***Review Article***

*Blastocystis hominis* in the Philippines: A Neglected Parasite with Emerging

Diagnostic and Public Health Concerns

**ABSTRACT**

*Blastocystis hominis* is an anaerobic, single-celled protist classified under the class Blastocystea. It is globally recognized as a significant intestinal protozoan associated with gastrointestinal disturbances and is considered the most commonly detected non-fungal microeukaryote in human fecal specimens. Clinical presentations among infected individuals are frequently asymptomatic or mild; however, symptomatic cases may involve diarrhea, abdominal discomfort, bloating, and altered bowel habits. In the Philippine setting, *B. hominis* continues to be a noteworthy public health issue, particularly in communities lacking adequate sanitation and hygiene. Reported infection rates vary widely, with higher prevalence noted among immunocompromised populations such as the elderly in urban settings and even more so in rural areas. Specific subpopulations, including inmates and food service workers, have also shown measurable infection rates. Among the known subtypes, ST3 emerges as the most prevalent, consistent with global trends and indicating potential pathogenicity. Zoonotic transmission is supported by its detection in a range of animals, including poultry, swine, non-human primates, insects, and domestic dogs, with pigs exhibiting the highest carriage rates. Although molecular methods like PCR have improved detection accuracy, microscopy remains the most commonly used diagnostic tool in Philippine laboratories, largely due to economic and logistical limitations. Addressing these diagnostic constraints alongside implementing targeted public health strategies is essential. Given the limited scope of local studies on *B. hominis* from 2011 to the present, this review underscores critical research gaps and emphasizes the need for comprehensive national surveillance and intervention programs to mitigate the parasite’s impact.

**Keywords:** *Blastocystis hominis;* subtypes; prevalence; epidemiology; Philippines

**I. INTRODUCTION**

*Blastocystis hominis* is a unicellular, anaerobic protist parasite classified under the protozoan class *Blastocystea* (Amoak & Soldera, 2024). Despite its protozoan classification, molecular studies based on SSU rRNA and elongation factor-1α genes position it within the phylum *Heterocontophyta* (stramenopiles), a diverse group of eukaryotes, although it lacks the typical flagellar structures found in many of its relatives (Sekar & Shanthi, 2015). This organism primarily inhabits the large intestine of humans and various animals, demonstrating a broad host range that includes birds, pigs, rodents, reptiles, amphibians, fish, and invertebrates like cockroaches (Tasić et al., 2017).

Globally, *B. hominis* is recognized as the most frequently detected non-fungal microeukaryote in human fecal samples, with a prevalence significantly exceeding that of other protozoan parasites such as *Entamoeba histolytica*, *Giardia* spp*.*, and *Cryptosporidium* spp*.* (Adao et al., 2016). It is widespread in both industrialized and developing nations, although the prevalence varies significantly—ranging from 0.5% to 35% in developed countries and as high as 55% to 100% in resource-limited settings (Pérez et al., 2020). Recent estimates suggest that more than one billion people may be infected worldwide (Wahid et al., 2023).

Morphologically, *B. hominis* exhibits several forms, with four distinct types frequently observed: vacuolar, granular, ameboid, and cystic stages (Barua et al., 2015). The vacuolar form predominates in clinical samples, whereas the cyst form is considered responsible for transmission (Amoak & Soldera, 2024). Molecular subtyping has identified at least 38 subtypes (STs), along with eight additional non-mammalian and avian subtypes (NMASTs). Human infections are typically associated with ST1 through ST9, with over 90% of cases attributed to ST1 to ST4, particularly ST3, which is the most frequently reported globally (Cian et al., 2017; Adao & Rivera, 2024; Rudzińska & Sikorska, 2023).

The pathogenic potential of *B. hominis* has been the subject of ongoing debate. While often detected in asymptomatic individuals, accumulating evidence supports its association with gastrointestinal symptoms, especially in immunocompromised hosts (Matovelle et al., 2022). Reported symptoms include abdominal discomfort, flatulence, diarrhea, constipation, and in some cases, extraintestinal manifestations such as urticaria, fatigue, anorexia, hypersalivation, and perianal itching (Amoak & Soldera, 2024). Additionally, the organism has been linked to irritable bowel syndrome (IBS) and persistent diarrhea in certain populations.

Transmission occurs primarily through the ingestion of cysts via contaminated water or food. Risk factors for infection include poor hygiene, inadequate sanitation, consumption of untreated water, and close contact with infected individuals or animals—conditions that are prevalent in densely populated or underserved communities (Belleza et al., 2015). These environmental and socio-economic conditions are key drivers of infection, especially in tropical regions.

Diagnostic methods for *B. hominis* range from basic to highly specialized. Direct light microscopy, particularly using saline or iodine wet mounts, remains the most accessible method in many clinical laboratories, despite its limited sensitivity (Elsayad et al., 2019). Trichrome staining improves visibility, while xenic in vitro culture (XIVC), typically using Jone’s medium, offers enhanced sensitivity over direct microscopy. Serological approaches such as ELISA and IFA can detect specific IgA and IgG responses to infection (Tasić et al., 2017). For epidemiological and subtyping studies, nucleic acid amplification methods like PCR and RT-PCR are the gold standard (Adao & Rivera, 2018). Advanced imaging techniques such as transmission electron microscopy (TEM) and scanning electron microscopy (SEM) provide detailed structural data, but their application is mainly limited to research due to cost and resource constraints (Elsayad et al., 2019).

The global burden of *B. hominis* infection varies greatly between regions. In tropical developing countries, prevalence may reach up to 100% in certain populations, compared to 0.5–23.1% in industrialized settings (Gong et al., 2019). This disparity reflects differences in water quality, public health infrastructure, population density, and sanitation practices. In Southeast Asia, the prevalence is notably high: 49.1% in the Philippines, 34.25% in Indonesia, 22.31% in Thailand, and 19.25% in Malaysia (Nemati et al., 2021). In parts of Africa, rates have exceeded 80%, with specific communities in Senegal reporting up to 100% prevalence (Rudzińska & Sikorska, 2023). These findings underscore the significant role of environmental and infrastructural determinants in *B. hominis* transmission and persistence.

In the Philippines, *B. hominis* continues to be a critical public health concern. Limited but notable studies have reported exceptionally high prevalence rates. Adao et al. (2016) documented an 82.9% infection rate among asymptomatic residents in Pateros, Metro Manila. Among children in urban communities, prevalence reached 40.7%, while 36.8% of patients at the Philippine General Hospital tested positive. These figures rank among the highest globally and suggest widespread, underrecognized transmission (Adao et al., 2016). Given the Philippines' tropical climate, sanitation challenges, and socio-demographic diversity, it presents a valuable setting for studying the ecology, subtypes, and transmission dynamics of the parasite (Belleza et al., 2015).

This review aims to synthesize available literature from 2011 to the present to assess the current understanding of *B. hominis* infection in the Philippines. By consolidating data on its epidemiological trends, subtypes, clinical relevance, diagnostic practices, and associated risk factors, this work seeks to address existing knowledge gaps and inform future research priorities. Furthermore, the findings may contribute to regional and global efforts to improve detection, surveillance, and control of this understudied yet widespread intestinal parasite.

**II. Biology and Transmission of *Blastocystis hominis***

*B. hominis* is an obligate anaerobic protozoan found in the intestinal tract of a wide variety of hosts such as insects, reptiles, birds and mammals, and it is one of the most common eukaryotic organisms reported in human stool sample (Elsayad et al., 2019; Parija & Jeremiah, 2013). They contain intracellular organelles resembling mitochondria; however, they lack cytochrome enzymes. These intracellular organelles play a role in various metabolic pathways such as amino acid metabolism, iron sulfur biogenesis, and tricarboxylic acid cycle. It also synthesizes essential cellular phospholipids and stores them in the storage vacuoles (Sekar & Shanthi, 2015).

*B. hominis* exhibits multiple morphologic forms. The four major forms commonly observed are the vacuolar, granular, ameboid, and cystic forms (Barua et al., 2015; Tasić et al., 2017). Aside from this, other morphological forms have been seen such as the avacuolar and multi-vacuolar forms. *B. hominis* is also known to show rare morphological forms such as the medusa head form and chestnut burr cell on exposure to oxygen and in aging cultures. Phase-contrast and bright field microscopy of wet mounts and stained smears, and electron microscopy can be used to view all of these forms (Parija & Jeremiah, 2013; Sekar & Shanthi, 2015).

The most commonly found form in stool cultures and fecal samples is the vacuolar form (Do Bomfim & Do Couto, 2013; Elsayad et al., 2019). It is round or spherical, containing a large central vacuole with a thin layer of peripheral cytoplasm. The nuclei and its intra-cellular components such as mitochondrion-related organelles and golgi apparatus can be located peripherally in its cytoplasm (Tasić et al., 2017). Its size varies from 3 to 120 μm with an average of 5 to 15 μm in diameter from most human isolates. Moreover, the central vacuole containing carbohydrates and lipids serve as storage organelles and takes part in apoptosis (Sekar & Shanthi, 2015).

Granular form of *B. hominis* is similar in size and shape to the vacuolar form except that its cytoplasm and central vacuole has dense granules present (Adao & Rivera, 2018). The granules may be classified as metabolic, reproductory, and lipid granules. The metabolic granules are found in the cytoplasm. The reproductory granules are found in the central body while lipid granules, which act as storage granules, are found on both the cytoplasm and central body (Parija & Jeremiah, 2013).

The vacuolar and granular form of *B. hominis* then adopt a more irregular shape known as the amoeboid form (Adao & Rivera, 2018). This form is rarely encountered. In a study by Do Bomfim & Do Couto (2013), the size of the amoeboid form ranges from 13.4 to 45.5 μm with an average of 22 μm. It has 1 or 2 pseudopodia even though this form is non-motile. The cytoplasm may contain a central vacuole or multiple smaller vacuoles (Sekar & Shanthi, 2015). Recent reports suggest the pathogenic potential of the amoeboid form since it is often identified in symptomatic patients (Parija & Jeremiah, 2013; Sekar & Shanthi, 2015).

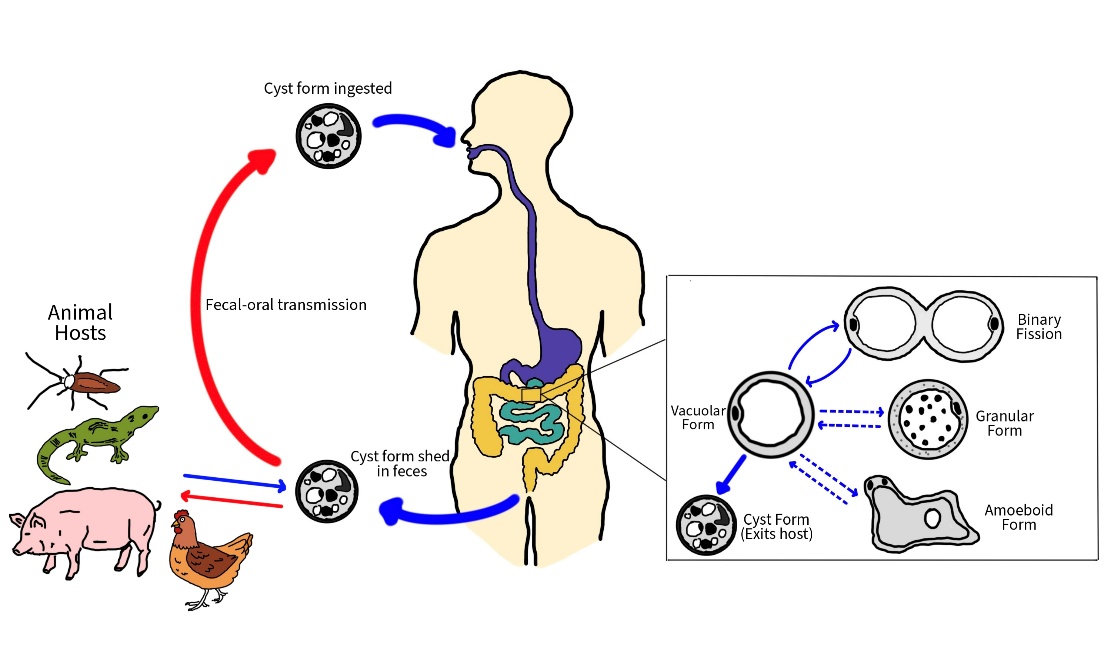
The most recently described form of *B. hominis* is the cyst form (Barua et al., 2015; (Parija & Jeremiah, 2013). It is round or oval, smaller, with a size of 3-6 μm from cysts isolated from humans (Parija & Jeremiah, 2013). The characteristic feature of this form is the thick multilayered cyst wall, with or without surface coating. The cytoplasm can have 1 to 4 nuclei, and it also contains the mitochondria, glycogen deposits, and small vacuole (Barua et al., 2015). The cyst form is postulated to be the infective stage (Rozi & Darlan, 2019). It exhibits environmental resistance, tolerance to low gastric pH, and resistance to standard chlorination procedures used in water treatment (Amoak & Soldera, 2024).

The life cycle of *B. hominis* is yet to be fully understood. However, recent studies show how it is transmitted and how its morphological form changes (Adao & Rivera, 2018). Past assumptions were debunked and it has been proven that cysts are the only transmissible form of *B. hominis* thorough the feco-oral route, based on infectivity studies conducted on mice and rats (Yoshikawa et al., 2004). The infection may occur after drinking contaminated and untreated water, eating food contaminated with cysts, and contact with unclean hands which serve as fomites for transmission of the cyst. (Lee et al., 2012). In a suitable host, upon ingestion, the cyst further develops into a vegetative form and its life cycle will continue if the subtype is suitable with the host. Excystation takes place in the large intestine releasing the vacuolar form. The vacuolar form can then transform into the amoeboid form or the granular form and vice versa. The vacuolar form also encysts in the large intestine which are excreted in feces for further transmission, continuing the cycle (Parija & Jeremiah, 2013). Figure 1 shows the life cycle of *B. hominis*. There is diversity in hosts and human to animal transmission and vice versa have been documented. Furthermore, various modes of reproduction have been claimed for this organism namely binary fission, budding, plasmotomy, multiple fission, endodyogeny and schizogony. Nonetheless, binary fission remains the most common and most established mode of reproduction (Parija & Jeremiah, 2013; Sekar & Shanthi, 2015).

Based on SSU rRNA gene sequence variations, 38 known subtypes (STs) may be identified and are designated as ST1–ST17, ST21, ST23–ST29, ST30, ST31, ST32, and ST35–ST38 (Adao & Rivera, 2024). Additionally, 8 nonmammalian and avian STs (NMASTs) are also identified based on the phylogenic studies of Cian et al. (2017) and Yoshikawa et al. (2016). Among the mammalian and avian STs, nine of them (ST1 – ST9) have been observed in humans with approximately 90% of these human isolates belonging to ST1 to ST4, with a predominance of ST3 at around 60% of these isolates (Cian et al., 2017). With the exception of ST9 which is only found in humans, the other 8 STs (ST1-ST8) may also be found colonizing various animal groups and exhibits low to moderate host-specificity. Some studies have also shown identical sequences of *Blastocystis* isolated from animals and humans, supporting zoonotic transmission (Rudzińska & Sikorska, 2023). In a study conducted by Adao & Rivera (2024), patterns of association for the Philippine samples resembled those from neighboring Southeast Asian countries and around the world: ST1–ST4 were found in humans with ST3 being the most common, ST5 were found in pigs, and ST6 and ST7 were found in poultry. As mentioned in the study of Adao et al. (2016), ST1 and ST3 has been associated with irritable bowel syndrome from patients in Mexico, ST2 with a patient from Europe having recurring gastrointestinal and urticarial symptoms, and ST4 has been associated with acute diarrhea from patients in Denmark. ST 3 is also associated with gastrointestinal symptoms, such as diarrhea, especially in symptomatic individuals (Zulfa et al., 2017). However, there is still no confirmation of direct links between disease and the presence of the parasite (Adao et al., 2016).

**III. PREVALENCE IN THE PHILIPPINES**

*Blastocystis hominis* is a significant global public health concern, affecting over 1 billion people worldwide, predominantly affecting populations in tropical regions where poor sanitation, inadequate hygiene practices, and consumption of contaminated food or water create ideal conditions for the spread of *B. hominis* (Matovelle et al., 2022; Wahid et al., 2023). Although its

****pathogenicity is still debated, it is commonly associated with gastrointestinal symptoms, especially in immunocompromised patients (Amoak & Soldera, 2024). In the Philippines, *B. hominis* is one of the most commonly identified protozoans and shows significant prevalence in humans, animals, and environmental reservoirs. Despite limited information, several researchers conducted studies in the Philippines to determine the prevalence and distribution of *Blastocystis hominis* (Table 1). For instance, Belleza et al., (2015) collected stool samples from 1,271 permanent residents aged 1 to 70 across 5 villages in an urban community in Pateros, Metro Manila to determine its prevalence. Using in vitro culture (fecal samples cultured in diphasic agar medium for 3-7 days at 37°) and light microscopy, it was revealed that the overall prevalence of *B. hominis*

**Figure 1.** Life Cycle of *Blastocystis hominis* (Adapted from CDC (2019) and Parija & Jeremiah (2013)

infection was at 12.98%. The study also showed minimal sex-specific differences with males having a prevalence of 12.65% and females at 13.65%. According to age distribution, children aged 1-4 years old had lower prevalence rate at 7.88%, while children aged 5-14 years old had higher prevalence rate at 15.06%. Adult populations showed varying prevalences: 15- 29 years (13.25%), 30-44 years (14.23%), 45-59 years (12.8%), and 60-69 years (8.33%), with a notable high increase in prevalence among individuals aged 70 and above at 20.59%, emphasizing the risk of immunocompromised patients especially elderly individuals. Furthermore, socioeconomic indicators, such as level of education, also had influence on prevalence rates, with high school level showing the highest prevalence at 15.78%, followed by individuals with no formal education (12.81%), elementary education (12.09%), and college education showing the lowest prevalence at 10.27%. Notably, dog ownership was revealed as a significant risk factor, with dog owners having a higher prevalence of 25% compared to non-dog owners at 11.30%

In another urban-based molecular study by Adao et al., (2016), 35 stool samples were collected from asymptomatic individuals living in Metro Manila for subtype analysis. Culture and microcopy revealed a notably high overall prevalence of 82.9% (29 out of 35 samples) among asymptomatic residents. For polymerase chain reaction (PCR), the 600-bp barcoding region of the SSU rRNA gene of *Blastocystis* sp. was amplified using the primers RD5 and BhRDr for subtyping. The molecular analysis revealed that ST3 was the predominant subtype, accounting for 65.5% (19 out of 29 positive samples), followed by ST1 at 31.0% (9 out of 29 positive samples) and ST4 at 3.44% (1 out of 29 positive samples). This result aligns with the worldwide subtype distribution, wherein 90% of subtypes identified in humans belonged to ST1–ST4, with a predominance of ST3 (Rudzińska & Sikorska, 2023). Furthermore, a larger study was conducted by Belleza et al., (2016) using 1,271 fecal samples to determine the prevalence and subtypes of *B. hominis*. Culture and microscopic examination revealed an overall prevalence rate of 13%. Seven pairs of ST-specific sequence-tagged-site (STS) primers were used for the genotyping of culture isolates. The subtype distribution analysis revealed a similar result to the study of Adao et al., (2016) wherein ST3 was the most dominant subtype at 41.4%. This raises public health concerns as ST3 is associated with gastrointestinal symptoms such as diarrhea (Zulfa et al., 2017). The other subtypes identified from greatest to least prevalence were ST1 at 22.6%, ST4 at 14.8%, unknown subtypes at 13.9%, ST5 at 4.1%, and ST2 at 3.1%.

Limited studies on specialized population groups also revealed varying prevalence in various occupational and institutional settings. In a recent study by Notorio et al., (2025) from 67 inmates diagnosed with tuberculosis in Tarlac Provincial Jail, Philippines, it was found that the prevalence of *B. hominis* was 5.97%. In-vitro culture with modified Lock Egg medium and microscopy revealed that 4 out of 67 samples tested positive. This prevalence shows a notable public health concern, especially in a correctional facility, as this environment creates ideal conditions for *B. hominis* transmission due to overcrowding, poor sanitation, and limited access to healthcare services. Another study by Dayaganon et al., (2014) investigated 34 randomly selected food handlers in eateries in Bankerohan Public Market, Davao City. With the use of microscopic examination, the prevalence of *B. hominis* was at 8.82% (3 out of 34 samples), emphasizing a critical food safety concern, as food handlers positive for *B. hominis* may contaminate food products through handling and preparation, increasing the risk of transmission to the general population. Rural areas also showed higher prevalence rates for *B. hominis*, with the study of Weerakoon et al., (2018) in Northern Samar, Philippines showing a prevalence of 58.70% (242 out of 412 samples). This is significantly higher compared to the prevalence of 12.98% reported in an urban community by Belleza et al., (2015). Co-infection with *S. japonicum* was also noted in this study from 110 out of 175 samples with dual infections (62.9%).

Several studies involving animal hosts provide valuable insights into their role in transmission, showing the zoonotic potential of *B. hominis*.  Adao et al. (2016) conducted comprehensive studies on livestock and poultry in Victoria and Pila, Laguna, Philippines, including fecal samples from pigs, cows, and goats, and cloacal samples from chickens, ducks, pigeons, geese, and turkey. Using in vitro culture, the overall prevalence among 182 animals was 15.9% (29 positive samples with 24 isolates obtained from fecal samples and 5 from anal/cloacal swabs). Pigs had the highest prevalence rate at 20.20% (20 out of 99), emphasizing the zoonotic risk of *B. hominis*, especially in communities that raise pigs in the Philippines. Prevalence for other animals in the study includes 16.17% for goats (1 out of 6), 14.71% for chickens (5 out of 34), and 9.68% for ducks (3 out of 31). Subtype analysis using PCR revealed that pigs contained ST1, ST5, and ST7, chickens and ducks were infected with ST7, and the goat sample contained ST14. The high prevalence of *B. hominis* in pigs is supported by specialized pig-farming studies conducted by De La Cruz et al. (2016) on the fecal samples of 122 backyard-raised pigs in 36 farms from the Municipality of Bay, Province of Laguna. The study revealed that 24 out of 36 farms had positive samples and using culture and microscopy, it showed a notably high overall prevalence rate among pigs at 38.5%. According to class, weaning pigs showed the highest prevalence at 60%, followed by growers at 33% and breeders at 26%. Sex-specific differences in prevalence were also noted, with female pigs having a higher rate at 46% compared to male pigs at 29%. Moreover, canine populations also serve as important reservoirs for *B. hominis*, as shown by the study of Belleza et al. (2016) which examined 145 dogs from an urban community in Pateros, Metro Manila. Culture and microscopic examination found an overall prevalence rate of 14.5%. Subtype distribution in dogs using PCR showed unknown subtypes as predominant at 47.8% followed by ST3 at 17.4%, ST4 and ST5 each at 13.0%, ST2 at 8.7%, and ST1 at 4.3%. This prevalence shows an increased risk, especially among dog owners.

More recent studies by Adao & Rivera (2024) examined a wider range of animals from Tanay, Rizal, Quezon City, and Laguna using in vitro culture and PCR to determine the prevalence and subtypes of *B. hominis*. In Tanay Rizal, ducks had the highest prevalence rate at 68.42%, with ST7 identified, followed by Turkeys at 34.78% with ST6, then chickens at 30.77% with ST6 and ST7 subtypes, while goats showed no infection. In Quezon City, chickens had a 20% prevalence (ST7), toads had a 15.63% prevalence (NMAST 1), and cockroaches (through gut inoculation) demonstrated 2.36% (NMAST 6 and mixed subtypes). Macaques from Quezon City Parks and Wildlife Bureau also showed a notable prevalence of 28.57%, and ST1, ST3, and NMAST 1 were identified. A pig sample from Laguna also tested positive with ST5 identified. The prevalence in different animals emphasizes the zoonotic risk possessed by *B hominis.*

Environmental studies conducted in the Philippines were limited, however, they provide important information regarding the possible transmission of *B. hominis* in environmental sources, especially water. Banaticla & Rivera (2011) conducted studies on a total of 62 water samples (31 influent and 31 effluent samples) from 31 wastewater treatment plants from geographically distinct locations across the Philippines. The overall environmental prevalence was at 15% (9 out of 62 samples). Influent samples (untreated wastewater) showed a higher prevalence at 23% (7 out of 31 samples), while effluent samples (treated wastewater) had a reduced prevalence at 7% (2 out of 31 samples). This showed that there is a notable difference between treatment stages emphasizing the need for water treatment. The prevalence in treated water samples also raises concerns as it shows that treatment processes may be ineffective in removing and preventing *Blastocystis* cysts from being released into the environment. Subtypes include ST1 for 7 positive samples and ST2 for 2 positive samples.

Table 1 summarizes the prevalence of *B. hominis* in the Philippines considering the human population, animal reservoir, and environment through various studies conducted by researchers from 2011 to 2025. The prevalence data provide a comprehensive understanding of the epidemiology of *B. hominis* in the Philippines, showing that it represents a significant public health concern in the Philippines, with high prevalence rates in human population, animal reservoir, and its persistence in the environment. The findings from these studies highlight the importance of adopting public health interventions and policies for *B. hominis* transmission in the Philippines and call for more studies to be conducted regarding its prevalence and potential pathogenicity.

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| Table 1. Summary of studies on the prevalence of *Blastocystis hominis* in the Philippines | | | | |
| **Study Overview and Sample Collection Details** | **Diagnostic Method** | **Purpose** | **Prevalence of *Blastocystis hominis*** | **Reference** |
| **Human Population** | | | | |
| Stool samples were collected from 1,271 permanent residents aged 1 to 70 (with median age of 24.7±19.9 years) across 5 villages in an urban community in Pateros, Metro Manila, Philippines. | In Vitro cultivation | Fecal samples cultured in diphasic agar medium for 3-7 days at 37°C for growth. | Overall prevalence:   * 12.98% infected out of 1271 samples (95% CI: 11.13%–14.83%)   Prevalence according to Sex   * Males: 12.65% (95% CI: 9.75%–15.38%) * Females: 13.20% (95% CI: 10.81%–15.59%)   Prevalence according to Age Distribution   * 1-4 years: 7.88% * 5-14 years: 15.06% * 15-29 years: 13.25% * 30-44 years: 14.23% * 45-59 years: 12.8% * 60-69 years: 8.33% * 70+ years: 20.59%   Prevalence according to Level of Education   * College: 10.27% * High school: 15.78% * Elementary: 12.09% * No education: 12.81%   Association with Dog Ownership   * Nondog owner: 11.30% * Dog owner: 25.00%. | Belleza et al., 2015 |
| Light microscopy | Used to detect samples with characteristic morphology *of B. hominis*. |
| Stool samples coming from 35 asymptomatic individuals living in Metro Manila were analyzed for *Blastocystis* species subtypes using molecular methods. | Culture and microscopy | Approximately 50 mg of fecal specimens were aseptically inoculated in diphasic medium and examined microscopically for *B. hominis* identification. | Overall prevalence:   * Overall Prevalence: 82.9% (29 out of 35 samples)   Subtype distribution   * ST3: 65.5% (19 out of 29 positive samples) * ST1: 31.0% (9 out of 29 positive samples) * ST4: 3.44% (1out of 29 positive samples) | Adao et al., 2016 |
| PCR (Polymerase Chain Reaction | The 600-bp barcoding region of the SSU rRNA gene of *Blastocystis* sp. was amplified using the primers RD5 and BhRDr. |
| Fecal specimens from 1,271 humans and 145 dogs were collected to determine the presence of *Blastocystis* infection and characterize their subtypes. | Culture and microscopic examination | Fecal specimens were collected and inoculated in diphasic culture medium and checked under microscopic examination to determine prevalence. | Overall prevalence in humans   * 13.0% (95% CI = 11.2–15.0)   Subtype identified and distribution:   * ST1: 22.6% (95% CI: 17.2-29.0%) * ST2: 3.1% (95% CI: 1.3-6.7%) * ST3: 41.4% (95% CI: 34.9-48.6%) * ST4: 14.8% (95% CI: 10.5-20.6%) * ST5: 4.1% (95% CI: 2.0-8.0%) * Unknown ST: 13.9% (95% CI: 9.6-19.4%) | Belleza et al., 2016 |
| PCR (Polymerase Chain Reaction | Seven pairs of ST-specific sequence-tagged-site (STS) primers were used for the genotyping of 168 culture isolates. |
| A total of 67 stool samples from inmates in Tarlac Provincial Jail were collected to be analyzed for correlation between *B. hominis* and tuberculosis. | In vitro cultivation | Modified Locke Egg (LE) Medium was used to culture samples. | Overall prevalence among inmates who had been diagnosed with TB   * 4 out of 67 samples (5.97%) | Notorio et al., 2025 |
| Microscopic examination | Employed direct wet-mount technique to identify different morphological forms *of B. hominis.* |
| Stool samples from 34 randomly selected food handlers were collected in Bankerohan Public  Market, Davao City. | Microscopy with (direct fecal smear and formalin-ether concentration technique) | Used to identify different intestinal parasites present in stool samples. | Overall prevalence among food handlers:   * 3 out of 34 samples (8.82%) | Dayaganon et al., 2014 |
| Stool samples collected from 412 participants from 18 barangays in a rural area in Northern Samar, Philippines, examining co-infections with Schistosoma japonicum and intestinal protozoans such as *B. hominis*. | Multiplex qPCR assay | To assess intestinal protozoan infection status (co-infections) | Overall prevalence in the rural area:   * 242 out of 412 samples (58.70%)   Co infection with S. Japonicum (dual infection)   * 110 out of 175 samples (62.9%) | Weerakoon et al., 2018 |
| **Animal Reservoir** | | | | |
| Fecal samples from backyard-raised pigs (n=99), cows (n=3) and goats (n=6) and cloacal swabs from chickens (n=34), ducks (n=31), pigeons (n=4), geese (n=2) and turkeys (n=3) were taken in Victoria and Pila, Laguna, Philippines | In-vitro cultivation | Samples collected were inoculated into a biphasic medium containing horse serum and antibiotics, penicillin and streptomycin to determine prevalence. | Overall prevalence in animals:   * 29 of 182 animals (15.9%)   24 isolates from animal fecal samples  5 from anal/cloacal swabs.  Prevalence in animals that tested positive:   * Pigs: 20 positive samples out of 99 = 20.20% * Chickens: 5 positive samples out of 34 = 14.71% * Ducks: 3 positive samples out of 31 = 9.68% * Goat: 1 positive sample out of 6 = 16.67%   Subtypes identified in positive samples   * Pigs = ST1, ST5, and ST7 * Chickens = ST7 * Ducks = ST7 * Goat = ST 14 | Adao et al., 2016 |
| PCR (Polymerase Chain Reaction) | Polymerase chain reaction (PCR) using primers RD5 and BhRDr for subtype identification. |
| Stool samples were collected from chickens (n = 13), ducks (n = 19), turkeys (n = 23), and goats (n = 11) from a farm in Tanay, Rizal; macaques (n = 63) from the Quezon City Parks and Wildlife Bureau (PAWB); a pig from Laguna (n = 1); chickens from Quezon City (n = 5); and toads from Quezon City (n = 64). Cockroaches (n = 127) were also captured from residential areas in Quezon City and *Blastocystis* sp. was collected by inoculating the gut contents. | Culture method and microscopy | Samples were inoculated onto a biphasic medium for growth and used microscopy to identify positive samples. | Prevalence in poultry and goats from Tanay, Rizal, and subtypes identified   * Chicken: 4 out 13 samples = 30.77% (ST6 ST7) * Duck: 13 out of 19 samples = 68.42% (ST7) * Turkey: 8 out of 23 samples = 34.78% (ST6, ST7) * Goat: 0 out of 11 samples = 0%   Prevalence in Quezon City   * Chicken: 1 out of 5 samples = 20% (ST7) * Toad: 10 out of 64 samples = 15.63% (NMAST 1) * Cockroach: 3 out of 127 samples = 2.36% (NMAST 6, mixed)   Prevalence in macaques from Quezon City Parks and Wildlife Bureau   * Macaque: 18 out of 63 samples = 28.57% (ST1, ST3, NMAST 1)   Prevalence in Laguna   * Pig: 1 out of 1 sample = 100% (ST5) | Adao & Rivera, 2024 |
| Polymerase chain reaction (PCR) | Performed using the primers RD5 and BhRDr to amplify the 600-bp barcoding region of the *Blastocystis* sp. for subtyping. |
| Fresh fecal samples were collected from a total of 122 backyard raised pigs in 36 farms from Municipality of Bay, Province of Laguna. | Culture | Approximately 50 mg of feces was inoculated, in duplicate, in diphasic medium to allow growth of Blastocystis within 48-72 hours at 37° Celsius. | Overall prevalence among farms in Bay, Province of Laguna   * 24 out of 36 farms * Forms observed = granular and cystic forms   Overall prevalence in pigs   * Pigs: 38.5%   Prevalence according to classification   * Weaning pigs: 60% * Growers: 33% * Breeders: 26%   Prevalence according to sex   * Female pigs: 46% * Male pigs: 29% | De La Cruz et al., 2016 |
| Microscopy | For subsequent detection of *B. hominis* using its characteristic morphology |
| Formalin-ether concentration technique | Positive fecal samples were subjected to fecal-concentration technique to estimate the intensity of infection. |
| Fecal specimens from 145 dogs were collected from an urban community in Pateros, Metro Manila, Philippines for subtype analysis | Culture and microscopic examination | diphasic culture medium was used to grow the organism and subsequently checked with microscopic examination for prevalence. | Overall prevalence in dogs   * Dogs: 14.5% (95% CI = 9.6–21.2%)   ST distribution in dogs   * ST1 with 4.3% (95% CI = 0.0–29.0) * ST2 with 8.7% (95% CI = 1.3–28.0), * ST3 with 17.4% (95% CI = 6.4–37.7), * ST4 with 13.0% (95% CI = 3.7–33.0), * ST5 with 13.0% (95% CI = 3.7–33.0) * Unknown ST with 47.8% (95% CI = 29.2–67.0). | Belleza et al., 2016 |
| Polymerase Chain Reaction (PCR) | Used for genotyping (ST-specific sequence-tagged-site (STS) primers were employed). |
| **Environment** | | | | |
| A total of 62 water samples (31 influent and 31 effluent samples) from 31 wastewater treatment plants from geographically distinct locations across the Philippines were collected. | In-vitro culture | To detect positive water samples. | Overall prevalence:   * 9 out of 62 samples (15%)   Prevalence in influent and effluent samples   * Influent samples (untreated): 7 out of 31 samples = 23% * Effluent samples (treated): 2 out of 31 samples = 7%   Subtypes identified from positive isolates   * ST1 (7 isolates, 6 from untreated sewage water and 1 from treated sewage water) * ST 2 (2 isolates, 1 from untreated sewage water and 1 from treated sewage water | Banaticla & Rivera, 2011 |
| PCR (Polymerase Chain Reaction) | PCR of the SSU rRNA gene was performed using GoTaqs Green Master Mix (Promega, Madison, WI) and oligonucleotide primers, SR1F and SR1R for subtyping. |

**IV. CLINICAL IMPACT AND PUBLIC HEALTH IMPLICATIONS**

The pathogenicity of *B. hominis* remains controversial, as numerous studies have either confirmed or excluded *B. hominis* as a disease-causing microorganism. Some studies show that it is associated with abdominal pain, acute or chronic diarrhea, nausea, anorexia, bloating, and perianal itching (with diarrhea, abdominal pain, flatulence, and constipation being the most common complaints) (Tasić et al., 2017). In most cases, symptoms may vary, ranging from absent to mild. The pathogenicity remains debated and controversial with the following reasons: (i) asymptomatic colonization is very common; (ii) evidence suggesting *Blastocystis*-induced pathogenicity has been inferred mainly from in vitro studies (while pathogenicity remains to be robustly demonstrated in vivo); (iii) no striking phenotypic virulence properties, such as the presence of flagella, lectins, or rhoptries have been identified, and phagocytosis has been described only once; (iv) no *Blastocystis*-associated outbreaks have been verified; (v) majority of evidence that exists regarding clinical improvement upon *Blastocystis* eradication in patients with gastrointestinal symptoms are anecdotal; and (vi) when epidemiological studies are used for inferring hypotheses on the basis of the pathogenic status of enteric microorganisms, distinctions between endemically and intermittently exposed populations are rarely, if ever made; such distinctions may be critical to understanding differences in symptom development in the event that host immune response plays a significant role in *Blastocystis-*associated disease (Andersen & Stensvold, 2016).

There are views that the clinical manifestations of *B. hominis* depend on the subtype of the parasite. ST1 is commonly found in symptomatic individuals. ST2 has a controversial pathogenicity because it has been positively demonstrated in some studies and disputed in others. ST3 is the most common subtype isolated in humans, but there are still limited data indicating its pathogenicity. However, recent studies show that in symptomatic individuals, ST3 is associated with gastrointestinal symptoms, especially diarrhea (Zulfa et al., 2017). Furthermore, only around 40% of ST4-infected individuals have gastrointestinal symptoms. ST5 is found in infected individuals with severe diarrhea, while ST6 (which is the common subtype passed in zoonotic transmission) is found to cause diarrhea in only 1/3 of infected individuals. Moreover, ST7 is also associated with the onset of diarrhea (Tasić et al., 2017). Around 84% of individuals with *B. hominis infection* had at least one known pathogen other than *B. hominis*, including *E. histolytica, G. duodenalis, and D. fragilis*. The behavior of *B. hominis* in people is comparable to that of *Giardia spp*. and *E. histolytica* (Wahid et al., 2023). *G. duodenalis* and *Blastocystis* spp. are also found to be responsible for the majority of diarrheic cases, and they are incriminated to be an important cause of acute diarrhea in children (Hamdy et al., 2020).

*B. hominis* is highly prevalent in tropical and subtropical settings, particularly in developing countries with inadequate hygiene conditions and consumption of contaminated food or water, including the Philippines. Although its pathogenic potential is still questioned, *B. hominis* is commonly recognized as a pathogenic contributor to diarrhea, abdominal pain, and irritable bowel syndrome in people. In immunocompromised individuals, such as the elderly, people with HIV/AIDS, or people with cancer, *B. hominis* infections can cause noticeable diarrhea. Children with recurrent diarrhea had a higher prevalence of intestinal parasitic infection, implying that this should be investigated in cases of chronic or recurrent diarrhea. Moreover, intestinal parasite infections are more common in children of school age and may have a negative impact on growth. Similarly, prior studies revealed that a higher cumulative burden of diarrhea prior to the age of 24 months was linked to a higher prevalence of stunting at that age (Wahid et al., 2023). Because of *Blastocystis*' potential threat, it is recommended to improve personal and environmental hygiene measures, promote health education, and regular screening and treatment for such infections must be employed. Further studies concerned with molecular and subtype identification of *Blastocystis* are also highly recommended (Hamdy et al., 2020).

**V. DIAGNOSTIC CHALLENGES**

As an emerging pathogenic concern in the Philippines, precise diagnosis of *B. hominis* is necessary to understand its prevalence and clinical impact (Adao & Rivera, 2024). Many diagnostic methods are currently employed to detect *B. hominis,* including microscopy, in vitro cultivation, immunodiagnostic assays, and more advanced and emerging methods such as molecular tests (Table 2).However, less sensitive (38.46% sensitivity) conventional microscopy is still the most commonly used method due to its cheap price and higher accessibility (Barua et al., 2015). Concentration technique using FECT could also be employed with much higher sensitivity compared to direct wet mount, but the parasite could be easily disturbed, producing a potential false negative result. The use of permanent stains like trichome, besides iodine, is currently being suggested to increase the sensitivity in detecting *B. hominis*. However, it was also revealed that trichrome staining is much more time-consuming, making it unsuitable for routine use (Elghareeb et al., 2015). Issues of the harmful effects of the use of fixatives (PVA and Schaudinn fixative) in permanent staining should also be considered. Therefore, it was recommended that in vitro culture method (RPMI 1640, 199, DMEM, and Jones medium) could be used with more improved sensitivity and specificity; however, disadvantages like labor extensiveness and its time-consuming nature must also be considered (Elghareeb et al., 2015; Zhang et al., 2012). Emerging new ELISA test was able to detect low parasite levels in infected individuals and can recognize subtypes 1, 2, 3, and 5, but need for further data about the technique is necessary (Dogruman-Al et al., 2015). Other staining techniques, like IFA stain, were also proven to be sensitive (73.3%). Although having high sensitivity, it is suitable only in large hospitals or public health laboratories in developed countries, owing to its high cost (EL-Marhoumy et al., 2015).

The routine diagnostic method used in the Philippines for the identification of *B. hominis* is microscopic observation (Belleza et al., 2015). However, it has some limitations, including the need for high expertise in microscopy, unable to differentiate *Blastocystis* subtypes, and low sensitivity. Thus, molecular techniques with advanced features, high specificity, and high sensitivity are preferred (Khademvatan et al., 2018). Even though considered as the gold standard for *Blastocystis* diagnosis, many countries, including the Philippines, have limited access to molecular techniques due to lack of resources and facilities (Rudzińska & Sikorska, 2023; Tasić et al., 2017). PCR and real-time PCR are highly sensitive methods for the diagnosis of many infectious diseases. However, a study in Thailand showed that they can produce false negative results due to the presence of PCR inhibitors such as bile salts in stool, low parasite levels, and transportation issues (Srichaipon et al., 2019). PCR using STS (sequence-tagged sites) primers is commonly employed in subtyping, which shows higher sensitivity and specificity in analyzing subtypes (Khademvatan et al., 2018).

Emerging techniques for detection and subtyping, like PCR-RFLP and HRM (High Resolution Melting Analysis), were proven to be cost-effective, simple, and rapid, suggesting their potential significance in future studies. (Srichaipon et al., 2019; Salehi Sangani et al., 2025). In cases of mixed subtype infection, PCR coupled with Sanger sequencing could be used, but it requires additional steps and may miss low-abundance subtypes. Next generation amplicon sequencing (NGS) has also shown greater sensitivity in detecting mixed subtype infections of *Blastocystis* in humans and animal studies (Higuera et al., 2021).

Due to the controversial pathogenicity of *B. hominis*, the issue of underdiagnosis has become a growing concern. Reliance on conventional diagnostic techniques may also contribute to underdiagnosis. One study in Morocco compared the sensitivity of three diagnostic tools (PCR, culture in Jones medium, and microscopy) and showed that PCR had the highest sensitivity, implying that accessible conventional techniques have a higher chance of not detecting true positive individuals for *B. hominis* (Boutahar et al., 2023). Furthermore, because of *Blastocystis*' polymorphic structure, issues with misdiagnosis have been a great concern in native preparation for microscopy, as they have been commonly misidentified as fungi, *Cyclospora spp*., fat droplets, *D. fragilis,* and yeast. It was also suggested that a combination of different diagnostic techniques must be employed, such as culture, if PCR is not available (Roberts et al., 2011; Tasić et al., 2017).

In the Philippines, because of limited access to advanced diagnostic tools, low laboratory capacity, and high costs, molecular methods are not used as a routine tool for diagnosing *B. hominis*. In fact, it is just usually used in research like the studies of Adao et al. (2016) and Belleza et al. (2016), which conducted subtyping analysis in an urban community in the Philippines. Currently, there is still a lack of a standardized procedure for the diagnosis of *B. hominis* in the Philippines, and conventional microscopy is still relied upon. Due to many concerning issues and challenges in diagnosing *B. hominis* in the Philippines, the incorporation of molecular diagnosis, such as PCR, in the clinical setting has been highly recommended (Boutahar et al., 2023; Rudzińska & Sikorska, 2023). Furthermore, employing subtype-specific studies in more local settings in the Philippines is necessary, as subtype distribution may vary geographically, affecting detection accuracy and pathogenicity (Adao et al., 2016).

A summary of the various methods used for detecting *B. hominis* is presented in Table 2, emphasizing the need to assess the strengths, limitations, and suitability of each method depending on the available resources of a certain area. This information will help in choosing the most appropriate diagnostic approach to ensure accuracy in detecting B. hominis.

**Table 2.** A comparative analysis of the currently available diagnostic methods used for detecting *B. hominis* and their limitations.

|  |  |  |  |
| --- | --- | --- | --- |
| **Diagnostic Methods** | **Purpose** | **Limitations** | **Reference** |
| Conventional Microscopy  (Direct Wet Mount) | Used for routine diagnosis of Blastocystis hominis. | High expertise, unable to differentiate *Blastocystis* subtypes, low sensitivity (38%), issues in underdiagnosis and misdiagnosis. | Khademvatan et al., 2018  Barua et al., 2015 |
| FECT | Slightly higher sensitivity compared with conventional microscopy. | Produces false negatives due to parasite disturbance. | Elghareeb et al 2015 |
| Trichome staining | Considered as the most sensitive staining technique for *Blastocystis* | Time consuming and harmful threat of fixatives (PVA and Schaudinn). | Elghareeb et al., 2015  Zhang et al.,2012 |
| IFA staining | Exhibit high sensitivity (73.3%) compared with MZN, Iodine, and SMB stains. | Only suitable in large hospitals or public health laboratories due to its high cost. | EL-Marhoumy et al., 2015 |
| In vitro culture method (RPMI 1640, 190, and DMEM) | Environmental safety, convenience in preparation and storage, facility in morphological discrimination, and outstanding performance with regards to sensitivity and specificity. | Time-consuming and cannot be used in emergency cases and field studies. | Zhang et al., 2012 |
| In vitro culture using Jones Medium | Higher sensitivity compared with conventional microscopy, FECT, and trichome stain. In other studies, cultivation techniques are considered as gold standard. | Labor extensive and time consuming. | Elghareeb et al.,2015  Santos & Rivera 2013 |
| Elisa Test | Can be used in diagnosing low parasite level in individuals and can recognize subtypes 1,2,3, and 5. | Limited data about the diagnostic method. | Dogruman-Al et al., 2015 |
| PCR and real time PCR | Considered as gold standard for the diagnosis of Blastocystis hominis, with high sensitivity and specificity. | Expensive and lack of facilities, especially in underdeveloped countries. One study in Thailand using PCR for SSU rDNA produced false negative results due to the presence of many PCR inhibitors in stool samples, low parasite levels and issues in transportation. | Srichaipon et., 2019 |
| PCR-RFLP | Simple, rapid, and cost-effective method for subtyping analysis of *B. hominis*. Allow to differentiate human Blastocystis subtype 1-9. | Lack of facilities and further studies about the method are important. | Srichaipon et al., 2019 |
| High Resolution Melting Analysis | Efficient and cost effective, provides a rapid and accurate method for *Blastocystis* subtype in developing countries, and can reduce the need for sequencing.  Potential significance in epidemiological surveillance and understanding cross species transmission. | Lack of facilities and requires further studies | Salehi Sangani et al., 2025 |
| PCR coupled with Sanger Sequencing | Used in diagnosing mixed subtype infection. | Expensive, lack of facilities, require additional steps, and may miss low abundance subtypes. | Higuera et al., 2021 |
| Next Generation Sequencing | Showed the greatest sensitivity in detecting mixed subtype infection. | Expensive and lack of facilities. | Higuera et., 2021 |

**VI. CURRENT CONTROL AND PREVENTION STRATEGIES**

Despite its high prevalence and potential clinical significance, *B. hominis* is not currently included in any dedicated parasite control programs in the Philippines. Existing national efforts continue to focus primarily on soil-transmitted helminths, particularly in response to their burden in tropical and subtropical regions of the country (Belizario et al., 2016). Nevertheless, research initiatives have been undertaken to investigate *B. hominis* subtypes, especially within urban populations (Adao et al., 2016). Notably, viable *Blastocystis* cysts have been detected in Philippine wastewater both before and after treatment, indicating the organism’s resistance to conventional wastewater processing methods. These findings raise significant public health concerns regarding environmental persistence and potential transmission, particularly in urban areas where wastewater reuse is common (Banaticla & Rivera, 2011).

Poor access to water, sanitation, and hygiene (WASH) remains a pressing issue in the Philippines, with an estimated 86% of diarrhea-related deaths in 2019 attributed to inadequate WASH services (Ulep et al., 2024). Although the transmission dynamics of *B. hominis* are not fully elucidated, evidence supports multiple routes including fecal–oral (via contaminated water and food), anthroponotic, and zoonotic pathways. Preventive strategies anchored in WASH interventions are therefore likely to play a crucial role in reducing transmission (Heydarian et al., 2024). In rural and mountainous regions, higher prevalence rates have been linked to unfiltered water sources, close contact with livestock, and poor hygiene practices, emphasizing the need for clean water access, proper animal management, and improved sanitation infrastructure (Asfaram et al., 2019).

As an emerging and controversial protozoan, the pathogenicity of *B. hominis*—particularly its association with specific subtypes and potential zoonotic transmission—remains a topic of ongoing debate. Public health education and awareness campaigns, core elements of the World Health Organization’s primary health care strategies for intestinal parasite control, are currently insufficient in the Philippines, contributing to limited awareness of *B. hominis* among both health professionals and the public (Belleza et al., 2016; Tasić et al., 2017). Furthermore, recent local studies have shown that dog ownership may be significantly associated with human infection, reinforcing the importance of integrating a One Health perspective into surveillance and prevention strategies (Belleza et al., 2016).

In terms of treatment, metronidazole is commonly used as the first-line therapy; however, its effectiveness is variable and may be influenced by the *Blastocystis* subtype involved. Reports of treatment failure and possible resistance have prompted the use of alternative therapies such as trimethoprim–sulfamethoxazole and, in specific cases, paromomycin—particularly for infections with associated dermatologic manifestations (Tasić et al., 2017). Nevertheless, therapeutic outcomes remain inconsistent, and further clinical studies are needed to clarify the relationship between subtype variation and drug responsiveness.

International initiatives such as the COST Action CA21105 "Blastocystis under One Health" (OneHealthBlastocystis) aim to advance global understanding of this parasite by promoting standardized diagnostic approaches, multidisciplinary collaboration, and integrated research. These efforts unite professionals from human and veterinary medicine, environmental science, and public health to address the complexities of *Blastocystis* epidemiology and pathogenesis (Tsaousis et al., 2024). Adopting similar frameworks in the Philippines would provide opportunities to strengthen local research, improve diagnostic capacity, and guide evidence-based public health interventions.

**VII. CONCLUSION**

*B. hominis* remains an underrecognized yet significant public health concern in the Philippines. Epidemiological studies have reported notably high prevalence rates among human populations in both urban and rural settings, as well as in specific vulnerable groups and various animal hosts. Its detection in humans, animals, and environmental sources suggests a potential for zoonotic transmission, warranting strengthened public health responses. In the Philippines, subtype ST3 is the most frequently identified among human isolates, mirroring global distribution patterns and supported by emerging evidence of its pathogenicity.

Although *B. hominis* has been implicated in gastrointestinal disturbances—including chronic diarrhea and irritable bowel syndrome—particularly in immunocompromised individuals, its clinical relevance in the Philippines remains underappreciated. This is largely due to the continued reliance on low-sensitivity diagnostic tools such as conventional microscopy. While molecular methods like polymerase chain reaction (PCR) offer greater diagnostic accuracy, their application remains limited in local laboratories due to cost and infrastructure constraints. The absence of national surveillance systems and targeted control initiatives further reflects the parasite’s neglected status within the country’s public health agenda.

Despite the presence of published prevalence data, current epidemiological information remains geographically limited, with most studies concentrated in Luzon. This highlights the need for updated, large-scale nationwide surveys to determine the true burden of *B. hominis* and to elucidate its transmission dynamics. Broader molecular epidemiological investigations involving diverse populations—particularly high-risk and immunocompromised groups—are essential to better understand the pathogenic potential of different subtypes.

Addressing *B. hominis* infection in the Philippines requires a multifaceted strategy. Strengthening Water, Sanitation, and Hygiene (WASH) interventions, enhancing public awareness through health education, and expanding diagnostic capabilities—especially for molecular detection—are critical steps. Incorporating *B. hominis* into national parasite surveillance and control programs is also imperative. Ultimately, a more comprehensive understanding of the parasite’s pathogenesis and transmission ecology will inform effective control measures and reduce its health impact, thereby improving the well-being of affected populations.

**VIII. RESEARCH GAPS AND FUTURE DIRECTIONS**

Despite growing recognition of its global distribution, *Blastocystis hominis* remains a neglected intestinal protist in the Philippines. Although some regional data exist, the majority of prevalence studies are geographically restricted to Luzon, resulting in a lack of nationwide epidemiological insight. Environmental surveillance is also limited, despite reports showing that *Blastocystis* cysts can survive various wastewater treatment processes in Philippine settings (Banaticla & Rivera, 2011). These findings highlight the organism’s environmental resilience and its potential to persist as a source of infection.

This neglect parallels similar challenges observed in the surveillance of other protozoan parasites such as *Entamoeba histolytica* (Beup et al. 2024) and *Giardia duodenalis* (Quidato et al. 2025), both of which are also underreported in rural and low-resource communities. Despite being established causes of gastrointestinal disease, accurate data on their distribution remain scarce in the Philippines. Like *B. hominis*, these protozoa are primarily detected through conventional microscopy, which has known limitations in sensitivity and specificity. Without the routine use of molecular diagnostics, coinfections and misidentification among these parasites are common, further complicating public health responses.

International studies, such as those by Fusaro et al. (2024), emphasize the necessity of molecular data to accurately characterize *Blastocystis* subtype (ST) diversity and geographic spread. In the Philippines, only a handful of molecular subtyping efforts have been conducted, with ST3 emerging as the predominant subtype in human isolates—consistent with global trends. Adao et al. (2016) recommended larger, more inclusive surveys to uncover additional circulating STs and to establish clearer associations between subtype distribution and clinical symptoms.

Notably, *B. hominis* has been linked to adverse outcomes in vulnerable populations. In developing countries, chronic asymptomatic infections have been associated with childhood stunting, while immunocompromised individuals—including those with HIV, cancer, or advanced age—are at higher risk for symptomatic disease (Wahid et al., 2023). However, in the Philippine context, the correlation between *Blastocystis* infection and disease remains underexplored, especially in rural areas where environmental exposures and poor sanitation are common. Belleza et al. (2015) initiated one of the few urban studies, but rural prevalence and clinical associations remain poorly documented.

A major barrier to progress is the lack of cost-effective and sensitive diagnostic tools available in most Philippine laboratories. Microscopy remains the primary method of detection despite its limitations. While PCR and other molecular tools, such as high-resolution melting (HRM) and PCR-restriction fragment length polymorphism (PCR-RFLP), have proven effective in subtyping and prevalence studies (Salehi Sangani et al., 2025; Srichaipon et al., 2019), their use is largely confined to research institutions. Studies exploring the feasibility of implementing these techniques in resource-limited settings like the Philippines are urgently needed.

Given its potential zoonotic transmission, *B. hominis* requires integration into One Health-based surveillance frameworks. Animal carriers—including swine, poultry, dogs, and non-human primates—may contribute to its environmental dissemination, emphasizing the need for cross-sectoral collaboration. Effective control strategies should incorporate epidemiological, parasitological, molecular, and zoological approaches (Belleza et al., 2016). Transmission studies must also include symptomatic individuals to better define associations between subtypes and disease severity.

Despite its apparent clinical and public health importance, *B. hominis* has not been integrated into national parasite surveillance or control programs. The Philippine public health system continues to focus on helminthic infections, neglecting intestinal protozoa despite their burden. Similar patterns are observed for *E. histolytica* and *G. duodenalis*, which also suffer from limited surveillance coverage and diagnostic underreporting.

Efforts such as the *Blastocystis under One Health* initiative (COST Action CA21105) offer a valuable model for developing countries. This international collaborative framework promotes harmonized diagnostics, interdisciplinary research, and improved understanding of *Blastocystis* transmission and pathogenesis (Tsaousis et al., 2024). Integrating such initiatives into national health strategies could fill knowledge gaps and improve parasite control in the Philippines and beyond.

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