

Identifying relationships between parasite infections and developmental milestones assessed by the ASQ-3 survey for children ages 4 months to 6 years residing in Batey Dos, Dominican Republic.

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**ABSTRACT**

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**Introduction:**

*Batey Dos* is a Haitian community in the Dominican Republic (DR) impacted by many factors that affect the children's developmental milestones, including lack of food, potable water, education about nutrition, and parasite infections. Our previous project in 2024 conducted research on the impact of a nutrition program on BMI percentile in children ages 2-6 years residing in Batey Dos. The research found that despite the nutrition program, BMI percentile decreased for children with parasites. All children were treated for gastrointestinal parasites at baseline. After one year of the program, 44 percent of children still had parasites. The children without parasites had a BMI percentile increase of 24 percent while the children with parasites had a BMI percentile decrease of 9 percent. According to a World Health Organization (WHO) study, parasitic infections in children significantly influence their growth and cognitive development. There is a critical need for targeted research into their impact on development milestones for such children among high-risk populations.<sup>1</sup> Children from tiny communities show poorer growth and higher anemia. The prevalence of intestinal parasites, linked to unsafe water and poor sanitation, contribute to a critical health situation and highlight urgent environmental health challenges.<sup>2</sup> ASQ-3 has proven to be an effective tool for early identification of milestone delays across various socio-economic backgrounds.<sup>3</sup> It has a demonstrated utility in diverse settings which highlights its role in facilitating early interventions in children. It's worth noting that information from Tropical Medicine and Infectious Disease<sup>4</sup> studies notes that

Parasitic infections like giardiasis and ascariasis correlate with stunting and undernutrition. This can indirectly affect a child's developmental progress. Stunting and undernutrition are known to impair cognitive development, which can delay the acquisition of motor skills, communication abilities, and social interactions. For instance, children with significant growth impairments might show delayed motor skills development compared to their healthier peers. Also, information from Neglected Tropical Disease studies notes that symptoms like anemia and decreased appetite, can affect a child's energy levels and overall health, potentially delaying milestone achievements. The disruption of gut processes by intestinal parasites can further exacerbate malnutrition, regardless of adequate dietary intake, impacting cognitive functions and physical development essential for learning and interacting. **Pascal's Pantry**, an American NGO, in partnership with **Alma del Cibao**, a program led by the Dominican NGO **Centro de Educación para la Salud Integral (CESI)**, have instituted a feeding program since 2017, and provided access to medical evaluations, nutritional education, and community gardens to improve nutritional screening and treatments for parasites.

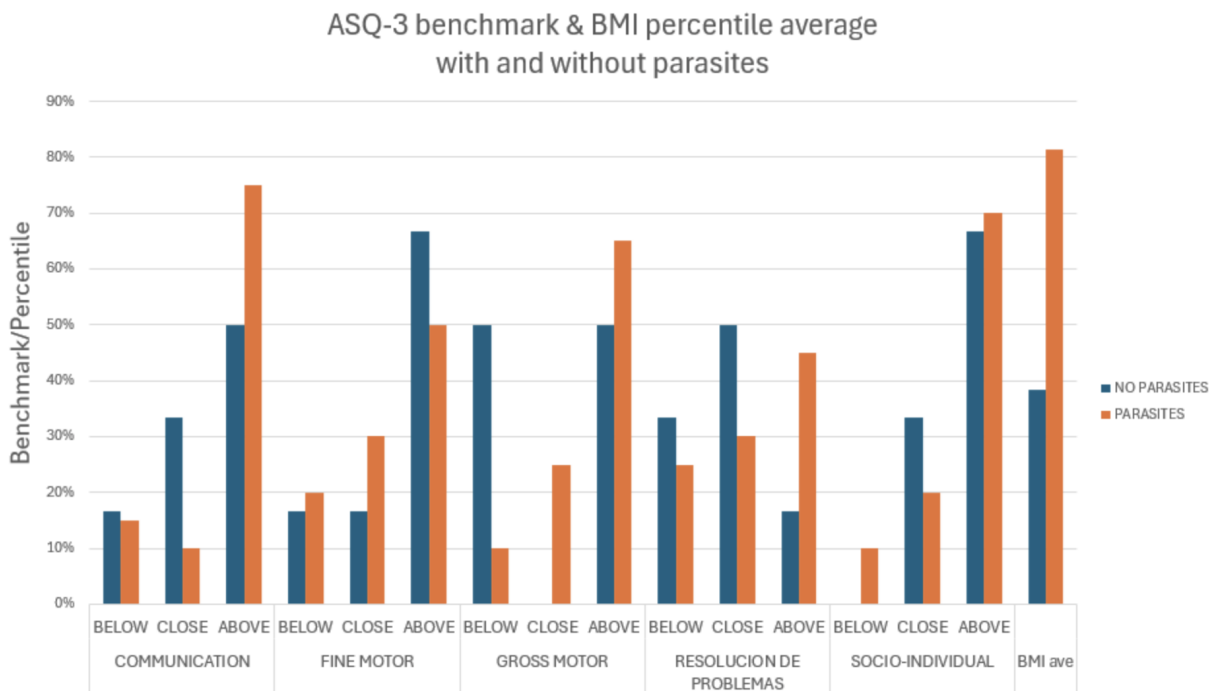
#### **Methods:**

This observational cross-sectional study is part of a research program designed to evaluate the impact of children's milestone status in the provision of nutritional education of Haitian children living permanently in Batey Dos. According to a survey provided by CHNA (2023 est.), *Batey Dos* has a population of 325 people. Twenty-six total children were aged 4 months to 6 years. These children were enrolled in the study after obtaining parental consent, and baseline data was collected in August 2024. Developmental milestones were assessed with *Ages and Stages Questionnaire® in Spanish*, Third Edition (ASQ-3™ *Spanish*), which consists of 21 forms assessing skills across multiple subjects as communication, fine motor skills, gross motor skills, problem-solving, personal-social, anthropometric measurements were obtained along with baseline laboratory studies and stool samples.

Based on prior findings, we have implemented family gardens as a support for **Pascal's Pantry's** dining facility to enhance nutritional content and support educational initiatives. These gardens provide fresh vegetables for meals and integrate practical agriculture education into daily classroom activities. This fosters both dietary improvement and learning before meal consumption. All children were tested for parasites. BMI and prevalence of stunting were calculated using percentiles. A statistical analysis was conducted using Microsoft Excel 2024 version 16.92 and statistical software.

**Results:**

Thirteen female and thirteen male children were enrolled. While doing the first intervention of the program, 77% of the 26 children tested positive for parasites, while 23% tested negative. Among the parasites, the most frequently found was *Giardia lamblia* (n=12, 46%), *Blastocystis hominis* (n=8, 20%), *Ascaris lumbricoides* (8%), *Endolix nana* (n=1, 3%) and *Entamoeba histolytica* (n=1, 3%). Two patients had simultaneous infections with two parasites (one with *Blastocystis hominis* and *Entamoeba histolytica*; and another with *Blastocystis hominis* and *Giardia lamblia*), and one patient was found with triple parasites (*Giardia lamblia*, *Blastocystis hominis*, and *Ascaris lumbricoides*).



**Graph 1.** Relationship between Parasitic Infections on Developmental Milestones and BMI percentiles in Child. This shows the difference in ASQ-3 benchmark results alongside the BMI percentile average for each group, with and without parasites.

We then compared the results of the ASQ-3 survey for children with and without parasites in five categories. For communication, 15% of the children **with parasites** were below the cutoff, 10% were close, and 75% were above. For gross motor skills, 10% were below, 25% were close, and 65% were above. For fine motor skills, 20% were below, 30% were close, and 50% were above. For problem solving skills, 25% were below, 30% were close, and 45% were above. For socio-individual skills, 10% were below, 20% were close, and 70% were above.

For children without parasites, 17% were below the cutoff for communication, 33% were close, and 50% were above. For gross motor skills, 50% were below, 0% were close, and 50% were above. For fine motor skills, 17% were below, 17% were close, and 67% were above. For problem-solving skills, 33% were below, 50% were close, and 17% were above. For socio-individual skills, 0% were below, 33% were close, and 67% were above.

### **Conclusion:**

According to the cross-sectional analysis, the high prevalence of parasitic infections (77%) among the children in this study highlights a significant public health challenge in this community. The study identified five species of intestinal parasites. The most frequently identified parasite was *Giardia lamblia*, representing 46% (n=12) of the cases, which aligns with another small community in Santo Domingo.<sup>5</sup>

According to results of the ASQ-3, in the group of the children **with parasites**, 15% in the communication, 20% in the fine motor skills, 10% in gross motor skills, 25% in problem-solving skills and 10% in socio-individual skills were below the expected cutoffs. For that reason, we recommend additional evaluations with greater depth alongside a primary care provider to follow up on these ASQ-3 results.

On the impact of education programs since 2017, the provision of a feeding program in this Haitian community with decreased access to food and healthcare had a positive effect on the children's nutritional status and BMI percentile over one year. Additionally, the feeding program over the past few years has provided access to medical evaluations, nutritional education, and community gardens to improve nutritional screening and treatments for parasites.

In *Batey Dos*, there are other factors besides nutrition that may affect a child's growth. One variable, the presence of parasites, can still be overcome with better nutrition and education. Ideally, addressing all variables over time would maximize the growth of these children. This research suggests further studies are needed to explore further ways to address effectiveness of feeding programs in other similar communities.

**Keywords:** Parasite, nutrition, Batey Dos, Haitian, ASQ-3.

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