

REVIEW ARTICLE

Review of Gastrointestinal Parasitic Infections in the Geriatric Population: A Decadal Analysis from 2010 to 2020

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ABSTRACT

Gastrointestinal parasitic infections (GIP) remain a significant global public health concern, particularly in tropical regions affected by poor socioeconomic conditions. Despite this, data on GIP prevalence and associated risk factors among the geriatric population are limited. This review synthesizes evidence on the global prevalence and risk factors of GIP in older adults between 2010 and 2020. Relevant studies were identified from reputable databases, focusing on both qualitative and quantitative human research. Findings suggest that single parasitic infections are more prevalent than multiple infections among the elderly. Major risk factors include inadequate sanitation, limited access to healthcare, sociodemographic conditions, and lifestyle practices. Additional contributors such as lack of awareness, disability, poor hygiene habits, and insufficient knowledge further increase susceptibility to infection. Strengthening education and awareness programs for older adults is crucial in reducing infection rates. Overall, this review underscores the need for targeted interventions to improve geriatric health and mitigate the global burden of GIP.

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INTRODUCTION

Gastrointestinal parasitic infections (GIP) are a major global public health concern, affecting more than two billion people, particularly in underdeveloped nations with poor sanitation and hygiene (1). These parasites inhabit and feed on the host's intestinal tract via the fecal-oral route, leading to significant morbidity and mortality worldwide (2). The most common parasites include helminths (*Ascaris lumbricoides*, hookworms, *Strongyloides stercoralis*, *Trichuris trichiura*) and protozoa (*Giardia duodenalis*, *Cryptosporidium spp.*, *Entamoeba histolytica*, *Blastocystis spp.*), all of which contribute substantially to disease burden (1).

The geriatric population, generally defined as individuals aged 60 years and above, is particularly vulnerable due to age-related immune decline and physiological changes. Some studies define geriatrics as individuals aged 65 years or older (3,4), while others use the threshold of 60 years (5). For this review, we considered studies involving populations aged 60 years and above.

Older adults are especially susceptible to gastrointestinal parasitic infections. With advancing age, immune system declines, and morphological changes increase vulnerability to enteric parasitosis, making it a growing concern in this group (4). Previous studies have consistently identified the elderly as one of the most at-risk populations; however, systematic research focusing specifically on GIP in older adults remains limited (6).

This review examines the prevalence, burden, and risk factors of GIP in geriatric populations, focusing on studies published between 2010 and 2020. To our knowledge, it is the first review in the past decade dedicated exclusively to GIP in the elderly. Despite the significant health impact of these infections, continuous reporting and comprehensive studies remain lacking. By addressing this gap, this review aims to provide updated insights to guide prevention, diagnosis, and management strategies for older adults.

METHODS

This review included studies on gastrointestinal parasitic infections (GIP) in the geriatric population. Articles were selected based on their relevance and assessed for quality according to several criteria: clarity of research objectives, clearly defined inclusion and exclusion

criteria, sound methodology, specificity of results, generalizability, and acknowledgment of limitations. Only journals deemed suitable for the scope of this review were included. Assessment of quality are made on whether there was clear research with specific results, a clear description of inclusion and exclusion criteria, a sound methodology, generalizability, and a mentioning of limitations.

Search strategy

A systematic literature search was performed using Medical Subject Headings (MeSH) and relevant keywords across PubMed, Scopus, Web of Science, ScienceDirect, ResearchGate, and Google Scholar. Search terms included cross-sectional studies, gastrointestinal parasites, helminths, protozoa, geriatric parasites, GIP in older adults, and elderly patients. Studies reporting GIP prevalence across multiple age groups were considered if data specific to geriatric populations were available. The search was restricted to human studies published in English between 2010 and 2020. Owing to limited literature, one study published after 2020 but conducted in 2020 was also included.

Selection of studies

Titles, abstracts, and full texts were screened in three stages (Fig. 1). Eligible studies included observational designs (prospective cohort, case-control, retrospective cohort, cross-sectional) and controlled clinical trials that reported the prevalence or incidence of GIP in geriatric patients. Case reports, case series, and studies comparing diagnostic methods were excluded.

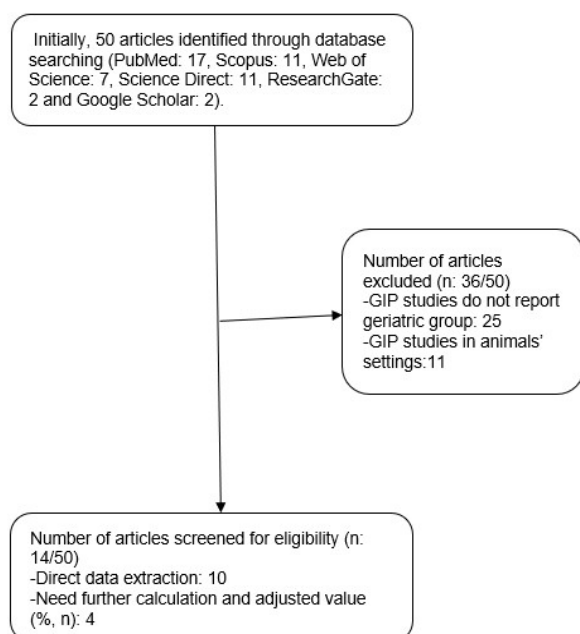


Fig. 1: Flow diagram of the selection process

For this review, the geriatric population was defined as individuals aged 60 years and above, consistent with previous studies (7–8). Both primary research articles and review papers were considered. Screening was conducted in three steps: (i) title review, (ii) abstract

screening, and (iii) full-text evaluation, including assessment of introduction, methods, results, and discussion. At each stage, studies not meeting the inclusion criteria were excluded.

Studies were included if they met the following criteria: (i) observational or controlled clinical trial design, and (ii) reporting baseline prevalence or incidence of GIP in geriatric patients. Studies were excluded if they were case reports, case series, or diagnostic accuracy comparisons.

Data extraction

Data from each eligible study was extracted using a standardized form. The following information was collected: first author, year of publication, study design, study location and population, sample size, number of positive cases (prevalence), diagnostic methods, gender distribution, and reported risk factors for GIP. Each study was subsequently analyzed to identify significant risk factors associated with infection.

RESULTS

A total of 50 articles were initially identified through database searches. After applying inclusion and exclusion criteria, 14 studies were deemed eligible for review. The screening process is summarized in Figure 1. Of the initially retrieved articles, 25 were excluded because they did not report GIP in geriatric populations, and 11 were excluded as they focused on animal studies. In addition, four studies reporting prevalence across multiple age groups were included, as they provided sufficient data for geriatric subpopulations. Reported infection rates among the elderly varied widely, ranging from 0.1% to 94.1%. The characteristics of included studies are presented in Table I.

Demographic characteristics of studies population

According to the studies included, participants ranged from 60 to 106 years of age (4,8). The mean sex distribution showed a predominance of females (57.8%) compared with males (42.2%).

Risk factor GIP among geriatric community

The risk factors of gastrointestinal parasites (GIP) have extensively been discussed by Santos et al. (2017), Naves & Costa-Cruz (2013), Neeti Mishra et al. (2016), Paula Engroff et al. (2016), Giroto et al. (2013), Zamari et al. (2023), Praharaj et al. (2017), Peerzada et al. (2022), Mathuria & Singh (2017) and Abu-Madi et al. (2010) (4,8-16). The burden of gastrointestinal parasites (GIP) varies from each region depending upon the social, environmental, religious affairs and economic factors of the specific countries (21).

The study by Neeti Mishra (2016) indicated that the risk factors in the Northern India community, which lives in poor sanitary conditions with limited access to

Table 1: Summary of studies review for gastrointestinal parasites among geriatric

No	Year	Country	Sample Size (geriatric only)	Overall prevalence (n,%)	Parasite species (n,%)	Reference
1	2017	Brazil	236	72, 30.5	<i>Entamoeba coli</i> (37, 44.6) <i>Endolimax nana</i> (18, 21.7) <i>Iodamoeba butschlii</i> (12, 14.5) <i>Schistosoma mansoni</i> (5, 6.0) <i>Ancylostomidae</i> (4, 4.8) <i>Strongyloides stercoralis</i> (4, 4.8) <i>Trichuris trichiura</i> (2, 2.4) <i>Enterobius vermicularis</i> (1, 1.2)	(8)
2	2013	Brazil	200	15, 7.5	<i>Strongyloides stercoralis</i> only (9, 4.5) <i>Strongyloides stercoralis</i> + <i>Giardia lamblia</i> (1, 0.5) <i>Giardia lamblia</i> only (2, 1.0) Hookworms (2, 1.0) <i>Balantidium coli</i> (1, 0.5)	(9)
3	2016	India	200	98, 49.0	<i>Trichuris trichiura</i> (30, 30.6) <i>Entamoeba histolytica</i> (30, 30.6)	(10)
4	2016	Brazil	581	63, 10.8	<i>Endolimax nana</i> (29, 42.7) <i>Entamoeba coli</i> (23, 33.8) <i>Giardia lamblia</i> (6, 8.8) <i>Ascaris lumbricoides</i> (4, 5.9) <i>Strongyloides stercoralis</i> (3, 4.4) <i>Trichuris trichiura</i> (2, 2.9) <i>Iodamoeba bütschlii</i> (1, 1.5)	(11)
5	2013	Brazil	293	28, 9.5	<i>Giardia duodenalis</i> (10, 35.7) <i>Cryptosporidium</i> spp. (3, 10.7) <i>Entamoeba coli</i> (9, 32.2) <i>Endolimax nana</i> (2, 7.1)	(4)
6	2023	Malaysia	37	34, 91.9	<i>Blastocystis</i> spp (34, 94.1) <i>Cryptosporidium</i> spp. (24, 70.6) <i>Enterobius vermicularis</i> (2, 5.9) <i>Giardia lamblia</i> (2, 5.9) <i>Entamoeba histolytica</i> (2, 5.9)	(12)
7	2017	South India	27,952	2214, 7.9	<i>Giardia intestinalis</i> (520, 1.86) <i>Entamoeba histolytica/Entamoeba dispar</i> (213, 0.76) <i>Ascaris lumbricoides</i> (173, 0.62) Hookworm (729, 2.61) <i>Trichuris trichiura</i> (93, 0.33) <i>Strongyloides stercoralis</i> (332, 1.19) <i>Hymenolepis nana</i> (37, 0.13) <i>Enterobius vermicularis</i> (63, 0.23)	(13)
8	2022	Kashmir India	NA (Overall: 2159)	14, NA	<i>Ascaris lumbricoides</i> (2, 1.2) <i>Giardia lamblia</i> (1, 0.6)	(14)
9	2017	Uttar Pradesh	643	102, 15.9	Hookworm (2, 1.79)	(15)
10	2010	Qatar	9208	943, 10.2	Hookworm (8, 0.9) <i>Trichuris trichiura</i> (4, 0.4)	(16)
11	2016	Western Iran	103	41, 39.8	NA	(17)
12	2020	Southern Thailand	439	69, 15.7	Hookworms (48, 10.9) <i>Strongyloides stercoralis</i> (15, 3.4) <i>Trichuris trichiura</i> (9, 2.1)	(18)
13	2018	Central Thailand	62	11, 17.7	NA	(19)
14	2011	Nepal	9	2, 22.2	NA	(20)

*NA: Not available in the manuscript

health care and is one of the world's most contaminated populations (10). This community also lacks access to safe water and improper hygiene practice. Neeti Mishra also added the factor of poverty and deprivation leads to the most infected population especially among the geriatric group (10).

According to Paula Engroff et al., (2016), the prevalence of intestinal parasites in elderly people was lower than previously reported, and the parasites found were predominantly non-pathogenic (11). Paula gave a wide range of perspective in GIP risk factor, which, she said that the people who have a pet and practice bathing frequently could be highly infected with protozoan, because of the frequent contact with the parasitic eggs and cysts in their fur (11). In another study also suggested that close contact with animals could be also specifically associated to *Blastocystis* infection (12).

According to Santos et al. (2017), the high prevalence of intestinal parasitosis among the elderly is largely attributed to immune deficiencies associated with ageing. Activities such as gardening and yard cleaning, which involve frequent contact with soil, further increase the risk of contamination (8). Polypharmacy, defined as the use of multiple medications, is also common in this population and may alter the gut microbiome, thereby creating a favourable environment for gastrointestinal parasitic (GIP) infections (8). In addition, risk factors are shaped by geographic, cultural, ethnic, and behavioural influences, with prevalence being higher in areas where living conditions and basic sanitation are poor or absent. Inadequate hygienic practices, such as neglecting handwashing after using the toilet or before meals, as well as contamination of food and water with faecal matter, further contribute to the elevated burden of infection among the elderly.

Like the findings of Paula et al., contact with domestic animals has been associated with *Giardia duodenalis* infection in the elderly (11). According to Giroto et al. (2013), this protozoan can be transmitted from person to person, through contaminated food, soil, or water, as well as via interaction with animals (4). Poor hygiene practices, such as inadequate handwashing and the consumption of contaminated food and water, facilitate the spread of these pathogens and contribute to the high prevalence of infection among older adults. Likewise, Zamari et al. (2023) reported that consumption of contaminated food and poor hygiene behaviors are significant risk factors for *Blastocystis* infection in the geriatric population (12).

According to Zamari et al. (2023), based on a study conducted in 2020, immobility or limited movement for self-care, along with high population density among the elderly, may increase the likelihood of gastrointestinal parasitic (GIP) infections (12). Naves reported the presence of *Strongyloides stercoralis* among elderly

individuals in Brazil and found that chronic alcoholism was a contributing factor favouring hyperinfection. In such cases, a few individuals shed infective (L3) larvae in their feces. With regard to *Cryptosporidium*, previous studies have suggested that an increased inherent host susceptibility to parasitic infection may lead to acute infectious diarrhoea in the geriatric population (9). In contrast, studies by Praharaj et al. (2017), Peerzada et al. (2022), Mathuria and Singh (2017), and Abu-Madi et al. (2010) did not identify any risk factors associated with GIP infections (13–16).

Prevalance rate & types of GIP infection among geriatric community

According to Neeti Mishra (10), the prevalence of protozoal and helminthic infections among the elderly was equal, with each accounting for 30.6% (n=30). Parasites like *Trichuris trichiura* and *Entamoeba histolytica* were the most common helminth and protozoan identified, respectively. The study also reported multiple infections in 38.7% (n=38) of the geriatric population. Similarly, Paula Engroff et al. (2016) investigated 581 elderly individuals and reported an overall prevalence of gastrointestinal parasites (GIP) of 10.8% (n=683). The most frequently identified species were *Endolimax nana* (n=29, 42.7%), *Entamoeba coli* (n=23, 33.8%), *Giardia lamblia* (n=6, 8.8%), *Ascaris lumbricoides* (n=4, 5.9%), *Strongyloides stercoralis* (n=3, 4.4%), *Trichuris trichiura* (n=2, 2.9%), and *Iodamoeba bütschlii* (n=1, 1.5%). Co-infections were observed in five individuals: *E. nana* + *E. coli* (n=3, 4.76%), *E. coli* + *G. lamblia* (n=1, 1.5%), and *E. coli* + *I. bütschlii* (n=1, 1.5%) (11).

In another study, Santos et al. (2017) reported a predominance of protozoa (80.8%) compared to helminths (19.2%), with an overall prevalence of 30.5% (n=72). The most common parasites were *E. coli* (n=37, 44.6%), *E. nana* (n=18, 21.7%), and *I. bütschlii* (n=12, 14.5%) (8).

DISCUSSION

According to the World Health Organization (WHO), gastrointestinal parasitic infections (GIP) are classified as neglected tropical diseases (NTDs), a group of infectious conditions that disproportionately affect populations in regions of poverty and malnutrition (22). Infected individuals—particularly children, the elderly, and immunocompromised patients—may suffer complications such as anaemia, growth retardation, weight loss, vitamin A deficiency, abdominal pain, dyspepsia, and other physical and cognitive impairments (23). Our review indicates that the prevalence of GIP among the elderly varies considerably worldwide, reflecting differences in socio-economic status, environmental conditions, and healthcare accessibility.

High prevalence rates were observed in several studies. Mishra et al. (2016) and Santos et al. (2017) reported

prevalence rates of 49% and 30.5%, respectively, among older adults (8,10). Similarly, Kiani et al. (2016) found a prevalence of 39.8% in individuals over 60 years, although species distribution was not reported (17). These elevated rates are often associated with rural, resource-limited areas where sanitation is poor, and healthcare services are scarce (10). Santos et al. (2017) further emphasized that age-related immunological decline increases susceptibility to infection (8).

Conversely, substantially lower prevalence rates were documented in other regions. Engroff et al. (2016) and Giroto et al. (2013) reported rates of 10.8% and 9.5%, respectively, among elderly cohorts in Brazil (4,11). Gholipour et al. (2020) reported a prevalence of 19.1%, while Suntaravitun (2018) documented 17.7% in elderly patients, though without detailed species data (19,23). Similarly, Khanal et al. (2011) noted a prevalence of 22.2% in elderly patients in Nepal (20).

When viewed globally, higher prevalence rates consistently emerge in sub-Saharan Africa, South and Southeast Asia, and parts of Latin America. These patterns are closely linked to inadequate sanitation, poor health education, and socio-economic disparities. By contrast, lower prevalence rates in Europe and North America are attributed to improved sanitation, widespread medical screening, and higher health literacy. Preventive and educational programs in these regions likely contribute to reduced infection rates.

Public health interventions remain critical. Strategies such as improving sanitation, promoting hygiene education, expanding healthcare access, and implementing deworming programs are effective in reducing GIP prevalence (11,24). For instance, albendazole treatment (400 mg) has demonstrated significant reductions in *Ascaris lumbricoides* and *Trichuris trichiura* egg burden, even in heavy infections, supporting its use as a preventive approach (24). Nevertheless, elderly populations in rural and marginalized communities remain disproportionately affected due to low literacy, limited mobility, and immune decline (15,26).

This review also highlights heterogeneity in reported parasite species. Mishra et al. (2016) observed equal infection rates of protozoa and helminths, with *Trichuris trichiura* and *Entamoeba histolytica* as the most common (10). Engroff et al. (2016) reported *Endolimax nana* (42.7%) and *Entamoeba coli* (33.8%) as predominant (11), while Santos et al. (2017) found protozoa to be more prevalent (80.8%), with *Entamoeba coli* (44.6%) and *Endolimax nana* (21.7%) most frequent (8).

Despite these findings, several gaps remain in the literature. Many studies do not provide species-level data or stratify elderly participants into subgroups (e.g., young-old, middle-old, oldest-old), limiting insights into differential vulnerability. Furthermore, data from rural

regions of Africa and Southeast Asia remain scarce, hindering accurate global estimates.

From a public health perspective, addressing GIP in the elderly requires integrated, multi-sectoral strategies. Governments, NGOs, and community health systems must collaborate to expand access to clean water, improve sanitation infrastructure, and deliver targeted health education. Routine screening and deworming initiatives tailored to geriatric populations could substantially reduce disease burden and improve quality of life.

This review has limitations. The small number of eligible studies may limit the generalizability of findings, and publication bias cannot be ruled out, as studies with non-significant results are less likely to be published. Additionally, the lack of stratified age analysis reduces the ability to assess vulnerability across different elderly subgroups. Future research should aim to provide species-specific prevalence data, include more studies from underrepresented regions, and incorporate subgroup analyses to better inform prevention and treatment strategies.

In conclusion, GIP remains a significant but underrecognized health concern among older adults, particularly in low-resource settings. Effective control will require not only medical interventions but also long-term improvements in socio-economic conditions and infrastructure to reduce vulnerability in this rapidly growing population group.

CONCLUSION

This study reviewed the prevalence of gastrointestinal parasites among the geriatric population, drawing on data from 14 published studies conducted between 2010 and 2020. The objective of this review to examine the burden of gastrointestinal parasites in older adults over the past decade was successfully achieved. Based on the literature, it can be concluded that infections in the geriatric community are largely associated with limited awareness, physical disability, inadequate knowledge, and poor hygiene practices. These findings are consistently supported across the reviewed studies.

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REFERENCES

1. Mejia R, Damania A, Jeun R, Bryan PE, Vargas P, Juarez M, et al. Impact of intestinal parasites on microbiota and cobalamin gene sequences: A pilot study. *Parasit Vectors*. 2020;13(1):1–9.

2. Siti Farah Norasyikeen SO, Ngui R, Syaza Zafirah AR, Md Zoqratt MZH, Eng WWH, Ayub Q, et al. Study on intestinal parasitic infections and gut microbiota in cancer patients at a tertiary teaching hospital in Malaysia. *Sci Rep.* 2024;14(1):1–13.
3. Kanasi E, Ayilavarapu S, Jones J. The aging population: demographics and the biology of aging. *Periodontol 2000.* 2016;72(1):13–8.
4. Giroto KG, Grama DF, da Cunha MJR, Faria ESM, Limongi JE, Pinto R de MC, et al. Prevalence and risk factors for intestinal protozoa infection in elderly residents at Long Term Residency Institutions in Southeastern Brazil. *Rev Inst Med Trop Sao Paulo.* 2013;55(1):19–24.
5. Thakur U, Varma AR. Psychological Problem Diagnosis and Management in the Geriatric Age Group. *Cureus.* 2023;15(4).
6. Felizardo AA, Marques DVB, Caldas IS, Gonzalves RV, Novaes RD. Could age and aging change the host response to systemic parasitic infections? A systematic review of preclinical evidence. *Exp Gerontol.* 2018;104(January):17–27.
7. Hailu BY, Berhe DF, Gudina EK, Gidey K, Getachew M. Drug related problems in admitted geriatric patients: The impact of clinical pharmacist interventions. *BMC Geriatr.* 2020;20(1):1–8.
8. Santos PHS, Barros R de CS, Gomes KVG, Nery AA, Casotti CA. Prevalence of intestinal parasitosis and associated factors among the elderly. *Revista Brasileira de Geriatria e Gerontologia.* 2017;20(2):244–53.
9. Naves MM, Costa-Cruz JM. High Prevalence of *Strongyloides stercoralis* Infection among The Elderly in Brazil. *Rev Inst Med Trop Sao Paulo.* 2013;55(5):309–13.
10. Mishra N, Tripathi SM. Medical Science Intestinal Parasitosis Among the Elderly People in Northern India. *International Journal of Scientific Research.* 2016;5(10):17–8.
11. Engroff P, Ely LS, Silva AB da, Viegas K, Loureiro F, Gomes I, et al. Prevalence of intestinal parasites in the elderly enrolled in the Family Health Strategy in Porto Alegre, Brazil. *Geriatrics, Gerontology and Aging.* 2016;10(3):132–9.
12. Zamari NZA, Rosli N, Nadiyah N, Pin TM, Zain SNM, Davamani F, et al. First Report on Gastrointestinal Parasite (Gip) Infection Among Geriatric Community with Cognitive Impairment in Selangor, Malaysia. *Malaysian Journal of Public Health Medicine.* 2023;23(1):146–52.
13. Praharaj I, Sarkar R, Ajjampur SSR, Roy S, Kang G. Temporal trends of intestinal parasites in patients attending a tertiary care hospital in south India: A seven-year retrospective analysis. *Indian Journal of Critical Care Medicine.* 2017;146(May):111–20.
14. Peerzada BY, Mir RF, Samad L, Shah A. Prevalence of intestinal parasitic infections in a tertiary care hospital in Kashmir India 5 year retrospective study. *IP International Journal of Medical Microbiology and Tropical Diseases.* 2022;8(1):69–72.
15. Mathuria YP, Singh A. Prevalence of Intestinal Parasites at a Tertiary Care Centre at Moradabad, Western Uttar Pradesh, India: A One-Year Observational Study. *Annals of International medical and Dental Research.* 2017;2(5):7–10.
16. Abu-Madi MA, Behnke JM, Doiphode SH. Changing trends in intestinal parasitic infections among long-term-residents and settled immigrants in Qatar. *Parasit Vectors.* 2010;3(1):1–13.
17. Kiani H, Haghghi A, Rostami A, Azargashb E, Seyyed Tabaei SJ, Solgi A, et al. Prevalence, risk factors and symptoms associated to intestinal parasite infections among patients with gastrointestinal disorders in Nahavand, Western Iran. *Rev Inst Med Trop Sao Paulo.* 2016;58(1):1–7.
18. Kache R, Phasuk N, Viriyavejakul P, Punsawad C. Prevalence of soil-transmitted helminth infections and associated risk factors among elderly individuals living in rural areas of southern Thailand. *BMC Public Health.* 2020;20(1):1–10.
19. Suntaravitun P, Dokmaikaw A. Prevalence of intestinal parasites and associated risk factors for infection among rural communities of Chachoengsao province, Thailand. *Korean Journal of Parasitology.* 2018;56(1):33–9.
20. Khanal LK, Rai SK, Khanal PR, Ghimire G. Status of intestinal parasitosis among hospital visiting patients in Deukhury Valley, Dang, Nepal. *Nepal Med Coll J.* 2011;13(2):100–2.
21. Khan W, Rahman H, Rafiq N, Kabir M, Ahmed MS, Escalante PDLR. Risk factors associated with intestinal pathogenic parasites in schoolchildren. *Saudi J Biol Sci.* 2022;29(4):2782–6.
22. Rajoo Y, Ambu S, Lim YAL, Rajoo K, Tey SC, Lu CW, et al. Neglected intestinal parasites, malnutrition and associated key factors: A population based cross-sectional study among indigenous communities in Sarawak, Malaysia. *PLoS One.* 2017;12(1):1–17.
23. Gholipoor Z, Khazan H, Azargashb E, Youssefi MR, Rostami A. Prevalence and risk factors of intestinal parasite infections in Mazandaran province, north of Iran. *Clin Epidemiol Glob Health.* 2020;8(1):17–20.
24. Khir N, Nisha M, Yenn TW, Davamani F. Determining the Efficacy of Albendazole Against STH Infection Among Orang Asli. *Malaysian Journal of Medicine and Health Sciences.* 2023;19(Supplement 9):191–6.
25. Birhanu AA, Yimer M, Debash H, Abate MA. Prevalence and Associated Factors of Intestinal Parasitic Infections and Undernutrition Among Elementary School Children in Zenzelima Town, Northwest Ethiopia: A School-Based Cross-Sectional Study. *Health Sci Rep.* 2025;8(7):1–12.
26. Bupp MRG, Potluri T, Fink AL, Klein SL. The confluence of sex hormones and aging on immunity. *Front Immunol.* 2018;9(JUN).