American Journal of
Epidemiology & Public Health

Mini Review

Epidemiological Aspects of Cyclospora Cayetanensis Infection in Venezuela

Leonor Chacin-Bonilla* and Ricardo Cardenas

Instituto de Investigaciones Clinicas, Universidad del Zulia, Apartado Postal 23, Maracaibo, Venezuela

***Address for Correspondence:** Leonor Chacin-Bonilla, Instituto de Investigaciones Clinicas, Universidad del Zulia, Apartado Postal 23, Maracaibo, Venezuela, Tel: +58-202-340-1787; ORCID: 0000-0002-8203-3185; E-mail: leonorbonilla42@yahoo.com

Submitted: 14 December 2022; **Approved:** 20 December2022; **Published:** 21 December 2022

Cite this article: Chacin-Bonilla l. Cardenas r. Epidemiological Aspects of Cyclospora Cayetanensis Infection in Venezuela. American J Epidemiol Public Health. 2022 Dec 21;6(2): 050-054. doi: 10.37871/ajeph.id60

ISSN: 2644-0032

ISSN: 2644-0032

ABSTRACT

The epidemiology of *Cyclospora cayetanensis,* particularly in endemic areas, is not well known. The objective of this article is to review the findings on cyclosporiasis in low-income populations from Venezuela, to recommend future avenues of research and interventions for infection control. Cyclosporiasis is common in the country with high endemicity during the rainy time with a clear association to poverty. Soil transmission may be the main route of spread, suggesting the correlation between household socioeconomic level and infection; sustainable development is essential in low-resource settings to avoid and control cyclosporiasis. Additional studies are needed to confirm and expand these findings in analogous environments. Sampling plannings along with longitudinal and spatial analyses will be essential for knowing the specific *Cyclospora* relationships with poverty and environmental conditions that will guide intervention actions against infection..

Keywords: Cyclospora cayetanensis; Cyclosporiasis; Epidemiology; Risk factors; Soil-borne transmission; Venezuela

INTRODUCTION

Cyclosporiasis is an emerging infection of public health significance worldwide and an important etiology of diarrheal disease. In low-resource areas the infection is endemic and illness occurs mainly in children and patients with Acquired Immunodeficiency Syndrome (AIDS). Infection rates as high as 41% have been observed. A marked seasonality with different patterns has been reported. In developed regions, *Cyclospora cayetanensis* outbreaks have largely been caused by contaminated fresh food imported from endemic areas, and the parasite is considered a food- waterborne parasite [1].

In low-income areas, the distribution of *Cyclospora* could be different, with different infection sources and transmission routes, due to their low socioeconomic status, hygiene levels, and agricultural intensity work. Eating fresh food, factors linked to water, agricultural work, poor personal hygiene, contact with soil, and deficient sanitary facilities have been associated with infection [2].

Venezuela experiences a high burden of parasitic infections, including intestinal parasites [2-7]. *C. cayetanensis* as an enteropathogen is largely undefined. The diagnosis of cyclosporiasis is not part of routine stool examination in health-care facilities and it has not been included in the national reported diseases systems. Thus, infection and disease could be underestimated and the prevalence and significance of the parasite is largely undefined. There are knowledge gaps on *C. cayetanensis* and it remains enigmatic in several aspects, mainly in its biology and epidemiology. The modes of transmission of the parasite are not completely documented, especially in endemic areas.

The aim of this paper is to review the current status of knowledge of the epidemiology of human cyclosporiasis in Venezuela, emphasizing risk factors and routes of transmission for the infection, in order to institute appropriate risk management, control systems, and prevention of spread.

Geographical Distribution

To date, very few published papers have documented the occurrence of *C. cayetanensis* infection in different areas of Venezuela from the Capital District and Zulia, Falcon, Sucre, and Bolivar States located at the central, northwestern, northeastern and southeastern territories (Figure 1), suggesting that cyclosporiasis is widespread in this nation. Clearly, there is a lack of a comprehensive understanding of the epidemiological status and characteristics of the infection in the region.

Prevalence

A variety of populations including HIV/AIDS patients and community people have been investigated for the presence of *Cyclospora* oocysts through traditional methods, such as modified acid-fast staining. However, no data are available using molecular methods owing to limited resources.

The reported infection rates of various population groups are as follows: in the Capital District, outpatients (0.6%) [8]; in Zulia State, HIV/AIDS patients (6.8-9.8%) [9,10] children with diarrhea (5.3%) [9] community populations (6.1-8.3%) [11,12]; in Falcon State, rural populations (9.9%, 24.2%-40.7%) [13,14]; in Sucre State, indigenous population (9.9%) [15]; in Bolivar State, HIV/AIDS patients (19.5%) [16], day care children (2.7%) [17], orphanage children (3.8%) [18], community populations (0.6%-11.9%) [19,20].

The reported infection rates ranged from 6.8% to 19.5% in HIV/AIDS patients [9,10,16] reflecting that the parasite is an important opportunistic pathogen. In community populations, the prevalence ranged from 0.6% to 40.7% by state [14,19]. However, with the exception of the high infection rates (24.2-40.7) from 4 communities of Falcon State [14], most of the settings showed lower infection percentages from 0.6% to 11.9% [19,20].

The distribution of *Cyclospora* by age indicates that infection predominates in subjects less than 20 years of age, chiefly those ≤ 10 years of age. The symptomatic cases were noted only in this cohort, mostly in those 0-5 years [2,12,13,15,20]. The proportion of asymptomatic infections is remarkably high, from 64% to 98.8% [13,15], suggesting that early infections afford immunity [2].

Seasonal Variation

A pronounced seasonality of *Cyclospora* infection was observed in a community from Falcon State [21]. A relevant finding was the bimodal distribution of infection coinciding with the two peaks of rainfall, showing that infection rates can be highly variable from month to month (0% to 35.3%). This finding could explain, at least in part, the higher rates of infection (24.2%-40.7%) found in this state [14], with respect to other areas of the country.

Our results support those observed in other countries like Colombia, which borders Venezuela, as well as Peru, Guatemala, Honduras, Cuba, Mexico, Jordan, Indonesia, Nepal and China, where the rate of cyclosporiasis increased during maximal rainfall. However, they differ from those noted in Haiti, an island close to Venezuela**,** where infection predominated during colder times, when the temperature appears to be the moderator of the infection seasonality [1,2,22]. This suggests that various environmental factors affect the sporulation and spread of the coccidium.

Transmission Routes and Risk Factors

In Venezuela, there are only two studies discussing risk factors and transmission routes for *Cyclospora* infection. In two impoverished rural communities from Zulia State, among multiple plausible risk factors for cyclosporiasis, the multivariate logistic regression showed an overall strong model of prediction for the prevalence of *Cyclospora* reflecting the relevant finding of the explicit association of infection with extreme poverty and soil transmission. Several independent variables related to demographic, socio-economic,

DOI: https://dx.doi.org/10.37871/ajeph.id60

ISSN: 2644-0032

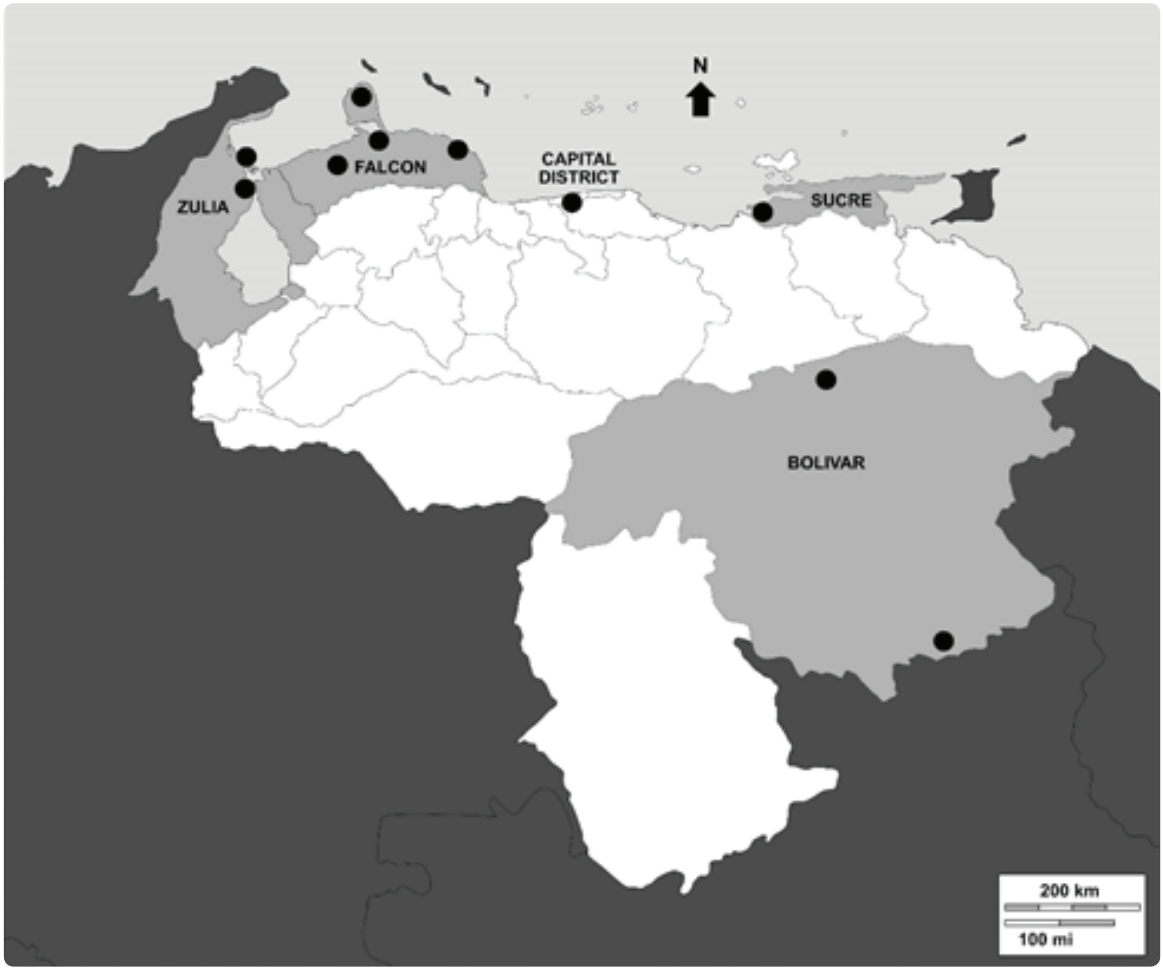

Figure 1: Geographical distribution of Cyclospora cayetanensis infection in Venezuelan states.

and environmental conditions were significantly associated with the infection. Prevalence was higher among children ≤ 10 years, living in huts, using well water source and drinking untreated water, lacking toilets and having contact with feces-contaminated soils and poultry. Infections were clustered in sectors and households with extreme poverty [12,13]. These findings reflect the household socioeconomic correlate of *Cyclospora* positivity. The higher infection rate in children ≤ 10 years suggests a greater propensity to infection due to other sub-factors strongly correlated with socio-economic status rather than age alone; *Cyclospora* is transmitted by exposure to contaminated environmental sources and these children may be more exposed by a longer and more frequent contact with them.

Cyclospora in Environmental Matrices

Fresh produce: In Bolivar City, Bolivar State, *Cyclospora* spp. were detected in 5.9% (6/120) samples of lettuce purchased from local markets. Parasitic contamination was evaluated by microscopic examination using formol-ether sedimentation and modified Zeihl-Neelsen staining [23]. In a study from Coro City, Falcon State, 127 vegetable samples (onions, tomatoes, peppers, lettuce, cabbage, parsley, cilantro, garlic joint, celery, and scallions) obtained from local markets were analyzed by microscopy using spontaneous sedimentation and modified Zeihl-Neelsen staining. *Cyclospora* spp. were identified in 8.6% (11/127 samples) from vegetable wash sediments: 2/18 (11%) of lettuce, 4/14 (28.5%) of cabbage, 1/5 (20%) of celery, and 4/21 (19%) of scallions [24]. In another report from a rural community from Falcon State, a total of 77 local samples of fresh produce (five units of lettuce, cabbage, celery, cilantro, parsley, lettuce, and cabbage, eight units of tomatoes, onions, peppers, and mushrooms; and twenty units of strawberries) were scanned by UV epifluorescence and phase-contrast microscopy for the presence of *C. cayetanensis* 3/77 (3.9 %) samples had *Cyclospora* oocysts [13].

Water matrices: There is only one study from a rural community in Falcon State that analyzed the presence of *Cyclospora* in water matrices using UV epifluorescence and phase-contrast microscopy; 4/14 (28.6%) water samples were positive; 2/10 (20%) water wells, 1/2 (50%) water trucks, and 1/2 (50%) river water [13].

Soil matrices: In the same setting of Falcon state, 9/50 (18%) soil specimens were positive for the parasite; all of these had clay texture [13]. The local detection of oocysts in soil, water, and produce suggests the potential transmission of the parasite by these vehicles in this region. Based on the association of infection with variables related to demographic, socio-economic, and environmental conditions in this country, we can postulate that, besides water and food, soil is a main reservoir and route of spread of *Cyclospora* in endemic areas [12,13,25].

Cyclospora in Animals

In Coro City, Falcon State, 516 fecal samples from domestic

DOI: https://dx.doi.org/10.37871/ajeph.id60

pigeons were analyzed for the presence of *Cyclospora* oocysts by microscopy using spontaneous sedimentation, zinc sulphate flotation and modified Zeihl-Neelsen staining. The parasite was detected in 67 (13%) of the samples [26].

Based on the present findings *Cyclospora* infection is common in Venezuela and has a marked seasonality with high endemicity during the rainy time. The infection predominates in children ≤ 10 years old, there is a remarkable high percentage of asymptomatic carriers and the disease prevails in infants and AIDS patients as observed in other developing countries [1,2].

An explicit correlation between *Cyclospora* infection and poverty exists; infections cluster in families living in substandard housing developments. Water, food and soil are potential reservoirs and routes of spread of *Cyclospora.* Soil transmission may be the predominant mode of spread.

Future Research

Future work should include an in-depth study to assess the potential links between social marginalization and *Cyclospora* positivity and the potential role of soil as a reservoir and avenue of infection. Sampling plannings along with longitudinal and spatial analyses will be decisive for knowing *Cyclospora* relationships with poverty and environmental conditions that will lead strategies against infection.

Future Program for Prevention and Control

The present findings highlight the potential link of *Cyclospora* infection with social marginalization; the unequal dissemination of cyclosporiasis implies a great impact for public health strategies in poor regions. Interventions should target on improvement of infrastructure and environmental sanitation. However, this mediation needs huge efforts in precarious neighborhoods, a steady conduct shift, and infrastructure preservation to be efficient for a very long time.

CONCLUSION

Cyclospora infection is common in Venezuela, with high endemicity during the rainy time. There is a clear association to poverty, and soil transmission may be the main route of transmission, suggesting the correlation between household socioeconomic level and cyclosporiasis. Sustainable development is essential in low-resource settings to avoid such widespread of the infection. Additional studies are needed to confirm and expand these findings in analogous environments.

ACKNOWLEDGMENT

Author contributions: All authors contributed to the conceptualization, writing, and editing of this manuscript.

Ethical approval: Not Required.

Competing interests: None declared.

Funding: None.

REFERENCES

1. Chacín-Bonilla L. Epidemiology of Cyclospora cayetanensis: A review focusing in endemic areas. Acta Trop. 2010 Sep;115(3):181-93. doi: 10.1016/j.actatropica.2010.04.001. Epub 2010 Apr 9. PMID: 20382099.
2. Chacín-Bonilla L. Cyclospora cayetanensis. In: Fayer R, Jakubowski W, editors. Water and sanitation for the 21st century: Health and aspects of excreta and wastewater management (Global Water Pathogen Project). East Lansing: Michigan State University; USA. 2017. p.1-43. doi: 10.14321/waterpathogens.32.
3. Chacín-Bonilla L, Dikdan Y. Prevalencia de Entamoeba histolytica y otros parásitos intestinales en una comunidad suburbana de Maracaibo. Invest Clín. 1981;22:185-203.
4. Chacín de Bonilla L, Mathews HM, Healy GR, Dikdan Y, Rodriguez de Zambran N. Serologic and parasitologic studies of amebiasis in two suburban communities of Maracaibo. Venezuela. Invest Clín. 1984;25:69-80.
5. Chacín-Bonilla L, Mathews HM, DikdanY, Guanipa N. Estudio seroepidemiológico de la amibiasis en una comunidad del estado Zulia, Venezuela. Rev Inst Med Trop. S Paulo. 1990;32:467-473.
6. Chacín-Bonilla L, Larreal Y. Prevalence of human toxoplasmosis in San Carlos Island. Interciencia. 2003; 28:457-462.
7. Chacín-Bonilla L. Perfil epidemiológico de las enfermedades infecciosas en. Venezuela. Invest Clín. 2017; 58:103-105.
8. Chacón N, Salinas R, Kuo E, Durán CE, Márquez W, Contreras R. Ocurrencia de Isospora belli, Cryptosporidium spp. y Cyclospora cayetanenesis en pacientes urbanos evaluados por síntomas gastrointestinales con o sin inmunosupresión. Rev Fac Med. 2009;32. doi: 10.1016/j.heliyon.2018.e00769.
9. Chacín-Bonilla L, Estévez J, Monsalve F, Quijada L. Cyclospora cayetanensis infections among diarrheal patients from Venezuela. Am J Trop Med Hyg. 2001 Oct;65(4):351-4. doi: 10.4269/ajtmh.2001.65.351. PMID: 11693883.
10. Chacin-Bonilla L, Panunzio AP, Monsalve-Castillo FM, Parra-Cepeda IE, Martinez R. Microsporidiosis in Venezuela: prevalence of intestinal microsporidiosis and its contribution to diarrhea in a group of human immunodeficiency virus-infected patients from Zulia State. Am J Trop Med Hyg. 2006 Mar;74(3):482-6. PMID: 16525110.
11. Chacin-Bonilla L, Mejia de Young M, Estevez J. Prevalence and pathogenic role of Cyclospora cayetanensis in a Venezuelan community. Am J Trop Med Hyg. 2003 Mar;68(3):304-6. PMID: 12685635.
12. Chacín-Bonilla L, Barrios F, Sanchez Y. Epidemiology of Cyclospora cayetanensis infection in San Carlos Island, Venezuela: strong association between socio-economic status and infection. Trans R Soc Trop Med Hyg. 2007 Oct;101(10):1018-24. doi: 10.1016/j.trstmh.2007.05.008. Epub 2007 Jul 25. PMID: 17655898.
13. Chacin-Bonilla L, Sanchez Y, Cardenas R. Factors associated with Cyclospora infection in a Venezuelan community: extreme poverty and soil transmission relate to cyclosporiasis. Trans R Soc Trop Med Hyg. 2022 Jul 26:trac070. doi: 10.1093/trstmh/trac070. Epub ahead of print. PMID: 35894776.
14. Cazorla PD, Lehmann S, Carrero C, Bravo F, Acosta-Quintero M, Morales-Moreno P. Perfiles clínicos y epidemiológicos de la infección por coccidios intestinales en Mirimire. Estado Falcón. Venezuela Saber. 2015; 27:46-60.
15. Gómez ME, Figuera L, Guilarte DV, Simoni Z, Díaz MT, Berrizbeitia M, Sayreth C. Primer reporte de *Cyclospora cayetanensis* en una comunidad indígena Kariña del municipio Sucre, estado Sucre. Venezuela. Bol Mal. Salud Amb. 2016;56:24-38.
16. Requena I, Añez H, Lacourt E, Blanco Y, Castillo H, Rivera M, D Rodolfo. Elevada prevalencia de coccidios intestinales en pacientes infectados con el virus de la inmunodeficiencia humana en Ciudad Bolívar, Venezuela. Rev Bioméd. 2007;18:73-75.
17. Tedesco RM, Camacaro Y, Morales G, Amaya I, Blanco Y, Devera R. Parásitos intestinales en niños de hogares de cuidado diario comunitarios de Ciudad Bolívar. Estado Bolívar. Venezuela. Saber. 2012;24:142-150.
18. Devera R, Ortega N, Suárez M. Parásitos intestinales en la población infantil del Instituto Nacional del Menor. Ciudad Bolívar, Venezuela. Rev Soc Venezol Microbiol. 2007;27:38-44.
19. Devera R, Amaya I, Blanco Y, Requena I, Tedesco RM, Rivas N, Cortesía M, González R. Parásitos intestinales en una comunidad suburbana de Ciudad Bolívar. estado Bolívar. Venezuela. Salud. Arte y Cuidado. 2012;5.
20. Devera R, Blanco Y, Cabello E. Elevada prevalencia de Cyclospora cayetanensis en indígenas del estado Bolívar, Venezuela [High prevalence of Cyclospora cayetanensis among indigenous people in Bolivar State, Venezuela]. Cad Saude Publica. 2005 Nov-Dec;21(6):1778-84. Spanish. doi:

ISSN: 2644-0032

10.1590/s0102-311x2005000600025. Epub 2006 Jan 9. PMID: 16410862.

21. Chacin-Bonilla L, Sanchez Y. Seasonal trends of Cyclospora cayetanensis infections in a community of Falcon State, Northwestern Venezuela. Trans R Soc Trop Med Hyg. 2022 Jul 6;116(7):673-675. doi: 10.1093/trstmh/trab179. PMID: 34850236.

22. Frickmann H, Alker J, Hansen J, Dib JC, Aristizabal A, Concha G, Schotte U, Kann S. Seasonal Differences in Cyclospora cayetanensis Prevalence in Colombian Indigenous People. Microorganisms. 2021 Mar 18;9(3):627. doi: 10.3390/microorganisms9030627. PMID: 33803496; PMCID: PMC8002917.

23. Devera R, Blanco Y, González H, Lisdet García L. Parásitos intestinales en lechugas comercializadas en mercados populares y supermercados de Ciudad Bolívar, estado Bolívar, Venezuela. Rev Soc Ven Microbiol. 2006;26.

24. Cazorla-Perfetti D, Morales P, Chirinos M, Acosta ME. Evaluación parasitológica de hortalizas comercializadas en Coro, estado Falcón. Venezuela. Bol Mal Salud Amb. 2009;49.

25. Chacín-Bonilla L, Barrios F. Cyclospora cayetanensis: biología, distribución ambiental y transferencia [Cyclospora cayetanensis: biology, environmental distribution and transfer]. Biomedica. 2011 Mar;31(1):132-44. Spanish. doi: 10.1590/S0120-41572011000100016. PMID: 22159492.

26. Cazorla Perfetti D, Pedro Morales-Moreno P. Parásitos intestinales en poblaciones ferales de palomas domésticas (Columba livia domestica) en Coro, estado Falcón, Venezuela. Rev Invest Vet Perú. 2019;30.

DOI: https://dx.doi.org/10.37871/ajeph.id60