

# Intestinal parasitism and nutritional status among indigenous children from the Argentinian Atlantic Forest: Determinants of enteroparasites infections in minority populations

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## ABSTRACT

**Objective:** Intestinal parasitoses, especially in the less favored populations of tropical and subtropical areas, are a scourge of high impact in public health. We conducted a cross-sectional survey to investigate the prevalence of helminths and protozoa pathogens, malnutrition, and their determinants in children from indigenous Mbyá Guaraní villages of Iguazú, in the subtropical Atlantic Forest of Argentina.

**Methods:** Parasitological assessment was performed using a combination of flotation, sedimentation, and centrifugation techniques, as well as temporal and permanent stains. Nutritional assessment was based on nutritional indicators derived from anthropometric measurements. Statistical analysis of socio-demographic determinants was assessed by Generalized Linear Mixed Models at individual, household, and village levels.

**Results:** A total of 303 children from 140 families from Fortin Mbororé and Yriapú Jungle villages participated, and 87.8% of them resulted positive to at least one parasite. Multiparasitism reached 70% and children with up to six different parasites were detected. Thirteen genera were identified, of which eight were pathogenic. The most frequent soil-transmitted helminths were hookworms and *Strongyloides stercoralis* with 60.7 and 41.9%, respectively. *Enterobius vermicularis* was detected in 28.4% of children. *Giardia duodenalis* was the main protozoan and reached the 33.3%. The prevalence of stunting and underweight were 38.9% and 6.9%, whereas for overweight and obesity were 28.1% and 12.9%, respectively. An association was observed between stunting in older children and the presence of parasites, multiparasitism, and giardiasis. Individual conditions and habits were important determinants for most of the parasitoses.

**Conclusions:** We evidenced that the community is affected by the double burden of malnutrition and parasitoses. To face this alarming situation, public policies are needed to improve sanitation, hygiene education access, community deworming programs, and quality nutrition on a regular basis of intercultural approaches.

## 1. Introduction

Intestinal parasitic infections (IPIs), especially in vulnerable populations of tropical and subtropical areas, are of global public health concern (Hotez, 2014; WHO, 2012). Some of the most important causal agents of these infections are soil-transmitted helminths (STH) and the protozoan parasite *G. duodenalis* which are considered neglected tropical diseases (NTDs) (Hotez et al., 2008). Assessment of their impact over some neglected communities such as indigenous villages of Latin

America has provided mounting evidence of the severity of such impact (Gracey and King, 2009; Montenegro and Stephens, 2006; Navone et al., 2006; Taranto et al., 2003; Toledo et al., 2009; Zonta et al., 2010). In particular, the co-existence of IPIs and malnutrition among disadvantaged communities in developing countries has been well documented. Intestinal parasites can cause malabsorption, intestinal syndrome, iron and vitamins deficiencies, among other effects, provoking a deleterious effect on the nutritional status (Gamboa et al., 2011; Humphrey, 2009; Stephenson et al., 2000; Zonta et al., 2011). In

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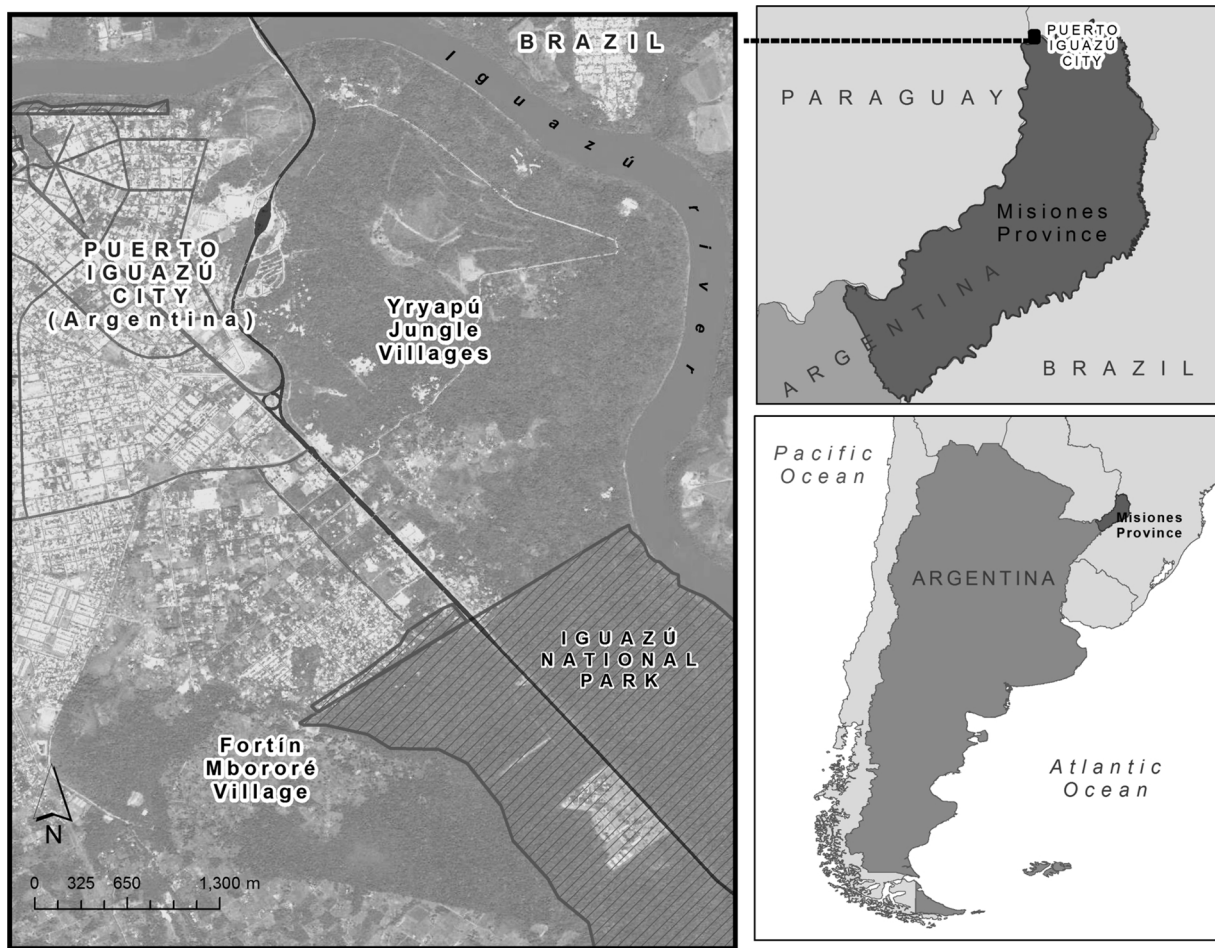


Fig. 1. Study area. Location of the Mbyá-Guaraní villages included in the survey and the Puerto Iguazú City at the tri-border area of Argentina, Brazil and Paraguay.

addition, environmental degradation, forced migrations, precarious housing, socioeconomic difficulties, substandard hygiene and sanitation, lack or limited access to health care, cultural habits, and discrimination define a complex scenario over indigenous communities where children health and development are constantly threatened (Brandelli et al., 2012; Escobar-Pardo et al., 2010; Hotez, 2014; King et al., 2009; Montenegro and Stephens, 2006).

At the northeastern subtropical Argentine region in Misiones province, the indigenous ethnic group Mbyá-Guaraní constitutes almost half of the indigenous population of the province and most live in rural areas (INDEC, 2010). The Mbyá-Guaraní is an ancient indigenous ethnicity of Amazonian roots. Their ancestors arrived from Paraguay and Brazil, and the current population migrates between these countries. Although few, some studies concerning infectious diseases, including IPIs (Delfino et al., 2012; Eirin et al., 2017; Navone et al., 2006; Tonon et al., 2004; Zonta et al., 2010), and nutritional aspects concerning Mbyá-Guaraní communities have been reported (Hirsch et al., 2015; Orden and Oyhenart, 2006). However, most Amerindians have undergone a rapid socioeconomic transition, which has affected strongly their lifestyles (Hotez, 2014; Montenegro and Stephens, 2006). Consequently, the establishment of baseline data is urgently needed.

The relation among the factors that influence parasite infections remains one of the most fundamental questions in this field of study, being its comprehension at different levels and cultures a critical element in the rational development of control strategies (Halpenny et al., 2013; Karagiannis-Voules et al., 2015; Pullan et al., 2008). The degree to which Mbyá-Guaraní children are acquainted with IPIs remains largely unknown. Thus, in this work we aimed to evaluate the prevalence of intestinal parasites and multi-parasitism among Mbyá-Guaraní

children that live in a tri-border area in the Atlantic rainforest of Puerto Iguazú, Argentina. Through a cross-sectional survey, we also examined individual factors as malnutrition, and family and household conditions that individually or combined can be determinants of the persistence of IPIs in these vulnerable communities.

## 2. Material and methods

### 2.1. Ethical considerations

This study was approved by the Bioethical Committee of Dr. Madariaga Hospital and Research Ethical Committee of Misiones, Argentina. We followed the Declaration of Helsinki and national regulations concerning personal data protection (national law No. 25.326), Indigenous Policy, and Support to Indigenous Communities (national laws No. 23.302 and 24.071). We held village meetings, and handed over detailed explanations of the aims, procedures, potential risks, and benefits of the study to village authorities and local health personnel. Informed written consent (signature) was obtained from each child's mother. We offered treatment to those children detected positive to any parasite infection following standard clinical practice according to the National Ministry of Health.

### 2.2. Study area and population

Misiones province is part of the Atlantic Forest Eco region (Olson and Dinerstein, 1998). The region is characterized by a subtropical climate with no dry season. The predominant soil type is lateritic of deep red color (Bertonatti and Corcuera, 2000). The population of this

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