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Intestinal parasites in children from native communities of Salta, Argentina

Parásitos intestinales en niños de comunidades originarias de Salta, Argentina

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Palabras clave:

Parásitos intestinales; pueblos indígenas; enfermedades desatendidas; análisis espacial; Giardia lamblia; Hymenolepis nana

Abstract

Introduction:

Intestinal parasites particularly affect vulnerable populations, making their management crucial in endemic areas.

Objective:

To evaluate the relationship between intestinal parasites, socioeconomic characteristics, and anthropometric nutritional status.

Methods:

This is an observational, cross-sectional study conducted on children aged 1 to 15 years in Tartagal, Argentina, for a year. Intestinal parasitic infections were determined through fecal analysis using sedimentation techniques (Teleman), Kato-Katz, and the Baerman method. Demographic and socioeconomic data were collected using a standardized survey. Height, weight, and mid-upper arm and head circumference were measured in the participants.

Results:

Of the 588 participants who provided fecal samples, 55.4% had intestinal parasites, with G. lamblia and H. nana being the most prevalent species. Additionally, 31.9% of participants were found to have malnutrition due to excess weight. Risk factors for intestinal parasite presence included age, overcrowding, and walking barefoot, while owning a refrigerator, having an animal corral, adequate water storage, and belonging to the Guaraní ethnic group were protective factors. High vulnerability areas were observed regarding housing conditions and access to public services.

Conclusions:

An association between socioeconomic conditions and the risk of intestinal parasite presence was observed. However, no association was found between anthropometric nutritional status and the presence of intestinal parasites.

Conflict of interest:
None

Author credits statement:
Scavuzzo, Carlos Matías: Conceptualization, Data curation, Software, Formal analysis, Investigation, Methodology, Writing - Review and Editing, Visualization. Campero, Micaela Natalia: Investigation, Methodology, Writing - Review and Editing, Visualization. Oberto, María Georgina: Investigation, Writing - Review and Editing, Visualization. Porcasi, Ximena: Conceptualization, Investigation, Methodology, Writing - Review and Editing, Visualization. Periago, María Victoria: Conceptualization, Investigation, Methodology, Writing - Review and Editing, Visualization.

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Resumen

Introducción:

Los parásitos intestinales afectan particularmente a grupos poblacionales vulnerables siendo de importancia su abordaje en zonas endémicas.

Objetivo:

Evaluar la relación de parásitos intestinales con características socioeconómicas y estado nutricional antropométrico.

Métodos:

Estudio observacional, y transversal en niños de 1 a 15 años de Tartagal, Argentina durante un año. Las parasitosis intestinales se determinaron por análisis de materia fecal usando técnicas de sedimentación (Teleman) y Kato Katz, y el método de Baerman. Los datos demográficos y socioeconómicos se colectaron con una encuesta estandarizada. Se midió talla, peso, perímetro braquial y cefálico a los participantes.

Resultados:

De los 588 participantes que entregaron materia fecal, el 55.4% presentó parásitos intestinales, siendo Giardia lamblia e Hymenolepis nana las especies más prevalentes. El 31.9% de los participantes presentaron malnutrición por exceso. Los factores de riesgo para la presencia de parásitos intestinales fueron la edad, el hacinamiento y caminar descalzo, mientras que tenencia de heladera, corral para animales, almacenamiento de agua adecuado y pertenecer a la etnia Guaraní, actuaron como factores protectores. Se observaron zonas de alta vulnerabilidad de las viviendas y de acceso a servicios públicos.

Conclusiones:

Se evidenció una asociación entre las condiciones socioeconómicas y el riesgo de presencia de parásitos intestinales. Sin embargo, no se observó asociación entre el estado nutricional antropométrico y la presencia de parásitos intestinales.

Remark

1) Why was this study conducted?

This study was conducted to evaluate the relationship between intestinal parasite infections, socioeconomic characteristics, and anthropometric nutritional status in children and adolescents from indigenous communities in Tartagal, Argentina. The objective was to provide a comprehensive perspective on the health status of these vulnerable populations, particularly in the context of endemic intestinal parasitic infections. The study aimed to assess the influence of environmental, social, and cultural factors on the prevalence of these infections and their potential association with nutritional status.

2) What were the most relevant results of the study?

The prevalence of intestinal parasites among the participants was 55.4%, with H. nana, G. lamblia, and hookworms being the most frequent species. Helminth infections were more prevalent (56.6%) than protozoal infections (43.4%). A significant association was observed between the presence of intestinal parasites and various socioeconomic factors, such as age, parental education level, overcrowding, and the habit of walking barefoot. Protective factors included owning a refrigerator, adequate water storage, and belonging to the Guaraní ethnic group. No significant association was found between the presence of intestinal parasites and anthropometric nutritional status, although a notable proportion of participants exhibited signs of malnutrition, such as stunting and high rates of overweight and obesity.

3) What do these results contribute?

These results contribute to the understanding of how socioeconomic and environmental factors influence the prevalence of intestinal parasitic infections in vulnerable populations. By identifying high-risk factors and protective elements, the study provides valuable insights into areas that require targeted public health interventions. Additionally, the lack of association between parasitic infections and anthropometric nutritional status highlights the need for a multifactorial approach to addressing malnutrition, considering biochemical, dietary, and clinical parameters beyond just parasite burden. The findings support the development of more tailored public health policies aimed at reducing the burden of intestinal parasites and improving overall health in indigenous communities.

Introduction

Neglected Tropical Diseases are a group of twenty diseases caused by viruses, bacteria, and parasites that predominantly affect vulnerable populations, representing one of the most significant public health and socioeconomic development challenges [1]. Intestinal parasites (particularly soil-transmitted helminths - STH) impact vulnerable populations across different geographic areas, especially affecting children [2].

Behaviors such as poor hygiene (e.g., lack of handwashing) or walking barefoot, particularly in areas with limited basic sanitation and consequent fecal contamination of soil, water, and food, are associated with a higher risk of STH infections, especially hookworms [3]. From an epidemiological perspective, these behaviors, along with sociocultural factors (such as socioeconomic and educational levels or hygiene practices), are determinants of intestinal parasitic infections in both rural and urban areas of developing countries [4].

Furthermore, intestinal infections caused by nematodes can be associated with various nutritional alterations, such as reduced appetite, impacting energy intake and that of essential micronutrients (zinc, folate, and B12) [5,6]. Additionally, there is a slight reduction in protein digestion and absorption, increasing endogenous losses due to the use of dietary protein to supply energy [7], and iron (blood) loss in the intestines [8]. The northwest of Argentina is endemic for intestinal parasites, and in the province of Salta, a prevalence of almost 50% of STH has been reported, including *Strongyloides stercoralis* (20%-48%) and hookworms (20%-45%) [9]. Specifically in the city of Tartagal, an 88.6% prevalence of intestinal parasites has been reported [10].

This study, conducted in indigenous communities settled in Tartagal, aims to evaluate the relationship between intestinal parasites, socioeconomic characteristics, and anthropometric nutritional status, to provide a comprehensive perspective on intestinal health.

Materials and Methods

A cross-sectional observational study was conducted between November 2021 and November 2022, involving children and adolescents aged 1 to 15 years from indigenous communities in peri-urban neighborhoods and rural areas along National Route (RN) 86, which crosses the city of Tartagal (General José de San Martín Department, Salta, Argentina). A non-probabilistic convenience sampling was carried out through block-to-block and door-to-door home visits.

In Tartagal (22°30'58.9" S, 63°48.079' W), Salta Province (northern Argentina), in the General José de San Martín Department, lies National Route 86, where numerous indigenous communities are settled. These communities comprise ethnic groups such as the Wichí, Toba, Chorote, and Guaraní. Some communities live in remote forest areas and are more isolated, while others are located on the outskirts of Tartagal and have a higher population density. Tartagal is characterized by its cultural diversity, due to the presence of various native ethnicities and the continuous migration of people from the neighboring country, Bolivia. This diversity significantly impacts the cultural, social, and economic profile of these communities [11].

Ethical approval was obtained from the Ethics Committee of the Provincial Commission for Health Sciences Research, Teaching and Research Program, Human Resources Directorate of the Ministry of Health of Salta Province, Resolution 1480/2011. All participants provided signed consent/assent, and parental consent was obtained.

Data sources

Demographic and socioeconomic data were collected for each household through a structured questionnaire directed at the head of the household, which had been validated in previous studies [12-15]. The study included children aged 1 to 15 years willing to participate, as evidenced by the signing of the informed consent or assent form and the informed consent form by their parents or guardians. Children living outside the study area, those outside the age range of the study, or individuals with behavioral, cognitive, or psychiatric conditions that could affect their ability to understand and cooperate with the research protocol were excluded from the study.

Anthropometric data were analyzed using growth standards according to sex and age established by the Argentine Society of Pediatrics [16] and the World Health Organization (WHO) [(,17].

Intestinal parasite detection was performed by collecting a single stool sample from each individual. The samples were processed at the laboratory of the Fundación Mundo Sano - Tartagal branch, using three different methods: Telemann sedimentation and Baermann techniques for the diagnosis of the presence/absence of intestinal parasites, and the Kato-Katz technique to determine infection intensity through the count of excreted eggs [18,19].

Data analysis

Differences between variables were analyzed using the t-test, and associations were evaluated using Pearson's χ^2 test (for qualitative variables) and the linear correlation coefficient (for quantitative variables), with a 95% confidence level.

To comprehensively assess the behavior of socioeconomic variables, they were grouped into three dimensions: the "structural or building dimension" (which includes 9 variables related to the predominant construction material of the dwelling), the "behavioral dimension" (comprising 9 variables related to the household head's education, water treatment and storage, hygiene practices, and animal slaughtering habits, as well as the possession of goods and energy to meet basic food and hygiene needs), and the "access to public services dimension" (which includes 6 characteristics related to access to water, electricity, health services, and waste collection). Each dimension received a score based on the variables that comprised it, dichotomized as 0 and 1, with 1 representing the category with the greatest vulnerability within the respective variable. Thus, each dimension was scored according to the sum of its dichotomous variables. The behavioral and structural or building dimensions had scores ranging from 0 to 9, while the access to public services dimension had a range from 0 to 6. An optimized hotspot analysis was performed to evaluate the existence of clusters of high values within the dimensions using ArcGIS Pro software.

To assess the extent to which variables influence the risk of intestinal parasite presence (binary dependent variable), a multivariate logistic regression analysis was conducted, reporting odds ratios (OR). All statistical analyses were performed using Stata 15 software [20)] (https://www.stata.com/). Thematic mapping was conducted using QGIS 3.22 [21] (https://qgis.org).

Results

From 717 invited participants, 588 fecal samples were collected and analyzed, with 49.6% of the samples corresponding to males. The average age was 7.2 ± 4.0 years, with middle childhood (school-aged children) being the most predominant age group (41.2%). χ^2 analysis showed a significant association between age and the presence of intestinal parasites ($p \leq 0.001$).

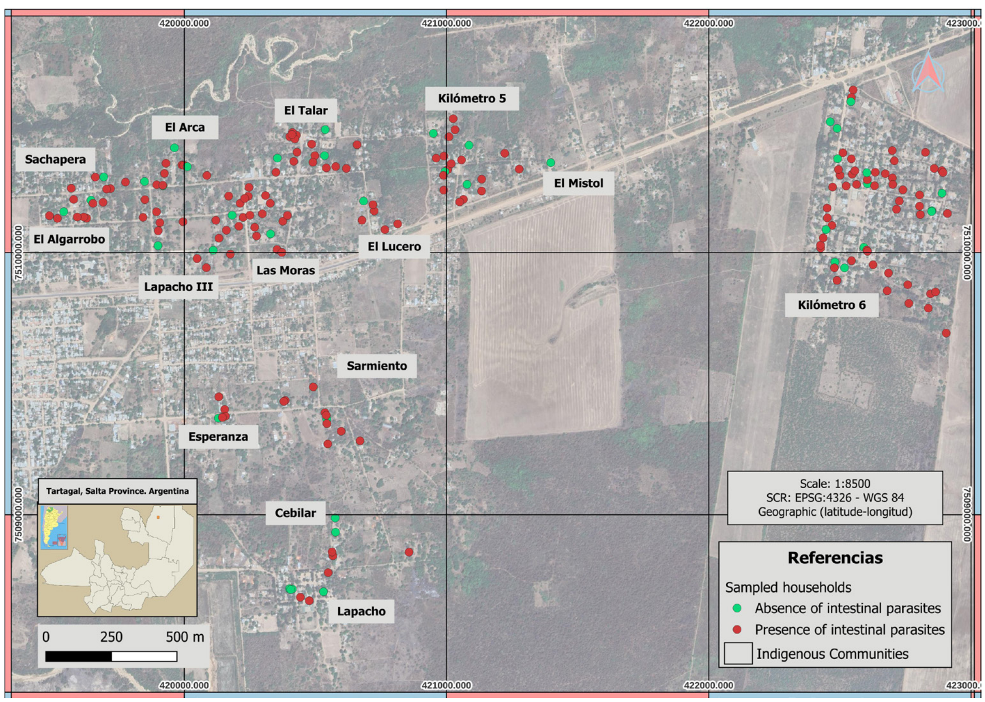

Figura 1. Geospatial distribution of sampled households inhabited by children and adolescents aged 1 to 15 years from indigenous communities in Tartagal (Salta, Argentina), 2021-2022. The area included in this study corresponds to the city of Tartagal, province of Salta (Argentina). Map data © 2023 Google. Basemap obtained through Quick Map Services QGIS plugin - QGIS Geographic Information System. Open source: Geospatial Foundation Project. http://qgis.osgeo.org. Source: Own elaboration.

Table 1. Description of intestinal parasite infections in children and adolescents aged 1 to 15 years from indigenous communities in Tartagal, Salta (Argentina), 2021-2022.

	Total Number of individuals/ households	Presence n (%)
Proportion of households with individuals infected with parasites	202	160 (79.2)
Proportion of individuals with intestinal parasites	588	326 (55.4)
Type of parasitism	326	
Monoparasitism		209 (35.5)
Poliparasitism		117 (19.9)
Infection by soil-transmitted helminths	129	
Hookworm		92 (71.3)
Strongyloides stercoralis		23 (17.8)
Ascaris lumbricoides		14 (10.9)
Hookworm infection intensity	80	
Mild		78 (94.0)
Moderate		3 (3.6)
Severe		2 (2.4)
Frecuency by species		
Helminths		263 (56.6)
Hymenolepis nana		118 (25.4)
Uncinarias		92 (19.8)
S. stercoralis		23 (5.0)
Enterobius vermicularis		16 (3.4)
A. lumbricoides		14 (3.0)
Protozoa		202 (43.4)
Giardia lamblia		105 (22.6)
Cryptosporidium spp.		40 (8.6)
Entamoeba coli *		31 (6.7)
Complex Entamoeba spp.		22 (4.7)
Endolimax nana *		4 (0.8)

* Non-pathogenic species clinically evaluated to determine if the patient requires medical treatment, based on professional judgment.

The spatial distribution of households with at least one child infected with intestinal parasites (red dots) and those with no cases (green dots) is detailed in Figure 1. The indigenous communities are grouped into three large, spatially distinguishable settlements arranged in an east-west direction along the bio-ethnic corridor of National Route 86. Of the children, 70.1% identified as Wichi, 9.3% as Chorote, 9.3% as Guaraní, 5.0% as Criollo, and 6.0% as belonging to other ethnic groups (Mixed, Toba, and Weenhayek).

Table 1 describes the results of fecal sample analysis based on the presence or absence of intestinal parasites. Infected children were present in 79.2% of the households (n= 160). Of the 588 children who provided fecal samples, 55.4% had at least one parasitic species (35.5% were mono-parasitized, and 19.9% were poly-parasitized). The specific frequency identified included 10 species, with the most prevalent being *Hymenolepis nana* (n= 118; 25.4%) and *Giardia lamblia* (n= 105; 22.6%). Additionally, 129 (22.3%) participants were infected with STH, mainly hookworms (71.3%), with most infections (94.0%) being mild (83 samples analyzed using the Kato-Katz technique). The presence of other STH was also detected, including 23 cases of *S. stercoralis* (17.8%) and 14 (10.9%) mild infections of *Ascaris lumbricoides* (μ= 48, σ= 12.8, min= 24, and max= 72).

The assessment of anthropometric nutritional status (Table 2) showed that the percentages of stunting were 7.9% and severe stunting 5.0%. Regarding weight-for-height (W/H), a high proportion of children were found to be at risk of being overweight (34.3%) and overweight (11.6%). Additionally, 88.9% of the children had an appropriate head circumference-for-age (HC/A), while using mid-upper arm circumference-for-age (MUAC/A), 15.8% showed a risk of malnutrition, and 7.6% were malnourished. Finally, 66.4% had an appropriate Body Mass Index-for-age (BMI/A). However, the proportions of overweight (23.4%) and obesity (8.6%) were high compared to the categories indicating malnutrition.

Table 2. Anthropometric assessment based on the presence of intestinal parasites in children and adolescents aged 1 to 15 years from indigenous communities in Tartagal, Salta (Argentina), 2021-2022

	Without intestinal parasites n(%)	With intestinal parasites n(%)	Total n(%)
Weight/Age (n*= 368)			
Very low weight	3 (1.9)	1 (0.5)	4 (1.1)
Low weight	3 (1.9)	3 (1.4)	6 (1.6)
Normal weight	145 (92.4)	203 (96.2)	348 (94.6)
High weight	6 (3.8)	4 (1.9)	10 (2.7)
Total	157 (100)	211 (100)	368 (100)
Height/Age (n*= 478)			
Severe stunting	12 (5.5)	12 (4.6)	24 (5.0)
Stunting	18 (8.4)	20 (7.6)	38 (7.9)
Normal height	185 (86.1)	231 (87.8)	416 (87.1)
Total	215 (100)	263 (100)	478 (100)
Weight/Height (n*= 181)			
Severely wasted	1 (1.2)	0 (0)	1 (0.5)
Wasted	1 (1.2)	3 (3.0)	4 (2.2)
Normal	45 (54.2)	48 (48.9)	93 (51.4)
Possible risk of overweight	26 (31.3)	36 (36.8)	62 (34.3)
Overweight	10 (12.1)	11 (11.3)	21 (11.6)
Total	83 (100)	98 (100)	181 (100)
Head Circumference/Age (n*= 179)			
Microcephaly	9 (10.9)	7 (7.2)	16 (8.9)
Normal	70 (85.4)	89 (91.8)	159 (88.9)
Macrocephaly	3 (3.7)	1 (1.0)	4 (2.2)
Total	82 (100)	97 (100)	179 (100)
Mid-Upper Arm Circumference/Age (n*= 184)			
Malnutrition	7 (8.4)	7 (6.9)	14 (7.6)
Risk of malnutrition	11 (13.3)	18 (17.8)	29 (15.8)
Normal	65 (78.3)	76 (75.3)	141 (76.6)
Total	83 (100)	101 (100)	184 (100)
Body Mass Index/Age (n*= 479)			
Severe malnutrition	4 (1.9)	0 (0)	4 (0.8)
Malnutrition	1 (0.5)	3 (1.2)	4 (0.8)
Normal	140 (65.1)	178 (67.4)	318 (66.4)
Overweight	51 (23.7)	61 (23.1)	112 (23.4)
Obesity	19 (8.8)	22 (8.3)	41 (8.6)
Total	215 (100)	264 (100)	479 (100)

* n: Number of individuals. The n for different indicators varies due to: a) not all age ranges are evaluated using the same indices, and b) in some cases, it was not possible to perform all the stipulated measurements on all individuals.

For the "access to public services" dimension, 48.7% of the surveyed households had income from social welfare programs, 28.1% from pensions, 17.7% had informal work, and only 5.4% had formal employment. Additionally, most families (76.3%) reported not having health coverage. However, 99.0% of households had access to electricity, and only 60.0% had running water inside the home for drinking, cooking, and handwashing. Another 20.0% relied on water provided by water trucks, bottled water, or rainwater. Regarding waste disposal, 77.3% of households used burning as a method.

From the constructed dimensions, the "building" dimension showed that 90.4% of households had a handwashing facility, and 64% did not have a refrigerator to store food. Most homes used wood-burning stoves (91.7%) for cooking, with only 8.4% using gas. Additionally, 54.5% of homes had walls made of brick with cement, while the remaining 45.4% had wooden walls. Most homes had sheet metal roofs (96.1%) and dirt floors (55.9%), with some having cement floors (32.6%). Furthermore, 98.5% of households had a bathroom or latrine, and excreta disposal was mainly through pit latrines (71.1%). An association was found between the presence of intestinal parasites and the presence of a refrigerator (p= 0.04).

The "behavioral" dimension revealed that most household heads had completed only primary education (57.7%), with only 4.9% reaching a university or tertiary level; 89.1% reported being able to read and write. Regarding water treatment, only 9.9% boiled their water or used sodium hypochlorite, while most households (91.2%) stored water; 62.9% in tanks, and the

Table 3. Dimensions of access to public services, building, and behavioral factors in households positive for intestinal parasites inhabited by children and adolescents aged 1 to 15 years from Indigenous Communities in Tartagal, Salta (Argentina), 2021-2022.

Cumulative score of each dimension	Building	Access to public services	Behavioral dimension
2	5.0 (2.48%)	19 (9.41%)	14 (6.93%)
3	23.0 (11.39%)	64 (31.68%)	8 (3.96%)
4	34.0 (16.83%)	54 (26.73%)	44 (21.78%)
5	11.0 (5.45%)	10 (4.95%)	44 (21.78%)
6	52.0 (25.74%)	6 (2.97%)	10 (4.95%)
7	2.0 (0.99%)	0 (0.00%)	7 (3.47%)
8	3.0 (1.49%)	0 (0.00%)	8 (3.96%)

rest in buckets, jugs, pots, or other containers. Additionally, 96.4% washed their hands before eating, 97.5% after defecating, and 54.8% of children walked barefoot. A significant association was found between walking barefoot and the presence of intestinal parasites (χ^2; p= 0.02). Furthermore, a positive correlation (linear correlation test; r= 0.14) was found between the "behavioral" dimension and the number of people living in the house (p= 0.03), indicating an association between the presence of intestinal parasites and overcrowding.

When comparing the vulnerability scores across different dimensions, the scores significantly increased ($p \leq 0.001$) alongside the proportion of positive cases (Figure 2). The "access to public services" dimension showed higher sensitivity, as the increase in positive cases occurred with lower scores referred to the other dimensions. This dimension showed the highest number of positive households with a cumulative score of 3, reaching 64 households (31.7%), indicating high sensitivity to this dimension even with a relatively low score. This observation suggests that access to public services is a critical variable affecting most of the population (Table 3).

In comparison, the "building" dimension showed a significant increase in the positive households starting with a cumulative score of 6 and reaching 52 households (25.7%). Although this increase is substantial, it requires a higher score compared to "public services," indicating relatively lower sensitivity to this dimension. Finally, the "behavioral" dimension presented two significant peaks at cumulative scores of 4 and 5, with 44 positive households (21.8%) each. These values highlight the importance of behavioral factors in determining vulnerability, showing a high proportion of affected households at intermediate cumulative score levels.

The hotspot analysis results for the three dimensions identify areas of higher vulnerability concerning each analyzed attribute (Figure 2). For the building dimension, a zone of higher vulnerability is observed between the "Sarmiento" and "Esperanza" communities. Additionally, two other zones of high vulnerability in the "access to public services" dimension are observed in the "Km 6" community. Regarding the behavioral dimension, no statistically significant hotspots were identified, but the "Km 6" community shows a lower proportion of households with low vulnerability scores, with most households falling into the medium and high categories.

Table 4 presents the statistically significant variables associated with the risk of intestinal parasite infection based on logistic analysis. Children aged 3 to 5 years (early childhood) were, on average, 3.07 times more likely to have intestinal parasites compared to the reference category (adolescents aged 12 to 15 years). School-aged children (middle childhood) were, on average, 2.16 times more likely to have the infection compared to adolescents. In households with overcrowding, there was an average of 1.35 times higher probability of intestinal parasite infection compared to those without (p= 0.05). Additionally, children who walked barefoot were 2.27 times more likely to have intestinal parasites.

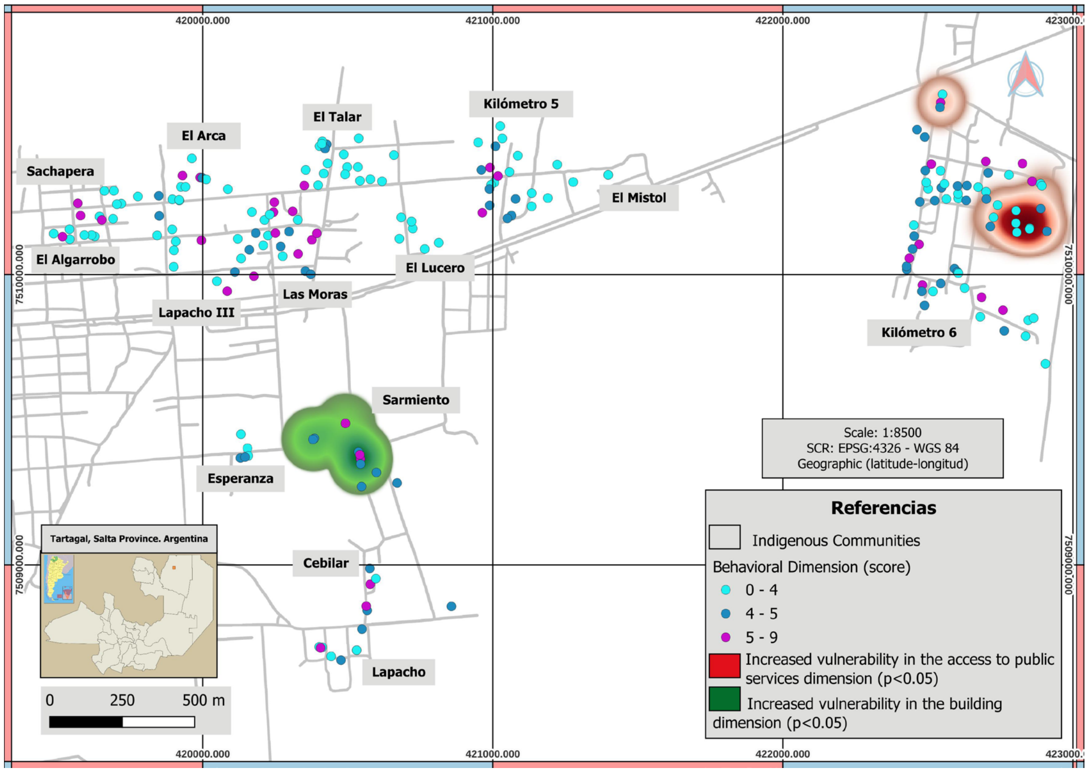

Figure 2. Hotspot analysis of the socioeconomic dimensions of households from Indigenous Communities in Tartagal, Salta (Argentina), 2021-2022. The area included in this study corresponds to the city of Tartagal, province of Salta. Map data © 2023 Google. Basemap obtained through Quick Map Services QGIS plugin - QGIS Geographic Information System. Open source: Geospatial Foundation Project. http://qgis.osgeo.org.

Table 4. Risk associated with the presence of intestinal parasites in children and adolescents aged 1 to 15 years from indigenous communities in Tartagal, Salta (Argentina), 2021-2022

	Odds Ratio	p (z) [a]	95% Confidence Intervals
Early Childhood (3 to 5 years inclusive)	3.07	0.000	1.80-5.22
Middle Childhood (6 to 11 years inclusive)	2.16	0.000	1.33-3.51
Overcrowding	1.35	0.05	1.04-1.77
Walks barefoot	2.27	0.02	1.13-4.63
Ownership of a refrigerator	0.06	0.04	0.008-0.46
Presence of a pen or pigsty for containing animals	0.003	0.04	0.08-0.99
Use of a lid for water storage	0.05	0.03	0.003-0.80
Guaraní Ethnicity	0.8	0.05	0.8-0.9

Discussion

The spatial distribution of intestinal parasites in children in Argentina exhibits heterogeneity due to environmental, socioeconomic, and cultural variability [22-24], with the northeastern and northwestern regions being endemic areas [25]. Previous studies conducted in the same communities of Tartagal, particularly in "Km 6," reported intestinal parasite prevalence ranging from 70.5% to 94.6% [10,11]. In the present study, the prevalence was 55.4%, with the most common species being *H. nana, G. lamblia*, and hookworms. A higher prevalence of helminths (56.6%) compared to protozoa (43.4%) was observed, differing from studies conducted in other regions of Argentina such as Buenos Aires, La Pampa, Córdoba, and Santiago del Estero [26-28]. This variability may be explained by the specific environmental, social, and cultural conditions of each region, which are more or less conducive to the transmission of each species [5,26].

In Argentina, the prevalence of malnutrition is relatively low compared to the Latin American context[29]. However, in this study, 13.9% of the children presented some degree of stunting, an indicator reflecting chronic malnutrition. Other studies report higher prevalence rates of chronic malnutrition in northwestern Argentina (>20%) [30] and regional inequalities [29,31]. In this context, parasitized pediatric populations, particularly those from indigenous communities, are sensitive to malnutrition. Within this framework, 19.8% of the sampled children were infected with hookworms, an infection that can exacerbate or prolong malnutrition, hinder cognitive development, and cause anemia [32].

The most recent National Nutrition and Health Survey (ENNyS) reported a 41.6% prevalence of overnutrition among children aged 5 to 14 in northwestern Argentina [31]. This result likely stems from the sociodemographic and economic characteristics that define the northern region of the country, where clear social inequalities persist compared to other regions of Argentina [30]. In this context, the anthropometric analysis results of the present study reveal one of the features of nutritional transition, specifically high rates of overweight and obesity in poverty-stricken contexts, with a prevalence of 32% [29].

This study did not find significant associations between the presence of parasites and anthropometric indicators. Some studies have shown associations [33], while others, like the present study, have not detected such an association [34-36]. It is essential to consider that diagnosing malnutrition, whether due to deficiency or excess, does not rely solely on anthropometric parameters. Although valuable, these parameters are often insufficient to comprehensively determine an individual's nutritional status [37]. For this reason, it is important to assess biochemical parameters, dietary habits, and clinical examination, which should be considered in future studies [38].

This study corroborates significant associations between the presence of intestinal parasites and factors such as age [39], parents' education level [21], overcrowding [40], and the habit of walking barefoot. Walking barefoot was identified as a risk factor, associated with a hookworm prevalence of nearly 20%, confirming results from previous studies [41,42]. Protective factors include owning a refrigerator, which improves food storage and hygiene conditions, and using a cover for water storage, which prevents contamination [43].

As a limitation, this study employed non-probabilistic convenience sampling, constrained by the logistics of data collection in households, which directly impacts the representativeness of the sample. This approach restricts the extrapolation of results to the general population. The capacity for population inference is therefore considerably limited, underscoring the importance of exercising caution in generalizing the findings.

Conclusion

This study enabled the assessment of intestinal parasite infections in indigenous communities. Although no association was observed between nutritional status and infection, the high burden of malnutrition reveals a fragile health scenario. The spatialization of influencing contextual factors, grouped by dimensions, allowed the detection of areas of greater vulnerability. Together with the identification of risk factors, this facilitates the identification of areas susceptible to intervention, providing an operational basis for redirecting public health policies.

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