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Original Article

Amoebic Dysentery in Northeastern Thailand: Contributing Factors in Border Provinces (2019-2023)

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Abstract

Background: We investigated the contributing factors of amoebic dysentery across five provinces in Northeastern Thailand from 2019 to 2023. Comprehensive data were collected regarding agricultural practices, disaster impacts, and demographic characteristics for Sisaket, Ubon Ratchathani, Yasothorn, Amnat Charoen, and Mukdahan.

Methods: Overall, 1,112 cases of amoebic dysentery were analyzed, revealing a higher prevalence among males in younger age groups, while females dominated in older cohorts. Sisaket reported the highest number of cases, followed by Ubon Ratchathani, Amnat Charoen, Yasothorn, and Mukdahan. Notably, Sisaket demonstrated the highest incidence rate of 10.28 cases per 100,000 population, compared with Ubon Ratchathani's 5.27 cases.

Results: The study highlights the interplay between environmental factors, agricultural practices, and sociodemographic characteristics, emphasizing how high disaster impact and reliance on natural agriculture may facilitate amoebic dysentery transmission. The findings underscore the importance of tailored public health interventions to mitigate the disease burden, particularly in vulnerable populations. Future research should focus on pinpointing specific factors driving the observed variations in disease prevalence across the region.

Conclusion: This study serves as an essential resource for policymakers and public health officials aiming to enhance amoebic dysentery management strategies in Northeastern Thailand.



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Introduction

Dysenteric diarrhea, characterized by bloody or mucus-filled stools, is primarily caused by the protozoan *Entamoeba histolytica*. This parasite infects the large intestine, leading to amoebiasis, a gastrointestinal disease with significant morbidity and mortality worldwide, especially in children and young adults. Symptoms include severe diarrhea, abdominal pain, fever, and the passage of blood or mucus in stools (1,2).

Inadequate sanitation and hygiene practices, as identified by the World Health Organization (3), are major contributors to the global prevalence of amoebic dysentery caused by *E. histolytica*. The WHO estimates that approximately 500 million people are infected with this parasite, with 10% experiencing invasive amoebiasis (4). Over 55,000 deaths annually due to acute intestinal amoebiasis underscore the urgent need for public health interventions that address the environmental and social determinants of disease transmission.

Dysentery remains a significant public health issue in Thailand, particularly in rural and underserved areas (5). Amoebic dysentery is the third most prevalent food and waterborne disease in the country, accounting for 5-15% of annual diarrheal deaths, especially among children (2). An analysis from 2016-2020 showed that children under 15 represented 35.2% of cases, with border provinces like Chiang Mai and Sisaket having the highest rates (49.8% of total cases). Despite advancements in healthcare and sanitation, dysentery caused by *E. histolytica* continues to be a challenge, particularly in vulnerable populations. Socioeconomic factors, such as lower GDP per capita and higher income inequality, are associated with increased risk, along with individual and household characteristics (6,7).

Environmental factors, socioeconomic conditions, housing conditions, and sanitation practices all contribute to the transmission of

dysentery. The prevalence of amoebic dysentery is unevenly distributed, with socioeconomic factors such as overcrowding, poor health infrastructure, and inadequate sanitation significantly increasing the risk (8,9). China has a higher incidence of dysentery compared to developed nations like the United States and France (10).

We to identify risk factors for amoebic dysentery and inform targeted interventions by examining data on gender assigned at birth, age, geographic distribution, socioeconomic conditions, and environmental factors. The study area, with a population of over 4.6 million, provided a valuable opportunity to investigate the prevalence and distribution of the disease within the border provinces of northeastern Thailand.

Materials and Methods

Ethical approval

The study protocol was reviewed and approved by the Ethics Committee of Ubon Ratchathani Provincial Health Office, Ministry of Public Health (reference number: SSJ.UB 2566-055). All experimental procedures were conducted in accordance with ethical research standards.

Study Area and Data Sources

This study was conducted in five northeastern Thai provinces bordering Laos and Cambodia: Ubon Ratchathani, Mukdahan, Amnat Charoen, Yasothon, and Sisake (Fig. 1). This region, encompassing 36,683 square kilometers, has a population of 4,658,957 with an average density of 806 people per square kilometer (National Statistical Data, 2024).

Data sources included the Office of Disease Prevention and Control Region 10 Ubon Ratchathani, National Statistical Office of Thailand, Humanitarian Data Exchange (OCHA), Digital Government Development Agency, and Land Development Department.

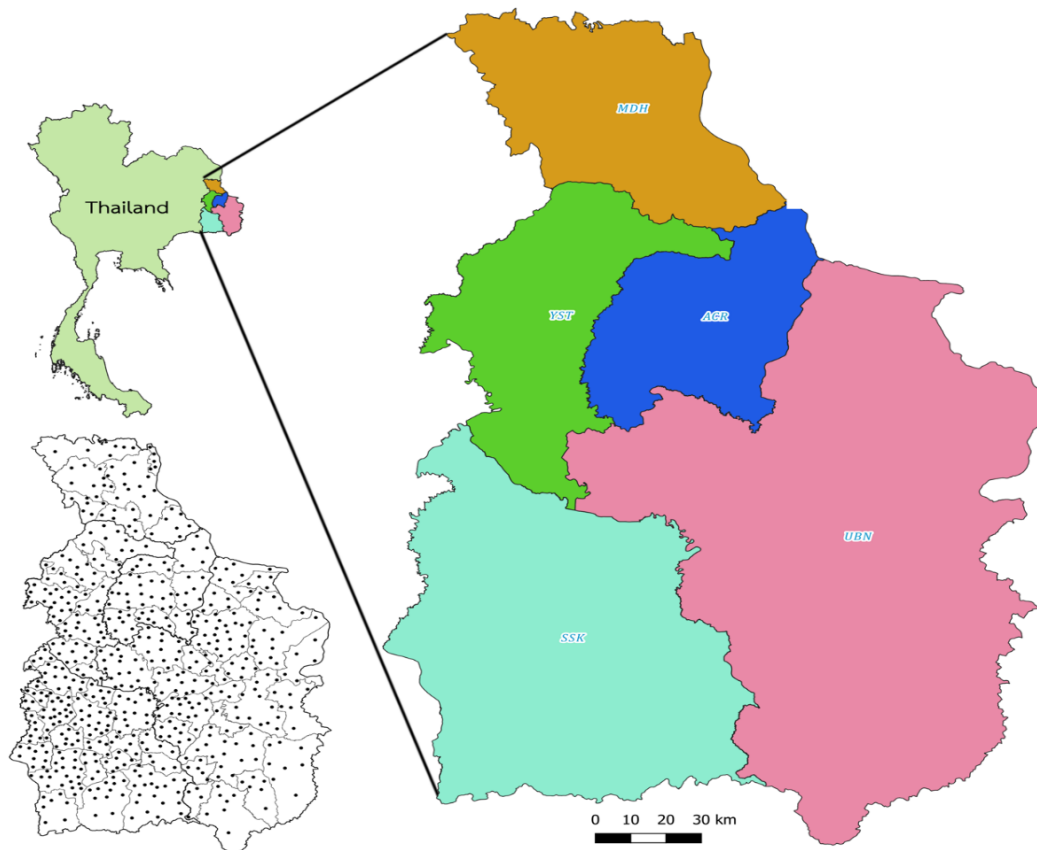


Fig. 1: Study Area Map. The map depicts the five provinces included Yasothon (YST), Amnat Charoen (ACR), Ubon Ratchathani (UBN), Sisaket (SSK), and Mukdahan (MDH)

Amoebic dysentery cases

This study analyzed five years of amoebic dysentery data (2019-2023) obtained from the Office of Disease Prevention and Control Region 10 Ubon Ratchathani. The dataset, comprising both paper and electronic records from local healthcare facilities, included 1,112 reported cases. The primary diagnostic method was direct smear microscopy of stool samples, based on the characteristic morphology of *E. histolytica*. Polymerase chain reaction (PCR) with species-specific primers was used for confirmation in a subset of cases. Case records included onset date, patient demographics, and clinical presentation.

Spatial Data Acquisition

Population data for the five provinces, 70 districts, and 609 sub-districts were obtained from the Office of Disease Prevention and Control

Region 10 Ubon Ratchathani. This ensures comprehensive demographic information for the study area.

Amoebic dysentery data for the period 2019-2023 was also acquired from the same source. The dataset, comprising both paper and electronic records from local healthcare facilities, included a total of 1,112 reported cases. Each case record contained essential information such as onset date, patient demographics, and clinical presentation.

Additionally, amoebic dysentery data were obtained from the Office of Disease Prevention and Control Region 10 Ubon Ratchathani. This data includes details of onset date, location (sub-district level), and type of dysenteric allowing for targeted analysis of disease burden.

Geospatial Data Acquisition

To gain a deeper understanding of the distribution of amoebic dysentery cases within the study area, several data sources were analyzed. The latitude and longitude coordinates were acquired from the Digital Government Development Agency (DGA) for each sub-district, enabling us to map the location of reported cases. Provincial and District Boundaries was conducted using data from the Humanitarian Data Exchange (HDX). Land use information for each province was accessed from the Land Development Department.

By integrating amoebic dysentery data (including sub-district level information) with the corresponding geographic coordinates, we were able to perform spatial analysis using Geographic Information Systems (GIS) software like QGIS (<https://www.qgis.org/>). This facilitated visualization of disease burden across the study area and identification of potential spatial patterns. Latitude and longitude coordinates for each sub-district were acquired from the Digital Government Development Agency (DGA). Provincial and District Boundaries were verified from the Humanitarian Data Exchange (HDX). Land Use Data was accessed the land use information for each province from the Land Development Department.

Data Cleaning, Analysis, and Management

The amoebic dysentery data was meticulously reviewed for completeness and consistency. Data imputation and record merging techniques were employed to address missing values and duplicate entries. Population data for each province was verified against national census data from reliable open sources like the National Statistical Office and Provincial Statistical Offices during the five-year study period (2019-2023). Demographic information within the amoebic dysentery data, such as age, gender

assigned at birth, and occupation, was cleaned and categorized for analysis.

Descriptive statistics were calculated to analyze the distribution of amoebic dysentery across the five provinces over the five-year period. Trends in total cases and illness severity were also analyzed to identify potential patterns over the years. Correlation and regression analyses were employed to investigate potential associations between amoebic dysentery incidence and several key factors, including spatial distribution, environmental characteristics, and demographic factors.

The study incorporated environmental profiles of the provinces, examining differences in mechanization, agricultural practices, and disaster impacts. This included a comprehensive analysis of each province's area, reliance on natural and organic farming, levels of mechanization, field crop production, and disaster impacts, to understand the regional dynamics and resource allocation. This multifaceted approach provided a thorough investigation into how these variables may influence the prevalence and distribution of amoebic dysentery.

Data Visualization

For efficient data handling and analysis: A combination of open-source software were utilized. The MariaDB (Version 10.6.17) of this popular relational database management system (<http://mariadb.org/>) was used to manage the amoebic dysentery data. Population demographics (sub-district level) and geographical coordinates were also integrated within this database.

The widely used programming language, PHP version 5.6.40 (<http://www.php.net/>), was employed to calculate the incidence rate. This rate represents the number of new amoebic dysentery cases per unit population within a defined period.

Results

The study focused on five northeastern Thai provinces bordering Laos and Cambodia, namely Mukdahan (MDH), Amnat Charoen (ACH), Yasothon (YST), Sisaket (SSK), and Ubon Ratchathani (UBN). These provinces collectively from the Office of Disease Prevention and Control Region 10 Ubon Ratchathani. The agricultural and environmental profiles of five provinces reveal diverse characteristics shaping their landscapes. Sisaket spans 8,839.93 sq. km and faces a high disaster effect of 67.13%, relying on natural agriculture (43.1%) with significant mechanization (79.14%). Ubon Ratchathani, the largest at 16,112.62 sq. km, encounters a slightly lower disaster impact (57.03%) but emphasizes natural agriculture (43.8%) and machine work (75.8%). Yasothon, though smaller at 4,161.66 sq. km, leads in organic farming (26.7%) and mechanization (91.26%), despite experiencing the highest disaster effect (67.95%). Amnat Charoen, covering 3,161.60 sq. km, shows considerable mechanization (90.80%) and field crop production (10.30%), balanced with moderate disaster effects (66.87%). Mukdahan, with 4,407.00 sq. km, while having the lowest natural agriculture (22.8%), achieves high field crop output (10.14%) and mechanization (86.47%) amid a moderate disaster impact (61.1%). These diverse practices and environmental impacts are crucial for understanding regional dynamics and resource allocation (Fig. 2).

A total of 1,112 cases of dysenteric amoebiasis were analyzed between 2019 and 2023. The analysis revealed significant differences in

age and gender distribution. Of the cases, 524 were male (47.1%) and 588 were female (52.9%), with a mean age of 35.4 years (standard deviation: 24.75 years). The 0-4 age group had the highest prevalence (12.94%), while the 85-89 age group had the lowest (1.80%) (Fig. 3). A notable trend emerges in the relative gender assigned at birth distribution across age groups. In early childhood (0-4 years), the male population is disproportionately higher (76.4% males and 26.4% females), yet this trend reverses significantly in older age. For instance, in the 65-69 age group, there are 32 males compared to 66 females. This trend continues into the 70-74 years and older age, where the female population consistently outnumbers males, with 42 females to 44 males in the 70-74 years and 35 females to 28 males in the 75-79 years (Fig. 3).

Sisaket Province reported the highest absolute number of amoebic dysentery cases in 2023, with 756 cases, followed by Ubon Ratchathani (494 cases), Amnat Charoen (38 cases), Yasothon (30 cases), and Mukdahan (6 cases). However, when considering the incidence rate per 100,000 population, Sisaket still maintains the highest rate at 10.28 cases, followed by Ubon Ratchathani (5.27 cases), Amnat Charoen (2.02 cases), Yasothon (1.11 cases), and Mukdahan (0.34 cases). Interestingly, while the other four provinces experienced a general trend of decreasing cases, Sisaket saw a significant surge in amoebic dysentery cases from 2022 to 2023 (Fig. 4).

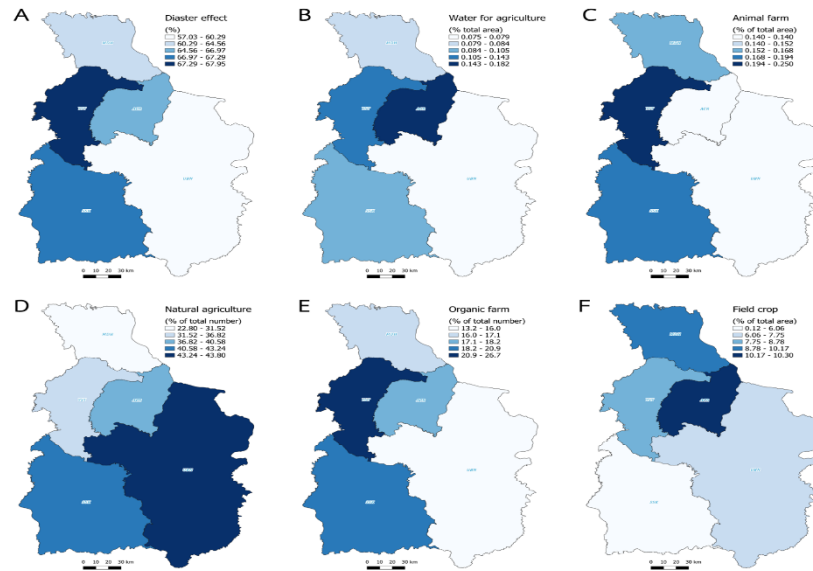


Fig. 2: Agricultural and Environmental Profiles of Five Provinces in Thailand. A: Illustrate variations in disaster effects, B: water usage for agriculture, C: animal farm density D: natural agriculture reliance, E: organic farming practices, and F: field crop production. MDH = Mukdahan, YST = Yasothon, ACR = Amnat Charoen, SSK = Sisaket, and UBN = Ubon Ratchathani

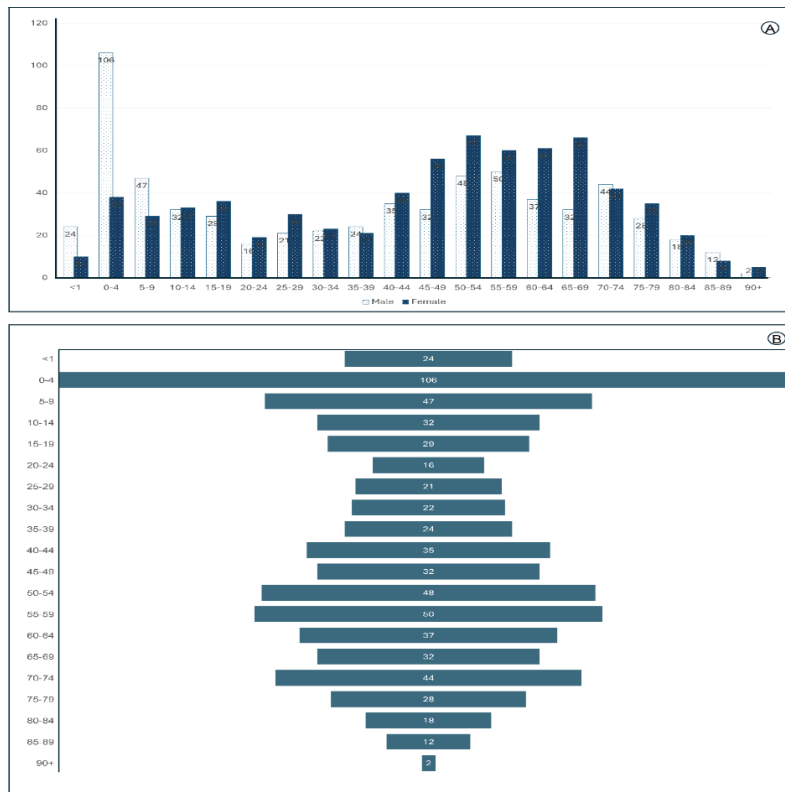


Fig. 3: Amoebic dysentery cases by gender assigned at birth and age. A, B: Gender differences across all five border provinces affected by amoebic dysentery

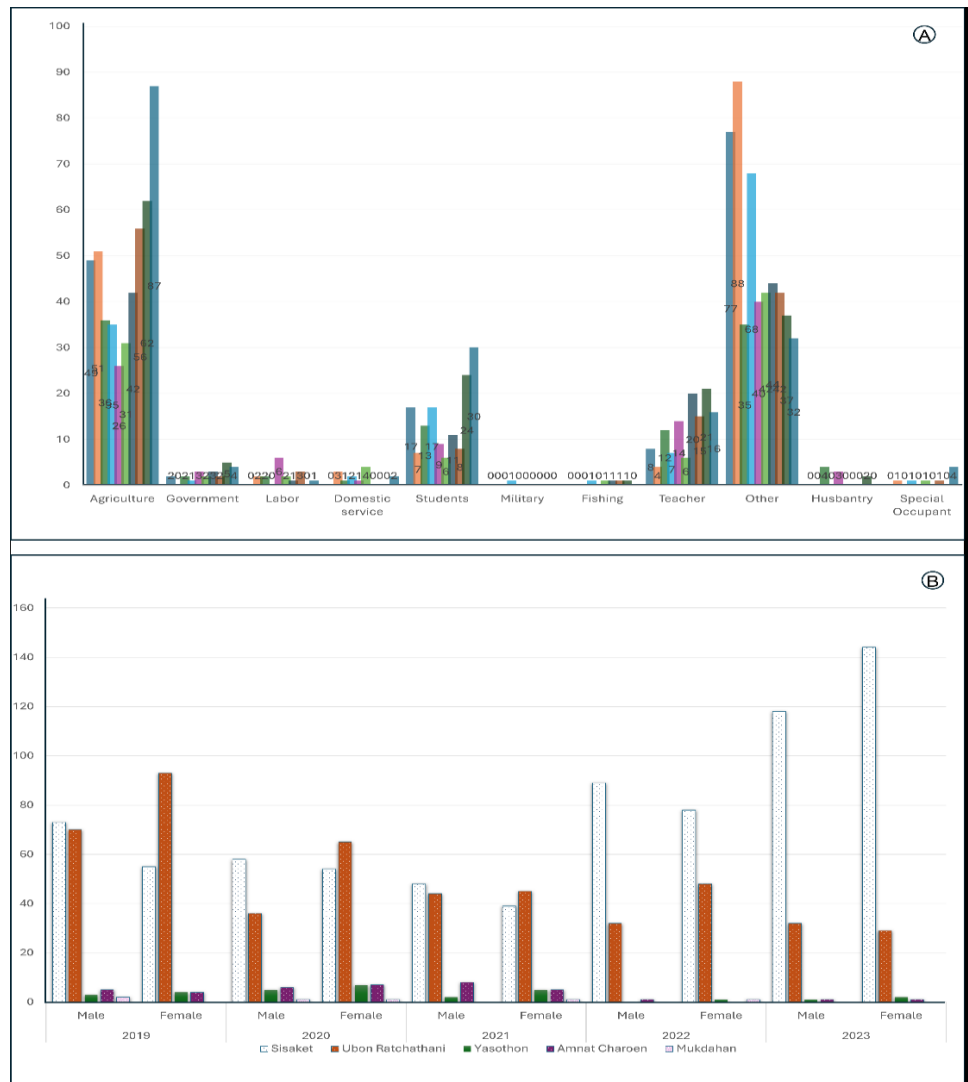


Fig. 4: Amoebic Dysentery Cases by Year, Gender as assigned at birth, and Occupation (2019-2023). A: The trends in amoebic dysentery by occupation, highlighting increases in agriculture. B: Amoebic Dysentery Cases by Province, Year, and Gender assigned at birth

Sociodemographic Factors affect dysenteric amoebiasis

Over the 2019-2023 period, amoebic dysentery cases exhibited varying trends across different occupations within the study area (Fig. 4A). Agriculture experienced a steady increase, with a significant rise among females (from 51.00% of the total in 2019 to 58.38% in 2023). Government workers saw a gradual rise, though numbers remained low ($n = 2, 3, 5, 5, 9$). Labor cases fluctuated, peaking in 2021 and

declining to zero by 2023. Students showed an increase, with a notable shift towards male cases. Teaching professionals experienced a moderate rise, with a male preference (56.76% to 70.00%). Other occupations saw a general decline, except for a notable rise among individuals in "special occupations" in 2023.

Over the study period, Sisaket province experienced fluctuating patterns of amoebic dysentery prevalence. While females generally had higher rates of amoebic dysentery in the other

border provinces, Sisaket demonstrated a slight male predominance in most years. Males accounted for a higher proportion of cases, ranging from 51.79% to 57.03%, compared to females (42.97% to 48.21%). However, this trend reversed in 2023, with females representing a slightly higher proportion of cases. In contrast, Ubon Ratchathani experienced a gradual decline in cases over the same period. Similar to the overall trend, females in Ubon Ratchathani also had higher rates of amoebic dysentery than males. Yasothorn and Amnat Charoen reported low prevalence, with minor fluctuations. Mukdahan consistently had the lowest rates, with no cases reported in 2023 (Fig. 4B).

In the outpatient department (OPD), females sought healthcare services for dysentery more frequently than males, with a total of 553 cases compared to 476 cases in males. This suggests

that females are more likely to seek medical attention for dysentery symptoms. However, in the inpatient department (IPD), males had a slightly higher number of cases (159 cases of male and 136 cases of female).

Amoebic dysentery cases (2019-2023) varied significantly by district (Fig. 5). Mueang Si Sa Ket had a low incidence (48.09/100,000) despite a larger population, while Khun Han had a much higher rate (162.57). Mueang Chan's rate was highest (471.28) due to a 2023 spike. Si Mueang Mai consistently had high rates (433.68), peaking in 2019. Sirindhorn successfully reduced its rate to 64.46. Phrai Bueng's rate was 146.90 (71 cases/48,331 residents). Amnat Charoen, despite low overall cases, saw persistent transmission in Senangkhanikhom (35 cases, 85.60 rate).

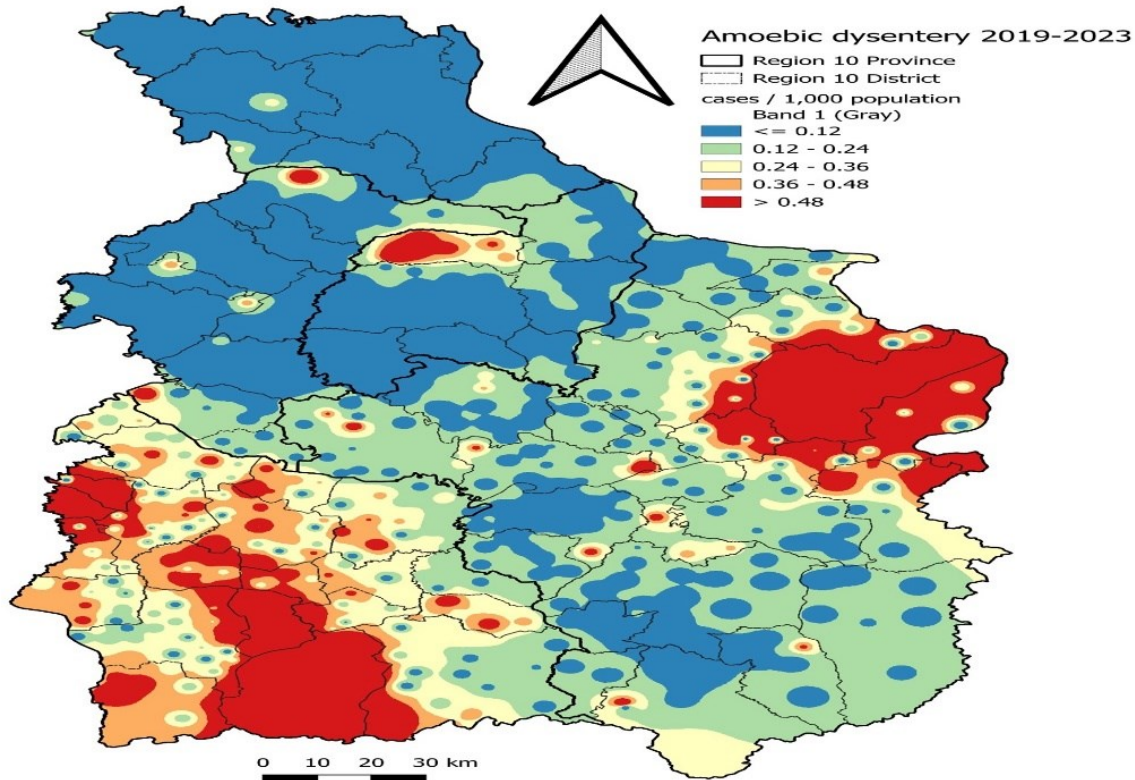


Fig. 5: Distribution of Amoebic Dysentery Cases in 5 provinces under the Region 10 Province, 2019-2023

This study analyzed 1,112 amoebic dysentery cases across five northeastern Thai provinces (Mukdahan, Amnat Charoen, Yasothorn, Sisaket, and Ubon Ratchathani) from 2019-2023, investigating risk factors and epidemiological trends. Sisaket province emerged as a clear hotspot, reporting the highest number of cases (756) and incidence rate (10.28 per 100,000), marked by a unique surge in 2023. Age and gender distribution varied, with males more affected in early childhood and females in older age. Occupational trends showed increasing cases in agriculture, particularly among females, and a slight rise in government jobs. Substantial district-level disparities in incidence rates pointed to localized risk factors. These complex epidemiological patterns likely reflect the diverse agricultural practices and environmental conditions, including disaster impacts and mechanization levels, across the provinces.

Discussion

The agricultural and environmental profiles of the five provinces provide critical insights into factors impacting the prevalence of amoebic dysentery. High disaster impact levels, particularly in Sisaket (67.13%) and Yasothorn (67.95%), can disrupt sanitation and water supply, creating favorable conditions for water-borne diseases like amoebic dysentery. The established correlation between disasters and increased incidence of intestinal diseases is well-documented (8,10,11). Underscoring the necessity for resilient infrastructure and effective emergency preparedness. Disasters can result in stagnant water and waterlogged soil, serving as reservoirs for cysts, which can remain dormant until ingested by a host. Research indicates that soil environments can harbor cysts for extended periods, preserving their viability (12). Additionally, disaster-prone areas often face compromised sanitation and water quality, further contributing to higher disease transmission rates.

The reliance on natural agriculture in Sisaket (43.10%) and Ubon Ratchathani (43.80%) may significantly impact soil quality and water resources, thereby influencing pathogen survival and transmission (8,9). In contrast, the high levels of mechanization in Yasothorn (91.26%) and Amnat Charoen (90.80%) could alter land use and water management practices. Notably, Yasothorn's emphasis on organic farming (26.70%) suggests focusing on sustainable practices that may mitigate certain health risks. Previous studies have established a relationship between agricultural activities, environmental stressors, and health outcomes. Increased mechanization and agricultural intensity can result in habitat changes for pathogens and their vectors, potentially heightening vulnerability to diseases such as dysentery. While organic farming could alleviate some health risks, further investigation is needed to assess its specific impact on amoebic dysentery.

E. histolytica infection patterns vary by age and gender. Young children (0-4 years, including 34 infants) have the highest incidence, with males (76.4%) predominating. This reverses with age, females surpassing males, especially in the 65-69 group. Food preferences likely play a role. Studies suggest females' preference for fruits/vegetables, linked to *E. histolytica* (12,13), aligns with gendered foodborne outbreak patterns: males overrepresented in meat/dairy/shellfish outbreaks, females in plant-based outbreaks (14-16). Conversely, males' higher infection rates are linked to behaviors like consuming unwashed produce, well water, dining out, neglecting medication, and crowded housing (2). Children acquire infections via contaminated food/water and close contact, mainly via shared meals (17-20).

Amoebic dysentery cases show occupational trends (Fig. 3A). Agriculture saw a steady increase, especially among females (51.00% in 2019 to 58.38% in 2023), likely due to contaminated water/soil and poor sanitation (14). Increased female cases may reflect changing agricultural labor dynamics, requiring targeted interventions. Labor cases fluctuated, peaking in

2021 and reaching zero by 2023, possibly due to economic/seasonal factors (National Statistical Data, 2024). Student cases, particularly male, increased, highlighting the need for improved school hygiene and education.

The prevalence in Sisaket province during the study period reveals notable fluctuations. Unlike other border provinces where females generally exhibited higher rates of infection, Sisaket showed a slight male predominance in most years. Specifically, males comprised a higher proportion of cases. This trend is particularly interesting as it indicates a potential deviation from the regional pattern, suggesting localized factors that may contribute to male vulnerability in Sisaket. In 2023, however, this trend reversed, with females representing a slightly higher proportion of cases. This shift could be attributed to various factors, including changes in behaviors, environmental conditions, or public health interventions that may have affected infection rates differently among genders. Further investigation is warranted to understand the dynamics influencing this shift.

Ubon Ratchathani, Yasothon, Amnat Charoen, and Mukdahan all demonstrated a decline in the prevalence of amoebic dysentery, with Mukdahan reaching zero cases in 2023. This trend suggests effective public health measures and improved sanitation. Ubon Ratchathani experienced a significant reduction in cases, decreasing from 494 cases in 2019 to 55 cases in 2023, likely due to increased health awareness and effective interventions. Yasothon maintained low prevalence rates, documenting 30 cases in 2023, while Amnat Charoen recorded 38 cases, indicating stability and the success of public health strategies. Mukdahan consistently recorded the lowest rates, reporting no cases in 2023. This absence reflects successful implementation of preventive measures or decreased susceptibility to transmission factors associated with amoebic dysentery (1).

The department (OPD) data reveals that females sought healthcare services for dysentery more frequently than males, reporting 553

cases compared to 476 in males. This indicates a greater willingness among females to seek medical attention for dysentery symptoms. In contrast, the inpatient department (IPD) showed that males had a slightly higher cases, with 159 male cases versus 136 female cases. This disparity suggests that males may be more prone to severe symptoms, such as liver abscesses and other extraintestinal complications that require hospitalization (21).

Conclusion

This study highlights the complex interaction of agriculture, environment, and demographics in amoebic dysentery prevalence across five provinces. Disaster impacts and reliance on natural agriculture contribute to waterborne disease risk. While mechanization may offer sustainable solutions, its health effects need further study. Demographics show young children's vulnerability and the need for gender-specific interventions. Decreasing incidence in some areas proves public health measures' effectiveness, while varying healthcare-seeking behaviors require tailored strategies. Continued surveillance, research, and targeted interventions are crucial for addressing amoebic dysentery and ensuring population well-being.

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Conflict of Interest

We declare that no competing interests exist in relation to the work reported in this manuscript. Additionally, this research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

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