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PREVALENCE AND RISK FACTORS OF INTESTINAL PARASITIC INFECTIONS AMONG FARMERS IN DEVELOPING COUNTRIES: A LITERATURE REVIEW

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ABSTRACT
Intestinal parasitic infections remain a serious public health challenge in developing countries, particularly among high-risk population groups such as farmers and agricultural workers. This literature review aims to describe the prevalence of intestinal parasitic infections, identify the most dominant parasite species, and analyze associated risk factors in adult farmers and agricultural workers. A literature search was conducted across PubMed, Google Scholar, and ScienceDirect using Boolean keyword combinations for articles published between 2021 and 2026. Of 687 articles identified, 10 were screened, and four cross-sectional studies from Nepal, Senegal, and Ethiopia were selected based on pre-defined inclusion criteria: original research, adult populations aged ⩾18 years, farmer or agricultural worker communities, and reporting of both prevalence and risk factors of intestinal parasitic infections. Results showed that the prevalence of intestinal parasitic infections ranged from 22.2% to 54% across study sites, with hookworms (Necator americanus/Ancylostoma duodenale) and Giardia lamblia as the most consistently dominant species.

Keywords: agricultural workers; developing countries; intestinal parasites; prevalence; risk factors

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INTRODUCTION

Intestinal parasitic infection is one of the most neglected yet continuously expanding public health problems in the world, particularly in developing countries. Soil-transmitted helminths (STH), which include Ascaris lumbricoides, Trichuris trichiura, and hookworms (Necator americanus and Ancylostoma duodenale), constitute the group with the highest case numbers globally, with an estimated 1.5 billion people infected worldwide and a disease burden of 1.38 million Disability-Adjusted Life Years (DALYs) in 2021 (Chen et al., 2024). Beyond STH, intestinal protozoan infections such as Giardia lamblia and Entamoeba histolytica also contribute significantly to global morbidity, with Entamoeba histolytica estimated to be responsible for more than 100,000 deaths annually (Nasrallah et al., 2022). A recent study in southern Iran also confirmed protozoan dominance among patients with gastrointestinal symptoms, where Blastocystis spp. (5.9%) and G. lamblia (4.1%) were recorded as the protozoa most frequently found in diarrheic patients, while helminth infections overall showed a decline alongside improvements in community sanitation (Najafi-Asl et al., 2023).

The burden of intestinal parasitic infection is borne disproportionately by communities in developing countries living in conditions of poverty, poor sanitation, and limited access to clean water (Getachew et al., 2022; Razafiarimanga et al., 2022). Among the various vulnerable population groups, adult farmers and agricultural workers are consistently identified as one of the groups with the highest risk of intestinal parasitic infection. This is due to occupational exposure to contaminated soil, the use of organic manure as fertilizer, the habit of working barefoot in

agricultural fields, and limited access to sanitation facilities and health services (Gautam et al., 2024; Walden et al., 2022). Various studies in developing countries consistently show that the prevalence of intestinal parasitic infection in farming communities can range from 9% to over 70%, depending on geographic location, climatic conditions, and prevailing hygiene practices (Nigus et al., 2025; Zacharia et al., 2023).

Although scientific evidence on the high burden of intestinal parasitic infection among adult farmers continues to mount, global parasite control programs remain heavily focused on school-age children as the primary target group. Current WHO strategy for deworming (preventive chemotherapy) remains essentially directed at preschool children, school-age children, and women of reproductive age, so that economically active adults, including farmers, are largely excluded from routine intervention programs (World Health Organization, 2023). This creates a significant protection gap, given that adult farmers not only bear an equally high infection burden but may also serve as a source of parasite transmission within their communities (Goshu et al., 2021).

The clinical impact of intestinal parasitic infection in adult farmers is extensive, encompassing iron-deficiency anemia from chronic blood loss caused by hookworms, malnutrition, reduced physical work capacity, and decreased agricultural productivity (Chen et al., 2024; Wondimagegn & Hailu, 2024). A longitudinal study in Senegal showed that anemia prevalence among farmers and their family members reached 74% in the dry season and remained high at 75% in the rainy season, illustrating the close relationship between parasitic infection, anemia, and the health burden in these farming communities (Walden et al., 2022). In addition, co-infection with multiple parasite species, as reported from Uganda (Byagamy et al., 2025), is commonly encountered and worsens the cumulative clinical impact on the health and productivity of farmers.

Based on this background, this literature review aims to: (1) describe the prevalence of intestinal parasitic infection among adult farmers and agricultural workers based on previously published studies from various regions in developing countries; (2) identify the most dominant intestinal parasite species in this population group; and (3) analyze the risk factors that significantly contribute to the occurrence of intestinal parasitic infection among adult farmers and agricultural workers. The results of this literature review are expected to serve as a robust scientific evidence base for developing more inclusive, evidence-based parasite control strategies.

METHOD

This article uses a literature review methodology. The literature search was conducted systematically across three databases: PubMed, Google Scholar, and ScienceDirect. The search was limited to articles published between 2021 and 2026. The Boolean keyword combination used was: ("intestinal parasite") AND ("farmer" OR "agricultural worker") AND ("prevalence" OR "risk factor" OR "epidemiology").

Inclusion criteria comprised: (1) an observational original research design; (2) a population of adult farmers or agricultural workers aged ≥18 years; (3) reporting of intestinal parasitic infection prevalence and associated risk factors; and (4) availability in full-text format. Exclusion criteria comprised: systematic review, meta-analyses, editorials, case reports, studies with predominantly child populations without separated adult-group data, and studies focusing on animal subjects. A total of 687 articles were obtained from the initial search. Title and abstract screening were then conducted to obtain 10 articles. Finally, selection was conducted based on inclusion and exclusion criteria, resulting in four articles meeting all inclusion criteria which were selected for synthesis and analysis in this review.

RESULT

Characteristics of Included Studies

Four original research articles published between 2021 and 2026 were included in this literature review. All studies used a community or institution-based *cross-sectional* design and specifically examined adult populations in farming or rural communities engaged in the agricultural sector. The studies originated from three different countries: Nepal (Gautam et al., 2024), Senegal (Walden et al., 2022), Ethiopia (Aschale et al., 2022; Gurmassa et al., 2024) providing geographic coverage spanning Asia and Africa. Sample sizes ranged from 29 to 363 participants. Various diagnostic methods were used across the studies, including microscopic examination by direct wet mount, saturated salt flotation technique, the formol-ether concentration technique (FECT), and the Kato-Katz technique, used either alone or in combination. The full characteristics of all included studies are presented in table 1.

Table 1.
Characteristics and Key Findings of Included Studies (n=5)

No.	Author / Year / Country	Study Population	Diagnostic Method	Prevalence (%)	Significant Risk Factors
1	Gautam et al. (2024) Nepal	n = 205 Adults aged 18–70 years Badi indigenous farming community, Gurbhakot Municipality, Surkhet, Western Nepal	1. Direct wet mount 2. Saturated salt flotation 3. Formal ether sedimentation technique	27% (55/205) *Giardia lamblia*: 16.1% *A. lumbricoides* : 5.9% *E. histolytica*: 2.9%	Agricultural occupation (AOR=5.37; 95% CI: 2.31–12.47) Raising pigs/free-range poultry (AOR=5.22; 95% CI: 1.87–14.53) Not using soap before eating (AOR=9.96; 95% CI: 2.11–46.99) Consumption of raw/undercooked meat (AOR=2.76; 95% CI: 1.08–7.05)
2	Walden et al. (2022) Senegal	n = 84 (Diawara) n = 29 (Mpal) Adult farmers and family members Two farming zones along the Senegal River	1. Formalin-ethyl acetate sedimentation (FECT) 2. Trichrome staining for protozoa	7% (dry season) → 54% (rainy season) in Diawara 7% → 23% in Mpal *Giardia sp. Entamoeba coli*	Rainy season: dramatic increase in prevalence (p<0.05) Child age group and female sex associated with anemia Remote location far from town center (higher risk) Seasonal environmental conditions (temperature & rainfall)
3	Aschale et al. (2022) Ethiopia	n = 363 Pregnant women aged ≥17 years 73.3% (266/363) employed as farmers Debre Elias District, Northwest Ethiopia	1. Direct wet mount (saline) 2. Macroscopic stool examination	43.5% (158/363) Hookworm: 65.2% *E. histolytica*: 12.7% *G. lamblia*: 11.4%	Farming occupation (AOR=6.41; 95% CI: 1.05–39.16; p=0.034) Housewife occupation (AOR=8.84; 95% CI: 1.29–60.28) Unsafe drinking water source (protective: piped water AOR=0.52; 95% CI: 0.30–0.88)
4	Gurmassa et al. (2024) Ethiopia	n = 216. Adult vegetable farmers, ages <30 to >50 years (majority 41-50). Akaki River bank, Addis Ababa, Ethiopia	1. Kato-Katz	22.2% (48/216). A. lumbricoides : 11.1%. Hookworm: 7.4%. T. trichiura: 3.7%	Monthly household income <1000 ETB (AOR=1.85; 95% CI: 1.25-5.99). No handwashing before feeding (AOR=2.25; 95% CI: 1.58-11.3). No fingernail cleanliness (AOR=1.97; 95% CI: 0.56-39.5). Not wearing shoes/boots at work (AOR=3.4; 95% CI: 1.02-5.43). Washing vegetables with irrigation wastewater (AOR=2.1; 95% CI: 1.95-45.2). No protective wear during farming (AOR=2.99; 95% CI: 1.58-22.4)

Note: AOR = Adjusted Odds Ratio; OR = Odds Ratio (unadjusted, reported as the only estimate in the source study); CI = Confidence Interval; IPI = Intestinal Parasitic Infection; FECT = Formalin-

Ether Concentration Technique; STH = Soil-Transmitted Helminths.

DISCUSSION

Prevalence of Intestinal Parasitic Infection among Adult Farmers and Agricultural Workers

The four studies included in this article consistently show that adult farmers and agricultural workers bear a substantial burden of intestinal parasitic infection, with prevalence figures ranging from 22.2% to 54%. This fairly wide range reflects the influence of various factors, including geographic location, climatic conditions, the diagnostic methods used, and the specific characteristics of the farmer populations studied. The highest prevalence was documented by Walden et al. (2022) in Senegal during the rainy season (54%), illustrating how seasonal rainfall variation dramatically alters the environmental conditions that support parasite survival and transmission in farming communities. The warm, humid conditions typical of the rainy season accelerate the development and survival of the free-living larval stages of STH and protozoan cysts in the soil, thereby increasing transmission pressure on farmers who work with daily direct soil contact.

The lowest prevalence in this review was reported by Gurmassa et al. (2024) among wastewater-irrigation vegetable farmers along the Akaki River in Addis Ababa, Ethiopia (22.2%), an urban-adjacent farming setting that, despite lower overall prevalence than the other rural farming communities reviewed, still demonstrated a clinically meaningful infection burden tied directly to occupational exposure. It should be noted, however, that deworming programs focused on school children do not always benefit the adult group; a community study in Bibugn Woreda, Ethiopia, documented an STH prevalence of 20.9% among adolescents and adults despite a school-based deworming program having been implemented in that area (Goshu et al., 2021). Even at 22.2%, this infection level remains clinically meaningful for an adult farming population whose productivity depends heavily on physical health, particularly given that low household income remained an independent predictor of infection in that same setting (Gurmassa et al., 2024).

Aschale et al. (2022) documented a 43.5% prevalence among pregnant women in Northwest Ethiopia, of whom 73.3% were employed as farmers, with farming occupation identified as a significant independent predictor of infection. This finding directly confirms the occupational vulnerability of farmers, given that soil-tilling activity inherently increases exposure to parasite eggs and larvae. Gautam et al. (2024) reported a 27% prevalence in the Badi indigenous farming community in Nepal, where, despite the national deworming program having run for years, infection rates among the adult group remained high, underscoring the limitations of intervention programs that target only school children in protecting the adult farming population.

Dominant Intestinal Parasite Species

Across the studies reviewed, hookworms (*Necator americanus/Ancylostoma duodenale*), *Ascaris lumbricoides*, and *Giardia lamblia* emerged as the intestinal parasites which most consistently found in adult farmer populations, a pattern consistent with global epidemiological trends (Chen et al., 2024) and confirmed by community studies in Africa where Ascaris lumbricoides consistently dominates with a prevalence of 12.5–14% in rural Ethiopian communities (Getachew et al., 2022; Goshu et al., 2021). Hookworm was the most dominant species in the study by Aschale et al. (2022), accounting for 65.2% of all positive cases, a finding consistent with this parasite's hematophagous nature and its strong association with soil contact and the habit of working barefoot, a behavior that is professionally inseparable from farming activity. The risk of hookworm infection through skin penetration by infective filariform larvae is directly reinforced by farming practices involving bare-foot contact with damp, contaminated soil.

Giardia lamblia was the most dominant species in the study by Gautam et al. (2024) in Nepal, with a prevalence of 16.1% in the Badi indigenous farming community. This protozoan species is

primarily transmitted via the fecal-oral route, and its dominance in this setting reflects the important role of contaminated drinking water and inadequate hand hygiene in the epidemiology of intestinal parasitic infection in farming communities. Walden et al. (2022) reported Entamoeba coli as the species most frequently found during the rainy season in Senegal, while Gurmassa et al. (2024) identified Ascaris lumbricoides as the most common species (11.1%) among wastewater-irrigation vegetable farmers in Ethiopia, followed by hookworm (7.4%) and Trichuris trichiura (3.7%), a distribution that diverges from the hookworm-dominant pattern seen in Aschale et al. (2022) despite both studies being conducted in Ethiopia, likely reflecting differences in irrigation practices, soil contamination pathways, and the specific routes of wastewater-related exposure in this urban-adjacent farming setting. The variation in dominant species across studies, and even within the same country, underscores the importance of local ecological, cultural, and behavioral factors in shaping the parasitological profile of farming communities.

Risk Factors Associated with Intestinal Parasitic Infection in Adult Farmers

The reviewed studies collectively identify several categories of risk factors that are consistently and significantly associated with a higher likelihood of intestinal parasitic infection among adult farmers and agricultural workers. These factors can be grouped into occupational, behavioral, environmental, and socioeconomic factors. Working in the agricultural sector is the strongest and most consistently reported risk factor across the studies in this review. Gautam et al. (2024) showed an AOR of 5.37 (95% CI: 2.31–12.47) for agricultural workers compared with non-agricultural groups, while Aschale et al. (2022) reported an AOR of 6.41 (95% CI: 1.05–39.16) for female farmers compared with other occupations. This finding is biologically plausible, since tilling soil, harvesting crops, managing irrigation, and working barefoot in the field directly expose farmers to soil-transmitted parasites through both skin penetration and the fecal-oral route. A similar occupational risk pattern has also been documented in farming communities in Africa and Southeast Asia (Byagamy et al., 2025; Getachew et al., 2022; Jinatongthai et al., 2026).

Behavioral risk factors such as poor hand hygiene show a strong relationship with intestinal parasitic infection across all the reviewed studies. Gautam et al. (2024) identified not using soap before eating as the strongest single behavioral predictor (AOR=9.96; 95% CI: 2.11–46.99). After extensive soil contact while working in the field, the habit of not washing hands with soap before eating creates a direct pathway for parasite eggs to enter the body. A comparable pattern was documented among wastewater-irrigation vegetable farmers in Ethiopia, where Gurmassa et al. (2024) found that not wearing shoes or boots while working was associated with a markedly higher risk of soil-transmitted helminth infection (AOR=3.4; 95% CI: 1.02–5.43), alongside not washing hands before feeding (AOR=2.25; 95% CI: 1.58–11.3), poor fingernail hygiene (AOR=1.97; 95% CI: 0.56–39.5), and washing vegetables with contaminated irrigation wastewater (AOR=2.1; 95% CI: 1.95–45.2); the absence of protective wear during farming activities further increased the odds of infection (AOR=2.99; 95% CI: 1.58–22.4). In terms of personal hygiene, Wondimagegn and Hailu (2024) and Getachew et al. (2022) consistently identified the habit of not washing hands after using the toilet, along with having untrimmed nails, as significant independent predictors of helminth infection, given that both practices facilitate the transfer of parasite eggs from a contaminated environment into the body via the fecal-oral route. Ownership of free-roaming livestock, particularly pigs and poultry, was also identified as a significant risk factor by Gautam et al. (2024) (AOR=5.22; 95% CI: 1.87–14.53), since free-roaming animals can contaminate the soil and water sources around dwellings with parasite eggs.

Socioeconomic status further compounds these behavioral and occupational risks. Gurmassa et al. (2024) found that farmers with a monthly household income below 1,000 Ethiopian Birr had significantly higher odds of STH infection (AOR=1.85; 95% CI: 1.25–5.99) than higher-income farmers, suggesting that poverty constrains farmers' ability to access protective equipment, soap, and adequate sanitation despite awareness of risk. This socioeconomic gradient is consistent with

evidence from rural agricultural communities elsewhere in Southeast Asia, where lower income and limited knowledge or perception of parasitic infection were similarly associated with higher infection risk, with each one-point increase in a composite knowledge-and-perception score corresponding to a 31% reduction in infection odds (OR=0.69; 95% CI: 0.57–0.84) (Jinatongthai et al., 2026), underscoring health literacy as a modifiable risk dimension that complements the purely occupational and behavioral determinants emphasized elsewhere in this review.

Environmental factors, particularly seasonal rainfall variation, play a fairly crucial role. Walden et al. (2022) demonstrated a sevenfold increase in intestinal parasitic infection prevalence, from 7% to 54%, between the dry and rainy seasons in Senegal. Access to safe drinking water is another important environmental determinant, with Aschale et al. (2022) finding that farmers relying on unprotected water sources had much higher infection rates, while access to piped water was identified as a protective factor (AOR=0.52; 95% CI: 0.30–0.88). These findings underscore the integral role of water, sanitation, and hygiene (WASH) infrastructure in determining the risk of intestinal parasitic infection in farming communities.

Implications for Public Health

The collective findings of this review highlight a gap in current global parasite control strategies, in which adult farmers remain largely excluded from preventive chemotherapy programs despite bearing a substantial and clinically meaningful infection burden. The high and persistent prevalence of intestinal parasitic infection documented in Nepal, Senegal, and Ethiopia shows that this is not a phenomenon confined to a single region, requiring systematic attention from public health policymakers; comparable patterns of occupational and gendered risk have also been reported among farming communities in Southeast Asia (Jinatongthai et al., 2026). Similar attention should be given to other vulnerable population groups living in poor sanitary conditions; a study among an internally displaced person (IDP) population in Nigeria recorded an IPI prevalence as high as 77.7%, with a lack of knowledge about parasite transmission mechanisms as the most significant independent predictor (AOR=1.91; 95% CI: 1.05–3.47), underscoring that health education interventions are an indispensable component of community-based parasite control strategies (Adamu et al., 2025). The protective effect of health literacy observed by Jinatongthai et al. (2026) reinforces this same conclusion. Evidence-based interventions targeting adult farmers and other vulnerable groups should simultaneously integrate several components, including community-based deworming for adult agricultural workers, health education programs focused on hand hygiene and footwear use while working in the field, improvement of WASH infrastructure in rural agricultural areas, and provision of access to safe drinking water.

CONCLUSION

Literature review shows that adult farmers and agricultural workers in developing countries bear a fairly high burden of intestinal parasitic infection, with prevalence figures ranging from 22.2% to 54% across studies. Hookworm, Ascaris lumbricoides, and Giardia lamblia are the most dominant parasite species, with species composition varying even within the same country depending on local irrigation and sanitation practices. Agricultural occupation, poor hand hygiene, working barefoot, the rainy season, unsafe drinking water sources, livestock ownership, and low household income are the main risk factors significantly associated with intestinal parasitic infection across the studies reviewed. Current global parasite control programs remain inadequate to meet the needs of this high-risk population group, as they remain focused on school-age children. A paradigm shift is needed toward inclusive intervention strategies that target adult farmers, encompassing deworming, hygiene behavior education, sanitation improvement, and provision of access to clean water.

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