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Diagnosis of lead in the blood of dogs and cats in urban and rural areas of the Calceta parish, Manabi

Diagnóstico de plomo en sangre de caninos y felinos de entornos urbanos y rurales de la parroquia Calceta – Manabí

Diana María Castillo Torres[1], Naomi Thais Valencia Angulo[1], Vicente Alejandro Intriago Muñoz[1]

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[1] Escuela Superior Politécnica Agropecuaria de Manabí - Manuel Félix López. Medicina Veterinaria. Campus Politécnico, Sitio El Limón. 131205. Calceta, Manabí, Ecuador.

Correspondence: vicente.intriago@espam.edu.ec

Abstract

The objective of this study was to determine blood lead levels in dogs and cats from urban and rural areas in Calceta parish, Bolívar canton, Manabí, Ecuador, where 32 blood samples (20 from dogs and 12 from cats) were collected. These samples were analyzed using atomic absorption spectrophotometry, additionally, surveys were conducted with pet owners to assess animal management conditions. The results showed that most samples had concentrations below the detectable limit (0.005 ppm). Animals from rural areas presented a mean of 0.01 mg L^{-1}, exceeding the reference values. However, statistical analysis did not reveal significant differences between species or location (urban vs. rural). On the other hand, a significant variation was found according to sex ($p = 0.0274$), with females being more susceptible to higher blood lead levels than males. This finding is attributed to physiological processes involving bone mobilization of lead into the bloodstream during gestation and lactation. Furthermore, several risk factors were identified, including mixed feeding practices (62.5%), constant outdoor exposure (53.1%), a marked lack of veterinary check-ups (59.4%), and absence of prior blood testing (93.8%). Although 87.5% of the animals did not show clinical signs, lead levels were detected in asymptomatic individuals, highlighting the importance of preventive diagnosis. In conclusion, companion animals in Calceta act as environmental sentinels for lead exposure, emphasizing the need to promote education on animal welfare and preventive veterinary medicine.

Keywords: cats, dogs, heavy metal, poisoning, rural, sex, spectrophotometry, urban.

Resumen

El objetivo de esta investigación fue determinar los niveles de plomo en sangre de caninos y felinos de entornos urbanos y rurales de la parroquia Calceta, cantón Bolívar, Manabí-Ecuador, donde se obtuvieron 32 muestras sanguíneas (20 caninos y 12 felinos). Éstas se analizaron mediante la técnica de espectrofotometría de absorción atómica; así mismo, se complementó con encuestas a los tutores para evaluar las condiciones de manejo de los animales de compañía. Los resultados revelaron que la mayoría de las muestras presentaron concentraciones inferiores al límite detectable (0,005 ppm); los animales del sector rural mostraron una media de 0,01 mg L^{-1}, superando los valores de referencia. Sin embargo, el análisis estadístico no muestra diferencias importantes entre especie o sector. Por otro lado, se encontró una variación significativa según el

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sexo (p = 0,0274), donde las hembras son más susceptibles a niveles altos de plomo en sangre que los machos. Este hallazgo se atribuye a procesos fisiológicos de movilización ósea del metal hacia la sangre durante la gestación y lactancia. Asimismo, se identificaron factores de riesgo como la alimentación mixta (62,5%), la permanencia constante con el exterior (53,1%), una marcada ausencia de controles veterinarios (59,4%) y de exámenes sanguíneos previos (93,8%). Pese a que el 87,5% de los animales no presentó signos clínicos, se detectaron niveles de plomo en animales asintomáticos, confirmando la importancia del diagnóstico preventivo. Se concluye que los animales de compañía de Calceta actúan como centinelas ambientales ante la exposición de plomo, siendo importante fomentar la educación sobre bienestar animal y medicina preventiva.

Palabras clave: caninos, espectrofotometría, felinos, intoxicación, metal pesado, rural, sexo, urbano.

1. Introduction

Lead [Pb] is a toxic heavy metal that has a relatively high density, and its toxicity can occur even at low doses (Rădulescu et al., 2019). This element comprises approximately 0.002% of the Earth's crust and is harmless at low concentrations. However, at higher levels, it can be dangerous when ingested by living organisms, which may be exposed through air, water, food, and dust. Dust contaminated with lead is dispersed into the environment through anthropogenic activities such as mining, smelting, industrial use, and recycling (Herrera Vargas et al., 2025).

Lead poisoning is more common in dogs due to their greater exposure to this metal, as other species tend to have more restricted access and more selective feeding habits, reducing the risk of intoxication (Ensley, 2020). In cats, exposure commonly occurs during grooming, when they ingest particles containing this metal (Blakley, 2021). Lead enters the body through absorption in the small intestine and subsequently reaches the bloodstream. There, it binds to erythrocytes and is distributed to tissues such as the liver, kidneys, bone marrow, and central nervous system. Lead intoxication causes gastrointestinal and neurological signs, including anorexia, vomiting, diarrhea with colic, ataxia, opisthotonus, blindness, mydriasis, paresis, and even paralysis (Monfrinotii, 2020).

A study on heavy metals in dogs was conducted in northwestern Spain comparing rural and urban environments. The study evaluated factors such as diet, age, and sex, and the results showed that the average lead concentration was significantly higher in dogs fed commercial diets than in those fed homemade diets. The researchers concluded that lead levels were not affected by sex or age, but rather by the type of food consumed (López et al., 2007).

Similarly, Valladares et al. (2014) conducted a study in the city of Toluca, Mexico, to determine blood Pb concentrations in dogs. In this study, 300 samples were analyzed to assess Pb levels. Only eight samples showed detectable concentrations of this metal (0.005 ppm), whereas in the remaining 292 samples the concentration was below this minimum detectable level.

Human exposure to this metal is commonly associated with occupational environments, resulting in a high prevalence of diseases related to this compound (Rodríguez, 2017). Despite awareness of the associated risks, including cancer, kidney damage, developmental disorders, and even death, exposure to this contaminant persists and may increase due to continuous urban growth and industrial expansion (Santander, 2007). Therefore, lead levels in animal populations can serve as sentinel indicators for assessing environmental contamination and the associated risks to human health (Blakley, 2021).

To date, there are no studies determining the levels of this contaminant in this parish. Therefore, this research represents an important contribution toward understanding the Pb exposure levels affecting the animal population, their welfare, and that of their guardians. Furthermore, it will contribute valuable information to scientific knowledge and public health by providing specific local data, as well as serving as a basis for future research.

2. Materials and Methods

This experimental research was conducted in the urban area of Calceta and in surrounding rural areas of this parish in the Bolívar canton of the Manabí province, Ecuador. According to the Instituto Nacional de Estadísticas y Censos (INEC, 2022), there are a total of 2,690 households with dogs and cats in this parish.

2.1. Experimental material

For this study, 10 dogs and 6 cats were randomly selected from urban areas, and an additional 10 dogs and 6 cats were selected from rural areas. Equal proportions of males and females were included (50% each), resulting in a total of 32 samples. This sample represented 1.19% of the domestic animal population in the parish, calculated proportionally using the total number of pets registered in the households of Calceta as a reference population.

2.2. Experimental procedure

At the beginning of this study, households located in the urban center and rural areas of Calceta parish were randomly selected. A survey was conducted with the guardians of companion animals, including questions related to habitat, age, type of diet, sex, veterinary care, blood testing history, and body weight. Subsequently, an evaluation of the animals' body condition and apparent health status was performed.

Following data collection, blood samples were obtained primarily from the cephalic vein and, when required, from the jugular vein. After identification of the venipuncture site, a tourniquet was applied and the area was aseptically prepared using an alcohol swab. Approximately 3 mL of blood was collected using a sterile syringe and immediately transferred into EDTA anticoagulant tubes. Each tube was properly labeled and stored in a cooler containing ice packs to preserve the cold chain during transportation.

As indicated by Baranda et al. (2022), the blood samples were stored at a temperature of 2–8 °C until analysis and were subsequently checked with a thermometer. It is important to note that the blood samples were sent to the Atomic Absorption Laboratory of the Universidad Técnica Particular de Loja [UTPL] on the same day they were obtained, ensuring their optimal condition, as specified by that institution; finally, the results were awaited in the following days.

2.3. Laboratory analysis

The analyses to determine blood lead levels were performed at the Atomic Absorption Laboratory of UTPL. The procedure followed the methodologies described by González Martínez et al. (2019) and Rivera & Pernía (2021), who employed graphite furnace atomic absorption spectrophotometry for data acquisition. This technique is based on the ability of free atoms to absorb light at a specific wavelength. During the process, the sample is atomized using a thermal energy source, such as a graphite furnace or flame. The concentration of the element is then determined by measuring the amount of radiation absorbed by the atoms (Martínez, 2020).

2.4. Statistical analysis

After data collection, survey variables were analyzed using the Chi-square test to identify potential statistical associations. Blood lead concentrations were subsequently analyzed using the non-parametric Wilcoxon rank-sum test (Mann–Whitney U test). Comparisons were performed according to species (dog or cat), habitat (urban or rural), and sex (female or male).

3. Results

During the diagnostic phase of this study, a survey was conducted prior to sample collection to assess the condition of the animals included in the study. A total of 32 blood samples were analyzed, including 20 from dogs and 12 from cats from urban and rural areas of Calceta parish, Manabí Province. The objective was to determine the presence of lead in the blood samples using atomic absorption spectrophotometry. Detectable lead concentrations were found in three samples, whereas the remaining samples showed levels below the minimum detectable concentration of 0.005 ppm. The results of the blood analyses are presented below:

To identify variations in blood lead concentrations in Calceta parish, the factors species, habitat, and sex were analyzed (Table 1) using the non-parametric Mann–Whitney test. Regarding species, dogs presented a mean concentration of 0.0049 ± 0.00095 mg L^{-1}, while cats showed values of 0.01 ± 0.01 mg L^{-1}. Although cats exhibited concentrations above the reference limit, statistical analysis indicated that there was no significant difference between the two groups.

With respect to habitat, animals from rural areas presented mean blood lead concentrations of 0.01 ± 0.01 mg L^{-1}, whereas animals from urban areas showed concentrations of 0.005 ± 0.00095 mg L^{-1}. Although no statistically significant differences were detected between habitats, lead concentrations in rural animals exceeded the established reference values, suggesting the existence of environmental exposure sources in rural areas.

Regarding sex, females presented mean blood lead concentrations of 0.01 ± 0.01 mg L^{-1}, while males showed concentrations of 0.0046 ± 0.0012 mg L^{-1}. Statistical analysis detected significant differences between sexes. This result may be related to physiological and hormonal mechanisms in females that favor the mobilization of minerals from bone tissue into the bloodstream, potentially leading to transient increases in blood lead concentrations.

In the dogs' group (Table 2), blood lead concentrations were analyzed according to habitat and sex. Dogs from rural areas presented mean concentrations of 0.0046 ± 0.0012 mg L^{-1}, whereas those from urban areas showed concentrations of 0.01 ± 0.0006 mg L^{-1}. However, no statistically significant differences were detected between habitats within this species.

With respect to sex in dogs, females exhibited mean blood lead concentrations of 0.01 ± 0.00060 mg L^{-1}, whereas males presented concentrations of 0.0046 ± 0.0012 mg L^{-1}. Although differences in mean concentrations were observed, statistical analysis revealed no significant differences between sexes, indicating that sex was not associated with blood lead accumulation in dogs under the conditions evaluated in this study.

In the cat population (Table 3), blood lead concentrations were analyzed according to habitat and sex. Similar concentrations were observed between animals from rural and urban areas. Statistical analysis showed no significant differences between habitats, suggesting that environmental lead exposure may occur uniformly among cats regardless of the area evaluated.

With respect to sex in the cat population, females exhibited mean blood lead concentrations of 0.01 ± 0.00056 mg L^{-1}, whereas males presented concentrations of 0.0045 ± 0.0012 mg L^{-1}. However, no statistically significant differences were detected between sexes, suggesting that sex was not associated with blood lead accumulation in cats under the conditions evaluated in this study.

Guardians of the evaluated companion animals completed a six-question survey aimed at obtaining information regarding living conditions, diet, and veterinary medical evaluations. The survey results are presented below.

3.1. Type of feeding

Mixed diets represented the predominant feeding pattern among the evaluated animals, accounting for 62.5% of responses, followed by cooked food (21.9%), commercial balanced feed (12.5%), and raw food (3.1%). Statistical analysis demonstrated significant differences among dietary categories, highlighting a predominance of mixed feeding practices (Table 4).

In dogs, mixed feeding was the most frequent response at 70%, followed by balanced feeding at 20%,

Table 1. General data for comparison of blood lead levels.

Species	Lead level (mg L^{-1})	Sector	Lead level (mg L^{-1})	Sex	Lead level (mg L^{-1})
Dogs	0.0049 ± 0.00095	Rural	0.01 ± 0.01	Female	0.01 ± 0.01
Cats	0.01 ± 0.01	Urban	0.005 ± 0.00095	Male	0.0046 ± 0.0012
W (Wilcoxon)	208.00	W (Wilcoxon)	257.00	W (Wilcoxon)	301.00
p-value	0.5380	p-value	0.6764	p-value	0.0274

Table 2. Data on dogs according to sector and sex.

Sector	Lead level (mg L^{-1})	Sex	Lead level (mg L^{-1})
Rural	0.0046 ± 0.0012	Female	0.01 ± 0.00060
Urban	0.01 ± 0.0006	Male	0.0046 ± 0.0012
W (Wilcoxon)	95.50	W (Wilcoxon)	114.50
p-value	0.1680	p-value	0.1680

Table 3. Data on cats according to sector and sex.

Sector	Lead level (mg L^{-1})	Sex	Lead level (mg L^{-1})
Rural	0.0049 ± 0.00031	Female	0.01 ± 0.00056
Urban	0.0047 ± 0.0014	Male	0.0045 ± 0.0012
W (Wilcoxon)	37.00	W (Wilcoxon)	42.00
p-value	> 0.9999	p-value	0.7273

Table 4. Frequency of responses regarding the type of feeding provided to the companion animal.

Category	General	Dogs	Cats	Urban	Rural
Balanced diet	4	1	3	2	2
Cooked foods	7	4	3	5	2
Raw foods	1	1	-	-	1
Mixed feeding	20	14	6	9	11
Total	32	20	12	16	16
Chi-square	84.97	69.74	18.69	34.98	52.46
p-value	< 0.0001	< 0.0001	0.0003	< 0.0001	< 0.0001

while raw and cooked feeding each accounted for 5%, showing highly significant differences. Similarly, in cats, mixed feeding was the most prevalent response at 50%, followed by balanced and cooked feeding at 25% each, demonstrating significant differences (Table 4).

In urban areas, mixed diets were the most prevalent response at 56.3%, followed by cooked foods at 31.2% and balanced foods at 12.5%, showing highly significant differences. Similarly, in rural areas, mixed diets were common at 68.8%, followed by cooked and balanced foods at 12.5% each, and raw foods at 6.2%, indicating highly significant results (Table 4).

3.2. Hours a day away from home

The survey results showed that 53.1% of the animals remained exclusively indoors, whereas 21.9% spent between 10 and 15 hours outdoors per day, 15.6% between 1 and 5 hours, and 9.4% more than 20 hours daily. Statistical analysis demonstrated significant differences in the animals' housing and outdoor exposure conditions (Table 5).

In dogs, 60% remained exclusively indoors, whereas 30% spent between 10 and 15 hours outdoors per day, 5% between 1 and 5 hours, and 5% more than 20 hours outdoors daily. Statistical analysis demonstrated significant differences among housing and outdoor exposure conditions. In the cat population, the predominant condition was also indoor housing (42%), followed by 33% spending between 1 and 5 hours outdoors daily. Additionally, 17% remained outdoors for more than 20 hours per day, while 8% spent between 10 and 15 hours outdoors. Significant differences were likewise detected among cats (Table 5).

In urban areas, guardians indicated that 50% of animals do not leave home, followed by those who stay outside for 10-15 hours daily with 25% and from 1-5 hours to more than 20 hours with 12.5% each, which indicates high statistical significance, while in rural areas 56.2% do not leave home, followed by those who are outside between 1-5 hours and 10-15 hours with 18.8% each; finally, 6.2% belong to those who frequent the outside of their home for more than 20 hours daily, showing highly significant differences (Table 5).

3.3. Veterinary check-up frequency

Regarding veterinary care practices, 59.4% of guardians reported rarely taking their animals for veterinary check-ups, whereas 21.9% attended veterinary evaluations every six months, 12.5% annually, and 6.2% monthly. Statistical analysis demonstrated sig-

Table 5. Frequency of responses regarding the number of hours per day that the companion animal stays outside the home.

Category	General	Dogs	Cats	Urban	Rural
1-5 hours	5	1	4	2	3
10 -15 hours	7	6	1	4	3
More than 20 hours	3	1	2	2	1
Remains indoors	17	12	5	8	9
Total	32	20	12	16	16
Chi-square	55.92	47.36	14.73	24.36	32.31
p-value	< 0.0001	< 0.0001	0.0021	< 0.0001	< 0.0001

nificant differences among the reported frequencies, highlighting limited implementation of preventive veterinary care measures (Table 6).

In the dog population, 45% of guardians reported never taking their animals for veterinary check-ups, whereas 35% attended veterinary evaluations every six months. Additionally, 10% reported monthly check-ups and 10% annual evaluations. Statistical analysis demonstrated highly significant differences among the reported frequencies. In the cat population, 83.3% of guardians indicated that their animals had never received veterinary check-ups, while 16.7% reported annual veterinary visits, also revealing a highly significant association (Table 6).

In urban areas, 43.8% of guardians reported never taking their animals for veterinary check-ups, whereas 37.5% attended veterinary evaluations every six months, 12.5% annually, and 6.2% monthly. Statistical analysis demonstrated highly significant differences among the reported frequencies. In rural areas, 75% of guardians indicated that their animals had never received veterinary check-ups, followed by 13% reporting annual evaluations and 6% reporting monthly or semiannual visits, also revealing highly significant differences (Table 6).

3.4. Diagnosed diseases

Regarding this variable, 93.8% of guardians reported that their animals had not been diagnosed with any disease, whereas only 6.2% indicated a previous diagnosis. Statistical analysis demonstrated significant differences among responses, potentially associated with the low frequency of preventive veterinary evaluations (Table 7).

In the dog population, 90% of animals had no veterinary diagnosis, whereas 10% presented a previously diagnosed condition, with statistical analysis revealing significant differences between categories. In cats, all guardians (100%) indicated that their animals had no diagnosed diseases (Table 7).

In urban areas, 87.5% of guardians reported that their animals had not been diagnosed with any disease, whereas 12.5% indicated a previous veterinary diagnosis, with statistical analysis revealing significant differences between categories. Conversely, in rural areas, no diagnosed diseases were reported among the evaluated animals (Table 7).

3.5. Frequency of blood tests performed

Overall, 93.8% of the evaluated animals had never undergone blood testing, whereas only 6.2% had received hematological evaluations within the previous six months. Statistical analysis demonstrated significant differences among the reported frequencies, suggesting limited toxicological and clinical monitoring in companion animals (Table 8).

Table 6. Frequency of responses regarding the periodicity of veterinary check-ups.

Category	General	Dogs	Cats	Urban	Rural
Every month	2	2	-	1	1
Every 3 months	-	-	-	-	-
Every 6 months	7	7	-	6	1
Every year	4	2	2	2	2
Never	19	9	10	7	12
Total	32	20	12	16	16
Chi-square	164.81	61.14	126.91	46.13	134.43
p-value	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001

Table 7. Frequency of responses regarding the diagnosis of diseases by a veterinarian.

Category	General	Dogs	Cats	Urban	Rural
Yes	2	2	-	2	-
No	30	18	12	14	16
Total	32	11.54	12	16	16
Chi-square	22.30	0.0007	-	8.06	-
p-value	< 0.0001	11.54	-	0.0045	-

Ninety percent of dogs have never undergone blood tests, followed by 10% who have done so in the last 6 months, showing significant differences. Similarly, in cats, 100% had never had such tests performed (Table 8).

In urban areas, similarly to rural areas, 93.7% of guardians reported that they had never subjected their animals to blood testing, while 6.2% indicated that they had done so within the last six months, showing a statistically significant difference (Table 8).

3.6. Signs of illness present

Overall, 87.5% of guardians reported that their animals showed no clinical signs, whereas 12.5% reported symptoms such as respiratory problems, loss of appetite, weakness, excessive tearing, and gastrointestinal problems, revealing statistically significant differences (Table 9).

Eighty-five percent of dogs showed no signs of illness at the time of the survey, whereas 15% presented signs of illness, indicating a statistically significant difference. Similarly, among cats, 92% showed no signs of illness, while 8% presented signs of illness, also indicating statistically significant differences (Table 9). In urban areas, 81.2% of guardians reported that their pets showed no signs of illness at the time of the survey, whereas 18.8% reported signs of illness, with no statistically significant differences observed. In contrast, in rural areas, 93.8% reported no signs of illness, while 6.2% reported signs of illness, showing statistically significant differences (Table 9).

Table 8. Frequency of responses regarding the frequency of blood tests.

Category	General	Dogs	Cats	Urban	Rural
Last 3 months	-	-	-	-	-
Last 6 months	2	2	-	1	1
Never	30	18	12	15	15
Total	32	11.54	12	16	16
Chi-square	22.60	12.03	-	11.30	11.30
p-value	< 0.0001	0.0024	-	0.0035	0.0035

Table 9. Frequency of responses regarding the current presence of signs of illness.

Category	General	Dogs	Cats	Urban	Rural
Yes	4	3	1	3	1
No	28	17	11	13	15
Total	32	11.54	12	16	16
Chi-square	16.11	8.7	7.55	5.47	11.15
p-value	< 0.0001	0.0032	0.0060	0.0194	0.0008

4. Discussion

The results indicate that the studied population presents several risk factors for lead exposure, including mixed diets, time spent outdoors, and infrequent veterinary checkups and blood testing. Furthermore, the absence of clinical signs and previous diagnoses in most animals was notable; however, this does not exclude the possibility of lead poisoning. These findings highlight the importance of blood testing as a key diagnostic tool for detecting the presence of this metal in dogs and cats from urban and rural areas of the Calceta parish.

No evidence was found to suggest that blood lead concentration was associated with species or location. However, a statistically significant difference ($p = 0.0274$) was observed according to sex, with females presenting higher blood lead concentrations. This finding may be associated with the mobilization of bone lead reserves during gestation and lactation, particularly considering that a lactating female cat was included in the sampled population.

This trend differs from the findings reported by Valladares et al. (2014), who detected lead levels in female subjects across all samples analyzed. The authors suggested that factors such as topographic location, anthropogenic industrial activities, and vehicular traffic density are key determinants influencing the observed results.

Regarding the dog population, statistical analysis revealed no significant differences in blood lead levels according to sector (urban and rural) or sex (female and male). These findings are consistent with those reported by González Martínez et al. (2019), who, in their study of sentinel dogs, found no significant variations between males and females. This suggests that lead exposure in this species occurs relatively uniformly regardless of sex.

Regarding dietary habits, 70% of rural dogs consumed a mixed diet, a factor that may increase the risk of lead exposure due to the ingestion of viscera and bone tissue from local animals that can act as reservoirs of this metal. In contrast, Rosendahl et al. (2022) reported that blood lead concentrations were positively correlated with the consumption of wild game in raw diets. Specifically, they observed that dogs, particularly males, that consumed this type of food daily or weekly exhibited significantly higher lead levels than those that had never consumed a raw diet.

It was also observed that female dogs in rural areas had constant outdoor exposure, which may increase contact with contaminated food sources, wastewater, and other environmental pollutants. Similarly, Aeluro et al. (2021) reported that female cats showed an average lead concentration of 0.723 μg/g of hair, which was higher than that observed in males. In that study, lead exposure was attributed to outdoor access and poor body condition associated with living in socioeconomically disadvantaged communities.

According to the findings of the present study, 59.4% of dogs and cats had never received veterinary care, potentially limiting the early diagnosis of lead poisoning. This may be attributed to a lack of preventive knowledge among pet guardians. These findings are consistent with those of Valladares et al. (2014), who reported that most pet owners were unaware of the problem due to limited knowledge regarding animal welfare and inadequate veterinary services, thereby complicating efforts to address this public health issue.

It was found that 75% of pet guardians in rural areas had never taken their animals for veterinary checkups, compared to 43.8% in urban areas. This finding may be attributed to limited access to veterinary services in rural communities, as well as a lack of awareness regarding the importance of routine veterinary care, highlighting the critical need to strengthen communication and educational initiatives within these communities. As reported by Chipugsi Albán et al. (2025), community engagement plays a fundamental role in improving the health of companion animals in rural settings by promoting education on animal welfare.

Additionally, a high percentage of pet guardians (93.8%) reported that their companion animals had never undergone blood testing, indicating a considerable lack of awareness and responsibility regarding disease prevention. This finding is particularly concerning because, as noted by Lima Cazorla et al. (2005), lead poisoning is often clinically imperceptible, making diagnostic methods such as blood and urine testing essential for detecting the disease.

The marked absence of clinical signs among companion animals reached 87.5%. However, this asymptomatic condition does not rule out the presence of blood lead or potential lead poisoning, as animals with detectable lead levels in the present study showed no clinical signs at the time of sampling. As reported by Valladares et al. (2014), clinical manifestations of lead poisoning are often not evident during the early stages of exposure. Similarly, Alcántara-Villar et al. (2025) stated that continuous exposure to low doses of lead is associated with poorly defined clinical signs.

In this regard, Blakley (2021) reported that lead poisoning in dogs frequently causes acute neurotoxicity and severe gastrointestinal disorders, including opisthotonus, seizures, vomiting, and colic. In addition, clinical signs such as inappetence, lethargy, respiratory symptoms, and even central nervous system involvement have been described.

One limitation of the present study is the small sample size (32 animals), which may restrict the generalizability of the findings. Nevertheless, the results obtained provide important baseline information for future research.

5. Conclusions

It is concluded that animals from rural areas present a higher risk profile for lead exposure, as their mean values approached the upper reference limit, suggesting the presence of specific exposure sources in these environments, possibly associated with agrochemicals or contaminated soils.

Females appeared to be more susceptible to elevated blood lead levels than males. This phenomenon may be explained by physiological factors, as bone mineral mobilization processes, particularly during reproductive cycles and lactation, can facilitate the release of stored lead into the bloodstream.

No significant differences were observed between dogs and cats regarding blood lead concentrations, indicating that both species may function similarly as environmental sentinels in the Calceta parish, responding in a comparable manner to environmental pollution regardless of their behavioral habits.

In addition, limited preventive care practices were identified among pet guardians, as most dogs and cats had not undergone routine veterinary checkups or blood testing. This situation appears to be primarily associated with insufficient knowledge regarding disease prevention. Therefore, educational and awareness initiatives aimed at pet owners should be implemented in both urban and rural areas of Calceta, Manabí, through coordinated efforts involving relevant authorities and private veterinary professionals.

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Contributor roles

- Diana María Castillo Torres: formal analysis, investigation, resources, visualization.
- Naomi Thais Valencia Angulo: formal analysis, investigation, resources, visualization.
- Vicente Alejandro Intriago Muñoz: conceptualization, supervision, writing – review & editing.

Data Availability

Data will be made available on request

Use of Artificial Intelligence

The authors declare that no artificial intelligence has been used in the preparation of the manuscript.

Ethical Implications

The authors declare that this research was conducted under authorization No. ESPAM MFL-CEIB-2025-008-M.

Conflict of Interest

The authors declare that they have no affiliation with any organization with a direct or indirect financial interest that could have appeared to influence the work reported.

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