a]-value
Age (years)					
< 18	306 (33.4)	100 (33.3)	101 (33.3)	101 (32.2)	0.330
19- 39	166 (18.1)	58 (19.3)	45 (14.9)	67 (21.3)	
40- 59	137 (14.9)	41 (13.7)	55 (18.2)	41 (13.1)	
≥ 60	308 (33.6)	101 (33.7)	102 (33.7)	105 (33.4)	
Génder					0.181
Male	391 (42.4)	115 (38.3)	131 (43.1)	145 (45.6)	
Female	531 (57.6)	185 (61.7)	173 (56.9)	173 (54.4)	
Level of schooling					< 0.001
None	254 (27.8)	81 (27.0)	97 (32.3)	76 (24.1)	
Primary	388 (42.4)	104 (34.7)	95 (31.7)	189 (60.0)	
≥ Secundary	273 (29.8)	115 (38.3)	108 (36.0)	50 (15.9)	
Incomes/month (USD)					< 0.001
≤ 350	830 (90.0)	254 (84.7)	275 (90.5)	301 (94.7)	
> 350	92 (10.0)	46 (15.3)	29 (9.5)	17 (5.3)	
Residence time (years)					< 0.001
≤ 10	135 (14.7)	92 (30.8)	24 (7.9)	19 (6.0)	
> 10	786 (85.3)	207 (69.2)	280 (92.1)	299 (94.0)	
Identification with ethnic groups- Yes (Quechua)	828 (90.0)	295 (98.3)	215 (71.2)	318 (100)	< 0.001
Identification with some religion – Yes	782 (84.9)	289 (96.3)	201 (66.3)	292 (91.8)	< 0.001
Current job – Yes	184 (20.0)	69 (23.0)	75 (24.7)	40 (12.6)	< 0.001
Health care					< 0.001
Only conventional medicine	694 (76.3)	283 (96.9)	170 (56.1)	241 (76.8)	
Only traditional healers/medicine	25 (2.8)	0 (0.0)	1 (0.3)	24 (7.6)	
Conventional – traditional medicine	190 (20.9)	9 (3.1)	132 (43.6)	49 (15.6)	

[a] Chi-square test

Table 2. Knowledge regarding zoonoses in the population studied

Variable	Total (N = 922) n (%)	Urban (n = 299) n (%)	Rural (n = 304) n (%)	Protected area (n = 318) n (%)	p[a]-value
Prior training on zoonosis- Yes	82 (8.9)	13 (4.3)	26 (8.6)	43 (13.5)	< 0.001
Probable transmission of illness between animals and humans					
No	158 (17.1)	60 (20.0)	81 (26.6)	17 (5.3)	< 0.001
Yes	557 (60.4)	200 (66.7)	106 (34.9)	251 (78.9)	
Don´t know	207 (22.5)	40 (13.3)	117 (38.5)	50 (15.7)	
Probable transmission of illness by trading wild animals					
No	139 (19.6)	53 (22.4)	73 (27.4)	13 (6.3)	< 0.001
Yes	324 (45.8)	137 (57.8)	63 (23.7)	124 (60.5)	
Don´t know	245 (34.6)	47 (19.8)	130 (48.9)	68 (33.2)	
Recognition of particular illnesses like zoonosis					
Rabies	530 (57.3)	151 (50.3)	177 (58.2)	202 (63.5)	0.004
Chagas disease	333 (36.1)	54 ((18.0)	86 (28.3)	193 (60.7)	< 0.001
Yellow fever	106 (11.5)	8 (2.7)	67 (22.0)	31 (9.7)	< 0.001
Hantavirus	79 (8.6)	52 (17.3)	26 (8.6)	1 (0.3)	< 0.001
Covid-19	75 (8.1)	36 (12.0)	29 (9.5)	10 (3.1)	< 0.001
Chikungunya	25 (2.7)	14 (4.7)	10 (3.3)	1 (0.3)	0.003
Tuberculosis	22 (2.4)	0 (0.0)	20 (6.6)	2 (0.6)	< 0.001
Brucellosis	17 (1.8)	1 (0.3)	16 (5.3)	0 (0.0)	< 0.001
Salmonellosis	17 (1.8)	7 (2.3)	8 (2.6)	2 (0.6)	0.133
Leptospirosis	7 (0.8)	0 (0.0)	7 (2.3)	0 (0.0)	< 0.001
All	21 (2.3)	0 (0.0)	21 (6.9)	0 (0.0)	< 0.001

[a] Chi-square test

transmission likely, while 45.8% attributed it to wildlife trade, with the highest percentages in the Protected Area.

Attitudes regarding interaction with wild animals

Among the respondents, 70.7% expressed concern about zoonotic disease outbreaks (Table 3), with less concern in rural areas (26.6%) compared to urban areas (97.7%) and Protected Areas (87.4%). In the protected area, (84.6%) considered wild animals as harmful, while (85.8%) supported their protection. In addition, (67.9%) rejected the trade and consumption of wild animals, although (48.7%) accepted their use for traditional medicine, cosmetics or health.

Practices related to human-animal contact

The main human-animal interactions include animal rearing (76.4%) keeping (75.2%) and slaughter (62.5%) (Table 4). Among farm animals, the most frequent interaction were slaughter (43.4%) and fresh consumption (14.8%); among pets, bites/scratches (13.8%) were the most reported incidents; and with wild animals, hunting (17.2%) was the primary interaction. Additionally, 35.2% saw feces in their food or nearby (29.5% farm animals, 6.9% pets, 2.0% wild animals), and 13.3% reported consuming or selling animals that had died from unknown causes in the last year.

Table 3. Attitudes concerning the interaction with wild animals and their use (positive responses).

Attitudes	Total I (N = 922)	Urban (n = 299)	Rural (n = 304)	Protected area (n = 318)	p[a]-value
Concern about zoonotic disease outbreaks	652 (70.7)	293 (97.7)	81 (26.6)	278 (87.4)	< 0.001
Wild animals must be protected from people	652 (70.7)	236 (78.7)	143 (47.0)	273 (85.8)	< 0.001
Wild animals are harmful to people	641 (69.5)	163 (54.3)	209 (68.8)	269 (84.6)	< 0.001
Wild animals should not be sold or consumed	548 (59.4)	186 (62.0)	146 (48.0)	216 (67.9)	< 0.001
Wild animals generate benefits for people	360 (39.0)	122 (40.7)	113 (37.2)	125 (39.3)	0.674
Consumption of wild animals for traditional medicine, cosmetics, or health purposes is permitted	249 (27.0)	10 (3.3)	84 (27.6)	155 (48.7)	< 0.001

We present the absolute and relative frequencies of affirmative responses.
[a] Chi-square test

Table 4. Human-animal contact and related practices in the past 12 months.

Type of contact	Any animal	Domestic Animals (Farm)[a]	Domestic Animals (Pets)[b]	Wild animals [c]
Animal breeding	704 (76.4)	612 (66.4)	616 (66.8)	21 (2.3)
Pets	693 (75.2)	145 (15.7)	656 (71.1)	1 (0.1)
Handling recently slaughtered animals or parts of animals	576 (62.5)	400 (43.4)	3 (0.3)	3 (0.3)
Animal feces on or near food	325 (35.2)	272 (29.5)	64 (6.9)	18 (2.0)
An animal being hunted or trapped	237 (25.7)	68 (7.4)	2 (0.2)	152 (16.5)
Bitten or scratched	159 (17.2)	25 (2.7)	127 (13.8)	0 (0.0)
Fresh consumption of animals or their organs	137 (14.9)	136(14.8)	0 (0.0)	3 (0.3)
Animals that died of an unknown cause being sold, eaten, or shared	123 (13.3)	123 (13.3)	0 0.0)	0 (0.0)

We present the absolute and relative frequencies of affirmative responses
[a] Includes: Horse, mules, poultry, goats, sheep, pig, cattle, insects (bees)
[b] Includes: Dogs and cats
[c] Includes: wild rodents, rabbits, wild birds, carnivores, anteaters, tattoos, deer, peccaries, iguanas, amphibians, and fish

Differences were observed in meat purchasing habits and sale conditions across the rural, urban, and protected areas (Table 5). Respondents from Protected Area reported a higher percentage of self-supply and sale of live animals compared to the other areas. Almost all respondents used medicinal substances derived from wildlife, with a higher prevalence in rural areas compared to urban and protected areas.

DISCUSSION

In Presto, only 8.9% of respondents had received training in zoonotic diseases, and despite existing prevention campaigns, awareness of prevalent diseases—such as rabies, Chagas disease, and yellow fever—remained limited [24,25]. This underscores the need to strengthen educational programs and preventive measures, emphasizing the human-animal-environment relationship [26,27]. On the other hand, some contradictory attitudes regarding the protection, use and consumption of wild animals were identified, and practices that increase the risk of zoonotic transmission. Previous studies on KAP in Africa [4,28] and Latin America [8] has highlighted low awareness of zoonotic risks among individuals in frequent contact with farm animals, pets and, to a lesser extent, wildlife.

Our findings indicate that six out of ten respondents considered animal-to-human disease transmission plausible. Studies show low perception of zoonotic risk in people in contact with animal products at wildlife markets in Africa, America, Asia, Europe [7,29]. Another study found that pig farmers acknowledged zoonotic risks, but lacked awareness of the specific transmission mechanisms of swine-related diseases [30]. On the other hand,

Table 5. Places and conditions of sale of animal meat.

Variable	Total (N = 922) n (%)	Urban (n = 299) n (%)	Rural (n = 304) n (%)	Protected area (n = 318) n (%)	p[a]-value
Place of sale					
Warehouses or shops	515 (55.9)	230 (76.7)	68 (22.4)	217 (68.2)	< 0.001
Local market	422 (45.8)	68 (22.7)	260 (85.5)	94 (29.6)	< 0.001
Freight markets	317 (34.4)	6 (2.0)	299 (98.4)	12 (3.8)	< 0.001
Supermarket or butcher shops	52 (5.6)	5 (1.7)	42 (13.8)	5 (1.6)	< 0.001
Self-supply or supply by relatives	11 (1.2)	1 (0.3)	0 (0.0)	10 (3.1)	< 0.001
Terms of sale					
Dead, dismembered (in parts)	640 (69.4)	295 (98.3)	267 (87.8)	78 (24.5)	< 0.001
Alive	135 (14.6)	3 (1.0)	10 (3.3)	122 (38.4)	< 0.001
Preparing or applying any medicinal substance from wild animals	64 (6.9)	14 (4.7)	30 (9.9)	20 (6.3)	0.036
Dead, whole body	19 (2.1)	1 (0.3)	5 (1.6)	13 (4.1)	0.004

[a] Chi-square test

limited knowledge of zoonoses has been linked to lower educational attainment [31]. In our study, (27.8%) of respondents had no formal education, while 42.4% had only primary education, which may have influenced the findings. Likewise, education on wildlife and zoonotic diseases was higher in Protected Areas than compared to other studies sites, due to governmental and external initiatives [16]. In Palomares et al. research [8] identified gaps in knowledge, communication, perception, and prevention of zoonotic diseases in rural areas of Latin America. Consistent with their findings, our study revealed lower levels of zoonotic knowledge in rural areas compared to urban and protected areas, highlighting the need for further local research to explore these disparities.

A total of (70.7%) of Presto residents expressed concern about zoonotic outbreaks. This finding aligns with previous studies [8,32,33] that highlight Latin America's vulnerability due to favorable conditions for the transmission of diseases such as rabies, brucellosis, leptospirosis, cysticercosis, and tuberculosis. In response, the Food and Agriculture Organization (FAO), the United Nations Environment Programme (UNEP), the World Organisation for Animal Health (WOAH, formerly OIE), and the World Health Organization (WHO) have been working to enhance interinstitutional cooperation to mitigate zoonotic diseases and prevent pandemic outbreaks [32]. Monitoring and analyzing local and regional zoonoses is essential, alongside assessing their impact on the economy, human-animal health, and the environment.

Our study shows contradictory attitudes toward wildlife: While (70.7%) of respondents support wildlife protection, (69,5%) perceive it as harmful. This negative perception could be due to the unfavorable impact on agriculture and livestock farming. Previous research has linked these human-wildlife conflicts to land conversion for agricultural purposes [29,34]. In Presto, personal communications reported livestock losses due to attacks by the Andean bear (*Tremarctos ornatus*), puma (*Puma concolor*), Andean condor (*Vultur gryphus*), and fox species (*Cerdocyon thous, Pseudalopex gymnocercus*), as well as crop damage caused by the collared peccary (*Tayassu tajacu*) and the red-fronted macaw (*Ara rubrogenys*) [16] . Similar cases have been documented in other conservation areas [35,36].

Our study reveals that 39.0% of the respondents believed that wild animals provide benefits to humans, with no significant differences across study areas (urban area: 40.7%, protected area: 39.3%, rural area: 37.2%). Additionally, 59.4% of respondents rejected the sale and consumption of wild animals, although this percentage was significantly lower in rural areas (48%). While various studies promote positive attitudes toward wildlife, emphasizing its cultural, traditional, and touristic benefits, mainly driven by institutional efforts [19,37], in our context, further reinforcement is needed to enhance both current and potential benefits at different levels (e.g., human health, environmental sustainability, and ecosystem balance). Moreover, current conservation efforts are primarily focused on protected areas, whereas adjacent rural areas receive less attention, which may explain the lower level of awareness regarding wildlife trade and consumption among rural populations.

On the other hand, Overgaauw *et al.* [38], detected Toxocara, Giardia, and Cryptosporidium sp. in pet feces and fur, as well as household practices that facilitate zoonotic transmission [39]. Other studies have reported risks associated with airborne transmission, contact with urine (leptospirosis), and fecal-oral ingestion (salmonellosis and campylobacteriosis). In our study, 35.2% of respondents reported the presence of animal feces near food, primarily from livestock, followed by pets and wild animals. This could be attributed to practices where livestock roam freely during the day and are sheltered at night, while pets live close to human dwellings, thereby increasing the risk of zoonotic diseases such as bacterial infections, mycoses, chlamydiosis, rickettsioses, viral infections, and parasitic diseases [40,41]. Penakalapati *et al.* [42] found that in low- and middle-income countries, livestock contaminate food and water sources more frequently than pets, facilitating zoonotic transmission. It is crucial to develop interventions that consider sociocultural factors to mitigate these risks and improve community health.

This is the first study conducted in Chuquisaca, Bolivia, that reports on Knowledge, Attitudes, and Practices (KAP) regarding zoonoses, comparing three areas of interest (urban, rural, and protected areas). This research serves as a reference point for future interventions in zoonotic risk management, studies, and prevention, considering the specific characteristics of each area and its relationship with domestic and wildlife species.

Our study has some limitations. Although we employed instruments previously used in other studies, these have not been specifically validated for Bolivia, which could affect the contextualization of certain questions. Moreover, the sample may not adequately represent the most isolated communities, such as those in rural and protected areas, which could lead to an overestimation of knowledge on zoonoses and an underestimation of risk practices, given the greater interaction with domestic and wild animals in these regions. For this reason, we recommend not extrapolating the conclusions beyond the geographic area studied. Additionally, grouping respondents into four age ranges in the general analysis may have influenced the results, as these groups might differ in knowledge and experience relevant to the study's context. The differences in knowledge, attitudes, and practices across the evaluated areas highlight the need for comprehensive health interventions and research at the human-animal-environment interface, considering local particularities and respecting cultural traditions [29].

In conclusion, our study revealed low levels of knowledge about zoonoses, poor recognition of prevalent zoonotic diseases, and risk-prone practices. This provides a baseline for designing prevention strategies adapted to the local context. It is essential to further investigate the use, consumption, and trade of domestic and wild animals to identify specific zoonotic risks and their relationship with biodiversity conservation. Additionally, it is crucial to analyze the existing regulations, their enforcement, and control mechanisms, and to strengthen educational strategies related to knowledge of livestock, pets, and wildlife, in order to mitigate human-wildlife conflicts and reduce the risk of zoonotic diseases through preventive measures.

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