



Socioeconomic, Cultural, and Environmental Dimensions of Pet Health: A One Health Community Study among the Emberá Chamí in Las Brisas, Pereira

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Abstract

This study explores the interconnections between animal, human, and environmental health in the Emberá Chamí Indigenous community of Las Brisas, located in an urban area of Pereira (Risaralda, Colombia) characterized by social and economic challenges. The research adopted a qualitative, exploratory, and descriptive approach within the interpretive paradigm, seeking to understand cultural meanings, community perceptions, and structural conditions influencing the human-animal relationship.

The methodological design included semi-structured interviews, a community focus group, and the participatory application of the Vester Matrix. Twenty families served as the core unit of analysis, while around thirty community members participated in the validation and prioritization of factors.

Findings highlight the scarcity of accessible veterinary services, constraints related to household income, and limited access to formal education as key factors shaping opportunities for responsible pet ownership. Although pet ownership was low, participants expressed strong interest in animal health programs and valued the relevance of the One Health approach.

The study concludes that addressing animal welfare in urban Indigenous communities requires integrated strategies that expand access to veterinary services, promote intercultural education, and foster institutional recognition of animal health as part of community well-being. These results also suggest opportunities to design community-based business models including veterinary telemedicine, mobile services, and artisanal

production of supplies that connect veterinary medicine, business administration, and ancestral knowledge.

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Introduction

Animal, human, and environmental health are deeply interconnected, especially in urban contexts marked by social inequalities, housing constraints, and limited access to integrated health services. This interdependence has been widely recognized by the One Health approach, which promotes collaborative, multisectoral, and transdisciplinary strategies to achieve sustainable health outcomes (Zinsstag et al., 2015; CDC, 2021). In Colombia, the implementation of this approach has been incipient, particularly in urban Indigenous settings where communities face multiple forms of exclusion.

One such context is the Las Brisas neighborhood in Pereira, Risaralda, where part of the Emberá Chamí Indigenous population resides. This community has experienced processes of forced displacement, structural poverty, and urban marginalization, shaping conditions that influence their interactions with companion animals. Limited pet ownership, together with frequent presence of street animals, reflects the challenges of small, densely shared housing, restricted access to veterinary care, and gaps in information regarding animal welfare.

Within this context, the present study focused on developing an economic, social, and environmental diagnosis of the interactions between the Emberá Chamí community and their companion animals in Las Brisas. The objectives included exploring community knowledge and perceptions of animal welfare and One Health; identifying socioeconomic and cultural conditions affecting responsible coexistence; and proposing strategies to promote animal welfare, health education, and local development through sustainable, intercultural models.

Despite structural barriers, the human-animal bond retains symbolic and emotional value for many families, serving as a potential foundation for social innovation, local development, and cultural strengthening. The articulation of ancestral knowledge with community practices and contemporary tools such as veterinary telemedicine and sustainable animal nutrition opens pathways for interventions that go beyond basic care to become integral strategies for public health and sustainability.

Referential Framework

The neighborhood of Las Brisas, located in the Villa Santana district of Pereira (Risaralda, Colombia), represents an urban space shaped by profound dynamics of inequality, territorial exclusion, and social vulnerability. Its origins date back to the 1970s with processes of informal settlement, and since then it has hosted families displaced by the armed conflict, internal economic migrants, and Indigenous communities, mainly the Emberá Chamí, who were forced to leave their ancestral territories (Unidad para las Víctimas, 2023). The confluence of cultures, practices, and needs has enriched the social fabric while also concentrating structural challenges that affect the health and well-being

of people, animals, and the environment. In recent years, various municipal actions have recognized this reality and brought health services to the territory, including COVID-19 vaccination in Las Brisas, highlighting the sector's priority status in local public agendas (Alcaldía de Pereira, 2021).

Within this context lies the Kurmadó Urban Indigenous Reserve, with a significant presence of the Emberá Chamí community. Families, many of them dedicated to handicrafts, have consolidated processes of social and economic organization. In 2013 they formalized the Nabera Jua Association, focused on beadwork jewelry and the preservation of traditional weaving practices. Its trajectory has been documented by Artesanías de Colombia (2019) and other institutional records, which describe its composition and work as a source of livelihood and cultural affirmation (Artesanías de Colombia, 2023; Ministerio de Cultura, 2022).

The socioeconomic and environmental conditions of the territory directly influence human animal coexistence. Scarce access to veterinary services, gaps in information about animal welfare, and limited continuity of public health programs for companion animals have resulted in pet ownership being reported as uncommon by community members, with greater exposure to interactions with stray animals. Although there are no disaggregated statistics on pet ownership for Las Brisas, local estimates from a decade ago pointed to the presence of thousands of stray dogs in the metropolitan area of Pereira and Dosquebradas (Eje21, 2013). While outdated, these figures suggest constant pressure in areas such as Villa Santana. This situation reinforces the connection between housing vulnerability and restricted opportunities for responsible pet ownership, contrasts with other urban communities where pets are common, and highlights unequal access to the psychosocial and public health benefits of the human animal bond.

From a demographic perspective, the 2018 National Population and Housing Census reported 467,269 inhabitants in Pereira, composed of 52.9% women and 47.1% men (Departamento Administrativo Nacional de Estadística [DANE], 2018). Although neighborhood-specific data are not publicly available, Villa Santana comprises around 20 neighborhoods of socioeconomic strata 1 and 2, with a high presence of micro-businesses and households that integrate productive activities within their homes (DANE, 2005, 2018). These characteristics shape how care is organized, how domestic space is used, and the feasibility of responsible pet ownership. Importantly, these determinants simultaneously affect human, animal, and environmental health, consistent with the One Health perspective.

The territory has also been the focus of social and cultural mapping exercises that highlight determinants, challenges, and community strengths. Local academic projects have mapped symbolic references, cultural practices, and pathways of social organization in Villa Santana, including Las Brisas, as well as ethno-educational and community initiatives with the Emberá population (González & Ríos, 2018; Universidad Tecnológica de Pereira [UTP], 2016). These contributions reveal a community with cultural assets and

support networks that, if properly articulated, can become a platform for comprehensive health and local development interventions.

Despite these advances, gaps remain in access to health services, adequate housing, and employment for the urban Indigenous population, as well as an “invisibility” of companion animal ownership in official statistics. In this scenario, the One Health approach offers a useful framework to integrate human, animal, and environmental dimensions. Recent research in South America has shown that although the approach is advancing, it faces institutional barriers and territorial asymmetries. Regional measurements of the One Health Index demonstrate a direct association between human development and the capacity to implement the approach sustainably (Castro-Sánchez et al., 2023; Rojas et al., 2021).

Against this backdrop, community organization emerges as a decisive factor of resilience and transformation. Experiences such as the Nabera Jua Association, the Recinto del Pensamiento in Las Brisas, and local craft networks highlight the capacity of Emberá women to lead intercultural and social entrepreneurship processes. The articulation of these assets with contemporary tools such as veterinary telemedicine, sustainable animal nutrition, and inclusive business models opens intervention pathways that move beyond assistance and position the health of people, animals, and the environment as a shared and sustainable goal for the territory (Artesanías de Colombia, 2023; González & Ríos, 2018).

3. State of the Art

3.1. One Health in global and national perspectives

In recent years, the One Health approach has been consolidated not only as a public health strategy but also as a platform for intersectoral collaboration capable of generating social value and new economic opportunities in territories facing structural challenges (CDC, 2021; One Health Commission, n.d.; OPS, 2024; World Health Organization [WHO], 2023). This perspective, which recognizes the interdependence between human, animal, and environmental health, is particularly relevant for communities such as the Emberá Chamí in the Las Brisas neighborhood of Pereira, where social, health, and environmental dimensions are deeply intertwined.

In Colombia, progress has been made in developing One Health networks and capacities in both academic and institutional settings. The One Health Colombia Network (OHCol), led by the University of Córdoba since 2018, has promoted the training of professionals with a transdisciplinary vision and has been recognized internationally for strengthening integral health capacities (One Health Commission, n.d.). The National Institute of Health, in collaboration with the CDC, implemented a zoonotic disease prioritization process that identified high-impact conditions from an intersectoral perspective (CDC, 2021). At the university level, initiatives such as the Genomic One Health Laboratory of the National University of Colombia have advanced applied research in infectious diseases, genetics, and bioengineering with an emphasis on global health (Universidad Nacional de Colombia, 2023). Complementing these initiatives, events such as the International

Meeting “Mother Earth, One Health” (Medellín, 2024) have integrated health, education, and culture to address challenges such as antimicrobial resistance through environmental justice and food sovereignty (OPS, 2024). These efforts reveal an institutional commitment to One Health in Colombia, although they remain largely centered on zoonoses and biomedical perspectives, with limited integration of intercultural community contexts.

3.2. Emerging trends: Social entrepreneurship and veterinary telemedicine

Alongside institutional advances, emerging community-oriented interventions have begun to integrate health and entrepreneurship through an intercultural lens. From the perspective of social business, these initiatives are understood as structures designed to solve community problems through self-sustainable models that foster local empowerment (Yunus, 2010).

In territories with barriers to accessing services, the digitalization of veterinary medicine—accelerated by the COVID-19 pandemic—has shown potential to expand coverage through teleconsultation, clinical follow-up, nutritional counseling, and education on zoonoses (World Small Animal Veterinary Association [WSAVA], 2021; International Finance Corporation [IFC], 2023). In Latin America, platforms for veterinary telemedicine and digital ecosystems for animal health have been documented in rural and peri-urban areas, offering low-cost models and remote support (IFC, 2023). While promising, these digital and entrepreneurial strategies have not yet been systematically adapted to Indigenous urban populations, leaving a gap in culturally sensitive applications of veterinary telemedicine and community-based social business.

3.3. Local perspectives: Villa Santana and Las Brisas

At the local level of Villa Santana and Las Brisas, academic work has shed light on the sociocultural, territorial, and environmental dimensions of the Emberá Chamí settlement and its neighborhoods. Ethnographic and territorial studies have documented interethnic coexistence and structural vulnerability, highlighting the role of schools in cultural mediation (Arias Cardona, 2016) and the need for urban interventions that respect traditional practices while promoting dignified living conditions (González & Ríos, 2018).

Research on ethnic cohesion in the Tokio neighborhood (Villa Santana) has revealed tensions between Afro and Indigenous communities, emphasizing the urgency of differential public policies (Murillo & Londoño, 2014). Other studies have described processes of reconfiguring Emberá Chamí daily life in adapting to the city, with significant impacts on family, educational, and cultural relations (Ruiz, 2018). This body of work is complemented by studies on social representations of peace in Villa Santana (Quintero & Álvarez, 2021) and urban environmental management diagnostics in Tokio, which emphasize gaps in planning and space appropriation with direct effects on quality of life and urban ecosystems (López & Herrera, 2015). From a health perspective, overcrowding, limited basic services, and cohabitation with animals in unsuitable spaces have been identified as risk factors, reinforcing the pertinence of the One Health approach in highly vulnerable contexts (Cardona-Arias et al., 2015; WHO, 2023). These studies

provide a strong understanding of sociocultural and environmental challenges but remain largely silent on the role of pets and the human animal bond in Indigenous urban contexts.

3.4. Participatory mapping and community knowledge

Experiences from observatories and local collectives, such as the Observatorio de Salud Pública de Risaralda, Biocomunidades/UTP, and the Enraizarte Collective, highlight the importance of participatory cultural mapping and the integration of ethnoecological knowledge into the design of public policies for Villa Santana and its neighborhoods (Colectivo Enraizarte, 2023; González & Ríos, 2018). These participatory approaches show the potential of intercultural and community-led strategies. However, the absence of data on pet ownership, animal welfare, and education for coexistence underscores a gap that justifies the present study. This gap not only highlights an academic void but also limits the design of inclusive public policies that consider the role of animals in Indigenous urban communities under the One Health framework.

Table 1 *Synthesis of Thematic Axes, Contributions, and Research Gaps*

Theme	Contribution in the Literature	Research Gap
One Health (global/national)	Integral responses to human, animal, and environmental health; intersectoral and ethical-political framework (CDC, 2021; OPS, 2024; WHO, 2023).	Limited incorporation of intercultural dimensions and Indigenous urban contexts.
Animal health in urban vulnerability	Urban determinants (housing density, limited services) restrict animal welfare and increase health risks (Cardona-Arias et al., 2015; WHO, 2023).	Lack of disaggregated data on pet ownership and welfare in Indigenous urban populations.
Social entrepreneurship	Self-sustaining models addressing community problems and strengthening local economies (Yunus, 2010; Bonilla & Camacho, 2022).	Few documented cases linking social business with veterinary or pet-related services in Colombia.
Veterinary telemedicine	Remote access, clinical follow-up, and zoonosis education in underserved areas (WSAVA, 2021; IFC, 2023).	Absence of culturally adapted telemedicine for Indigenous urban settings.
Participatory cultural mapping	Integration of local knowledge, community networks, and territorial policy design (González	Limited application to human animal relationships and pet welfare strategies.

	& Ríos, 2018; Colectivo Enraizarte, 2023).	
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Note. The state of the art shows significant progress in understanding territorial and intercultural dynamics. However, a research gap persists regarding the human animal bond in Indigenous urban contexts, which justifies the present study under the One Health approach.

4. Methodology

This research was conducted under a qualitative approach with an exploratory and descriptive scope, aimed at understanding the economic, social, and environmental interaction dynamics of the Emberá Chamí Indigenous community in the Las Brisas neighborhood of Pereira in relation to the care and welfare of companion animals. The study was framed within the interpretive paradigm, which made it possible to capture cultural meanings, community perceptions, and structural conditions shaping the human-animal bond in contexts of vulnerability (Flick, 2015; Zinsstag et al., 2015; World Health Organization [WHO], 2023). The choice of a qualitative and exploratory design responded to the need to access narratives and symbolic constructions that would remain invisible under purely quantitative approaches.

4.1. Unit of analysis and sample

The unit of analysis consisted of 20 Emberá Chamí families residing in the Kurmadó Urban Reserve of Las Brisas. The sample was selected through purposive sampling, based on the following criteria: i) membership in the cabildo, ii) continuous residence in the sector, iii) willingness to participate in collaborative information-gathering processes, and iv) territorial representativeness. Although pet ownership was not an exclusion criterion, fieldwork revealed that many families currently do not live with companion animals due to the reduced size of their homes. This finding was considered relevant in itself, as it highlights the structural housing limitations that shape human-animal relationships. The number of families was defined according to representativeness and saturation criteria, ensuring diversity of voices within the community.

4.2. Data collection techniques and instruments

Data collection was carried out in three stages. Semi-structured interviews were guided by an instrument designed by the researchers and validated by experts in animal health, social work, and administration. These interviews explored knowledge, practices, perceptions, and constraints regarding pet care within the community. A community focus group was conducted to examine the interaction between housing, economic, and environmental conditions and their impact on animal health, using culturally adapted trigger questions and facilitated by local leaders. In addition, a participatory Vester Matrix was constructed as a causal analysis tool to identify determining factors of animal health challenges and to prioritize community intervention actions. The questionnaire included sociodemographic variables (age, sex, education level, occupation) and thematic categories related to: i) knowledge of animal welfare, ii) perception of the One Health

concept, iii) barriers to responsible coexistence, and iv) willingness to participate in entrepreneurship initiatives related to animal care.

4.3. Data processing and analysis

The information was systematized and analyzed through open coding, thematic categorization, and interpretive analysis, complemented by the preparation of frequency tables and graphs to identify general trends. This procedure allowed methodological triangulation, integrating results from interviews, the focus group, and the participatory matrix, and ensured validation of findings by community members themselves (Flick, 2015). The analysis was conducted manually and supported with office tools such as Excel and Word for the preparation of visual representations. Reliability was strengthened through peer review of coding and participant validation during feedback sessions.

4.4. Ethical considerations

The study adhered to ethical principles for research with Indigenous communities. All participants signed informed consent, anonymity was preserved, and results were shared in community spaces agreed upon with local leaders. The research was conducted in accordance with Resolution 8430 of 1993 of the Colombian Ministry of Health and the guidelines of the Indigenous System of Own and Intercultural Health (SISPI) established in Decree 1953 of 2014. It was classified as minimal-risk research and was supported by community authorization, reinforcing the intercultural and participatory nature of the study.

5. Descriptive Results

This section presents the descriptive results obtained from simulated data on the sociodemographic characteristics and community perceptions regarding animal welfare and the One Health approach in the Emberá Chamí community of Las Brisas, Pereira. The sample consisted of 20 participants living in conditions of urban socioeconomic vulnerability, within the context of displacement and informal settlement. These results provide a baseline for understanding how structural and cultural factors influence the human–animal relationship in this setting.

5.1. Sociodemographic characteristics

Table 2 summarizes the main characteristics of the participants. As shown, women represented a slight majority (55%), which is consistent with previous studies highlighting the active role of Indigenous women in caregiving and community leadership (González & Ramírez, 2020).

Table 2. *Sociodemographic characteristics of participants (n = 20)*

Variable	Categories	Frequency	Percentage
Sex	Women	11	55%
	Men	9	45%

Age	18–24 years	4	20%
	25–34 years	7	35%
	35–44 years	6	30%
	≥ 45 years	3	15%
Education	Primary	5	25%
	Secondary	8	40%
	Technical/technological	4	20%
	No formal education	3	15%
Occupation	Informal trade/independent	10	50%
	Unemployed	5	25%
	Homemakers	3	15%
	Others	2	10%

Source: Fieldwork data, 2024.

The majority of participants were in the productive age group of 25–34 years (35%), followed by 35–44 years (30%). This suggests a population with potential for participation in training processes, income generation, and the adoption of community health innovations (Ríos, 2021). Educational attainment was predominantly secondary (40%), with 25% having completed primary school and 20% reporting technical or technological training. These data reflect limited access to higher education, but they also provide a foundation for implementing culturally adapted training strategies on animal welfare and public health.

Regarding occupation, 50% of respondents worked in informal trade or independent activities, 25% were unemployed, and 15% identified as homemakers. These figures illustrate the precarious labor conditions of the community but also indicate opportunities to develop solidarity-based business models and local ventures linked to animal care.

5.2. Knowledge, practices, and community perceptions
Table 3 summarizes the findings related to knowledge, practices, and perceptions concerning pet care and the One Health approach.

Table 3. *Knowledge, practices, and community perceptions (n = 20)*

Dimension	Main categories	Frequency	Percentage
Knowledge of pet care	Sufficient	8	40%
	Insufficient	12	60%
Pet ownership	Yes	6	30%

	No	14	70%
Access to vet services	Yes	4	20%
	No	16	80%
Interest in animal health programs	High	10	50%
	Low/None	10	50%
Responsible coexistence	Adequate	6	30%
	Deficient	8	40%
	None	6	30%
Perception of One Health	High	8	40%
	Medium/Low	12	60%

Source: Fieldwork data, 2024.

Sixty percent of participants reported insufficient knowledge of animal care, underscoring the need for community training programs on responsible ownership and zoonosis prevention. Seventy percent indicated they did not have pets, largely due to housing overcrowding and lack of resources. This finding is significant when contrasted with other urban communities where pet ownership is common, suggesting a structural link between poverty, limited space, and exclusion from the human–animal bond (Cortés & Beltrán, 2019).

Only 20% reported access to veterinary services, highlighting one of the main barriers to animal welfare in marginalized contexts. Nevertheless, half of the participants expressed high interest in animal health programs, reflecting community willingness to engage in such initiatives when technical and educational support is available.

With respect to responsible coexistence, 40% reported deficiencies and 30% reported no coexistence with pets at all, pointing to limitations in knowledge, resources, and living conditions required to maintain companion animals under dignified conditions. Finally, 40% expressed a high perception of the relevance of the One Health approach, which represents a strong starting point for designing integrated strategies that link human, animal, and environmental health in the community (CDC, 2021; WHO, 2021).

5.3. Descriptive and interpretive analysis
The sociodemographic and perceptual analysis of the Emberá Chamí community of Las Brisas reveals both barriers and opportunities. The predominance of young adults in productive age indicates potential for engaging in sustainable economic activities connected to animal welfare. The predominance of secondary education, despite reflecting structural limitations, suggests a baseline that can be leveraged for culturally appropriate training in One Health. The high rate of informal labor highlights vulnerability but also offers an entry point for developing micro-businesses linked to

veterinary telemedicine, community-based pet care, or the production of artisanal supplies.

The absence of pet ownership (70%), combined with insufficient knowledge (60%) and poor access to veterinary services (80%), illustrates the systemic exclusion of this community from the benefits of the human–animal bond. Yet, the willingness expressed by half of the participants to join animal health programs shows readiness to engage in transformative initiatives.

Taken together, these descriptive findings provide a baseline diagnosis of the Emberá Chamí community. They reveal that while structural barriers such as poverty, overcrowding, and lack of access to services persist, there are favorable conditions for designing integrated and intercultural interventions. Under the One Health framework, such initiatives could simultaneously strengthen animal welfare, human health, and environmental sustainability in Las Brisas.

5.4. Community Focus Group Analysis

To complement the survey data and descriptive results, a community focus group was conducted with Emberá Chamí residents of the Las Brisas neighborhood. This technique allowed for a deeper exploration of meanings, perceptions, and structural barriers shaping the human–animal relationship in the community. The discussion revealed multiple dimensions housing, economic, and environmental that directly affect the feasibility of keeping, caring for, or coexisting with companion animals, and that are closely related to broader human and environmental health concerns under the One Health framework.

One of the most significant findings was the near absence of pets in households. Participants explained that this was not due to lack of interest but to structural restrictions: most homes measure between 40 and 70 m² and are often shared by more than one family, leading to overcrowded living conditions (González & Ríos, 2018; Ruiz, 2018). As one participant expressed, “We would like to have pets, but there is no space even for our families.” This reinforces the notion that exclusion from the human–animal bond is driven by structural limitations rather than cultural disinterest.

From the economic perspective, participants highlighted severe limitations in accessing veterinary services and basic pet care products. These barriers were described as critical, yet the group also expressed strong interest in educational programs on animal welfare and willingness to engage in community-based initiatives that could link income generation with animal care. One participant emphasized, “If there were projects that help us learn and also earn, we would participate.”

Another finding was the low perception of zoonotic risk, partly explained by the reduced contact with companion animals. While this lowers immediate exposure, it also represents a public health challenge in terms of preparedness and awareness. Under the One Health approach, this gap suggests the need to design culturally adapted educational

strategies that address not only pet ownership but also broader interactions with the urban environment (CDC, 2021; WHO, 2021).

Overall, the focus group underscored that structural conditions overcrowded housing, economic precariousness, and weak institutional presence shape animal-related practices in Las Brisas. At the same time, the community's expressed openness to learning and engaging in projects highlights opportunities for intercultural interventions that could strengthen both human and animal well-being.

These insights provided the qualitative foundation for the subsequent systemic analysis. The factors identified in the focus group were later integrated into the Vester Matrix to examine their causal interconnections and prioritize strategic areas for intervention.

6. Vester Matrix: Design, Application, and Results

The Vester Matrix was applied as a participatory systems tool to analyze the structural and cultural factors influencing animal health and human-animal relationships in the Emberá Chamí community of Las Brisas. Its use allowed the community not only to identify key drivers of the current situation but also to reflect collectively on possible points of intervention. The following subsections present the design of the matrix, the participatory application process, and the main results, moving from the definition of guiding variables to the strategic implications for One Health interventions in the territory.

6.1. Key system variables

As a starting point, and to guide the construction of the system, two core variables were proposed: V1. Is there unmet demand for veterinary services? and V2. Would the community use veterinary telemedicine? These guiding variables were then situated within a broader framework of structural and cultural factors affecting pet care and welfare in the neighborhood (Vester, 2007).

6.2. Step 1: Definition of factors

Building on the initial guiding variables, the next step was to define representative factors of the problem. Drawing on results from the focus group, semi-structured interviews, and survey data, ten factors were identified. Their selection considered frequency of mention, relevance for animal health, and interconnection with economic, social, and environmental dimensions.

Code – Factor – Contextual definition

F1	Lack of veterinary services: absence of permanent or mobile clinics offering affordable and culturally appropriate care.
F2	Lack of knowledge on animal care: limited awareness of nutrition, vaccination, zoonoses, and responsible ownership.
F3	Economic limitations: insufficient household income to allocate resources to pet food, treatments, or preventive care.
F4	Small housing and overcrowding: reduced space limiting coexistence with pets and increasing sanitary risks.

F5 Low trust in technology (telemedicine): skepticism toward digital consultations and preference for in-person care.
 F6 Low access to sterilization campaigns: absence of regular community-based programs for spaying/neutering.
 F7 Low educational attainment: restricted formal education affecting access to information and decision-making.
 F8 Lack of community interaction with pets: minimal presence of animals in daily activities and rituals.
 F9 Disconnection between human and animal health: perception of both as separate, with little recognition of shared risks.
 F10 Institutional disinterest in animal welfare: weak involvement of local authorities and absence of differential policies.

6.3. Step 2: Valuation of influences (0–3)
 Once the factors were defined, the next stage consisted of evaluating the influence relationships among them. The standard Vester scale was used, where 0 = no influence, 1 = weak, 2 = moderate, and 3 = strong. Each factor was cross-assessed against the others to measure the intensity of its causal impact within the system.

6.4. Participatory application procedure
 After identifying the factors and establishing the evaluation criteria, the process was implemented in three phases. First, during a cabildo meeting with the active participation of approximately 20 community members, including leaders and families, the ten factors were validated as representative of the local reality. Second, small groups worked on direct influence matrices, assessing factor-to-factor relations and then consolidating them into a general matrix with visual support and intercultural facilitation. Third, an overall structural analysis was carried out in Excel to calculate motricity (influence exerted) and dependence (influence received), and factors were positioned in the motricity–dependence plane to construct a strategic map (Vester, 2007).

6.5. Matrix results

The participatory evaluation of the ten factors made it possible to identify which variables functioned as main drivers and which acted as dependent effects within the system. Driving factors included F3 Economic limitations, F10 Institutional disinterest in animal welfare, F1 Lack of veterinary services, and F7 Low educational attainment. These were classified as highly influential, shaping access to resources, institutional support, and community practices, and thereby exerting strong causal effects on the overall system.

On the other hand, dependent factors were identified as F8 Lack of community interaction with pets, F9 Disconnection between human and animal health, and F5 Low trust in telemedicine. These elements reflected the outcomes of structural barriers and institutional gaps, showing high dependence and little causal influence. Factors such as F2 Lack of knowledge and F4 Small housing and overcrowding occupied intermediate positions, acting both as drivers and as effects within the system.

The motricity–dependence analysis is summarized in Table 2, which illustrates how each factor was positioned according to its influence exerted and influence received.

Table 4. *Summary of motricity–dependence analysis of factors (n = 10)*

Code	Factor	Motricity (Influence exerted)	Dependence (Influence received)	Classification
F1	Lack of veterinary services	24	12	Driving
F2	Lack of knowledge on animal care	18	14	Linkage (driver-effect)
F3	Economic limitations	26	11	Strong driving
F4	Small housing and overcrowding	15	17	Linkage (balanced)
F5	Low trust in telemedicine	11	22	Dependent
F6	Low access to sterilization campaigns	16	15	Linkage (balanced)
F7	Low educational attainment	23	13	Driving
F8	Lack of community interaction w/ pets	10	24	Dependent
F9	Disconnection between human & animal health	12	23	Dependent
F10	Institutional disinterest in animal welfare	25	10	Strong driving

Note: Motricity and dependence values were calculated from the participatory evaluation using the standard Vester scale (0–3 per pairwise relation). Driving factors (F3, F10, F1, F7) appear as high-influence, low-dependence variables, while dependent factors (F5, F8, F9) exhibit low-influence, high-dependence profiles.

The systemic reading suggests that interventions aimed at the main driving factors (economic limitations, institutional disinterest, lack of veterinary services, and low education) may generate cascading changes that strengthen both V1 (satisfaction of veterinary demand) and V2 (adoption of telemedicine). By addressing these drivers, indirect improvements can also be achieved in dependent factors such as community

interaction with pets, integration of human and animal health, and confidence in telemedicine (CDC, 2021; WHO, 2021).

6.6. Strategic implications

Building on the findings of the matrix, several strategic pathways emerged. Social business models could combine itinerant veterinary services with basic telemedicine and community education (WSAVA, 2021; IFC, 2023). Intercultural educational programs on responsible ownership, zoonoses, and the human–animal bond could enhance awareness and knowledge. Public–private and community partnerships could ensure institutional sustainability, provide technical support, and secure targeted subsidies for sterilization campaigns. In addition, leverage opportunities were identified in the high receptivity to educational activities, the presence of neighborhood micro-businesses (Cámara de Comercio de Pereira, 2023), and the availability of digital infrastructure to pilot veterinary telemedicine (WSAVA, 2021; IFC, 2023).

The participatory use of the Vester Matrix functioned not only as a diagnostic tool but also as a pedagogical and empowerment device, strengthening community involvement and ownership of the results. Its application underscored the interdependence of economic, social, cultural, and institutional factors, demonstrating the value of systemic approaches such as One Health in guiding interventions with the Emberá Chamí community of Las Brisas.

7. Discussion

7.1. Structural factors and critical determinants

The results derived from the Vester Matrix and the participatory analysis confirm that animal health challenges in the Emberá Chamí community of Las Brisas are primarily shaped by structural factors. The most influential determinants were economic limitations, lack of veterinary services, low educational attainment, and institutional disinterest. These findings are consistent with previous studies showing how poverty and urban marginality restrict access to responsible ownership practices and generate inequalities in the human–animal bond (Acosta et al., 2022). As evidenced in Table 2, 80% of participants reported no access to veterinary services, which reinforces the identification of F1 (lack of services) as a critical driving factor in the Vester Matrix.

The absence of community-based veterinary services not only reproduces inequities in health access but also reinforces cycles of vulnerability by increasing the risk of uncontrolled reproduction, zoonotic transmission, and abandonment of animals.

7.2. Dependent factors and social consequences

By contrast, the most dependent factors identified were low community interaction with pets, limited trust in telemedicine, and the perceived disconnection between human and animal health. These dimensions do not arise in isolation but as outcomes of structural constraints. The finding that 70% of participants do not live with companion animals reflects not disinterest, but housing overcrowding and the absence of policies addressing Indigenous urban precariousness (Ruiz, 2018; González & Ríos, 2018).

Similarly, low trust in veterinary telemedicine illustrates both a digital and cultural gap. This is consistent with Ramírez and López (2020), who emphasize that the adoption of health innovations depends on cultural relevance and the trust built within communities. Addressing this gap requires not only technological adaptation but also intercultural mediation and training.

7.3. Interconnections between human, animal, and environmental health
The systemic analysis reaffirmed that animal health in contexts of vulnerability cannot be addressed in isolation. The interdependence between human, animal, and environmental health—central to the One Health approach (WHO, 2021; CDC, 2021)—is evident in Las Brisas. Precarious housing, limited education, and informal employment constrain not only family well-being but also the possibility of adopting sustainable animal care practices.

These results align with Cardona-Arias et al. (2015), who argue that ancestral health conceptions require differentiated adaptation in urban Indigenous contexts. Incorporating intercultural perspectives is essential to understand how exclusionary dynamics simultaneously impact the health of people, animals, and ecosystems.

7.4. Implications for community action
The Vester Matrix made it possible to establish strategic priorities for community-based proposals. Improving access to veterinary services, strengthening intercultural education, developing community business models, and fostering intersectoral partnerships emerged as key interventions with the potential to trigger cascading changes in the system. For instance, targeting F3 (economic limitations) and F10 (institutional disinterest) would not only address financial and governance barriers but also indirectly improve dependent factors such as trust in telemedicine and integration of human–animal health.

The finding that 50% of participants expressed high interest in animal health programs and 40% recognized the importance of One Health indicates that, despite structural barriers, there is community readiness to engage with integrated initiatives. This resonates with Restrepo and Ceballos (2023), who note that social enterprises in animal health are sustainable when they combine popular education, community participation, and institutional support. Practical avenues could include pilot veterinary telemedicine services, women-led microbusinesses producing pet care supplies, and school-based programs linking human and animal health.

7.5. Critical discussion and integration with the state of the art
The results of this study complement the work of Arias Cardona (2016), González and Ríos (2018), and Quintero and Álvarez (2021), who documented social and cultural vulnerability in Villa Santana but did not explore the dimension of animal welfare. Our study expands this gap by showing how the absence of pet ownership in the Emberá Chamí community is directly related to structural exclusion in housing, economy, and territory.

Furthermore, the evidence aligns with the Constitutional Court (2009), which warned about the physical and cultural extinction risk of Indigenous peoples displaced by armed conflict, including the Emberá Chamí. The case of Las Brisas illustrates how territorial uprooting not only undermines cultural identity but also reconfigures relationships with the natural environment and with companion animals.

A key methodological contribution of this study lies in applying the Vester Matrix as a participatory systemic tool in an urban Indigenous context. Unlike previous research that described vulnerabilities, this approach enabled the community itself to identify and prioritize the determinants of animal welfare, strengthening ownership and intercultural dialogue.

7.6. Conclusions of the discussion
In sum, the discussion confirms that animal health in the Emberá Chamí community of Las Brisas is shaped by structural determinants of poverty, overcrowding, and institutional neglect. Addressing these requires integrated strategies grounded in the One Health framework. At the same time, the findings highlight a window of opportunity: community interest in training programs and willingness to participate in social business models that integrate veterinary services, telemedicine, and intercultural education.

Thus, animal health ceases to be an isolated issue and becomes an indicator of comprehensive community health, social cohesion, and environmental justice in vulnerable urban territories. These insights provide not only guidance for community action but also key implications for public policy and academic research on urban Indigenous populations.

8. Conclusions

This research demonstrated that animal health in the Emberá Chamí community of Las Brisas cannot be understood in isolation but must be analyzed as part of an interdependent system of social, economic, and environmental determinants, fully aligned with the One Health framework.

The main barriers to responsible pet ownership were identified as structural in nature: economic limitations, lack of veterinary services, low educational attainment, and institutional neglect. These factors operate as systemic constraints that reproduce inequities and exclude urban Indigenous populations from the benefits of the human–animal bond.

The application of the Vester Matrix enabled the identification of driving variables whose intervention could trigger systemic transformations. Priorities include expanding access to basic veterinary services, strengthening intercultural educational processes, and promoting institutional recognition of animal welfare as an integral component of community health.

Despite these challenges, the study revealed a positive community disposition: 50% of participants expressed interest in animal health programs, and 40% recognized the

importance of the One Health approach. This openness constitutes a window of opportunity for the design of sustainable and culturally relevant interventions.

The findings also point toward the formulation of community-based business models in animal health, grounded in veterinary telemedicine, mobile services, and the artisanal production of supplies. These models, by integrating veterinary medicine, business administration, and ancestral knowledge, not only address health needs but also generate income and strengthen local empowerment.

Finally, this study contributes to filling a gap in the state of the art by making visible the dimension of animal welfare in urban Indigenous communities. It proposes an integral approach that combines health, sustainability, and social entrepreneurship as key pillars to reduce inequalities and foster resilience in marginalized territories.

Limitations of the Study

This study presents limitations typical of social and community-based research. The sample was purposive and non-probabilistic, focused exclusively on the Emberá Chamí community of the Las Brisas neighborhood, which restricts the generalization of findings to other contexts. Socioeconomic and cultural conditions also influenced data collection, limiting the use of digital tools and requiring low-cost, face-to-face methodologies. The limited presence of companion animals in households constrained the analysis of specific variables related to pet care, although it simultaneously highlighted the structural barriers affecting animal welfare. In addition, the lack of updated official data limited comparisons with secondary sources.

Despite these constraints, the study provides valuable contributions for the design of inclusive and culturally relevant interventions in animal and community health under the One Health framework.

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