Prevalence and determinants of scabies among children in Ethiopia: a systematic review and meta-analysis

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Abstract

Scabies is a major neglected tropical disease affecting children in deprived communities like Ethiopia. This study aims to evaluate the prevalence and determinants of *Sarcoptes scabiei* infestation among Ethiopian children under 15 years. Studies were sourced from PubMed, Scopus, ScienceDirect, and African Journals Online through a systematic search, following PRISMA-2020 guidelines. The Joanna Briggs Institute's tool was used to appraise study quality. A random-effects model was used for analysis. Subgroup and sensitivity analyses were conducted to assess heterogeneity using I^2 statistics. Publication bias was assessed using a funnel plot and Egger's test. A total of 9,126 children from 14 studies were included, with a pooled prevalence of 14.94% (95% CI: 11.32-18.57). Being male, having a family size of more than five members, children with an education level below grade five, history of sharing clothes within the family, infrequent washing of clothes, lack of formal family education, poor family wealth or income status, using unimproved water sources, personal hygiene issues like untrimmed fingernails, sharing clothes with individuals diagnosed with scabies, poor knowledge about scabies among family members or caregivers, history of contact with individuals experiencing skin itching or scabies, sharing common sleeping beds or fomites, washing hands with water only, having family members with signs of itching or scabies, and infrequent bathing were factors significantly associated with *Sarcoptes scabiei* infestation among children under the age of 15 in Ethiopia. Therefore, policymakers and health planners should put a great deal of emphasis on the implementation of relevant prevention and control measures.

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Introduction

Scabies is a contagious skin disease caused by the *Sarcoptes scabiei* mite, characterized by severe itching and rashes, often worsened at night.[1] The condition can lead to secondary bacterial infections, causing complications like septicemia, rheumatic fever, and renal failure.[2] It significantly impacts individuals' physical, emotional, and social well-being, including stigma, isolation, and disruptions in daily life.[3] The economic burden on families and healthcare systems is equally notable.[4]

Prevalence of scabies varies widely, from 0.2% to 71.4% globally, with school-based studies reporting higher rates, such as 31% in Malaysia and up to 87.3% in Thailand.[5,6] African countries report diverse prevalence rates: 4.4% in Egypt, 5.2% in Guinea-Bissau, and up to 78.4% in Ethiopia.[7-9]

The factors that increase the chances of scabies include sharing beds or clothes, low income, younger age, large family size, lack of knowledge about scabies, parental illiteracy, seasonal conditions, and residency in rural areas.[10,11] In Ethiopia, prevalence of scabies can also be associated with conflict, civil war, drought, flooding, poor water supply and sanitation, and overcrowding living conditions.[12]

Ethiopia's unique geography and socio-economic challenges create a conducive environment for scabies outbreaks.[13] Scabies remains a major yet neglected public health concern in Ethiopia. A systematic review and meta-analysis conducted in Ethiopia and across Africa revealed that the prevalence of scabies among school children was 14.71% and 10.81%, respectively.[14,15] However, comprehensive data on the prevalence of scabies and associated risk factors among all Ethiopian children under the age of 15 remain scarce in Ethiopia. This systematic review and meta-analysis aim to provide updated estimates and identify critical risk factors to guide effective interventions.

Materials and Methods

Systematic review protocol and registration

This systematic review and meta-analysis were conducted following the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA-2020) guideline [16] (*Supplementary Materials*). Furthermore, the study protocol is registered in International Prospective Register of Systematic Reviews (PROSPERO) with an identification number of CRD42024530761.

Search strategy

Databases including PubMed, Scopus, ScienceDirect, and African Journals Online were searched without language or time restrictions. Boolean operators "AND" and "OR" were used with keywords such as "prevalence", "associated factors", "determinant factors", "predictors", "scabies", "child", "children", "children under 15", and "Ethiopia". Reference lists of selected articles were also reviewed using Google search engine.

Inclusion and exclusion criteria

Studies were included if they i) reported prevalence of scabies among Ethiopian children under 15, ii) employed observational study designs, and iii) were published between June 2015 and January 2023. Studies were excluded if they: Lacked original data or focused on other skin conditions; did not report prevalence; or had inaccessible full texts.

Study selection and quality appraisal

All retrieved articles were imported into EndNote X8 (Thomson Reuters, USA), and duplicates were excluded. Hereafter, the titles and/or abstracts of articles were independently screened by two authors (AG and IA). The articles that met the eligibility criteria and were quality appraised underwent full-text appraisal. The Joanna Briggs Institute (JBI) critical appraisal checklist for prevalence,[17] and case-control[18] studies was used for quality appraisal using 9, and 10 criteria, respectively. For each question, a score was assigned (no for 'not reported or not appropriate' and yes 'for reported'); the scores were summarized across the items to achieve a total score of 0 to 9, and 0 to 10, for prevalence and case-control studies, respectively. Studies were categorised as 'high risk of bias' (low quality), 'moderate risk of bias' (moderate quality) or 'low risk of bias' (high quality) when the overall score was ≤49%, 50-69% or ≥70%, respectively[19] (*Supplementary Materials*). All disagreements between authors were resolved through conversation.

Data extraction

Relevant studies that met the eligibility criteria were subjected to data extraction and summarized in an excel spreadsheet. The information extracted from the included studies were; the name of the first author, publication year, region, study design, study setting, sample size, cases, the magnitude of scabies, response rate, and risk factors (Tables 1 and 3).

Data analysis

STATA version 14/SE software was used for meta-analysis. A random effects model was used to determine the pooled magnitude and risk factors of scabies along with 95% Confidence Interval (CI). For risk factors, if the 95% CI does not include 1, the result is considered statistically significant. The I^2 statistics were used to assess the magnitude of heterogeneity of the included articles and values of <25% indicate low, 25-50% moderate, and >50% substantial heterogeneity.[20] I^2 p-value tests whether the observed heterogeneity is statistically significant or not. Subgroup and sensitivity analysis was performed to explore the possible source of heterogeneity. Egger's, test, and funnel plot were used to check the presence of publication bias among the included articles. Publication bias was assessed using Egger's test, with a $p<0.05$ indicating statistical significance.[21]

Results

Selection of studies

A total of 461 articles were identified through the databases mentioned. After 225 duplicates were removed, another 153 studies were also excluded from the remaining articles after evaluating the title and/or abstract. Furthermore, 69 articles were also excluded during the full text assessment for reasons mentioned in the eligibility criteria. Finally, only 14 of the articles met the eligibility

Table 1. Characteristics of included studies.

Study	Region	Study design	Study setting	Sample size	Cases	Prevalence (%)	Response rate (%)
22	Oromia	Cross-sectional	Hospital based	324	44	13.6	-
23	SNNPR	Cross-sectional	Institutional based	343	19	5.5	-
24	Amhara	Cross-sectional	Institutional based	494	46	9.3	91.84
25	Amhara	Cross-sectional	Community based	583	139	23.84	96.4
26	Amhara	Case-control	Institutional based	300	100	33.3	-
27	Tigray	Cross-sectional	Institutional based	495	64	12.93	100
28	SNNPR	Cross-sectional	Community based	825	135	16.4	97.6
29	SNNPR	Cross-sectional	Institutional based	864	46	5.3	-
30	Amhara	Cross-sectional	Community based	850	92	10.82	98.04
31	SNNPR	Cross-sectional	Community based	590	98	16.6	97.7
32	Amhara	Cross-sectional	Community based	1437	192	13.4	-
33	Amhara	Cross-sectional	Institutional based	622	55	8.8	98
34	Amhara	Cross-sectional	Community based	942	202	21.5	97.4
35	Oromia	Cross-sectional	Community based	457	88	19.26	99.13

SNNPR, Southern Nations, Nationalities, and Peoples' Region.

criteria and were included in the systematic review and meta-analysis (Figure 1).

Characteristics of included studies

Table 1 provides a summary of the specific features found in the studies that were included. The 14 eligible studies[22-35] were conducted in 4 regions. Amhara region had the highest number of eligible studies (seven studies), followed by Southern Nations, Nationalities, and Peoples' Region (SNNPR) (four studies) and Oromia (two studies). One study was conducted in Tigray region. Thirteen studies were cross-sectional and the remaining one was case-control. Seven, six, and one were community-based, institutional-based, and hospital-based studies. A total of 9126 children were examined for the presence of scabies. The sample size among children in included studies ranged from 300 to 1437.

Pooled prevalence of scabies

An overall prevalence of 14.94% (95% CI: 11.32, 18.57) was obtained from 1,328 children under 15 years of age infested with scabies. High heterogeneity was observed across studies (I^2= 96.3%, p<0.001) (Figure 2).

Subgroup analysis

With evidence of substantial heterogeneity, a subgroup analysis was performed. The results are shown in Table 2. The pooled prevalence of scabies among studies conducted using sample sizes

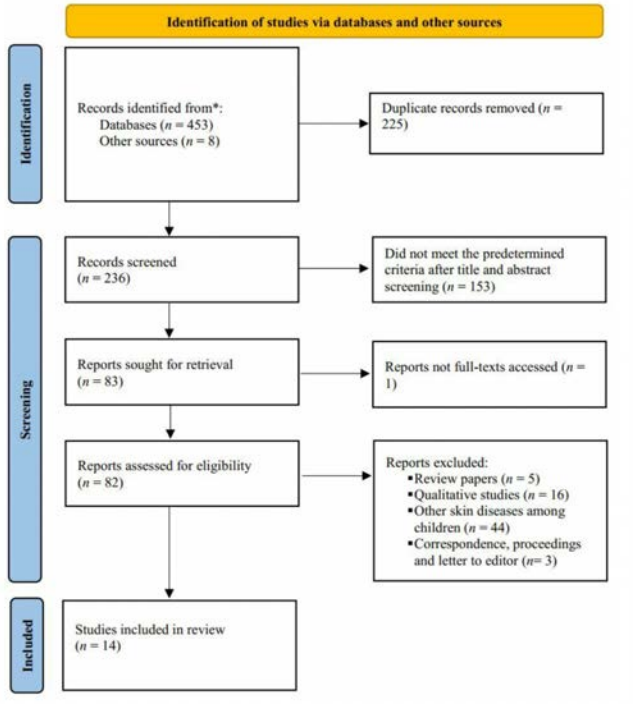

Figure 1. Flow diagram summarizing the selection of eligible studies.

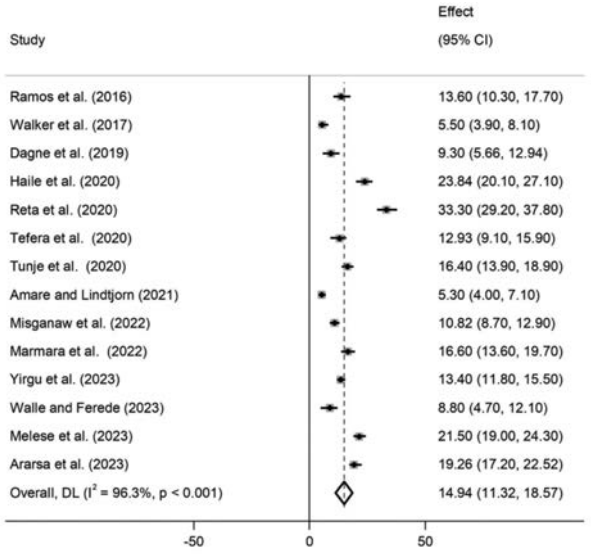

Figure 2. Forest plot displaying the pooled magnitude of scabies among children under 15 years of age in Ethiopia.

Table 2. Subgroup analysis of the magnitude of scabies among children in Ethiopia.

Variables	Characteristics	Included studies	Sample size	Prevalence (95% CI)	I^2, p
Sample size	<384	3	967	17.38 (95% CI: 1.99, 32.77)	98.5, p<0.001
	>384	11	8159	14.35 (95% CI: 10.78, 17.92)	95.4, p<0.001
Region	Oromia	2	781	16.58 (95% CI: 11.04, 22.12)	83.1, p=0.015
	SNNPR	4	2622	10.87 (95% CI: 4.85, 16.88)	96.7, p<0.001
	Amhara	7	5228	17.18 (95% CI: 11.75, 22.62)	96.1, p<0.001
	Tigray	1	495	12.93 (95% CI: 9.53, 16.33)	100, ———
Study design	Cross-sectional	13	8826	13.60 (95% CI: 10.31, 16.88)	95.4, p<0.001
	Case-control	1	300	33.30 (95% CI: 29.00, 37.60)	0.0, ———
Study settings	Hospital	1	324	13.60 (95% CI: 9.90, 17.30)	0.0, ———
	Institutional	6	3118	12.35 (95% CI: 6.02, 18.68)	96.8, p<0.001
	Community	7	5684	17.28% (95% CI: 13.98, 20.59)	91.8, p<0.001
Sampling method	Systematic random	4	1424	17.82 (95% CI: 7.03, 28.61)	98.1, p<0.001
	Simple random	10	7702	13.86% (95% CI: 10.14, 17.57)	95.4, p<0.001
Publication year	2016-2020	7	3364	16.32 (95% CI: 9.84, 22.80)	96.7, p<0.001
	2021-2023	7	5762	13.64 (95% CI: 9.07, 18.22)	96.4, p<0.001
	Overall	14	9126	14.94% (95% CI: 11.32, 18.57)	96.3, p<0.001

SNNPR, Southern Nations, Nationalities, and People's Region.

of less than 384 (17.38%; 95% CI: 1.99, 32.77) was higher than that of studies with sample sizes >384 (14.35; 95% CI: 10.78, 17.92). Among Ethiopian regions, the highest prevalence was reported in Amhara (17.18%), followed by Oromia (16.58%), Tigray (12.93%), and SNNPR (10.87%). A high overall estimate was observed in case-control studies (33.30%; 95% CI: 29.00, 37.60) than in cross-sectional studies (13.60%; 95% CI: 10.31, 16.88). The highest pooled prevalence of scabies among study settings was reported from community studies at 17.28% (95% CI: 13.98, 20.59), followed by hospital studies at 13.60% (95% CI: 9.90, 17.30) and institutional study settings at 12.35% (95% CI: 6.02, 18.68). The prevalence estimate of scabies was higher in the studies using systematic random sampling method, with a pooled prevalence estimate of 17.82% (95% CI: 7.03, 28.61), than in the studies using the simple random sampling method at 13.86% (95% CI: 10.14, 17.57). The prevalence of scabies decreased gradually from 16.32% during the period between 2016 and 2020 to 13.64% in the next three years (2021-2023).

Quality assessment and publication bias

Information on the quality assessment of individual studies is presented in Supplementary Materials. Briefly, all of the included studies were of high quality. The asymmetry of the funnel plot indicated the existence of publication bias among the included studies (Figure 3A). Similarly, the regression-based Egger test (S7 Figure) revealed statistically significant publication bias (p=0.001). Since there is a high level of heterogeneity in the included studies, a sensitivity analysis was performed by removing each study one at a time to assess the impact of each study on the pooled effect size. During the sensitivity analysis, two studies, Walker *at al.*[24] and Dagne *et al.*,[29] had relatively determinant effects on the overall magnitude of scabies among children under 15 years of age in Ethiopia. 13.45 (12.74-14.17) and 14.37 (13.61-15.13) were estimates after removing each study one at a time, namely Walker *et al.*[24] and Amare and Lindtjorn,[30] respectively. After completely removing those two studies, as indicated in Figure 3B, the estimate becomes 15.70 (14.88-16.51).

Factors associated with *Sarcoptes scabiei* infestation

In this systematic review and meta-analysis; the frequency of cloth washing, family education, and the habit of washing hands with water, sex, family size, educational status of children, cloth sharing with family, wealth or income status of the family, sharing clothes with scabies cases, and bath frequency were reported in three articles. In addition, two articles reported the water source, fingernail trimming, and family or caregiver knowledge of scabies. Furthermore, a history of contact with skin itching cases/scabies, sharing of sleeping beds/fomites and family members with itchy signs/scabies were reported in five articles, and all above mentioned factors were significantly associated with *Sarcoptes scabiei* infestation (Table 3).

Discussion

Scabies poses a substantial health burden for children under 15, especially in Low- and Middle-Income Countries (LMICs). Understanding the pooled prevalence and determinants of scabies is crucial for informing evidence-based policies and guiding interventions in detection, management, and prevention efforts. This systematic review and meta-analysis focused on estimating the pooled prevalence of scabies and its associated factors among Ethiopian children under 15 years. The analysis incorporated data from 14 studies, encompassing a total of 9,126 participants.

The pooled prevalence of *Sarcoptes scabiei* infestation among children under 15 years of age was 14.94%. This finding was consistent with surveillance studies conducted in Australia (16.5%),[36] and Cameroon (17.8%)[37] and meta-analysis among school children in Ethiopia (14.71%).[14] On the other hand, studies that showed a higher prevalence than our findings were done in Malaysia (31%),[5] Turkey (33%),[38] Solomon Islands (54.3%),[39] Bangladesh (61-62%),[40] Sierra Leone (67%),[41] and Thailand (87.5%).[6] However, our result was higher than those of studies conducted in Taiwan (1.4%),[42] Egypt (4.4%),[7] Australia (8.2%),[43] and Nigeria (10.5%) [44] and meta-analysis among school children in Africa (10.81%).[15] These variations could be due to sociodemographic characteristics, the season of data collection, study population, sample sizes, methodology used, and economic status.

In the present study, demographic factors include being male, having a family size of more than five members, and having children with an education level below grade five, which were associated with 2.04, 3.86, and 3.45 times higher odds of encountering scabies, respectively, compared to their counterparts. This finding is in agreement with studies conducted elsewhere.[14,15,39,45,46] Males have been observed to engage in less frequent personal hygiene practices, potentially contributing to higher scabies transmission. Conversely, females are generally more concerned about cleanli-

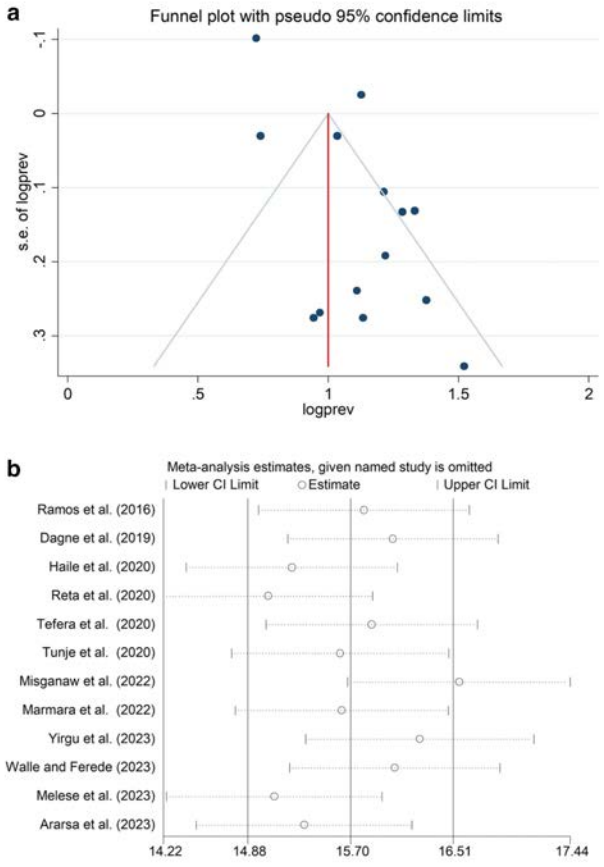

Figure 3. a) Funnel plot representing evidence of publication bias; **b)** sensitivity analysis result of the included studies that assessed the impact of each study on the overall magnitude of scabies.

ness and beauty so they take better care of themselves and maintain cleanliness compared to males.[47] Additionally, increased physical contact during play or sports may facilitate transmission among boys.[15] The possible explanation for family size could be related to sharing habits of bed and cloths in large family are high within a household and outside the household.[48] Finally, lower educational levels may correlate with poorer access to health information, including preventive measures and hygiene practices and delayed treatment, increasing the likelihood of scabies infestation.

Environmental factors, such as meaning Environmental factors, such as the use of the use unimproved water sources, were associated with 1.65 times higher odds of scabies among children under the age of 15 who used them compared to those who did not. Unimproved water sources and insufficient water supplies are significant contributors to the burden of scabies in low- and middle-income countries as documented from elsewhere.[49] This association might be attributed to the limited accessibility of water sources caused by factors such as lengthy water collection times, poor water quality, intermittent supply or scarcity, low socioeconomic conditions in rural areas, and unequal distribution of improved water sources by local administrations. These challenges often result in poor personal hygiene, a direct contributing factor to scabies infestation. Moreover, a community-based study conducted in drought-affected regions of Ethiopia found a high prevalence of scabies.[50]

Household and interpersonal factors include a history of sharing clothes within the family, sharing clothes with individuals diagnosed with scabies, and sharing common sleeping beds or fomites. Individuals exposed to these factors were 3.17, 10.51, and 3.40 times more likely to develop scabies, respectively, compared to their counterparts. This finding is consistent with meta-analysis conducted elsewhere.[14,15,45,46] The possible explanations for the above significant risk factors might be due to sharing beds or clothing with someone infected with scabies enables the mites to move directly from the infected individual to an uninfected person. Moreover, when one person in a bed-sharing situation has scabies, the close proximity can promote continuous transmission and reinfection.[51] Close contact or sleeping near someone with scabies is one of the main ways the infection spreads from an affected person to a healthy individual. The findings of this study reveal a significant association between the level of knowledge and awareness about scabies among caregivers and the likelihood of children contracting the condition. Children from families with poor knowledge were 2.65 times more likely to experience scabies compared to those from families with good knowledge. This reinforces the importance of targeted health education programs as a primary tool for scabies prevention. The observed odds ratio aligns closely with prior research.[53] This might be because limited knowledge may be linked to unhealthy behaviors, such as inadequate personal hygiene, sharing beds or clothing with others, and not seeking proper healthcare for scabies treatment. These consistent findings across diverse contexts underline the universal importance of education in disease prevention.

This meta-analysis revealed that behavioral and hygiene-related factors, including infrequent bathing, untrimmed fingernails, infrequent washing of clothes, and washing hands with water only, were associated with 3.85, 3.55, 6.15, and 2.68 times higher odds of developing scabies, respectively, compared to their counterparts. This finding was supported by different surveillance studies in different areas[37,52-54] and meta-analysis.[14,15,45,46] This could be because the respondents were less aware of the importance of personal hygiene, and poor personal hygiene could be a risk factor for the spread of scabies mites. The other reasons might be the inadequate supply of water for household consumption, including maintaining personal hygiene, especially during the dry season among rural and overcrowded areas of the community as a result the longer clothes and the body remain unwashed, the greater the opportunity for scabies mites to survive on them. This raises the risk of transmission to anyone who comes into contact with the contaminated items or skin.[14,15,45]

Socioeconomic factors include poor family wealth or income status, which was significantly associated with 2.26 times higher odds of acquiring scabies, and lack of formal family education, which was significantly linked to 1.91 times higher odds, compared to wealthy and literate families. The current result is in line with several previous surveillance studies conducted else-

Table 3. Factors associated with the magnitude of scabies among children under 15 years of age in Ethiopia.

Variables	Number of articles	Pooled odds ratio (95% CI)	I-squared (%)	I^2 p
Male	3	2.04 (1.09,3.00)	0	0.594
Family size above five	3	3.86 (1.44,6.28)	0	0.590
Children education less than grade five	3	3.45 (1.61,5.29)	0	0.918
Sharing history of cloth with family	3	3.17 (1.23,5.11)	1.4	0.363
Infrequent cloth wash	3	6.15 (2.41,9.88)	68.3	0.043
No formal family education	3	1.91 (0.41,2.79)	91.5	<0.001
Poor wealth or income status of the family	3	2.26 (1.33,3.18)	0	0.449
Unimproved water source	2	1.65 (1.08,2.22)	0	0.708
Untrimmed finger nail	2	3.55 (1.02,8.12)	48.4	0.164
Sharing clothes with scabies case	3	10.51 (5.38,15.64)	0	0.788
Family or caregiver poor knowledge about scabies	2	2.65 (1.22,4.07)	8.3	0.296
Having history of contact with skin itching cases/scabies	5	4.94 (2.37,7.52)	38.4	0.165
Sharing common sleeping beds/fomites	5	3.40 (1.93,4.87)	0	0.965
Habit of washing hand with water only	3	2.68 (0.97,4.39)	80.8	<0.001
Family member with itchy signs / scabies	5	5.92 (3.02,8.83)	0	0.704
Infrequent bath	3	3.85 (1.33,6.36)	0	0.789

where.[7,52,53,55-58] This could be explained by the fact that children from educated families have better opportunities to earn more money and better personal and environmental sanitation, in addition to better health-seeking behavior than others.[58]

Finally, health and contact-related factors include children who have a history of contact with individuals experiencing skin itching or scabies, who were 4.94 times more likely to acquire scabies. Additionally, children with family members showing signs of itching or scabies were 5.92 times more likely to develop scabies than their counterparts. This finding also supported by previous studies.[7,14,15] Scabies spreads easily through close physical contact. If children aged under15 frequently interact with siblings and parents, they are more likely to contract it if another family member is infected.[59]

Strengths and limitations

A key strength of this systematic review and meta-analysis is the pooled prevalence and risk factors associated with scabies infestation were identified among children under 15 years of age in Ethiopia. Even though, this review did not consider all regions in Ethiopia due to the lack of availability of articles this may limit the generalizability of the findings.

Conclusion

Sarcoptes scabiei infestation remains a critical issue among Ethiopian children, with community-based settings exhibiting the highest prevalence. Health programs should prioritize improved water access, community hygiene education, and targeted interventions for high-risk groups such as large households and children with low health literacy. Future research should expand to underrepresented Ethiopian regions and focus on long-term scabies control measures, including sustainable hygiene interventions and health education programs.

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Online supplementary materials
PRISMA-2020 checklist.
JBI critical appraisal checklist for cross-sectional (prevalence) and case-control studies.