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Prevalence and associated factors of head lice infestation among primary school children in low- and middle-income countries: systematic review and meta-analysis

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Abstract

Introduction Head lice infestation remains a persistent public health concern among primary school children in resource-limited settings, affecting their well-being and academic performance. Despite previous studies, there is no consistent evidence on the prevalence and factors associated with head lice infestation. This study aimed to determine the prevalence and factors related to head lice infestation among primary school children in low and middle-income countries.

Methods This review was conducted by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses 2020 guidelines. Relevant electronic databases, including PubMed, Cochrane Library, Web of Science, Science Direct, AJOL, and Google Scholar, were used to retrieve articles. The study included only published articles written in English languages between December 01, 2014 to January 31, 2024 for studies reporting the prevalence of head lice infestation or associated factors among primary school children in low- and middle-income countries. This review has been registered on PROSPERO with Prospero registration number CRD42024506959. The heterogeneity of the data was evaluated using the I^2 statistic. A meta-analysis was conducted using STATA 17 software, with a 95% confidence interval. Publication bias was evaluated using funnel plots and statistical tests, such as Egger's and Beggs's tests, to identify publication biases in the included studies. Meta-regression was also carried out to assess the source of publication of publication bias.

Results The review included 39 studies involving 105,383 primary school children. The pooled prevalence of head lice infestation among primary school children in low- and middle-income countries was 19.96% (95% CI; 13.97, 25.95). This review also found out that being a girl was 3.71 times (AOR = 3.71; 95% CI: 1.22–11.26) more likely to have head lice infestation as compared to boys, while children with a previous history of infestation were 4.51 times (AOR = 4.51; 95% CI: 2.31–8.83) more likely to have head lice infestation as compared to their counterparts.

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Conclusion The overall prevalence of head lice infestation among primary school children in low- and middle-income countries was found to be high. Female gender, children who had a previous history of infestation, and family size were significant predictors of head lice infestation. As a result, policymakers and program administrators should focus on the identified determinants.

Keywords Children, Head lice, Infestation, Low and middle-income countries, Primary school, Systematic review and meta-analysis

Introduction

Lice have been living off of humans as parasites for thousands of years and vary depending on where they are located on the host's body [1]. There are three types of sucking lice that commonly infest humans: the head louse, known scientifically as *Pediculus humanus capitis*, the body louse, also known as *Pediculus humanus corporis*, and the pubic louse, often referred to as the "crab" louse or *Pthirus pubis* [2]. Body lice transmit bacterial diseases such as epidemic typhus, trench fever, and relapsing fever to humans [1, 3, 4]. Children are more commonly affected by head lice, while body lice infestations are more frequently found in homeless shelters and migrant camps [5].

Pediculus humanus capitis is a common parasite that causes head lice infestation [6]. Head lice are small, wingless insects that feed on human blood and reside on the scalp. They are about 2 mm to 4 mm in length and have six legs [7]. It is primarily transmitted when people have close contact with each other, specifically through their hair [8, 9]. Children who are infested with head lice typically have fewer than 20 mature lice and often have less than 10. These lice can live for 3 to 4 weeks if not treated [10, 11]. Head lice thrive near the scalp as it offers them nourishment, heat, protection, and hydration [10]. It feeds on blood every 3 to 6 h by injecting saliva. After mating, the female louse can lay five or six eggs per day for 30 days, attaching them to the hair near the scalp [11]. After 9 to 10 days, the eggs hatch and turn into nymphs, which then molt multiple times within the next 9 to 15 days to reach the stage of adult head lice [12]. The hatched empty eggshells remain on the hair but are not a source of infestation. The female adult has a lifespan of around one month and lays around 300 eggs [13]. These eggs are deposited at the bottom of hair strands [14]. Nymphs and adult head lice can survive for only 1 to 2 days away from the human host [15].

The diagnosis of *Pediculus humanus capitis* involves identifying adult lice, nymphs, or eggs on the hair or scalp of the affected person [16]. The eggs are oval-shaped and typically yellow or white, with an average size of 0.8 mm by 0.3 mm [17]. At the end of the egg, there is a vault-like structure called the operculum [18]. Most people do not experience severe symptoms, some may suffer from itching, which can disrupt sleep and concentration. Excessive scratching can also lead to skin infections and swollen lymph nodes [19]. In addition, it can cause psychological and social issues, as well as academic difficulties in children [20].

Head lice are common and easily spread infestations that often affect school-aged children [21]. Different prevalence's of head lice infestation have been documented in children globally, including 67.5% in Ethiopia [22], 26.6% in Jordan [23], and 23.2% in Thailand [24]. It remains a persistent public health concern among primary school children in low and middle-income countries (LMICs), significantly impacting the well-being and academic performance of this vulnerable population [25].

Head lice infestation is a common and persistent health issue among primary school children in low and middle-income countries (LMICs). Despite several studies conducted in low- and middle-income countries, there is no consistent evidence regarding the prevalence of head lice infestation and its associated factors The existing literature on the prevalence of head lice infestation in primary school children within LMICs is fragmented and often lacks comprehensive data [26]. However, there is a dearth of consolidated evidence regarding the various determinants such as socio-economic status, hygiene practices, educational settings, and access to healthcare services that contribute to the prevalence of head lice among primary school children in LMICs [27].

Therefore, this study aimed to determine the overall prevalence of head lice infestation and associated factors in low- and middle-income countries through a systematic review and meta-analysis. The purpose of this research is to gain a thorough understanding of the prevalence of head lice infestation among primary school children in low- and middle-income countries, as well as the factors that contribute to it. By examining and analyzing existing literature, this study aims to provide valuable information that can be used to develop effective public health policies and interventions.

Methods and materials

Search strategy

This systematic review and meta-analysis were conducted according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 guidelines. A systematic search was conducted across major electronic databases, including PubMed, Web of Science, Science Direct, Cochrane Library, Google

Scholar, and direct Google were used to search articles. A combination of MeSH terms and keywords related to head lice infestation, prevalence, associated factors, and primary school children in LMICs was used to identify relevant studies.

The search used a mix of Medical Subject Heading terms and words found in titles, abstracts, and full texts. The language structure for PubMed look was as follows: ("*Pediculus humanus capitis*" OR "*Pediculus capitis*" OR "*Pediculi*" OR "*Pediculosis capitis*" OR "head louse infestation" OR "head lice infestation" OR "head louse" OR (head AND mite) OR "head lice" OR (head AND lice) OR "skin disorder" OR "skin disease") AND ("primary school student" OR "primary school" OR "school-aged children" OR "elementary school student" OR "school children" OR "school child") AND 2014/12/01: 2024/02/31. The study protocol for this systematic review and metanalysis has been registered in the PROSPERO database under the registration number CRD42024506959.

Eligibility criteria

Inclusion criteria

Cross-sectional studies published in peer-reviewed journals between December 01, 2014 to January 31, 2024 were included. Only studies conducted in low and middle-income countries focused on primary school children were considered.

Exclusion criteria

Studies with insufficient data, those not meeting quality assessment criteria, and non-original research articles (e.g., reviews, editorials) were excluded. Additionally, qualitative studies and studies that used experimental, cohort, and case-control study designs were excluded. Moreover, articles that were not fully accessible were excluded after attempting to contact the authors via email at least twice.

Study selection

Three independent reviewers (AMD, ETF, LWL) conducted the initial screening based on titles and abstracts for full-text review eligibility. Relevant data, including prevalence rates, associated factors, study design, sample size, and geographical location, were systematically extracted using a standardized data extraction form.

Quality assessment

The data quality was assessed using Joanna Briggs Institute's (JBI's) critical appraisal checklist for those included studies. The methodological quality of the included studies was assessed by three reviewers (NGW, MGM, MH) using standardized tools appropriate for cross-sectional studies, considering aspects such as study design, sample size, and reporting quality. The risk of bias within individual studies was evaluated, and potential biases were considered during data synthesis. This methodological approach aimed to provide a rigorous and transparent process for synthesizing evidence on the prevalence of head lice infestation and associated factors among primary school children in low and middle-income countries. Whenever necessary, another reviewer (TED) was involved and any discrepancy was resolved through discussion and consensus. Those studies with scores of 5 or more in JBI criteria were considered to have good quality and were included in the review [28].

Operational definition

In the fiscal year 2024, low-income economies are defined as those with a Gross National Income (GNI) per person of $1,135 or less. Lower middle-income economies have a GNI per person between $1,136 and $4,465. Upper middle-income economies have a GNI per person between $4,466 and $13,845, and high-income economies have a GNI per person of $13,846 or more [29]. In this review, we classified countries with low and lower-middle incomes as low-income countries and those with upper middle incomes as middle-income countries for the purpose of the study.

Data synthesis

Data were managed using reference management software, and rigorous procedures were followed to ensure accuracy and consistency. The results of the systematic review and meta-analysis were reported by PRISMA guidelines. Random-effects meta-analysis was performed using Stata 17 statistical software because heterogeneity I^2 statistics among studies was above 50% indicating substantial heterogeneity. Subgroup analyses were conducted based on geographical regions to explore potential sources of heterogeneity. Publication bias was evaluated using funnel plots and statistical tests, such as Egger's and Begg's tests, to identify potential biases in the included studies. Meta-regression was also carried out to explore and assess the potential sources of heterogeneity and publication bias.

Results

Selection of eligible studies

This systematic review and meta-analysis have been reported by the PRISMA 2020 statements. Initially, 1261 articles related to head lice infestation and/or associated factors were found. Of these, 583 duplicates and 510 articles by title and abstract were removed. After a thorough review, 87 articles were deemed irrelevant and excluded from the analysis. Ultimately, 39 articles were found to be suitable for the review and were included in the analysis (Fig. 1).

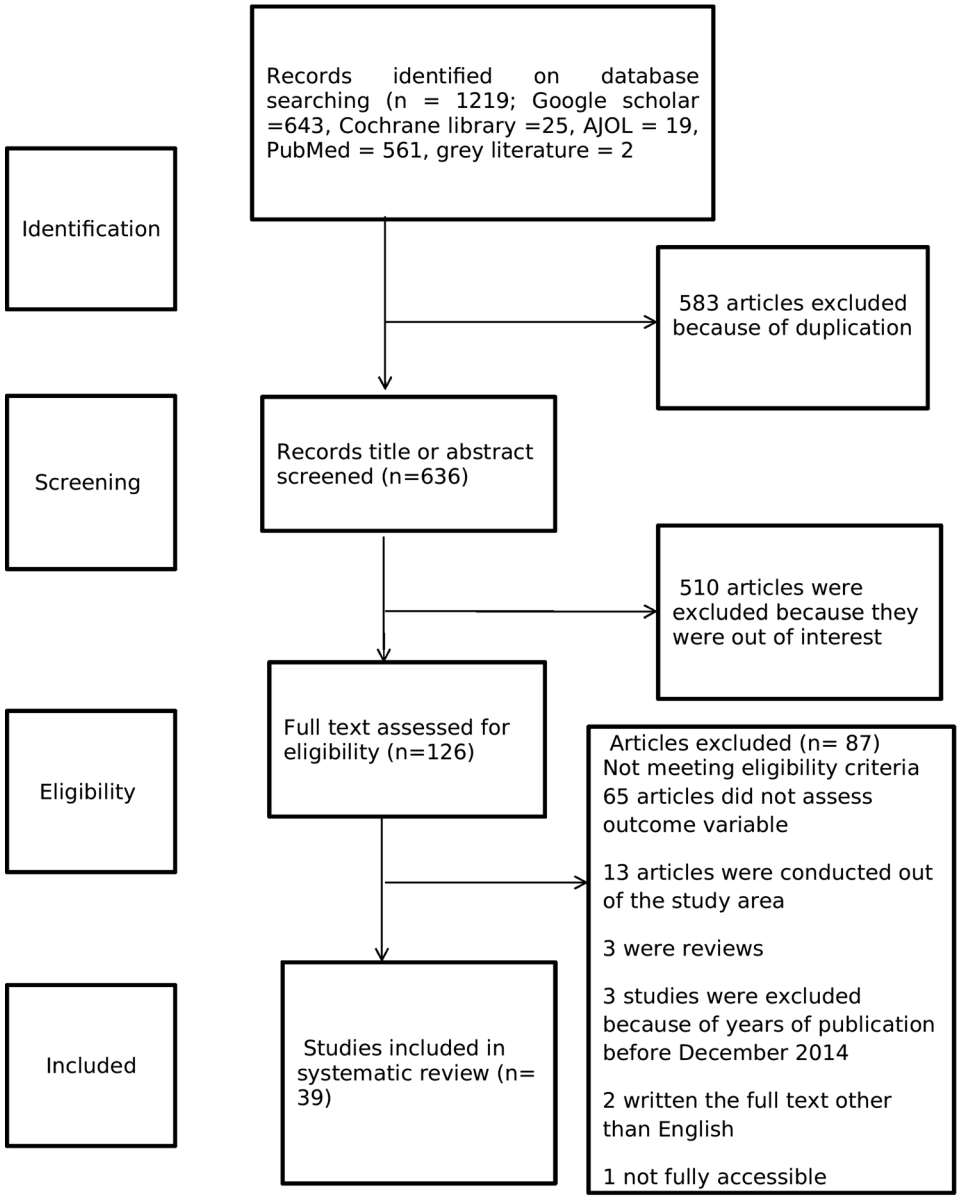

Fig. 1 PRISMA flow diagram for the study selection of prevalence of head lice infestation among primary school children in Low- and middle-income countries, 2024

Characteristics of included studies

A total of 39 studies with a total sample of 103,902 primary school children were included in this systematic review and meta-analysis. All the studies in this review were conducted using a cross-sectional study design and were published between December 01, 2014 to January 31, 2024. Among the 39 studies included, 27 were carried out in the Middle East and North Africa [30–55]. Out of the total number of studies, 33 included both male and female participants [31–34, 36–40, 43–45, 47–51, 53–68] while 6 studies were among female primary school children [30, 35, 41, 42, 46, 52]. The prevalence of head lice infestation ranges from 0.58% in Côte d'Ivoire [47] to 67.3% in Iran [42] among included studies (Table 1).

Pooled prevalence of head lice infestation

The pooled prevalence of head lice infestation among primary school children in low- and middle-income countries was found to be 19.96% (95% CI; 13.97, 25.95) (Fig. 2).

Subgroup analysis

Subgroup analysis was carried out based on geographical regions. Accordingly, the prevalence of head lice infestation among primary school children was found to be

Table 1 Characteristics of the included studies in meta-analysis for the prevalence of head lice infestation and associated factors among primary school children in low- and middle-income countries, 2024

Serial number	Author	Publication year	Country	Countries region	Study design	Gender	Sample size	Prevalence (%)	JBI Quality assessment total score
1.	Haghi, F (30)	2014	Iran	LMI	CS	Female	1510	3.6	8
2.	Abd El R (31)	2015	Egypt	LMI	CS	Both	10,935	16.7	8
3.	Dehghanzadeh, R (32)	2015	Iran	LMI	CS	Both	11,016	5.9	7
4.	El Magrabi, N (33)	2015	Egypt	LMI	CS	Both	1335	60.6	8
5.	Abbas, B (34)	2016	Iran	LMI	CS	Both	12,782	1.86	7
6.	Alborzi, M (35)	2016	Iran	LMI	CS	Female	750	4.8	7
7.	Karimah, A (56)	2016	Indonesia	UMI	CS	Both	123	55.3	6
8.	Kassiri, H (36)	2016	Iran	LMI	CS	Both	300	5.7	7
9.	Kassiri, H (37)	2016	Iran	LMI	CS	Both	750	2	7
10.	Nazari, M (38)	2016	Iran	LMI	CS	Both	700	3.2	8
11.	El-Sayed, M (39)	2017	Egypt	LMI	CS	Both	242	33	8
12.	Khidhir, K (57)	2017	Iraq	LMI	CS	Both	3490	14.52	7
13.	Majidi, S (40)	2017	Iran	LMI	CS	Both	707	6.8	6
14.	Sanei-Dehkordi (41)	2017	Iran	LMI	CS	Female	358	56.15	8
15.	Soleimani-Ahmadi, M (42)	2017	Iran	LMI	CS	Female	300	67.3	7
16.	Tohit, N (58)	2017	Malaysia	UMI	CS	Both	1336	15.3	7
17.	Khamaiseh, A (43)	2018	Jordan	LMI	CS	Both	500	20.4	8
18.	Moradiasl, E (59)	2018	Iran	LMI	CS	Both	1950	10.25	7
19.	Nategh, A (44)	2018	Iran	LMI	CS	Both	1950	10.25	6
20.	Nejati, J (45)	2018	Iran	LMI	CS	Both	28,410	10.5	6
21.	Saghafipour, A (46)	2018	Iran	LMI	CS	Female	1725	13.28	7
22.	Amelia, L (60)	2019	Indonesia	UMI	CS	Both	117	48.7	7
23.	Ghofleh Maramazi, H (47)	2019	Iran	LMI	CS	Both	851	23.38	8
24.	Basha, M (48)	2020	Egypt	LMI	CS	Both	355	35.8	6
25.	Djohan, V (61)	2020	Côte d'Ivoire	LMI	CS	Both	4805	0.58	7
26.	Haama, A (49)	2020	Iraq	UMI	CS	Both	4087	8.3	6
27.	Ibrahim, H (62)	2020	Libya	UMI	CS	Both	971	38.6	7
28.	Lintong, F (63)	2021	Indonesia	UMI	CS	Both	99	39.8	6
29.	Norouzi, R (50)	2021	Iran	LMI	CS	Both	3032	4.29	7
30.	Zahirnia, A (51)	2021	Iran	LMI	CS	Both	2515	2.5	7
31.	Bamaga O (68)	2021	Yemen	LI	CS	Both	467	58.5	7
32.	Bekri, G (52)	2022	Iran	LMI	CS	Female	361	7.2	6
33.	Ftattet, N (64)	2022	Libya	UMI	CS	Both	825	23.9	7
34.	Hama-Karim, Y. H (53)	2022	Iraq	UMI	CS	Both	2064	9.16	7
35.	Rasheed, F (65)	2022	Iraq	UMI	CS	Both	117	5.88	6
36.	Sepehri, M (54)	2022	Iran	LMI	CS	Both	400	10.3	6
37.	Souza, A. B (66)	2022	Brazil	UMI	CS	Both	327	19.8	7
38.	Abd, R (55)	2023	Iraq	UMI	CS	Both	1000	22.2	7
39.	Ozden, O (67)	2023	Turkey	UMI	CS	Both	340	9.4	7

Note: CS: Cross-Sectional; LMC: Low Middle Income; UMI: Upper Middle Income; LI: Low Income

24.30% (95% CI: 14.91– 33.69) in middle-income countries whereas it was 18.03% (95% CI: 10.48–25.59) in low-income countries (Fig. 3).

Factors associated with head lice infestation among primary school children

Gender, previous history of infestation and family size were found to be statistically significant factors associated with head lice infestation.

Gender

Based on 5 included studies [53, 58, 59, 61, 66], the odds of head lice infestation among girls was 3.71 (AOR=3.71; 95% CI; 1.22, 11.26) times higher as compared to boys (Fig. 4).

Previous history of head lice infestation

Based on 5 included studies [46, 47, 52, 53, 59], children who had a previous history of head lice infestation were

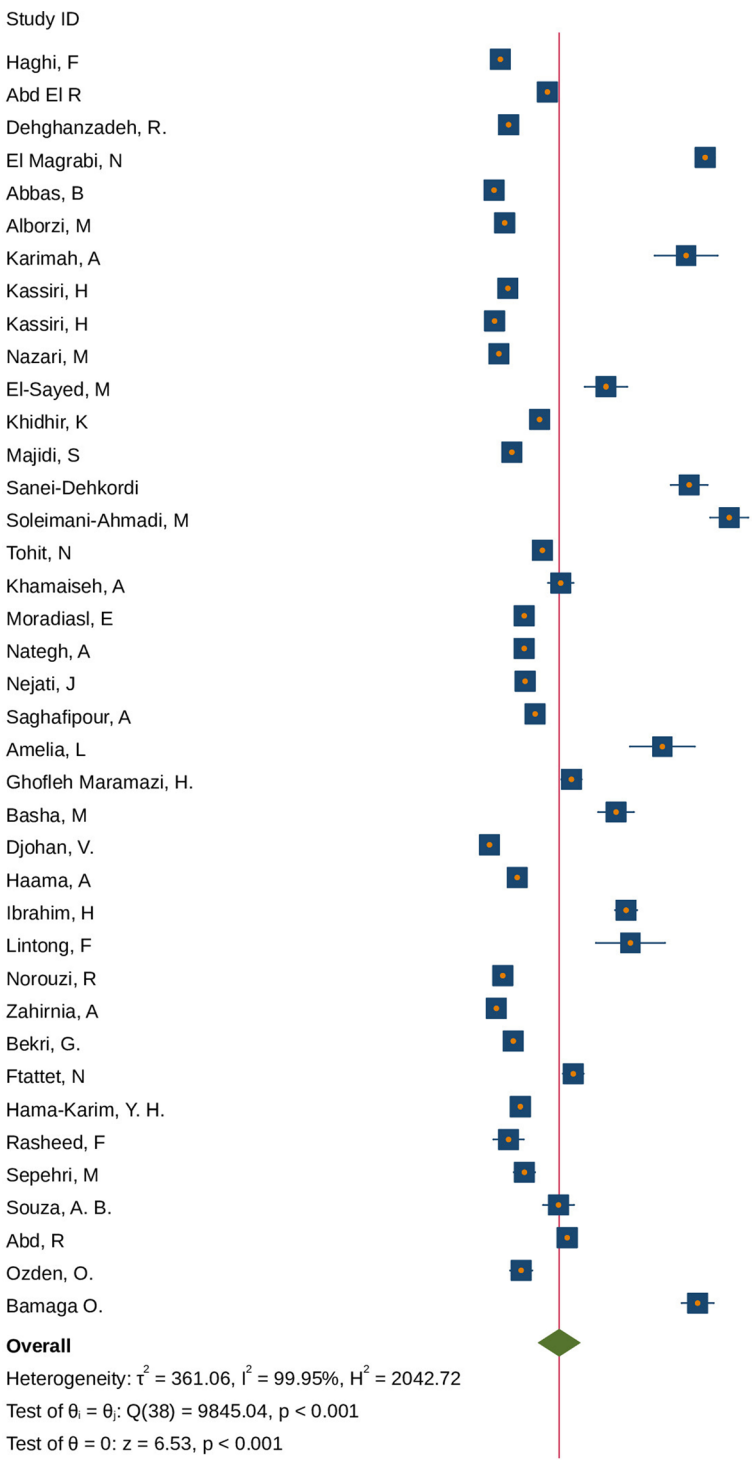

Fig. 2 The overall prevalence of head lice infestation among primary school children in Low- and middle-income countries, 2024

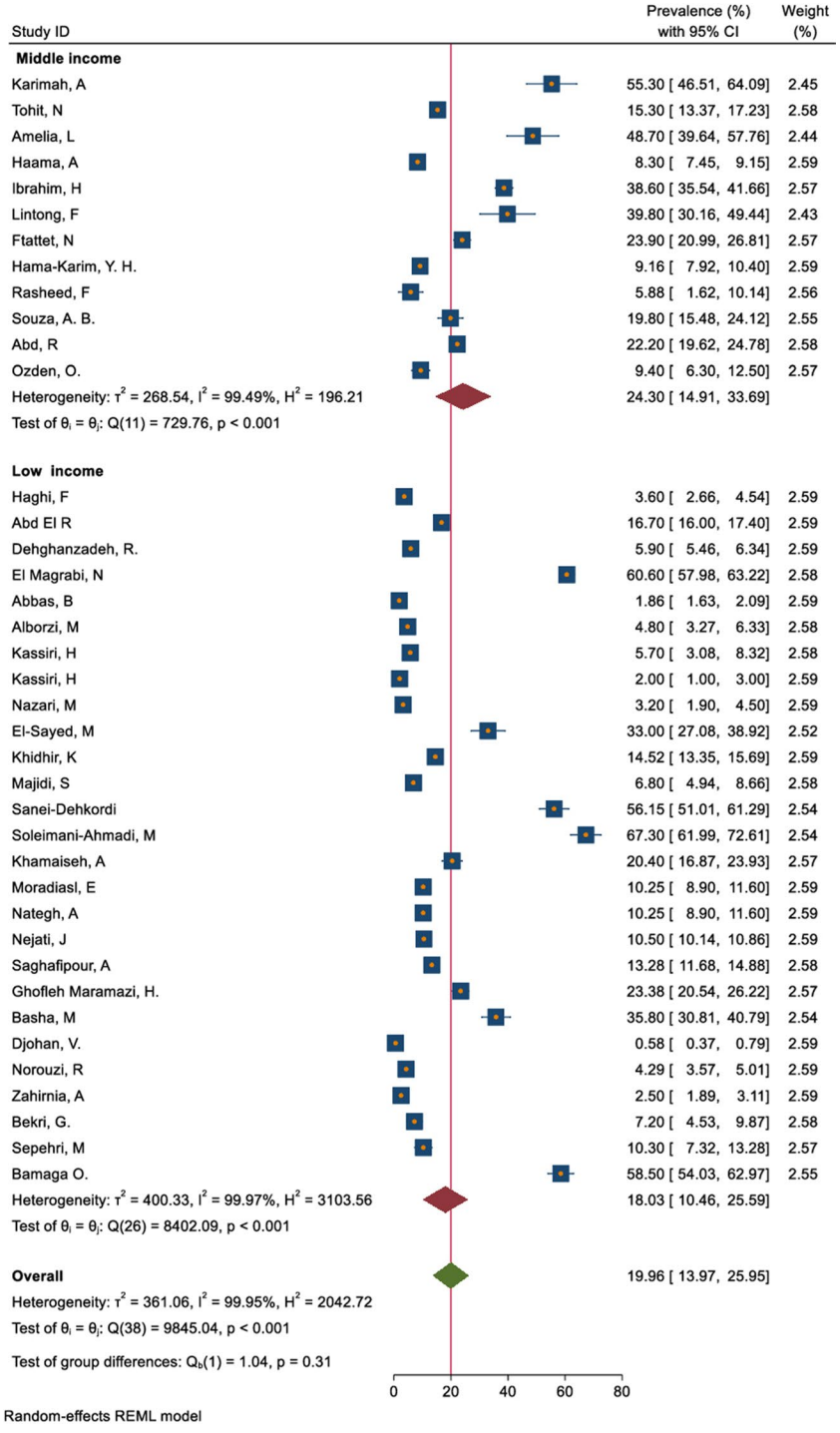

Fig. 3 Subgroup analysis based on the gross national income category of low- and middle-income countries for the pooles prevalence of head lice infestation among primary school children, 2024

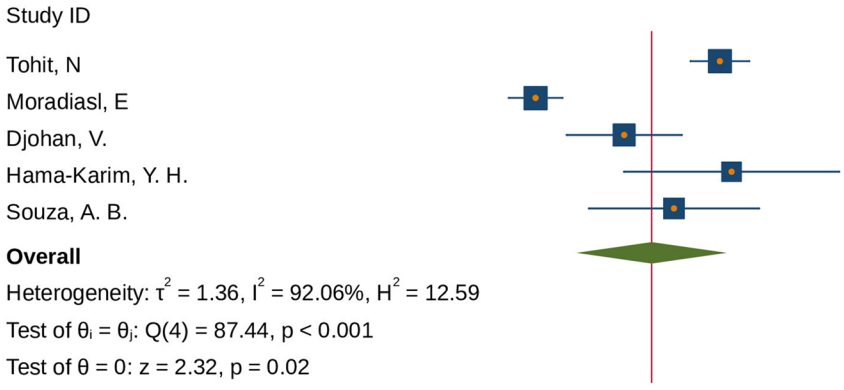

Fig. 4 The pooled adjusted odds ratio between gender and head lice infestation among primary school children in Low- and middle-income countries, 2024

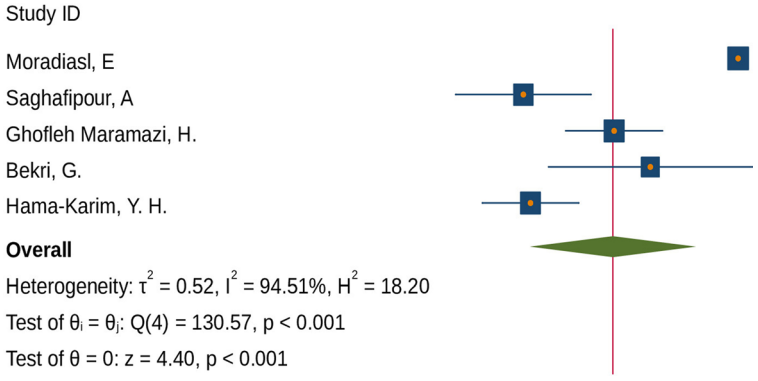

Fig. 5 The pooled adjusted odds ratio between children who had a previous history of head lice infestation and the likeihood of having head lice infestation again among primary school children in low- and middle-income countries, 2024

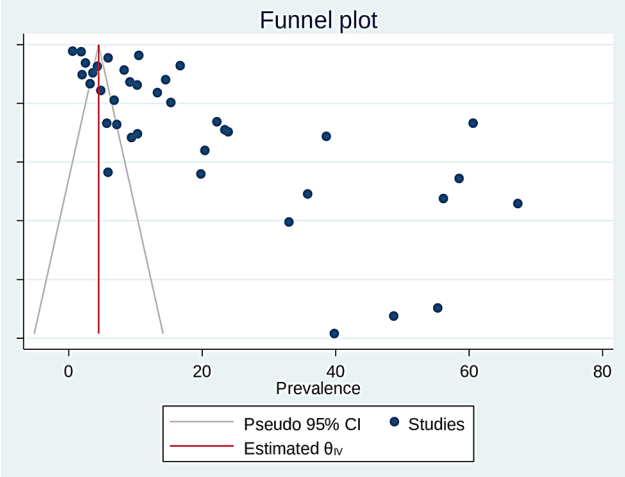

Fig. 6 Funnel plot on the overall prevalence of head lice infestation among primary school children in low- and middle-income countries, 2024

2.51(AOR=2.51: 95% CI; 2.31, 8.83) times more likely to have head lice infestation as compared to children who had no previous history of infestation (Fig. 5).

Family size

Based on two included studies conducted in Iran found that the number of family members is significantly associated with the likelihood of children having head lice infestation. Children from larger families, with 4 or more members, were more likely to have head lice compared to children from smaller families with 3 members [46, 50].

Publication bias assessment and sensitivity analysis

The researchers checked for publication bias by visually inspecting a funnel plot, as well as using statistical tests. Accordingly, Both Egger's and Beggs tests indicated the presence of publication bias in the pooled prevalence of head lice infestation among primary school children (Eggers test; P value=0.001 and Beggs test; P value=0.01) and the funnel plot was asymmetrical (Fig. 6). Moreover, meta-regression was performed to identify the source of heterogeneity by considering publication year, sample size, income category, and study population. None of the

variables displayed a significant source of variation as shown below (Table 2).

Sensitivity analysis

The result of sensitivity analyses revealed that none of the studies had a significant influence on the pooled prevalence of headlice infestation (Fig. 7).

Discussion

Primary school children, typically between the ages of 6 and 12 years, are at the highest risk of getting head lice [69]. Despite efforts made to decrease the occurrence of head lice infestation among primary school children, it is still estimated that 19% of school children worldwide are affected [70]. This review aimed to assess the overall prevalence and factors contributing to head lice infestation among primary school children.

Based on this systematic review and meta-analysis, the pooled prevalence of head lice infestation among primary school children in low and middle-income countries was found to be 19.96% (95% CI; 13.97, 25.95). This finding was comparable to a previous similar study conducted in worldwide prevalence of 19% [70], 20.4% in Southern Jordan [71], and 15.1% in Thailand [72]. However, the current finding of this study was higher than the previous systematic review conducted in Iran, which reported a percentage of 7.2% [73], 2.1% in Korea [74], and 2.01 in Poland [75]. It was lower as compared to 26.6% in Jordan [76], 44.3% in Norway [77], 49.35% in Brazil [78], 34.7% in Estonia [79]. This difference might be due to socioeconomic conditions, cultural practices, access to healthcare, and hygiene standards of respondents in the study area [80–82].

This systematic review and meta-analysis also revealed that being female gender and having a previous history of headlice infestation had a statistically significant association with head lice infestation. Females were found to be significantly more likely to have head lice infestation compared to males, with a 3.71 times higher likelihood. This aligns with a previous global analysis that found girls were infested 2.5 times more often than boys [70]. This finding was also consistent with a study conducted in Turkey which revealed that girls were 3.1 times more likely to have head lice infestation than boys [83].

A previous similar study conducted in Kuwait also revealed that a significant infestation rate was found in girls (50.4%) in comparison to boys (37.5%) [84]. A study conducted in Saudi Arabia also confirmed that girls have a higher rate of lice infestation [85]. Another study conducted in Greece found that girls are more likely than boys to have pediculosis capitis [86]. The possible explanation for this could be due possibly because their long hair provides a suitable environment for lice survival and reproduction while boys are less susceptible to lice infestation as their hair is regularly cut, which helps remove lice eggs and control the problem [77]. Another reason could be that girls tend to have closer contact in small gatherings due to gender-related behavioral differences [87].

This review also found out that the history of children who had a previous history of infestation was 4.51 times more likely to have a head lice infestation. This finding was also consistent with a study conducted in Thailand which states that having a history of head lice infestations were 3.99 times more likely to have head lice infestation [72]. This implies that children who have had head lice before are more likely to get infested again because they are more likely to come into contact with lice in places where close interaction is common, like schools or daycares. Another possible explanation is that a previous head lice infestation was not treated properly, some lice or eggs may have survived and caused a new infestation. children and their caregivers may not have taken enough precautions to prevent reinfestation, such as avoiding close contact or regularly checking for lice. Additionally, sharing personal items like combs or hats can also contribute to the spread of lice among children who have had previous infestations.

Consequently, this systematic review and meta-analysis also revealed that the number of family members is significantly associated with the likelihood of children having head lice infestation. Children from larger families, consisting of 4 or more members, have a higher chance of experiencing head lice infestation compared to children from smaller families with only 3 members. This finding

Table 2 Meta-regression for the pooled prevalence of headlice among primary school children in low- and middle-income countries, 2024

Domain	Variables	Categories	Coefficient	LCL	UCL	*P*-value
Prevalence of head lice infestation	Publication year		-2.1548	-4.7436	0.43383	0.103
	Sample size used		−0.0007	−0.0018	0.0004	0.222
	Income category	Upper middle income	Reference			
		Lower middle income	14.2166	-29.0547	0.6214961	0.060
		Low	34.6458	-1.25791	70.54962	0.059
	Study population	Only-female	Reference			
		Both male and female	-7.8629	-24.4150	8.6892	0.352

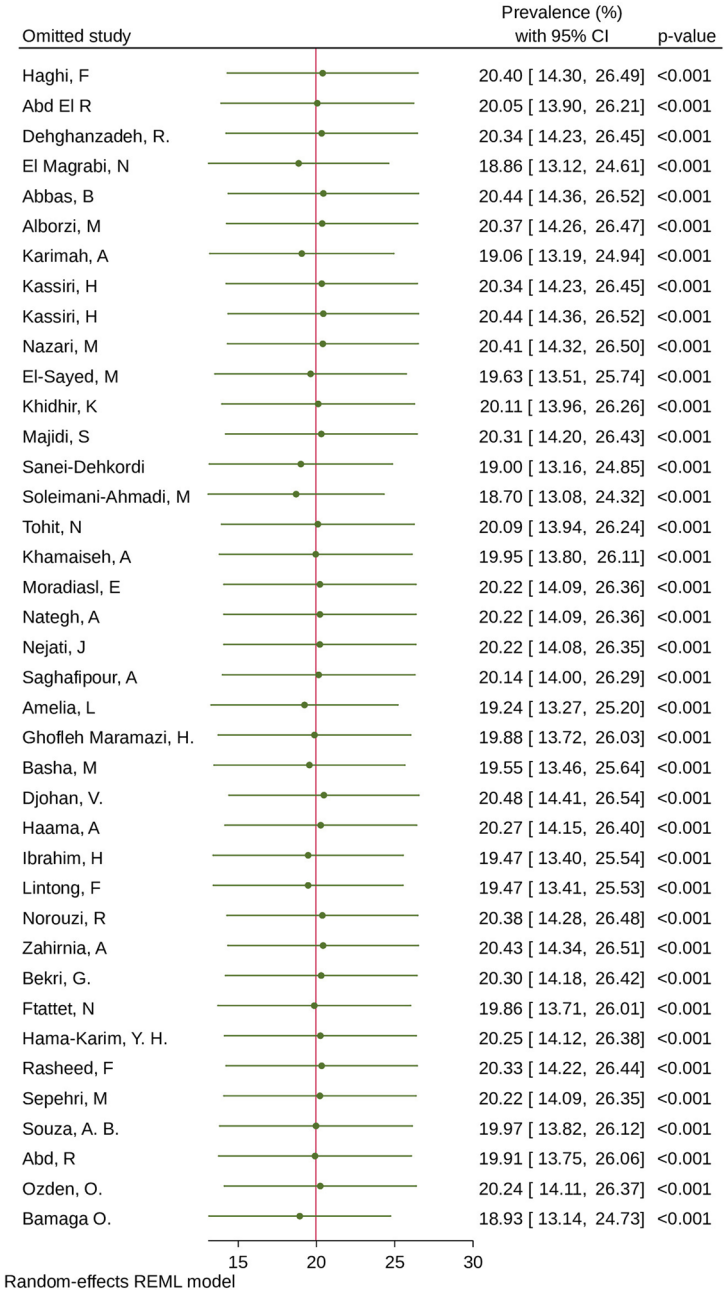

Fig. 7 Meta leave one out sensitivity analysis on the overall prevalence of head lice infestation among primary school children in Low- and middle-income countries, 2024

is supported by another study conducted in Spain [88]. This implies that the likelihood of head lice infestation increases when there is another infected member in the household, and having other children in the same living space also increases the likelihood of infestation, especially among children from larger families compared to those from smaller families [86, 89–91].

Limitation of study

The systematic review and meta-analysis followed the Prospero 2020 guideline but did not include studies published in languages other than English. Additionally, only articles published in peer-reviewed journals from December 01, 2014 to January 31, 2024 were included.

Conclusion

The overall prevalence of head lice infestation among primary school children was found to be high in low and middle-income countries. Females gender, children who had a previous history of infestation and larger family size were more likely to have head lice infestation. A comprehensive approach is needed to tackle the high occurrence of head lice infestation among primary school children in low and middle-income nations. Efficient and lasting strategies need to be created to reduce the prevalence of head lice infestation in primary school children, with particular attention given to girls and children who have previously experienced head lice infestations.

Abbreviations

AOR	Adjusted odds ratio
CI	Confidence interval
GNI	Gross national income
LMIC	Low- and Middle-Income Countries
PRISMA	Preferred reporting items for systematic reviews and meta-analyses

Author contributions

AMD, MH, ETF, LWL, NGW, MGM, DE and TED developed the protocol and were involved in the design, selection of the study, data extraction, and statistical analysis. AMD, ETF, MGT, AA, ETF, NKW, and DE were involved in data extraction and quality assessment. AMD, MM, MH and TED were developing the initial drafts of the manuscript. All authors read and approved the final draft of the manuscript.

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Data availability

All data relevant to the study are included in the article or uploaded as supplemental information.

Declarations

Ethical approval and consent to participate

Not applicable.

Competing interests

The authors declare no competing interests.

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