Review Article

The Prevalence of Soil-Transmitted Helminths (STH) and *Entamoeba* spp. Infections in Southeast Asia: A Systematic Review

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ABSTRACT

Background: Soil-Transmitted Helminths (STH) infection and *Entamoeba* species, specifically *Entamoeba histolytica* are known to infect billions worldwide – creating a global health problem; continues to be an international concern due to poor sanitation and unhygienic practices. The primary objective of this review is to evaluate the presence, prevalence, and trend of STH and *Entamoeba* spp., specifically, *A. lumbricoides, T. trichiura, N. americanus, A. duodenale, E. histolytica,* and *E. dispar* in Southeast Asia. **Materials and Methods:** Materials and methods include gathering and evaluating peer-reviewed and credible journal articles that have met the set standards for this review through PRISMA. **Results:** Among the fourteen journals reviewed, the most prevalent parasite in Southeast Asia is *A. lumbricoides*, with 36%, followed by *T. trichiura* garnered 35%, Hookworms, specifically, *N. americanus* and *A. duodenale* come third with 26%, and lastly, *Entamoeba* spp., specifically, *E. histolytica* and *E. dispar* come last with 3% rating. Along with this, the review also found that the Philippines garnered the highest-tallied intestinal parasitic infection, while Cambodia has the lowest number of recorded infections in the reviewed journals. Furthermore, the trend of parasitic infection in Southeast Asia was found to be highest in 2017. **Conclusion:** This review found that common factors such as poor sanitary conditions, and poor hygiene practices, along with tropical to warm and humid weather affect the longevity of the STH and *Entamoeba* species life cycle in Southeast Asia.

Keywords: *Entamoeba* species, Intestinal Parasites, Prevalence, Soil-Transmitted Helminths.

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INTRODUCTION

With more than a billion individuals affected, Soil-Transmitted Helminth (STH) infection continues to be a global health problem.[1] Additionally, whipworms (*Trichuris trichiura),* hookworms (*Necator americanus* and *Ancylostoma duodenale),* and roundworms (*Ascaris lumbricoides)* – commonly encountered STH species that are capable of negatively impairing one's nutritional status when infected.[2] Moreover, *Entamoeba histolytica* and *Entamoeba dispar* are the common parasitic species responsible for amoebiasis or amoebic dysentery, which usually occurs asymptomatically in people. However, *E. histolytica* infections are responsible for up to 50 million infections worldwide, mainly in developing countries.[3]

Water, Sanitation, and Hygiene (WASH) predictors are important in preventing the transmission of parasitic diseases, hence poor hygiene and sanitation practices and a lack of clean drinking water can easily transmit parasitic diseases. Furthermore, STH infections or "Neglected Tropical Diseases (NTDs)" impact poorer countries, where there is inadequate access and knowledge towards clean water and good hygiene and sanitation practices – hence, STH infections are a "marker of poverty".[4]

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Moreover, amoebiasis can be transmitted by fecal-oral transmission, which can be harder for areas with poor sanitation and hygiene practices.[3]

This review further discusses the presence, prevalence, and trend of (1) *Entamoeba* spp. (*E. histolytica* and *E. dispar*), (2) *A. lumbricoides*, (3) *T. trichiura,* (4) Hookworms (*N. americanus* and *A. duodenale*) in Southeast Asia. This review aims to provide novel knowledge and information by associating the different risk factors that may impact the prevalence of intestinal parasitic infections, thereby enhancing the current epidemiologic approach to the identification, mitigation, and control of intestinal parasites.

MATERIALS AND METHODS

The 2020 Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) were used as a structural guide in this review.

Search Strategy

The following databases were used: PubMed, ResearchGate, and Elsevier, as part of the comprehensive search approach for this review. Moreover, a manual search is conducted on Google Scholar. The following terminologies and their variations were used in this review to narrow down the data to be collected: "Intestinal Parasitism", "Prevalence", "Epidemiology", "Amoebiasis*", "Entamoeba histolytica", "Entamoeba dispar",* "Ascariasis*", "Ascaris lumbricoides",* "Hookworm*", "Ancylostoma duodenale", "Necator americanus",* and/or *"Trichuris", "Trichuris trichiura."* In addition, for the organization of collected articles, the ZOTERO was utilized.

Eligibility Criteria

This review covers all peer-reviewed cross-sectional study articles in English from January 1st 2015 to January 1st 2023 from reputable academic publishers in the databases aforementioned in the search strategy. As such, this review targets data from Southeast Asian countries, the prevalence of intestinal parasites in Indonesia, Myanmar, Singapore, Thailand, Malaysia, Philippines, Vietnam, Brunei, Lao PDR, and Cambodia are included. Although Timor-Leste is part of the country categories in the study selection of this review due to its frequent appearance among study reviews regarding public health analysis within Southeast Asia;[4] studies selected under Timor-Leste were excluded due to the study criteria.

Included in this review are the following intestinal parasites, dubbed as the most "common" intestinal parasites: *Entamoeba* spp. (*E. histolytica* and *E. dispar), A. lumbricoides,* Hookworm (*A. duodenale* and *N. americanus),* and *T. trichiura*.[5-8] Furthermore, exclusion of studies in this review are based on the following criteria: (i) studies without prevalence for Amoebiasis, Ascariasis, Hookworm infections, and Trichuriasis; (ii) prospective cohort/follow-up studies and case studies; (iii) studies where study participants are not permanent residents, such as refugees or migrants; (iv) prevalence rate among specific ethnic or indigenous groups; (v) intestinal parasitic infection among animals; (vi) studies that are not fully published; and (vii) an original study's duplicate or extension of analysis.

Data Selection and Extraction

The data extracted from the selected studies such as the country, year of publication, sample size and prevalence of the intestinal parasites was organized through tabulation by utilizing Microsoft EXCEL. As for the result generation among the selected studies, the presence of the following: (1) *Entamoeba* spp (*E. histolytica* and *E. dispar*), (2) *A. lumbricoides* (3) Hookworm (*A. doudenale* and *N. americanus*) were identified per countries located in Southeast Asia. If the selected journal fails to mention the exact date when the research was being conducted, the year of publication will then be used. Furthermore, as seen in Figure 1 is the PRISMA Diagram used for the study selection, wherein, a total of hundred and one (101) studies were gathered for the initial data selection by encoding different combinations of the keywords into a handful of reliable search engines. The selected studies were manually reviewed by the authors to single out the duplicated studies which led to the removal of 13 studies and only 88 studies were retained which were then reviewed to eliminate the studies that did not meet the author's exclusion criteria. 53 studies are excluded. The remaining 35 journals were screened to determine if they met the following eligibility requirements: (1) the sample size of the study must be generalizable and (2) the focal point of the study must be on prevalence and its associated risk factors. As a result, only 14 studies were able to meet the standards and criteria set by the authors.

RESULTS

Characteristics of Included Studies

101 cross-sectional research articles from different reputable journal publications, from 2015 to 2022, were gathered in this review for a robust analysis and examination of data using the set eligibility criteria for literature. Fourteen study articles were chosen in accordance with the following criteria set by the reviewers

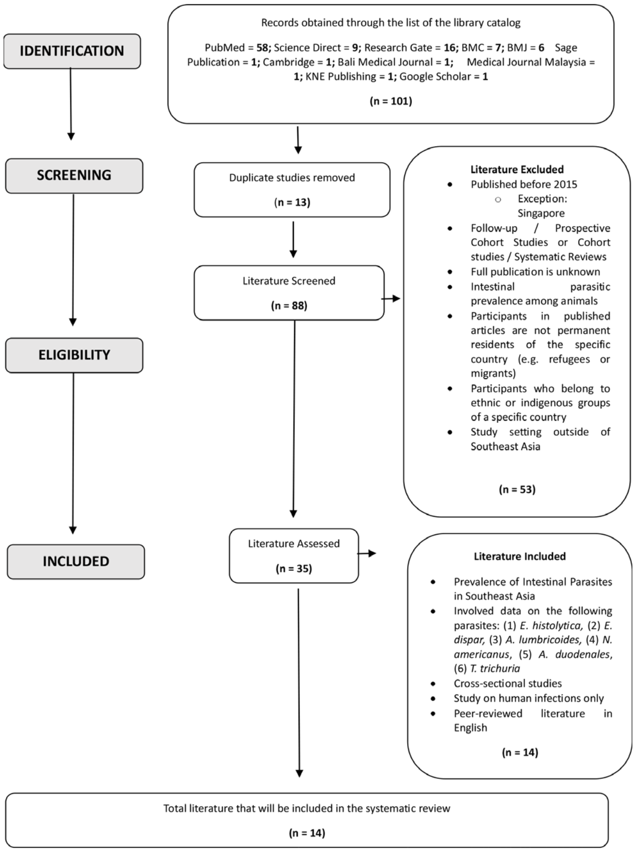

Figure 1: PRISMA Diagram for Study Selection.

(refer to Table 1): (i) studies that show prevalence rate in Southeast Asian countries aforementioned in the study on the following intestinal parasites: (1) *Entamoeba* spp. (*E. histolytica* and *E. dispar*), (2) *A. lumbricoides,* (3) Hookworm (*A. duodenale* and *N. americanus*), and (4) *T. trichiura*; (ii) articles that conduct their study on intestinal parasitic infection among the human population only; (iii) peer-reviewed articles published in English. This review narrowed down 101 articles to 14 journal articles from the following countries: 2 from the Philippines, 2 from Indonesia, 1 from Cambodia, 4 from Laos, 3 from Malaysia, and 2 from Thailand. It is also significantly noted that there are no studies that passed the review's inclusion criteria on the following countries: Vietnam, Timor-Leste, and Singapore – and will be further expounded in the discussion.

Table 1 shows the breakdown of identified studies according to the following: (i) country; (ii) the number of studies; (iii) the number of studies that have *E. histolytica, E. dispar, A. lumbricoides, N. americanus, T. trichiura,* and *A. duodenale* in their studies; (iv) the number of studies with a sample size of 50 and above; (v) the number of sample size is <50; (vi) no sample size was used; (vii) case presentations.

Table 1: Breakdown of Identified Studies.

		Number of studies by parasite							
Country	No. of Studies	*E. histolytica, E. dispar*	*A. lumbricoides*	Hookworm	*T. trichiura*	Sample size of >50	Sample size of <50	No sample size	Case presentation
Southeast Asia	9	2	2	3	2	2	—	7	—
Brunei	—	—	—	—	—	—	—	—	—
Cambodia	6	—	2	—	2	6	—	—	—
Indonesia	10	5	5	5	7	9	—	1	—
Laos	9	1	7	9	7	9	—	—	—
Malaysia	13	8	6	6	6	11	—	2	—
Myanmar	12	2	5	3	5	11	—	—	1
Philippines	20	3	10	9	10	16	3	1	—
Singapore	3	1	—	—	1	2	—	—	1
Thailand	9	3	5	8	7	9	—	—	—
Timor-leste	6	2	3	3	1	5	1	—	—
Vietnam	4	2	1	1	1	4	—	—	—

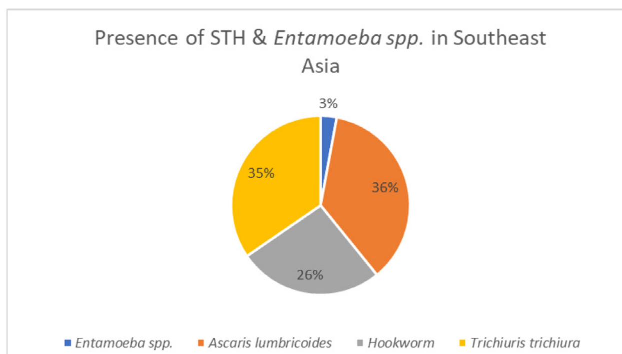

Figure 2: Presence of STH and *Entamoeba* spp. In Southeast Asia.

Presence of Intestinal Parasites in Southeast Asia

The most prevalent parasite in Southeast Asia is *A. lumbricoides,* with 36% (4,332/11,995) in comparison to other STH and *Entamoeba* species in this review (See: Figure 2). Meanwhile, *T. trichiura* garnered a 35% (4,332/11,995) percentile rate. Hookworms, specifically, *N. americanus* and *A. duodenale* come third in the causative agent among the parasitic disease infection in Southeast Asia with 26% (3,141/11,995). Lastly, *Entamoeba* spp., specifically, *E. histolytica* and *A. duodenale* comes last with a 3% rating (348/11,995).

Prevalence of Intestinal Parasites in Southeast Asia

The prevalence of *E. histolytica, T. trichiura, N. americanus, A. duodenale, E. dispar,* and *A. lumbricoides* in Cambodia, Laos, Malaysia, Philippines, Thailand, and Indonesia are illustrated in Figure 3 – which shows that the Philippines has the highest intestinal parasitic infection with a total of 6713/11955 (56.15%) cases. Most of these numbers are led by *T. trichiura* (3259), followed by *A. lumbricoides* (1925), Hookworms (1498), and *Entamoeba* spp. (31). The Philippines is then followed by Indonesia with a total infection of 3145/11955 (26.23%) – mainly burdened by *A. lumbricoides* (1960), followed by Hookworms (737), *T. trichiura* (372), and *Entamoeba* spp. (76). As for Laos, the total infections were 1117/11955 (9.34%). It is mainly predominated by Hookworms (630), *T. trichiura* (194), *Entamoeba* spp. (151) and *A. lumbricoides* (142). Malaysia comes in fourth place for the most prevalent intestinal parasite infection in Southeast Asia garnering a total infection of 904/11955 (7.56%); *A. lumbricoides* (298), *T. trichiura* (293), Hookworms (225), *Entamoeba* spp. (88). Second to last is Thailand which has a total infection of 56/11955 (0.4%); Hookworms (37), *T. trichiura* (14), *A. lumbricoides*, (3), and *Entamoeba* species (2). The least country with parasitic infection is Cambodia with only 20/11955 cases (0.17%); Hookworm (14), *A. lumbricoides* (4), *T. trichiura* (2), and *Entamoeba* spp. (0).

Soil-Transmitted Helminths and *Entamoeba* spp. Infection Trend

Figure 4 discusses the trend of infection of intestinal parasites from 2015 to 2023. The data seen from the Table 1 was analyzed based on the prevalence data of the ten studies included in this paper. Infections that occurred in 2015 were mainly caused by *A. lumbricoides, T. trichiura*, Hookworm and *Entamoeba* spp. being the lowest. However, the peak of infections occurred in 2017 which is predominantly caused by *T. trichiura* followed by *A. lumbricoides,* Hookworms and *E. histolytica* as the least infecting agent. In 2018, the infections were only minimal with *A. lumbricoides* as the leading cause of infection. However, in 2019, there was a gradual increase in infections that is mainly due to *T. trichiura*, Hookworm, and *A. lumbricoides*. In 2020, the most causative agent of intestinal infections is caused by *Entamoeba* spp. followed by Hookworms then *T. trichiura*. The detection of *A. lumbricoides* is not reported as the frequency of the infection is associated with *E. histolytica* infection. In 2021, *T. trichiura* is the most prevalent intestinal nematode known to cause the most infection in that year, followed by Hookworms, then *A. lumbricoides* with *Entamoeba* spp. having the lowest rate of prevalence. There is a moderate increase in infection in 2021 compared to 2020 as the parasites detected are much more prevalent in numbers which indicates the slight peak of intestinal infection in 2021. In 2022, the most prevalent parasite that is detected is Hookworms, which is then followed by *A. lumbricoides,* and lastly, *T. trichiura*. Moreover, the most prevalent intestinal parasite in 2023 is Hookworms, followed by *T. trichiura* with no presence or detection of *A. lumbricoides,* and no incidence of *Entamoeba* spp. as Soil-transmitted Helminths that causes the intestinal parasitic infection is the only priority of the study.

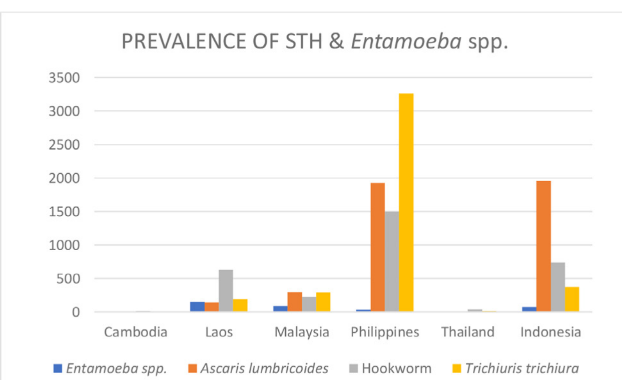

Figure 3: Prevalence of STH and *Entamoeba* spp. In Southeast Asia.

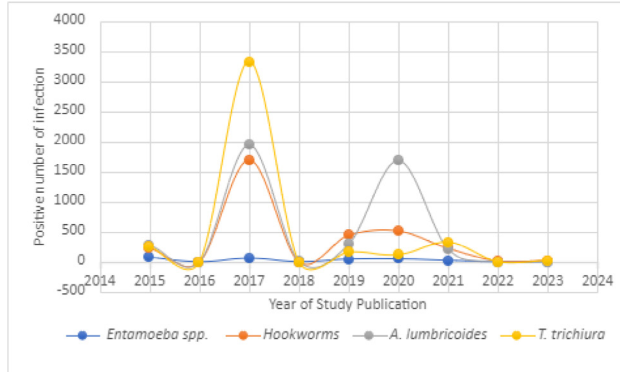

Figure 4: STH and *Entamoeba* spp. Infection Trend.

DISCUSSION

Among the Southeast Asian countries reviewed, studies from Indonesia and the Philippines have the greatest number of infections with *A. lumbricoides*. Its presence remains to be a global parasitic problem, wherein, the CDC describes it as the most common human helminthic infection globally that usually infects countries in impoverished regions.[9] In addition, *A. lumbricoides* has more than a billion infections in the world.[10] This data coincides with the results of this review wherein, *A. lumbricoides* is the most prevalent STH infection in Southeast Asia with a 36% percentile rate among *E. histolytica, E. dispar, N. americanus, A. duodenale,* and *T. trichiura.*

The Philippines is one of the countries with the highest prevalence rate for *T. trichiura* and *A. lumbricoides.*[11] In relation, this data coincides with this review, wherein, the highest parasitic prevalence in the Philippines are *A. lumbricoides,* followed by *T. trichiura.*

In Cambodia, the most prevalent intestinal parasites are Hookworms (*N. americanus* and *A. duodenale*). Meanwhile, in Malaysia, the number of infections among *T. trichiura* and *A. lumbricoides* are closely related. On the other hand, in Laos, the most prevalent species are Hookworm species. In Indonesia, the main burden of infection is caused by *A. lumbricoides* which make up 62% of the total infection in the country, followed by Hookworm and *T. trichiura.*

As for Thailand, it is the second least country to have a low prevalence of parasitic infections caused by STH and amoebiasis. There are only two journals in this study that discuss the prevalence of human intestinal parasites that are within the scope of our eligibility criteria. However, the total sample size of the two studies was 11,420. Upon synthesis, the total prevalence for *A. lumbricoides, T. trichiura,* Hookworms and *Entamoeba* spp. is low. The low prevalence of the said parasites is mainly due to the eradication campaign of the Ministry of Public Health of Thailand which aims to administer anti-helminthic drugs to its people annually. Aside from this, the study location of the literature used, which is the four districts of Nakhon Ratchasima, was quite dry. These contributing variables suppose the varying prevalence of parasitic infection. Another contributor in common behaviors contributing to garnering intestinal parasitic infection is not enacted. Thailand's vegetation system has also been altered from using manure to using chemical fertilizer, which will also help to reduce predominance.[12]

Among the journals screened, there is an insufficiency of recent database and studies in Singapore that focuses on the parasitic prevalence of STH and *Entamoeba* spp. (*E. histolytica* and *E. dispar*). Most cross-sectional studies or prevalence data of soil-transmitted intestinal parasitic infections are dated back to the year 1990 and below. Since this study focuses mainly on the latest data, only journals that are within 2015 and above are included, as per the eligibility criteria. On the other hand, the decrease in parasitic prevalence was significantly affected by the country's program on implementation of quality standards of sanitation and hygiene practices. Upon this knowledge, reviewers can deduce that the lack of cross-sectional studies found regarding intestinal parasitic infections in Singapore is most likely due to their improved access to sanitation facilities by 99.5% in 1996 to 100% in 2015 which continues to rise at an annual rate of 0.03%.[13] As a result, the chain of parasitic infection was halted through the means of promoting and strengthening their country's sanitary conditions.

Upon data analysis, a common factor among these infections is poor sanitation and hygiene predictors, accompanied by warm and humid tropical climates in Southeast Asian countries. In the Philippines, wherein has the highest number of infections with STH (*A. lumbricoides* and *T. trichiura*), 50.3 million Filipinos lack access to proper sanitation and hygiene practices.[14] In addition, this makes *A. lumbricoides* as a "marker of poverty" due to its more frequent occurrence in impoverished areas.[4] These intestinal parasitic infections among Southeast Asian countries entraps those in poverty over a cycle of gastrointestinal issues that leads to malnutrition.

Other factors include the consumption of raw fish and meat through traditional dishes – an example is eating traditions in Laos.[15] Similarly, age can be a factor in the infection of STH. Specifically, it is found in the same study that men in the age group 18 to 29 years old with a Lao-Thai ethnicity and who live in the Southern region of Laos, are most likely vulnerable to these STH infections.[15] This is evident in this review, wherein, hookworms are the most prevalent parasitic infection found in Laos.

Similarly in *A. lumbricoides,* other STH infections like hookworms and *T. trichiura,* their infection is usually associated with the infection among impoverished regions.[16] The same thing can also be observed among *Entamoeba* spp. (*E. histolytica* and *E. dispar*). However, a low infection prevalence among Southeast Asian countries is observed (3% percentile rate) and is already highest in Laos among the countries. However, the low prevalence of *Entamoeba* species can be due to the difficulty of detecting *E. histolytica* and *E. dispar* – and that there is a lack of tests that can tell whether a person is infected with what *Entamoeba* species.[6] Hence, in this review, it is evident in the different studies that analyzed the presence of *E. histolytica* and *E. dispar,* numbers are usually not as high or even half of the sample size of the study. Moreover, the CDC also states that only 10% to 20% of people who are infected with *E. histolytica* become sick from the infection, and infections with *E. dispar* are usually asymptomatic.[6] However, the low infection prevalence can be attributed to the life cycle of this *Entamoeba* species. Although, cysts can sustain themselves for short days or weeks outside the host, their trophozoites, which are excreted in faeces easily disintegrate outside of their host due to exposure to an unsuitable environment and barely live long enough to initiate a higher infection rate among their hosts.[6]

Lastly, the trend of intestinal parasitic infections, specifically STH and *E. histolytica* and *E. dispar* infections were analyzed in this review. Wherein, the data gathered found that 2017 was the highest year of infection. This peak started in 2016 and fell in 2018. The second highest infection rate year is 2019; while 2021 falls third in the years with the highest intestinal parasitic infections. One factor that can be attributed to the peak of infection cases in 2017 is climate change, wherein there is a direct relationship between larvae development and increased precipitation rate. In 2017, the average global temperature for 2017 was 0.92°C warmer than the 1951-1980 mean.[17] Hence, an increase in the temperature by approximately a degree Celsius increases the threat and survival of intestinal parasites. Furthermore, higher temperatures can cause faster larvae development and an increased precipitation rate induces a greater survival rate for STHs since they are already present in soils before human infection.[18] An increase in intestinal parasitic trend can also be evident, specifically with *A. lumbricoides.* During the year 2020 was the world's battle against the COVID-19 pandemic – wherein, various sanitation and hygiene programs were implemented. However, it is evident that for some reason, there seems to be a "neglect" or a "pause" for the control of intestinal parasitic infections which led to an increase in the incidence of different parasitic infections in 2020.[19] However, as the world has adapted to the new normal, different health programs have also been redirected into continuation.

Throughout the years, intestinal parasitic control through the World Health Organization's holistic approach in the "One Health" program determines all potential risk factors for the transmission of intestinal parasites. Moreover, novel detection methods were increasingly developed and improved – an example is eDNA wherein it can collect data within a short time period and can be applied in large-scale detection to aid the control programs against parasitic infection. Programs such as *school health promotion* through the implementation of health programs on sanitation, hygiene, and deworming were further reinforced in Southeast Asia.[20] Hence, the decline is evident from 2022 to 2023.

Limitations

In this review, there is a lack of availability for high-quality epidemiological data on STH infections and *Entamoeba species* in Southeast Asia. There are also discrepancies in the study design of the reviewed selected studies, sampling strategies, and the number of sample sizes which restricted the reviewers from identifying and understanding the true prevalence of *A. lumbricoides, N. duodenale, T. trichiura, A. duodenale, E. histolytica,* and *E. dispar.* The reviewers extended their best to set a limited number of sample sizes required for each country to have an equal baseline for sample sizes to better understand the true prevalence of each parasite among Southeast Asian countries. Additionally, countries like the Philippines, Thailand, and Indonesia provided a larger sample size compared to other countries that the study gathered. However, in Cambodia, due to the limited availability of high-quality epidemiological data, a smaller sample size is seen compared to the other countries. Moreover, no study was selected for Singapore, Myanmar, Vietnam, and Timor-Leste. Due to these limitations, study results in this review cannot truly be generalized and can still vary.

CONCLUSION

This review found that among Southeast Asian countries, *A. lumbricoides* is the most frequently found parasite in Southeast Asia, with a higher prevalence in the Philippines. Next to *A. lumbricoides* is *T. trichiura,* which is more prevalent in the Philippines and Indonesia. STH infections, along with amoebiasis caused by *E. dispar* and *E. histolytica* infections have been a global burden – especially to developing countries where these infections rise much more than first-world countries like Singapore – to which this review found it difficult to obtain parasitic epidemiological data due to low prevalence rate of intestinal parasitic infections in the country. Out of 101 studies, this study has reviewed, only 14 were able to provide sufficient data on *A. lumbricoides, T. trichiura, N. americanus, A. duodenale, E. histolytica,* and *E. dispar's* prevalence in Cambodia, Philippines, Laos, Indonesia, Thailand, and Malaysia – countries of which are tropical or subtropical regions that provides a warm and humid climate for parasitic infections to survive and transmit; and countries that are affected by poverty, wherein sanitation and hygiene practices are poor among them. It is interesting to note that Thailand, a tropical region, has a low prevalence rate of parasitic infections caused by STH species in this review. This is mainly due to different parasitic eradication programs in their country – which can also be seen in an effort to be implemented in countries like Singapore and Thailand. It can also be deduced that sanitation and hygiene factors are not just the factors that mainly play in intestinal parasitic control, such as in the case of the COVID-19 pandemic with an increase in intestinal parasite infection despite strict sanitation and hygiene measures.

RECOMMENDATION

The researchers recommend studying other parasitic infections besides *N. americanus, A. duodenale, A. lumbricoides, T. trichiura, E. histolytica,* and *E. dispar* regarding their presence, prevalence, and trend in other countries besides Southeast Asia. Lastly, a more specific study for this review regarding the risk factors associated, which were briefly discussed in this review, can be studied in association with the prevalence of other parasites in other countries.

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

ABBREVIATIONS

STH: Soil-Transmitted Helminths; ***A. lumbricoides***: *Ascaris lumbricoides;* ***N. americanus***: *Necator americanus;* ***E. histolytica***: *Entamoeba histolytica;* ***E. dispar***: *Entamoeba dispar;* ***T. trichiura***: *Trichuris trichiura;* ***A. duodenale***: *Ancylostoma duodenale.*

SUMMARY

Soil-Transmitted Helminths (STH) and *Entamoeba* spp. *(E. histolytica* and *E. dispar)* are regarded by the World Health Organization (WHO) as the primary cause of intestinal parasitism in humans. Currently, STH and *Entamoeba* species remain a burden to most countries in Southeast Asia due to the low quality of hygiene and sanitary practices. In formulating this review, journals are screened through selection criteria to ensure cogency and uniformity of the gathered data. The journals are collected through known credible references. The findings of the study revealed that the most prevalent parasite in Southeast Asia is *A. lumbricoides* while the least prevalent is *Entamoeba* spp. As for the prevalence per country, the Philippines garnered the highest tallied infection while Cambodia has the lowest number of infections. The trend of parasitic infection was found to be highest in 2017. The results from the study concluded that the most common factor that affects the prevalence of parasitic infections is due to poor sanitary conditions and practices enacted by the general population.

Authors' Contributions

All authors contributed to the final writing of this review. Specifically, all authors contributed to the gathering of raw data, and collating articles for study selection, results, and discussion. Author A is responsible for the PRISMA study selection and introduction. Author A, B, and F for methods of the study. Author F contributed greatly to the breakdown of the identified studies. Authors B, C, D, and E worked on representing the data through graphic illustrations.

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