IJID Regions 11 (2024) 100365

Contents lists available at ScienceDirect

IJID Regions

journal homepage: www.elsevier.com/locate/ijregi

Prevalence of *Sarcoptes scabiei* infestation and its associated factors among primary school children: A school-based cross-sectional survey in the Rufiji district, Tanzania

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ARTICLE INFO

Keywords:
Sarcoptes scabiei
Scabies
Primary School Children

ABSTRACT

Objectives: This study aimed to investigate the prevalence of *Sarcoptes scabiei* infestation and its associated factors among primary school children (PSC) in the Rufiji district.
Methods: A quantitative school-based cross-sectional study was conducted among 447 PSC in the Rufiji district. The prevalence of scabies among PSC was determined by clinical examination and by microscopic examination of skin samples for the presence of *S. scabiei*. A structured questionnaire was used to gather data on factors associated with *S. scabiei* infestation. Descriptive analysis, Fisher's exact, chi-square tests, and logistic regression analysis were used to analyze the data.
Results: The prevalence of scabies was 2.0%. Of the assessed factors, only physical contact with a person having itchy skin lesions (Adjusted Odds Ratio [AOR]=4.04, 95%CI 4.39-12.50) and infrequency of changing clothes before laundry (AOR=2.99, 95%CI 1.35-4.94) were significantly associated with scabies. The majority of participants demonstrated low levels of knowledge, with half exhibiting poor attitudes and inappropriate healthcare–seeking behaviors.
Conclusions: There was an ongoing transmission of scabies among PSC in the Rufiji district, with the factors associated with the transmission being physical contact with a person who had an itchy skin lesion and the infrequency of changing clothes before laundry. Therefore, there is a need for regular clinical screening and treatment of positive cases with preventive measures on contact and provision of health education.

Introduction

Sarcoptes scabiei var hominis is an ectoparasite that causes a skin infestation known as scabies. The distribution of scabies is unusual for a neglected tropical disease (NTD) because it appears to be global [1]. According to a systematic review conducted in 2015, the global prevalence of scabies ranged from 0.2% to 71.4%, with a high burden of scabies in countries with a low human development index and refugee camps [2]; however, there is also a recent increase in prevalence in European and North American countries [3].

Approximately 200 million individuals are infested at any given time, and 455 million people are infested per year, which makes scabies one of the highest-burden NTDs [1]. The prevalence varies across Africa, ranging from 4.7% to 65% in Nigeria, 2.5-78% in Ethiopia, and 2.5-7.4% in Tanzania [4–6]. Outbreaks are common in institutions such as residential care homes, prisons, and schools [1]. Scabies occur when a female mite burrows into the skin and lays her eggs. The mites, eggs, and feces trigger immune reactions, leading to rashes and itching that become intense at night [6,7]. Commonly affected areas in adults and children include the hands (especially between the fingers), armpits, wrists, buttocks, and genitalia [8]. Scabies also increase the risk of secondary bacterial infections, such as impetigo, abscesses, cellulitis, septicemia, renal impairment, and rheumatic heart disease [6,9]. It may result in stigma and discrimination against persons having the disease. Scabies affects all ages, with children and the elderly at a higher risk. The rare, severe type of scabies, known as crusted scabies, characterized

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https://doi.org/10.1016/j.ijregi.2024.100365
Received 7 February 2024; Received in revised form 3 April 2024; Accepted 4 April 2024

by “crusted” skin covered with thousands of mites, is more prevalent in individuals with weakened immune systems [7,10–13].

Scabies spreads mainly through direct skin contact or indirectly via fomites, such as shared bedding or clothing, especially in cases of crusted scabies [8]. The risk factors include age; low socio-economic status; overcrowding; poor hygiene; and insufficient knowledge, attitudes, and practices regarding the disease—all of these can favor infestation [7,13–15]. The World Health Organization has classified scabies as one of the skin-related NTDs that must be addressed by initiating a worldwide scabies control programme, along with other NTDs, including lymphatic filariasis and soil-transmitted helminths [5,16].

In Tanzania, there is a paucity of data on the burden of scabies. A study in the Kongwa district of Dodoma showed that scabies prevalence fell from 4% to 0.8% after the initial ivermectin treatment but rose to 2.5% and 2.9% in the 3rd and 4th years, respectively. For low-endemic areas, an integrated control strategy involving active case detection and treatment of infested individuals is recommended [17]. There is a gap in the burden of this disease in many countries across sub-Saharan Africa, Tanzania being among them [5,13], because of inhomogeneous diagnostic methods, probable underreport bias brought on by a lack of expertise, a low propensity among patients to seek treatment, and stigma related with the illness [1]. Hence, infested individuals continue to have considerable morbidity. This study aimed at investigating the current prevalence of *S. scabiei* infestation and associated factors among primary school children (PSC). By assessing the disease burden, the study will add updated information that will guide the establishment of effective control strategies for the disease’s control.

Materials and methods

Study area and demographics

Rufiji District Council is located in the coastal region, it has a total area of 9942 km^2 made up of both land and water based on the 2022 census [18]. It has 13 wards, 38 villages, and 177 suburbs as per 2022 census. According to the 2022 Population and Housing Census, the population is 159,906 (82,325 men and 77,581 women), with a 4.9% annual population change [18]. At least one primary school is present in every village.

The district experiences annual rainfall ranging from 800 to 1200 mm and temperatures ranging from 20°C to 33°C. It is estimated that around 95% of Rufiji district dwellers practice agriculture and fishing activities. The remaining 5% are central government, district council, and non-government organization employees. In approximation, the income per capita for each dweller is 1,272,855 shillings (498.88 US$) per year (based on the Rufiji district website).

Rufiji district is among the districts that received mass drug administration (MDA) with ivermectin and albendazole from 2002 to 2015 [19] and had a history of scabies infestation based on the study conducted in 1975 [20]. Ivermectin has been reported to be effective in treating, controlling, and preventing scabies infestation. In addition, water, sanitation, and hygiene (WaSH) have improved in the Rufiji district where previous studies conducted before improvement had observed that scarcity of water and hygienic practices had an influence on the scabies burden [20,21]. Our study aimed to provide updated data on the prevalence and associated factors for scabies infestation in this area.

Study design and population

A school-based cross-sectional study using quantitative data collection methods was conducted among PSC to assess the prevalence of *S. scabiei* infestation and associated factors in the Rufiji district. The study involved clinical and parasitological examinations of selected PSC from classes 1-7, residing in the area for at least two months, with consent from head teachers and parents. Children unable to communicate because of health issues were excluded.

Sample size determination and sampling technique

The sample size was calculated by using a cross-sectional formula ($N = z^2\ p\ (100 - p)/\ \varepsilon^2$), taking into account the proportion of scabies (p) of 12.9% [22], the margin of error (ε) of 4.0%, and the standard normal deviate (z) of 1.96 at the 95% confidence level (CI). The sample size was then adjusted to account for a 10% non-response rate and a designing effect of 1.5. Therefore, a total of 450 PSCs were sampled. However, only 447 PSCs were able to participate in this study.

Using a three-stage, multistage sampling technique, three wards (Utete, Ikwiriri, and Mbwara) were randomly chosen from 13 wards. From these, one village per ward (Utete, Ikwiriri, and Nyamwaga) and then one primary school per village (Ikwiriri, Nyamwage, and Mapinduzi) were selected. A sample of students, comprising 11% from Ikwiriri, 14% from Mapinduzi, and 12% from Nyamwaga primary schools, was randomly chosen.

Clinical diagnosis of scabies

Scabies was diagnosed based on the criteria listed in the 2020 International Alliance for the Control of Scabies, which is attached in Supplementary Table 1 [23]. The focused areas for lesion examination were the face, neck, armpit, forearm, wrist, between the fingers of hands, trunk, and feet. The examination was performed by qualified medical doctors in a private room to maintain the privacy of each participant.

Parasitological examination

The skin scraping technique, which was conducted by trained laboratory scientists, involved gently scraping burrows/lesions with a surgical blade to collect samples. These samples were placed on slides, treated with potassium hydroxide (10%), and covered with a cover slip for 30 minutes. Microscopic examination at 10 × and 40 × magnification confirmed the presence/absence of *S. scabiei* mites, eggs, or feces [23].

Questionnaire survey

The pre-tested structured questionnaire gathered information on socio-demographic characteristics, personal hygiene, living conditions, and knowledge, attitude, and healthcare–seeking behaviors on scabies among PSC. The PSC were interviewed after being examined for scabies. The interview took 30 to 45 minutes.

Quality control

The research tool (structured questionnaire) was pre-tested in 45 PSC (10% of the estimated sample size). This gave room for modification of the tool in questions that were not clear to the PSC. The actual data gathering did not involve the school that took part in the pretest of the tool.

Dependent and independent variables

The dependent variable was the positivity for clinical scabies among PSC. The independent variables were socio-demographic factors (age, sex of PSC, and a class of study), personal hygienic factors, living condition factors (availability of water, family size, sharing of sleeping beds, and fomites, and classroom arrangement), knowledge, attitudes; and healthcare–seeking behavior.

Data analysis

Data collected were double-entered, cleaned, and analyzed by using a statistical package for the social sciences (SPSS) version 23. The prevalence of scabies obtained was summarized based on the independent variables by using descriptive statistics, Fisher’s exact, and chi-square

test. A univariate logistic regression analysis was used to determine the association between an outcome variable and independent variables. Independent variables with $P < 0.25$ were subjected to multivariable logistic regression analysis to take into account potential confounders at a significance level of 5% ($P = 0.05$).

A scoring scale assessed participants' knowledge using eight multiple-choice questions, contributing to a total of 21 marks. Correct answers scored one point, whereas incorrect answers scored zero. Final scores ranged from 0 to 21, categorizing knowledge into low (≤7 points), moderate (8-15 points), and high (≥16 points) levels based on the total score.

Attitudes and care-seeking behaviors were assessed using a five-point Likert scale. The participant's attitudes and practices scores were added to determine the participant's overall attitude and overall care-seeking behaviors scores. A participant's attitude and care-seeking behavior were rated as "good or poor" and "appropriate or inappropriate" based on the total mean attitude (46.3) and health care–seeking behavior (40.7) scores, which were derived from the total scores, respectively.

Ethical approval

Ethical approval was obtained from the Muhimbili University of Health and Allied Sciences Ethical Review Committee with the Reg. No.DA.282/298/01.C/1646. The district administrative secretary permitted the implementation. Written informed consent was obtained from the head teacher and parents, as well as assent from the children aged ≥12 years before the study after providing them information on the study. Information about research subjects was kept confidential. Feedback on the study results was given to parents, and scabies-positive participants were directed to a nearby hospital for treatment.

Results

Socio-demographic characteristics of the study participants

A total of 447 out of 450 PSC were recruited in this study, with a response rate of 99%. More than half of the participants (236 of 447, 52.8%) were females, belonged to classes 1-4 (244 of 447, 54.6%), and their age ranged from 5 to 19 years, with a mean age of 10(±2.6) years (Table 1).

Prevalence of S. scabiei *infestation according to socio-demographic characteristics of the study participants*

The overall prevalence of *S. scabiei* infestation among study participants was 9 of 447 (2.0%) by clinical diagnosis (clinical scabies), with all infested participants being negative upon confirmation by microscopic examination. According to the socio-demographic characteristics of the study participants, a high prevalence of *S. scabiei* infestation was observed among males (6 of 211, 2.8%), age group 5-10 years (7 of 242, 2.9%), and class 1-4 (7 of 244, 2.9%). Despite this observation, none of the socio-demographic characteristics was statistically significantly associated with the prevalence of *S. scabiei* infestation (Table 1).

Personal hygienic factors related to S. scabiei *infestation among the study participants*

According to descriptive statistics, the highest prevalence of infestation was observed among those who reported changing their clothes infrequently (4 of 409, 2.2% prevalence among those who changed frequently vs 5 of 38, 13.2% among those who did not). The difference

Table 1
Prevalence of *S. scabiei* according to socio-demographic characteristics and personal hygienic factors of the study participants.

Variable	n (%)	Clinical scabies		P-value
		Yes (%)	No (%)	
Sex				
Male	211 (47.2)	06 (2.8)	205 (97.2)	0.237[a]
Female	236 (52.8)	03 (1.3)	233 (98.7)	
Age group (mean age = 10.00 ±2.6)				
5-10	242 (54.1)	07 (2.9)	235 (97.1)	0.349[a]
11-15	197 (44.1)	02 (1.0)	195 (99.0)	
>16	8 (1.8)	00 (0.0)	08 (100)	
Class				
1-4	244 (54.6)	07 (2.9)	237 (97.1)	0.158[a]
5-7	203 (45.4)	02 (1.0)	207 (99.0)	
School name				
Mapinduzi primary school	148 (33.1)	02 (1.4)	146 (98.6)	0.544[a]
Nyamwage primary school	85 (19.0)	01 (1.2)	84 (98.8)	
Ikwiriri primary school	214 (47.9)	06 (2.8)	208 (97.2)	
Frequency of bathing				
Frequently	429 (96.0)	08 (1.9)	421 (98.1)	0.275[a]
Infrequently	18 (4.0)	01 (5.6)	17 (94.4)	
Use of soap when bathing (n = 429)				
Yes	406 (94.6)	07 (1.7)	399 (98.3)	0.366[a]
No	23 (5.4)	01 (4.3)	22 (95.7)	
Washing of clothes				
Frequently	416 (93.1)	09 (2.2)	407 (97.8)	0.408[a]
Infrequently	31 (6.9)	00 (0.0)	31 (100)	
Frequency of changing clothes before laundry				
Frequently	409 (91.5)	04 (2.2)	405 (97.8)	<0.000[a,b]
Infrequently	38 (8.5)	05 (13.2)	33 (86.8)	
Sharing of clothes with others at school				
Yes	16 (3.6)	00 (0.0)	16 (100)	0.559[a]
No	431 (96.4)	09 (2.1)	09 (97.9)	
Frequency of changing bed sheets				
Frequently	361 (80.8)	07 (1.9)	354 (98.1)	0.819[a]
Infrequently	86 (19.2)	02 (2.3)	84 (97.7)	0.275[a]

[a] Fisher's exact;
[b] P ≤0.05 indicates significance level

appeared significantly different, with P <0.000. No other significant differences were observed through descriptive statistics according to sex, age group, class, school, frequency of bathing, sharing clothes, or changing bed sheets (Table 1).

Living condition factors related to S. scabiei *infestation among the study participants*

About half of the study participants (232 of 447, 51.9%) had families with five or more family members and an overcrowding index of >1.5 was observed in more than half of the participants (263 of 447, 58.8%). The majority of participants (320 of 447, 71.6%) reported sharing sleeping beds with others. However, among those who share beds, only a few participants (20 of 320, 6.3%) reported sharing sleeping beds with a person who has itchy skin lesions.

Having a family member with an itchy skin lesion (0.5 of 46, 1.9% vs four of 401, 1.1%), contact with a person with an itchy skin lesion (seven of 43, 16.3% vs two of 404, 0.5%), and sleeping with a person who had an itchy skin lesion (three of 20, 15% vs four of 300, 1.3%) were all statistically significantly associated with scabies infection (P <0.000) (Table 2).

Knowledge of scabies among the study participants

Only a few participants (eight of 447, 1.8%) correctly reported mites as a causative agent. About a quarter of participants (113 of 447, 25.3%) correctly reported skin contact as the mode of transmission, with the most reported symptom being intense skin itching and skin lesions (253 of 447, 56.6%). Furthermore, more than two-thirds (296 of 447, 66.2%) correctly reported that scabies could be treated, with more than half of the participants (178 of 447, 60.1%) correctly mentioning topical and oral drugs as a method of treatment (Supplementary Table 2).

Classification of scabies knowledge levels according to socio-demographic characteristics of the study participants

The majority of participants had a low level of knowledge (321 of 447, 71.8%) (Figure 1). A lower level of knowledge was more prevalent in the age groups 5-10 years (188 of 242, 77.7% P = 0.006%) and among students of class 1-4 (192 of 244, 78.7% P = 0.000) than others. There was a statistically significant difference between knowledge levels and schools attended by study participants, with Mapinduzi having the highest prevalence for low scores (78.8% vs 69% vs 68.2%, P = 0.023) (Table 3).

Table 2
Living condition factors, level of knowledge, attitude, and healthcare–seeking behavior related to *S. scabiei* infestation among the study participants.

Variables	N (%)	Clinical scabies (%)		P-value
		Yes	No	
Number of family members				
1-5	215 (48.1)	03 (1.4)	212 (98.6)	0.370[a]
>5	232 (51.9)	06 (2.6)	226 (97.4)	
Number of rooms at home				
1-3	260 (58.2)	03 (1.2)	257 (98.8)	0.249[a]
4-6	168 (37.0)	05 (3.0)	163 (97)	
>6	19 (4.3)	01 (5.3)	18 (94.7)	
Overcrowding index				
≤ 1.5	184 (41.2)	04 (2.2)	184 (97.8)	0.840[a]
> 1.5	263 (58.8)	05 (1.9)	258 (98.1)	
Having a family member with itchy skin lesions				
Yes	46 (10.3)	05 (1.9)	41 (98.1)	<0.000[a,b]
No	401 (89.7)	04 (1.1)	397 (98.9)	
Having contact with a person with itchy skin lesion in 2 months				
Yes	43 (9.6)	07 (16.3)	36 (83.7)	<0.000[a,b]
No	404 (90.4)	02 (0.5)	402 (99.5)	
Sharing of sleeping beds with others at home				
Yes	320 (71.6)	07 (2.2)	313 (97.8)	0.677[a]
No	127 (28.4)	02 (1.6)	125 (98.4)	
Sleeping with a person who has an itchy skin lesion (n=320)				
Yes	20 (6.3)	03 (15.0)	17 (85)	<0.000[a,b]
No	300 (93.8)	04 (1.3)	296 (98.7)	
Sharing of garments with family members at home				
Yes	254 (56.8)	04 (1.6)	250 (98.4)	0.449[a]
No	193 (43.2)	05 (2.6)	188 (97.4)	
Number of pupils sitting at one desk				
1-2	42 (9.4)	01 (2.4)	41 (97.6)	0.965[a]
3-4	403 (90.2)	08 (2.0)	495 (98)	
≥5	02 (0.4)	00 (0.0)	02 (100)	
Access to water				
Yes	442 (98.9)	8 (2.1)	434 (97.9)	0.747[a]
No	05 (1.1)	01 (1.7)	04 (98.3)	
Knowledge level				
High	7 (1.6)	0 (0.0)	07 (100)	0.190[a]
Moderate	119 (26.6)	5 (4.2)	114 (95.8)	
Low	321 (71.8)	4 (1.2)	317 (98.3)	
Level of attitude				
Good	209 (46.8)	5 (2.4)	204 (97.6)	0.740[a]
Poor	238 (53.2)	4 (1.7)	234 (98.3)	
Level of care seeking behavior				
Appropriate	193 (43.2)	5 (2.6)	188 (97.4)	0.509[a]
Inappropriate	254 (56.8)	4 (1.6)	250 (98.4)	

[a] Fisher's exact;
[b] P ≤0.05, which indicates significance level.

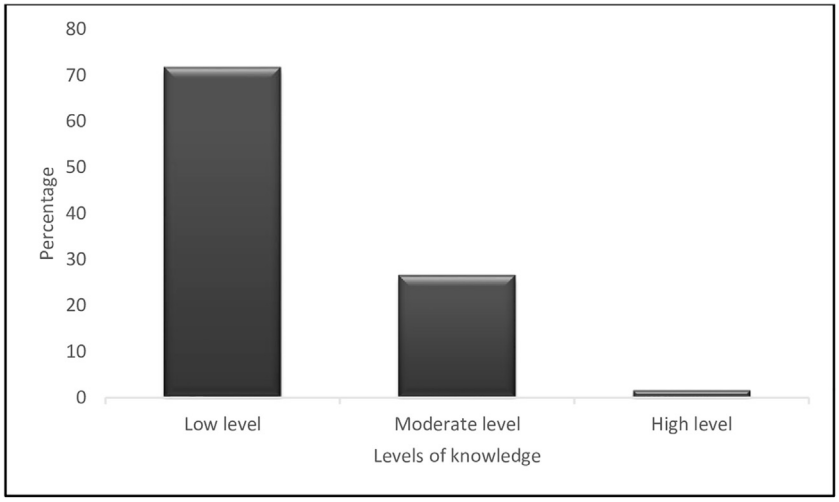

Figure 1. Levels of knowledge on scabies among the study participants.

Table 3
Classification of scabies knowledge levels according to socio-demographic characteristics of the study participants

Variable	High level (%)	Moderate level (%)	Low level (%)	P-value
All participants	7 (1.6)	119 (26.6)	321 (71.8)	447 (100%)
Sex				
Male	05 (2.4)	53 (25.1)	153 (72.5)	0.365[a]
Female	02 (0.8)	66 (28.0)	168 (71.2)	
Age- group				
5-10	06(2.5)	48 (19.8)	188 (77.7)	<0.006[a,b]
11-15	01 (0.5)	68 (34.5)	128 (65.0)	
>15	00 (0.0)	03 (37.5)	05 (62.5)	
Class				
1-4	07 (2.9)	45 (18.4)	192 (78.7)	<0.000[a,b]
5-7	00 (0.0)	74 (36.5)	129 (63.5)	
School name				
Mapinduzi	00 (0.0)	31 (21.1)	115 (78.8)	0.023[a,b]
Nyamwage	00 (0.0)	26 (31.0)	58 (69.0)	
Ikwiriri	07 (3.2)	62 (28.6)	148 (68.2)	

[a] Fisher's exact;
[b] $P \leq 0.05$, which indicates significance level.

Attitudes and healthcare–seeking behavior toward scabies among study participants

About 47% of participants perceived scabies as a disease that affects elderly and children. However, more than a quarter of the participants (28.2%) perceived scabies as a shameful disease and reported that scabies-infested students should be stigmatized by their peers and society (26.8%). Furthermore, only a few (9.8%) believed that scabies is a superstitious disease and pupils with scabies perform poorly in class because of itching (43.4%) (Figure 2).

According to care-seeking behavior, nearly half of the participants (48.3%) agreed that it is crucial to seek care at health facilities once having symptoms of scabies, whereas a few (11.2%) reported that scabies is self-limiting and thus does not need to be assessed by a doctor. More than a quarter of participants (28.4%) preferred buying scabies medication from local pharmacies instead of going to the hospital. About 43.6% of participants agreed that treating scabies can prevent further complications, whereas 46.5% agreed that untreated scabies can lead to absenteeism from school and poor performance, as shown in Figure 3.

Classification of attitude and healthcare–seeking behavior of study participants according to socio-demographic characteristics

More than half of the participants had inappropriate health care–seeking behavior (254 of 447, 56.8%) and poor attitudes toward scabies (254 of 447, 53.2%) (Figure 4).

Poor attitude was highly observed among participants of the age group 5-10 years (153 of 232, 63.2%, P <0.000) and among participants belonging to class levels 1-4 (152 of 244, 62.3%, P <0.000). In addition, inappropriate level of healthcare–seeking behavior was highly observed in the same age group 5-10 years (163 of 232, 67.4%, P <0.000) and in participants belonging to class levels 1-4 (168 of 244, 68.9%) (Table 4).

Prevalence of S. scabiei *infestation according to knowledge, attitude, and healthcare-seeking behavior*

No statistically significant difference in clinically diagnosed scabies was observed across all levels of knowledge, attitudes, and health care–seeking behavior (Table 2).

History of scabies disease and accessibility to treatment among participants

A total of 81 participants stated that they had experienced *S. scabiei* infestation. The majority (87.7%) received treatment, with nearly two-thirds (64.8%) reported receiving treatment from the hospital (Supplementary Table 3).

Factors associated with S. scabiei *infestation among study participants*

In the univariate analysis, the frequency of changing clothes before washing them, history of a family member with itchy symptoms, physical contact with someone with itchy skin lesions, and sharing a bed with

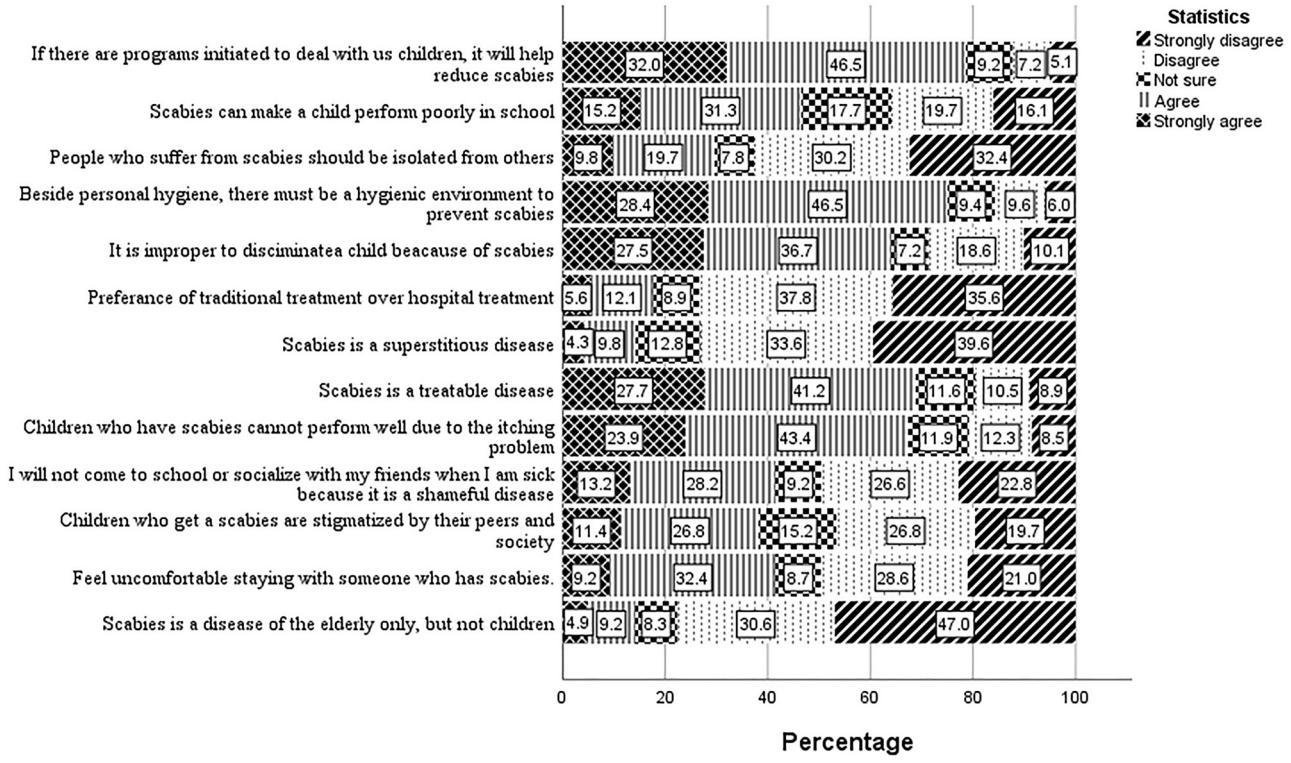

Figure 2. Attitudes toward scabies among the study participants.

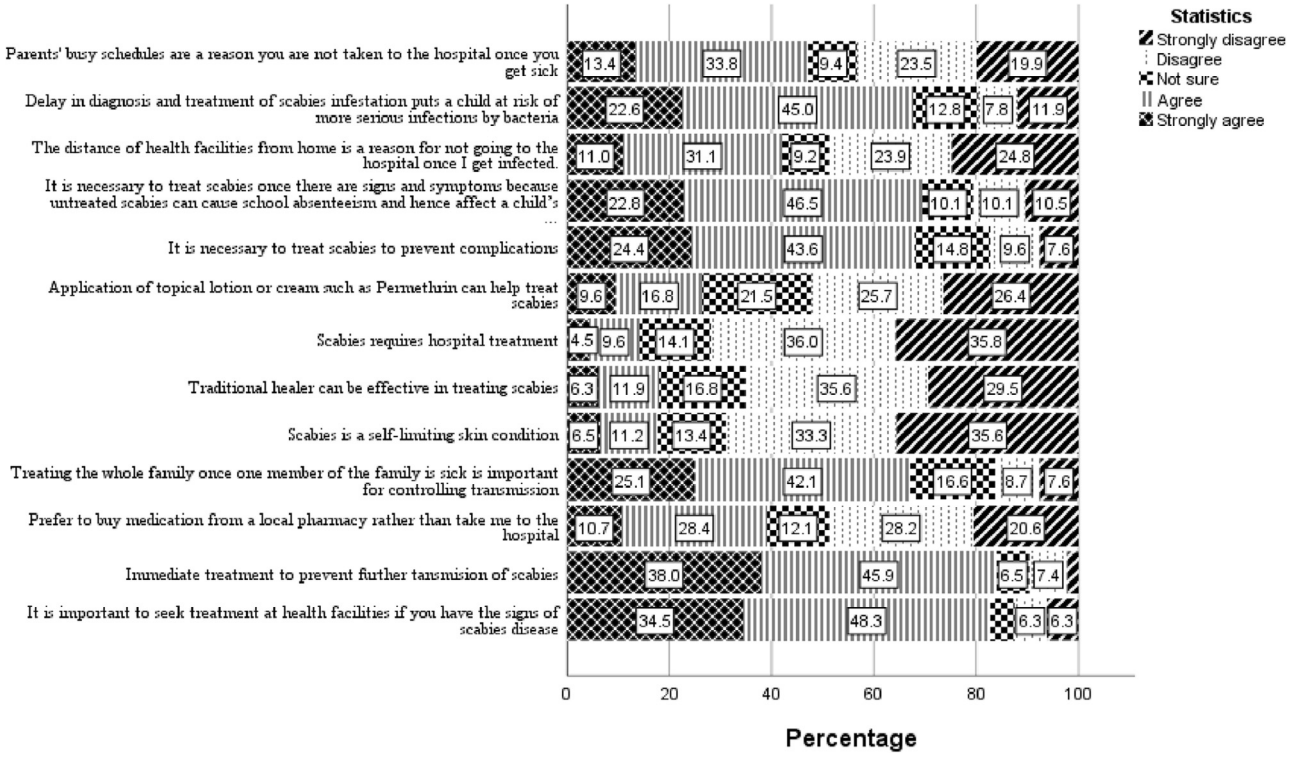

Figure 3. Health care–seeking behavior toward scabies in the study.

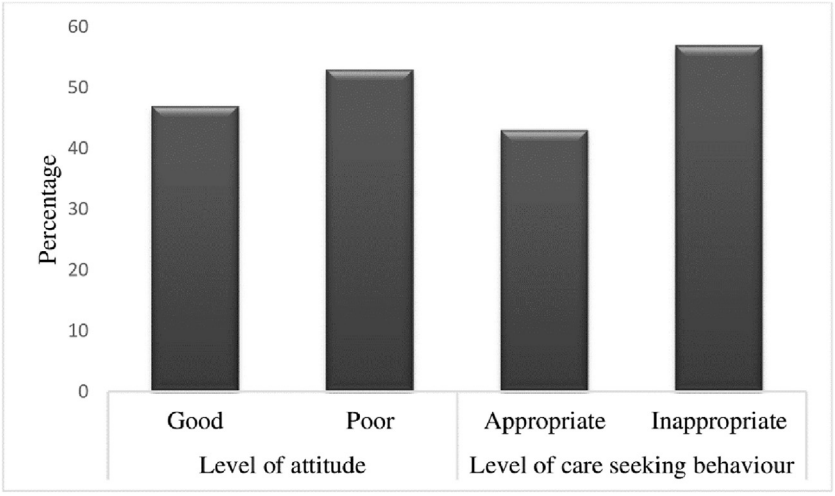

Figure 4. Classification of attitudes and healthcare–seeking behavior among the study participants.

Table 4
Classification of attitude and healthcare–seeking behavior according to socio-demographic characteristics of study participants.

Variable	Level of attitude			Level of care of seeking behavior		
	Good	Poor	P-value	Appropriate	Inappropriate	P-value
Sex						
Male	92 (43.6)	119 (56.4)	<0.206[a]	85 (40.3)	126 (59.7)	0.243[a]
Female	117(49.6)	119 (50.4)		108 (45.8)	128 (54.2)	
Age group						
5-10	89 (36.8)	153 (63.2)	<0.000[b,c]	79 (32.6)	163 (67.4)	<0.000[b,c]
11-15	115 (58.4)	82 (41.6)		111 (56.3)	86 (43.7)	
>15	05 (62.5)	03 (37.5)		03 (37.5)	05 (62.5)	
Class						
1-4	92 (37.7)	152 (62.3)	<0.000[a,c]	76/ (31.1)	168 (68.9)	<0.000[a,c]
5-7	117 (57.6)	86 (42.4)		117 (57.6)	86 (42.4)	
School name						
Mapinduzi	75 (50.1)	73 (49.3)	<0.437[a]	71 (48.0)	77 (52.0)	0.316[a]
Nyamwage	36 (42.4)	49 (57.6)		30/84 (35.3)	55/84 (64.7)	
Ikwiriri	98 (45.8)	116 (54.2)		92 (43.0)	122 (57.0)	

[a] Chi-square test;
[b] Fisher's exact;
[c] P <0.05, which indicates significant level.

an individual with itchy lesions were all statistically significant. After adjusting for confounders in multivariate regression, only physical contact with an individual with itchy skin lesions (AOR 4.04, 95%CI 4.39-12.50) and frequency of changing clothes before laundry (AOR 2.99, 95%CI 1.35-4.94) remained statistically significantly associated with *S. scabiei* infestation (Table 5).

Discussion

The clinical prevalence of scabies among participants was 2.0%, which suggests a potential ongoing transmission of scabies infestation in the Rufiji district. Our findings align with the prevalence documented in other studies carried out in Tanzania, encompassing participants from the community or pediatric age groups. These studies indicated a prevalence ranging from 2.1% to 2.9% [17,24]. The findings are also consistent with the study conducted in Côte d'Ivoire (West Africa), which reported a prevalence of 1.9% [25]. The observed prevalence is low compared with other studies conducted in the African setting, specifically in Ethiopia and Nigeria, where the prevalence ranged from 8.9% to 16% [4,11,22,26,27] but slightly higher than a household survey in Pikine/Dakar that found a 1.6% scabies prevalence, primarily among school-aged children [28]. The low scabies prevalence in our study could be explained by past MDA for lymphatic filariasis and improved WaSH in Rufiji. The comparatively higher prevalence in Ethiopia and Nigeria could reflect the differences in socio-cultural and economic statuses, living conditions, access to prevention and treatment, and variations in WaSH infrastructures.

Clinically diagnosed cases underwent parasitological investigation through skin scraping microscopy assessment to confirm the diagnosis by visualizing mites, eggs, or feces from skin scrapings. Of the nine clinically suspected cases of scabies, none were confirmed by parasitological investigation. Previous studies highlight the low sensitivity of microscopy for scabies diagnosis [8] because testing is contingent on the availability of the required equipment, operator skills, and sampling techniques, which are prone to error [29]. A study in Ghana found that none of the clinically diagnosed scabies cases were confirmed via microscopy, emphasizing the method's high specificity but low sensitivity. This underscores the challenges of relying on microscopic diagnosis in settings with limited resources, where clinical diagnosis often serves as a more practical approach to diagnosing scabies [30]. Thus, we cannot exclude the possibility that the findings of negative results were false negatives from a parasitological perspective. In addition, the low clinical prevalence found in this study could be justified by the distribution of ivermectin MDA carried out in the study setting that aimed at prevention and control programs for lymphatic filariasis. Although the programme did not target scabies directly, several studies have shown that ivermectin MDA reduces the prevalence of scabies immediately after distribution [3].

Table 5
Factors associated with S. scabiei infestation among study participants.

Variables	Univariate		Multivariate	
	Crude odds ratio (95%CI)	P-value	Adjusted odds ratio (95%CI)	P-value
Sex				
Male	2.27 (0.56-9.21)	0.250		
Female	Ref			
Age	0.73 (0.54-0.99)	0.045	0.80 (0.43-1.48)	0.469
Class group				
1-4	2.97 (0.61-14.45)	0.178	3.02 (0.15-16.44)	0.824
5-7	Ref		Ref	
Frequency of bathing				
Frequently	Ref			
Infrequently	3.10 (0.366-26.17)	0.299		
Washing of clothes				
Frequently	Ref			
Infrequently	0.32 (0.08-1.22)	0.095	0.13 (0.01-1.98)	0.143
Frequency of changing clothes before laundry				
Frequently	Ref		Ref	
Infrequently	2.73 (1.22-4.586)	0.001	2.99 (1.35-4.94)	0.001[a]
Number of family members				
1-5	0.533 (0.13-2.16)	0.379		
Greater than 5	Ref			
Having a family member with itching				
Yes	3.10 (3.13-16.85)	<0.000	1.030 (0.10-10.50)	0.980
No	Ref		Ref	
Had contact with a person with itchy skin lesions				
Yes	5.08 (2.83-15.14)	<0.000	4.04 (4.391-12.50)	<0.007[a]
No	Ref			
Sleeping with a person with itchy skin lesions				
Yes	9.46 (2.22-30.34)	<0.002	7.020 (0.714-49.04)	0.095
No	Ref			
Sharing garments with other family members				
Yes	0.60 (0.16-2.27)	0.453		
No	Ref			
Knowledge level				
Low level	Ref		Ref	
Moderate level	3.48 (0.92-13.17)	0.067	3.49 (0.85-14.33)	0.083
High level	0.000 (0.000)	0.999	0.000 (0.000)	0.999
Level of attitude				
Good	Ref			
Poor	1.43 (0.39-5.41)	0.595		
Level of healthcare-seeking behavior				
Appropriate	Ref			
Inappropriate	0.60 (0.159-2.27)	0.453	0.60 (0.159-2.27)	

CI, confidence interval; Ref, reference.
Fisher's exact.
[a] P <0.05, which indicates a significant level.

This study identified a statistically significant association between scabies infestation and infrequently changing clothes, with contrasting findings from Ethiopia (Arba Minch Zuria and Raya Alamata district) showing no statistically significant association between the infrequency of changing clothes and scabies infestations [26]. Poor personal hygiene is reported to increase the risk of secondary bacterial superinfections, such as impetigo; however, soap use has been shown to reduce the risk of these complications [31]. The role of personal hygiene in scabies prevalence is inconsistently reported across studies, indicating a complex and varied understanding of how personal hygiene influences scabies infestation [4,6,31].

Of the assessed living condition factors, contact with someone with an itchy skin lesion was the only variable that remained independently associated with scabies. Physical contact is known to be the main method of spread of scabies [16]. This finding is comparable to the study conducted in Ethiopia, which showed that people who had contact with a person with scabies were more likely to contract the disease than those who did not have contact with a person without scabies [11,32].

This study also assessed pupils' knowledge of scabies and found that the majority of participants had low knowledge levels. The reason may be that scabies is one of the neglected diseases that are underemphasized in sub-Saharan Africa, especially in the aspect of providing specific health education. Other studies carried out among students in an Islamic education institution in Jatinangor (Indonesia) [15] and among community informants in Bijagós Islands [33] also reported low knowledge of the disease's etiology or methods of prevention among adolescents and adult population, respectively, in a different geographic setting.

In this study, more than half of the participants had inappropriate health care–seeking behavior and a poor attitude. The observed findings may be because of the low knowledge level observed among the study participants. This is supported by the study conducted in Jatinangor (Indonesia) in which the participants displayed good attitudes and moderate levels of practice that were consistent with their observed levels of knowledge and the surrounding environment [15].

Our study was also able to report on the general attitudes and health care–seeking behaviors of the study participants toward scabies. The finding contributes to the understanding of the low healthcare–seeking behavior observed in this setting. Burki emphasized that many infected individuals never seek health care in the first place. This is often the case in communities where scabies is prevalent, and parents might not consider it necessary to seek treatment for their children [1]. In addition, the widespread stigma associated with scabies further deters people from seeking care [1]. The study conducted in central Ghana aligns with the findings from the current study, which reported a preference for self-

treatment among some participants [34]. Studies of the Bijagós Islands reveal that scabies adversely impact quality of life, children's school attendance, and stigma, predisposing infected individuals to feelings of shame and influencing their health care–seeking behavior [33].

Limitations of the study

Despite the study adding the current epidemiological data on the prevalence of scabies and factors associated with ongoing transmission among PSCs, it had the following limitations. The study was school-based; thus, we were unable to observe the participants' home living conditions. It was hard to interview PSCs in class 1 and 2 because of their inability to express themselves. However, it was mitigated by explaining the questions and giving them enough time to provide answers. Some of the questions required recalling the previous information and hence could have been subjected to recall bias, resulting in over- or underestimation of their response. Knowledge, attitudes, and practices toward scabies infestation were not assessed among the parents, and the study could not provide information on how these aspects could influence the infestation rate in kids. The absence of a dermatologist in the team limited the broadening of the differential diagnosis process, emphasizing the need to move from a disease-centered approach to an integrated approach for skin NTD assessment.

Conclusion and recommendations

Clinical scabies was observed in 2% of the participants in the Rufiji district, suggesting a potential ongoing transmission of *S. scabiei* in this setting. Physical contact with someone with an itchy skin lesion and frequency of changing clothes before laundry were statistically significantly associated with *S. scabiei* infestation. Furthermore, the majority of participants had low knowledge levels, with more than half having poor attitudes and inappropriate care-seeking behavior.

Considering an observed prevalence of <10%, our findings suggest a test-and-treat approach through routinary school-based screening of clinical cases with ivermectin and topical permethrin, as per the World Health Organization guidelines. Integration with other skin NTD prevention and control programmes is desirable due to the need to carry out a differential diagnosis that includes other skin NTDs, as well as other skin diseases. Given the low knowledge observed among study participants, the Neglected Tropical Disease Control Programme should design a health education programme and integrate it into the primary school curriculum to increase their knowledge of scabies and change their poor attitudes and inappropriate practices.

Declarations of competing interest

The authors have no competing interests to declare.

CRediT authorship contribution statement

Mary Joseph: Conceptualization, Formal analysis, Investigation, Methodology, Writing – original draft, Writing – review & editing. **Vivian Mushi:** Conceptualization, Formal analysis, Investigation, Methodology, Writing – original draft, Writing – review & editing. **Hoseenu Palilo:** Investigation, Methodology, Writing – review & editing. **Valeria Silvestri:** Writing – original draft, Writing – review & editing. **Clemence Kinabo:** Investigation, Methodology, Writing – review & editing. **Irene Mshana:** Investigation, Methodology, Writing – review & editing. **Suleiman Chombo:** Formal analysis, Writing – review & editing. **Ismail Ndaile:** Writing – review & editing. **Donath Tarimo:** Conceptualization, Investigation, Methodology, Writing – review & editing.

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Acknowledgment

The authors express their utmost thanks to the PSC for participating in this study and to their parents and head teachers for allowing the children to be part of the study. The authors also extend their sincere appreciation and thanks to the district medical officer, district health officer, and district education officer (primary schools) of the Rufiji district for providing permission to conduct the research in the Rufiji district.

Availability of data and materials

The data and materials used in this study, including the questionnaire, are attached in the supplementary file.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.ijregi.2024.100365.

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