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Epidemiological Study and Evolution of Monospecific and Low Transmission Schistosomiasis Guineensis Foci in Absence of Praziquantel Chemoprevention: Edea and Eseka in Cameroon

Cyrille Bruno MOGO[1], Leopold Gustave LEHMAN[2], Thomas KUETE[3,*]

[1]Center for Medical Research in Health and Priority Pathologies, Institute of Medical Research and Medical Plant Studies, Yaoundé 13033, Cameroon
[2]Faculty of Sciences, The University of Douala, Cameroon
[3]Faculty of Medicine and Pharmaceutical Sciences, The University of Douala, Cameroon
*Corresponding author: thomaskuete@hotmail.com

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Abstract Implementation of chemoprevention with praziquantel against schistosomiasis significantly decreased prevalence and intensities of infection in moderate to heavy transmission settings. However, evolution of schistosomiasis transmission pattern in previously known low transmission areas remains of concern. This study aimed to evaluate prevalence and intensities of infection of human *Schistosoma* infection and specific snail intermediate hosts cercaria shedding in Edea and Eseka, two previously known monospecific hypoendemic *Schistosoma guineensis* transmission foci in Cameroon, then compare data to previous epidemiological surveys. This community-based cross-sectional study was undergone in 2024 in Edea and Eseka by collecting socio-demographic data, stool and urine samples from consenting dwellers. Stool and urine samples were processed using Kato-Katz and urine centrifugation techniques respectively to count *Schistosoma* eggs under microscope. Parasitic loads and intensities of infection were determined. *Schistosoma* intermediate hosts were collected in waterbodies at human-water contact sites, identified using shell morphology specific identification keys, then tested for cercarial shedding. Data were compared to previous epidemiological reports in 1969 and 1981. Data were statistically analyzed considering a *p-value* < 0.05 as significant. Of a total of 502 dwellers included in the study, 444 provided stool samples and 448 urine samples in the two areas. Only *S. guineensis* eggs were detected in humans with a prevalence of 0% (0/215) and 1.7% (4/229) at Edea and Eseka respectively. Being adolescent (p=0.008) and attending waterbodies for bathing and fishing or laundry (p=0.02) were associated to *S. guineensis* infection. Only *Bulinus forskalii* were harvested in the two areas. Of the 43 alive *B. forskalii* collected, the prevalence cercariae shedding was 0%. Compared to epidemiological data gathered 45 years ago, the prevalence of *S. guineensis* infections has decreased significantly in the two sites. Prevalence of schistosomiasis has decreased in Edea and Eseka, *S. guineensis* remaining the only specie. Infected subjects harbor low to moderate intensities of infection. *Bulinus forskalii* were cercariae free.

Keywords: *Bulinus forskalii, cercaria shedding, low transmission, praziquantel chemoprevention, schistosomiasis, Schistosoma guineensis, Edea, Eseka, Cameroon*

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1. Introduction

Schistosomiasis is a parasitic neglected tropical disease (NTD), which is mainly endemic in 76 countries in the intertropical areas of Africa, America and Asia where at least 600 million persons are at risk and 200 million persons parasitized by at least one of the human infective species [1]. Schistosomiasis is caused by infection by trematode flukes of the genus *Schistosoma* (Weinland, 1858), transmitted to human through skin penetration of free-living forked tail cercaria shed by specific snail intermediate host when human or other appropriate vertebrate enter in contact of freshwater containing these larvae [2]. Three of the six *Schistosoma* species that infect human worldwide are endemic in Cameroon namely *Schistosoma haematobium* (Bilharz, 1852; Weinland., 1858), *Schistosoma mansoni* (Sambon., 1907) and *Schistosoma guineensis* (Pages *et al.*, 2003) [3,4,5,6]. The

distribution and prevalence patterns of these species in Cameroon are heterogenous with existence all regions of low, moderate and even high transmissions foci close to no transmission areas [4,5,7]. Transmission of schistosomiasis is closely related to presence in waterbodies of specific freshwater snails, humans or vertebrate who practice open air defecation or urination, and activities which bring human into contact with contaminated water like laundry, bathing, fishing. *Schistosoma* infected persons who harbor moderate to heavy parasite loads may experience impairment of nutritional status and cognitive development in children, spleen and liver enlargement, portal hypertension in advanced cases, kidney and bladder pathologies [8].

Since the early 2000, the World Health Organization recommended to public health decision makers of schistosomiasis endemic countries to implement an integrated control approach to eliminate schistosomiasis as a public health problem [6,9,10]. This integrated approach includes regular mass treatment with praziquantel of high-risk groups especially school-aged children in moderate and high transmission areas complemented with basic sanitation and adequate safe water supplies through improvement of water, sanitation and hygiene (WASH) and behavior change, snail control and environmental management [6,9,10,11]. Preventive chemotherapeutic with praziquantel remains the most implemented control strategy used so far in almost all African schistosomiasis endemic countries [5,7,10,11]. Impact assessment studies on praziquantel chemoprevention in Sub-Saharan African countries reported significant decreased prevalence as well intensity of infections of schistosomiasis up to 67.9% against *S. haematobium* 53.6% against *S. mansoni* under preventive chemotherapy [12,13,14]. Following this significant reduction of schistosomiasis prevalence and intensity of infections, the WHO as well as the National Program for Control of STH and Schistosomiasis (NPCSIH) in Cameroon elaborated and published a roadmap in 2021 to eliminate of schistosomiasis by 2030[10,13,15]. This road map advocates complete mapping precision of STH transmission settings as a cornerstone of the new approach as well as scale-up and expand access to treatment to all populations in need namely preschool-aged children and adults [10,11,13].

Praziquantel mass distribution to at risk population is however recommended only in moderate or high schistosomiasis transmission settings [10,15]. Therefore, evolution of low transmission areas where chemoprevention with praziquantel as never been implemented remains of concern. In low schistosomiasis transmission setting, the WHO suggests that the intervention be continue at the same or reduced frequency towards interruption of transmission where there has been a program of regular preventive chemotherapy, or to use a test and-treat approach instead of preventive chemotherapy targeting a population where there has not been a previous programme of regular preventive chemotherapy [9,11].

Edea and Eseka are two urban areas in the Littoral region and the center region of Cameroon respectively where first epidemiological studies carried out in 1969 and 1978 reported these towns as monospecific and low *Schistosoma guineensis* transmission areas with presence in waterbodies *Bulinus forskalii* shedding *Schistosoma*-like cercariae [16,17]. These epidemiological studies first described the terminal spined *Schistosoma* eggs voided in stool samples of residents as *Schistosoma intercalatum* [16,17]. Based on genetic and molecular characteristics, further studies identified the lower Guinea strain of *S. intercalatum* as *S. guineensis* in Central Africa countries, and the strain found in the Democratic Republic of Congo strain maintained as *S. intercalatum* [18]. *Schistosoma guineensis* has a particular biology that its major foci are in town areas and clearings, *B. forskalii* being its specific snail intermediate host, and it can hybridize with *S. haematobium* in mixed foci as reported in Cameroon at Loum and Kinding-Djabi and in Gabon. The epidemiological study undergone in 1979 at Edea and Eseka was followed by specific treatment at spot with praziquantel of all subjects who voided *Schistosoma* eggs in their stool samples [17]. Since then, few epidemiological data available on schistosomiasis in Edea and Eseka usually referred to the 1979 reports and consider these towns as hypoendemic [3,5,19]. Due to their hypoendemic foci feature, Edea and Eseka schistosomiasis *guineensis* foci were not eligible for praziquantel chemoprevention strategy since its beginning in Cameroon. In absence of implementation of praziquantel chemoprevention in low schistosomiasis transmission settings, the transmission trend of schistosomiasis may evolve towards either an aggravation to moderate or high transmission area, or to a decrease or stable transmission settings. Previous epidemiological studies in Cameroon before the launch of praziquantel chemoprevention reported significant decline of prevalence of *S. guineensis* in mixed foci with *S. haematobium* at Loum [20] and even disappearance of *S. guineensis* in a previous mixed focus with *S. mansoni* at Nkolmebanga [21]. The decline of *S. guineensis* despite any implementation of praziquantel chemoprevention was thought to be due to either increased urbanization or genetic competition [20,21]. The evolution of monospecific and low transmission *S. guineensis* setting has not been reported yet in Cameroon. Edea and Eseka have undergone changing due to rapid urbanization and increased population. Such changes may have therefore contributed to evolution of schistosomiasis status of the two towns trough importation of new Schistosoma species or changing in epidemiological trend of the existing specie. This study was therefore carried out to assess parasitological prevalence of human schistosomiasis and infection of *Schistosoma* specific snail intermediate hosts at Edea and Eseka and compare to reports gathered some 45 years ago in the two areas.

2. Materials and Methods

2.1. Study Type, Period and Place

This was a community-based cross-sectional study undergone from March 2024 to July 2024 in two main urban areas of Cameroon namely Edea in the Littoral region and Eseka in the Center region (Figure 1).

Edéa is the headquarter of the Sanaga Maritime division in the Littoral region of Cameroon. Edéa is located

3°48'0" N and 10°7'60" E. It has two main subdivisions namely Edéa 1 and Edéa 2. The population of Edéa is estimated at 122 300 inhabitants. Edea is an urban area made of two subdivisions namely Edea I and Edea II. Populations of Edea 2 are mainly civil servants, employees of in industry, farmers of banana, palm trees, cocoa and animal husbandry. The hydrographic network is dominated by the Sanaga river and its tributaries namely Pongo. Housing is mixed predominantly made of boards, carabots close to house made of concrete bricks [22,23].

Eseka is the head quarter of the Nyong-et-Kelle division in the Center region of Cameroon. Its geographic coordinates are 3°39'0" N and 10°46'0" E. Eseka is a semi-urban area situated at about 126 km from the nation capital Yaoundé. Its population is estimated at 23 242 inhabitants. Main occupations of residents are farming (palm trees, cocoa, bananas) and few civil servants. The hydrological network is made of river Nyong and tributaries namely Kellé, Mouanda, Djogob, Maloume et Mbope [22].

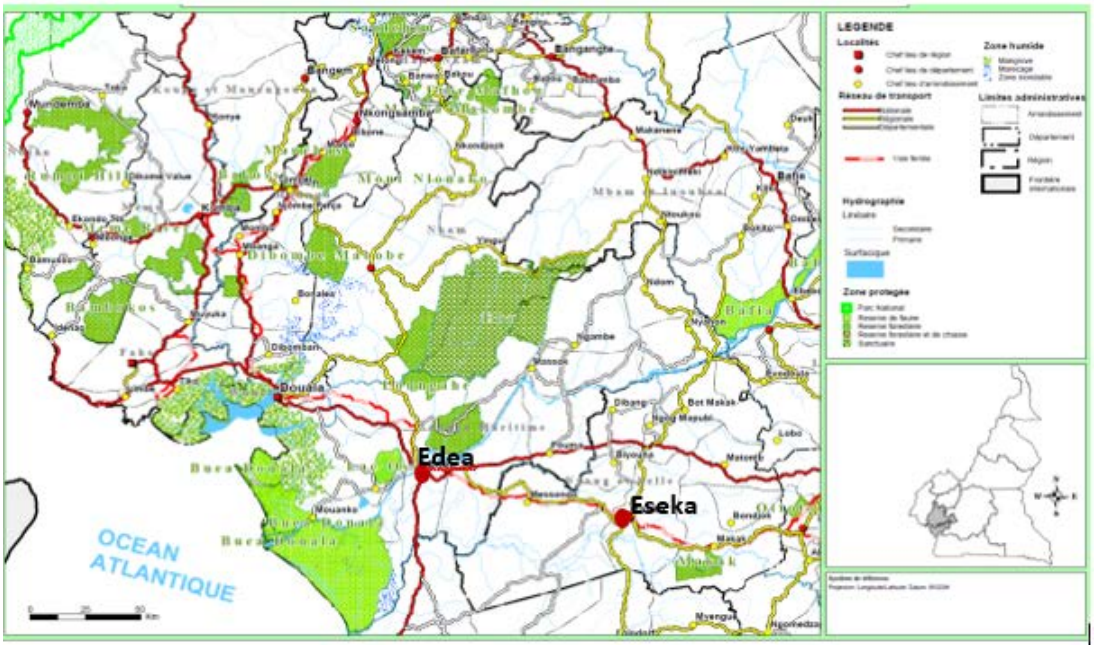

Figure 1. Location of Edea and Eseka in Cameroon [23]

In each of the study area, data were collected in quarters where S*chistosoma* infected subjects and snail intermediate hosts were detected in previous epidemiological studies [17]. At Edea 1 subdivision, the study took place in four quarters namely Edea-gare, Amour, Nkongmondo and Pongo. At Eseka, sampling was done in seven quarters crossed at least by a tributary of river Nyong namely Adna, Aviation, Likabo, Lycée, PK3, Tetem and Village.

2.2. Ethical Statement

The study protocol was approved by the Institutional review board of the Faculty of Medicine and Pharmaceutical of the University of Douala, the Institutional Ethic Committee of the University of Douala hosted by the Faculty of Medicine and Pharmaceutical Sciences, and the Regional Delegations of Public Health of the Littoral region in Douala and the center region in Yaoundé and the National Ethic Committee. The Institutional Ethic Committee of the University of Douala and the National Ethic Committee granted the ethical clearances N°4023CEI-Udo/10/2023/M and N°2024/02/143/CE/CNERSH/SP respectively for this study. The Regional Delegations of Public Health of the Littoral region and the center region granted each a research authorization to undertake the study. The district medical officer of each of the health district was approached to seek an authorization to access the population and waterbody sites. Data were collected on the field by the study investigators with the help of community health workers (CHW).

2.3. Study Criteria

All inhabitants aged at least 5 years of each selected quarter of the Edea and Eseka district health were targeted as the study population. The inhabitant should be resident in the area since at least six months. He should have signed the study informed consent and should give a convenient quantity of stool sample and at least 15 ml of urine. For under 15 years persons, its parent or legal guardian should have signed the study informed consent. Visitors and those who (or whose parent) did not sign the study inform consent were not admitted in the study.

For malacological study, Schistosoma snail intermediate hosts were sought in smooth running waterbodies at human water contact points and their accessibility for anthropogenic activities.

2.4. Data Collection

The study consisted in: i) collection and laboratory analysis of stool and urine specimens from each participant, ii) collection of freshwater snails potent schistosome intermediate hosts followed by cercariae shedding testing to estimate the prevalence of schistosome infection in snails.

2.4.1. Collection of Data for Human Schistosomiasis Assessment

Data related to humans were collected in four quarters at Edea II HD including Edea Gare, Amour, Nkongmondo and Pongo, while at Eseka HD, the recruitment of participants took place in seven quarters namely Adna, Aviation, Likabo, Lycée, PK3, Tetem and Village.

After obtaining ethical clearances, a meeting was convened and held with the head of the district hospital and traditional authorities were met to present and explain them the protocol and plan for a meeting with the population.

In each town, a meeting was held with the health district head and his collaborators during which the study protocol was presented. Then the study investigator asked for an authorization to sensitize the local population of each quarter with the company of community health workers. In the quarter, residents were convened at the residence of the local quarter head during which the study was carefully read and explained to the participants or the legal guardian (for children), then each participant was asked for consent before his (or his child) enrolment into the study. He (or the parent) was asked to sign the study informed consent sheet if he accepted to participate. Each person who agreed to participate in the study was questioned for the following data: sex, age, occupation, sanitation type ownership, provision of drinking water, history of any praziquantel treatment in the previous days. Participants were classified into five occupational groups namely schoolchildren, university students, civil servant, farmer, housewife, fisherman. The volunteer was then asked to give a stool and urine samples each in a clean plastic container given by the investigator. Stool and urine samples were then transported to the nearest laboratory for analysis.

Each urine and stool samples were analyzed in laboratory using centrifugation technique and Kato-Katz technique respectively according to laboratory routine procedures [24,25]. For urine centrifugation technique, 10 ml urine of urine was centrifuged at 3000 rotors/ minute for 5 minutes, then the centrifugation pellet was examined under light microscope for detection and counting *S. haematobium* eggs. For stool analysis, duplicate Kato-Katz calibrated thick smears were made from each stool sample, then examined under light microscope for detection and count of *Schistosoma* sp eggs. Parasitic load of each *Schistosoma* specie was then brought to number of eggs per gram of feces for each participant.

Prevalence, intensity of infection and transmission level of each Schistosoma specie detected was estimated according to WHO guidelines [10,26]. Prevalence of each diagnosed infection was estimated as the percentage of subjects who harbored the parasites in the biological sample after parasitological data. The transmission level of each Schistosoma specie in the study area was classified using parasitological prevalence as low (prevalence less than 10%), moderate (prevalence range between 10% and less than 50%) or high (prevalence of 50% or higher). Intensity of infections were classified according to parasitic load as follow: low (if parasitic range between 1 and 99 epg of feces for intestinal schistosomiasis or less than 50 eggs of *S. haematobium*/10 ml of urine), moderate (if parasitic range between 100 and 399 epg of feces for intestinal schistosomiasis), heavy (if parasitic range equal or greater than 400 epg of feces for intestinal schistosomiasis, or at least 50 eggs of *S. haematobium*/10 ml of urine).

2.4.2. Collection, Identification and Cercariae Shedding Test of Freshwater Snail Potent Schistosome Intermediate Host

Freshwater snails were sought in each of the selected quarters in streams which were previously reported has bearing *Bulinus forskalii* shedding forked-tailed cercariae [17]. At Edea, freshwater snails were sampled in Mambandé which crosses Edéa Gare, while at Eseka, sampling took place in river Tetem, Lake Mala and streams in Briqueterie. Other waterbodies point where human water contact points were identified were also screened for snail detection and collection.

Freshwater snails were sampled between 7 am and 10 am for 20 minutes per spot using standardized sampling techniques in all running and standing waterbodies at spots namely rivers, streams, ponds, pools, and springs. Sampling techniques varied according to habitat. Snails hanged on aquatic vegetation were sampled using a scoop made of an iron frame kitchen sieve (with a mesh size of 2 mm x 2mm) mounted on a 1.5 m long wooden handle. Snails on stony substratum, floating aquatic macrophytes were picked up with soft clippers.

Snails collected were first identified macroscopically and counted at spot then immediately placed in plastic containers containing a sample of water and few micro plants from the water-contact site before onward transfer to the Parasitology laboratory of the nearest health facility for their identification and cercarial shedding testing. In laboratory, snails were then identified under a dissecting microscope using specific standardized taxonomic keys based on the shell morphology and structure [3,27,28].

After identification, each alive potent snail intermediate host of schistosome was isolated in a transparent flask containing 10 ml of filtered water and exposed to artificial bulb light (fluorescent bulb 60 Watts) for 2 hours (between 10 am and 2 pm) to stimulate the release of schistosome cercariae. The incubation solution was then examined under a dissecting light microscope for detection of swimming forked-tailed cercariae. The incubation solution was discarded daily after microscope examination then replaced by a fresh solution. Any detected forked-like cercariae was fixed with 5% iodine solution for counting under dissecting microscope. The cercariae shedding test of snails was repeated the next two days. The infection rate or prevalence of infection of each specific snail was estimated. Then, snails were preserved in well labelled plastic tubes containing 70% ethanol.

Data analysis. Data collected from humans were analyzed using Epi-info (Cspro 4.0), GraphPad (8.02) and statistical package for the social sciences (SPSS) 22 statistical softwares. The Fisher Exact test was used for statistical analysis assuming a significant difference threshold for a *P-value* less than 0.05

3. Results

A total of 502 residents participated in the study of whom 444 provided a stool sample and 448 provided

urine samples in the two areas. A total of 502 residents participated in the study. As indicated in table I, a total of 444 participants provided each a stool sample and 448 provided each a urine sample. Of the stool samples, 215 (48.4%) samples were collected at Edea and 229 (51.6%) collected at Eseka. Of urine samples, 210 urine samples (46.9%) were collected at Edea II and 238 urine samples (53.1%) collected at Eseka.

3.1. Distribution of the Sample Study According to Sociodemographic Factors

As indicated in Table 2, female participants were predominant in both sites with sex-ratio of 0.99 and 0.69 at Edea and Eseka respectively. According to age, participants aged over 30 years were predominant in the two sites followed by those aged less than 10 years. With respect to occupation, schoolchildren were the most represented group in either area.

3.2. Prevalence of *Schistosoma* Species Detected in Investigated Quarters at Edea and Eseka

As indicated in Table 1 and Table 2, *Schistosoma guineens*is was the only Schistosoma specie found in the study. This specie was detected only at Eseka. The overall prevalence of human schistosomiasis *guineensis* was 0% (0/215) and 1.7% (4/229) at Edéa and Eseka respectively. This prevalence of human schistosomiasis indicated a decrease of prevalence of human *S. guineensis* compared to data in 1979, and no implantation of urogenital schistosomiasis.

According to quarters, *S. guineensis* infections cases were found in two quarters of Eseka namely Adna and Lycée at prevalence of 3.7% and 3.8% respectively.

Being adolescent (p=0.008) and attending waterbodies for bathing and fishing or laundry (p=0.02) were associated to *S. guineensis* infection at Eseka.

3.3. Prevalence of *Schistosoma guineensis* Infection in Edea and Eseka According to Gender, Age and Occupation

As indicated in Table 2, sex did not significantly influence the prevalence of *S. guineensis* infections at Eseka (p=0.3) though female participants had the highest prevalence.

Age significantly influenced the prevalence of *S. guineensis* infections (p=0.008). *S. guineensis* was detected among participants aged between 10 to 19 years with the highest prevalence recorded among 15 to 19 years old participants.

S. guineensis infections were recorded among schoolchildren and housewives with the higher but not significant prevalence found among schoolchildren (p=0.9).

Table 1. Prevalence of *Schistosoma* infection in Edea and Eseka and their quarters

Town	Quarter	Stool samples					Urine samples		
			S. mansoni		*S. guineensis*			*S. haematobium*	
		N	Positive	%	Positive	%	N	Positive	%
Edea	Amour	58	0	0	0	0	54	0	0
	Gare	51	0	0	0	0	52	0	0
	Nkongmondo	81	0	0	0	0	81	0	0
	Pongo	25	0	0	0	0	23	0	0
	Total 1	215	0	0	0	0	210	0	0
Eseka	Adna	54	0	0	2	3,7	56	0	0
	Aviation	67	0	0	0	0	74	0	0
	Likabo2	8	0	0	0	0	12	0	0
	Lycée	53	0	0	2	3,8	32	0	0
	Pk3	26	0	0	0	0	28	0	0
	Tetem	7	0	0	0	0	7	0	0
	Village	14	0	0	0	0	29	0	0
	Total 2	229	0	0	4	1.7	238	0	0

Table 2. Prevalence of *S. guineensis* infection in Edea and Eseka according to gender, age and occupation

Factor		Eseka					Edea				
		N	Sg+	Sg-	%	*P*	N	Sg+	Sg-	%	*P*
Gender	Male	114	1	113	0.8	*0.31*	88	0	0	0	NA
	Female	115	3	112	2.6		127	0	0	0	
	Total	229	4	225	1.7		215	0	0	0	
Age (years)	5-9	52	0	52	0	0.008	75	0	75	0	NA
	10-14	47	1	46	2,1		33	0	33	0	
	15-19	32	3	29	9,3		16	0	16	0	
	20-29	25	0	25	0		18	0	18	0	
	≥ 30	73	0	73	0		73	0	73	0	
Occupation	Schoolchildren	126	3	123	2,3		122	0	122	0	
	Student	9	0	9	0		11	0	11	0	

Factor	Eseka					Edea				
	N	Sg+	Sg-	%	*P*	N	Sg+	Sg-	%	*P*
Civil servant	14	0	14	0	0.92	6	0	6	0	NA
Housewives	42	1	41	2,3		55	0	55	0	
Farmer	31	0	31	0		15	0	15	0	
Fishermen	4	0	4	0		1	0	1	0	

N: stool samples size. Sg+: *Schistosoma. guineensis* positive. Sg-: *Schistosoma guineensis* negative

3.4. Prevalence of Schistosoma Infection According to Water Contact Purpose

Three activities were identified which brought residents into contact with waterbodies namely bathing, laundry and fishing (Table 3). *S. guineensis* infection was found mainly among residents who spent time in waterbodies for laundry (1.4%) or for both bathing and fishing (1.3%).

Table 3. Prevalence of Schistosoma infection according to water contact purpose.

Water contact purpose	Eseka			Edea		
	N	Sg+	%	N	Sg+	%
Bathing	37	0	0	26	0	0
Laundry	78	1	1,4	33	0	0
Fishing	17	0	0	12	0	0
Bathing and fishing	29	3	1,3	78	0	0
No water contact	68	0	0	66	0	0

N: sample size. Sg+: *S. guineensis* positive. Sg-: *S. guineensis* negative.

3.5. *Schistosoma Guineensis* Infection Loads and Intensities of Infection

Schistosoma guineensis eggs loads ranged between 48 epg of feces and 240 epg of feces. Mean parasitic load was 126±86.3 epg of feces. Of the four participants who harbored *S. guineensis*, 2 had low intensity of infection and the two other had moderate intensities of infection. Mean parasitic loads recorded were lower than previous reports at Eseka [17]. The decrease in parasitic load might indicate decreased contact frequencies with water points as Eseka is becoming a town according to development plan published by the local council (PCD, 2015). It should be noted that after the 1979 epidemiological study in Edea and Eseka, participants who were infected by Schistosoma as shown by parasitological techniques were treated accordingly with praziquantel [17]. This treatment may have had a significant impact on the parasitic load.

3.6. Freshwater Snails Collected and Prevalence of Cercarial Shedding

Only *Bulinus forskalii* specimens were harvested in waterbodies of Edea and Eseka as potential Schistosoma intermediate hosts. Of a total of 43 *B. forskalii* collected in Edea and Eseka, none shed cercaria. The prevalence of cercaria infection in *B. forskalii* was therefore 0% in the two towns.

3.7. Evolution of Prevalence *Schistosoma guineensis* Infection at Edea and Eseka between 1969 and 2024

As shown in the Figure 2 below, prevalence of *S. guineensis* has continuously decreased from 1969 to 1979 and 2024 in Edea Eseka. Also, in snail intermediate hosts, prevalence of *B. forskalii* shedding cercaria decline so that in 2024, no cercaria was recorded from alive snails collected.

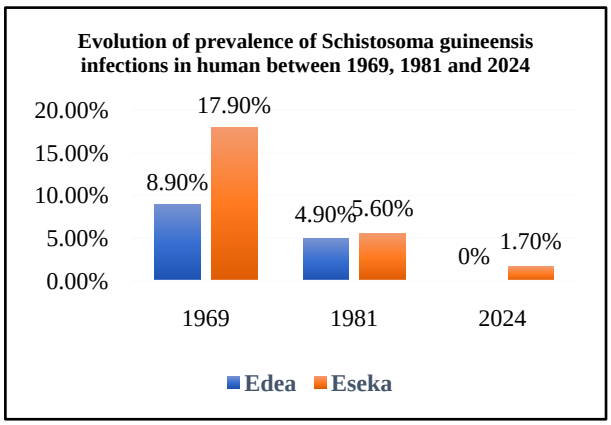

Figure 2. Evolution of prevalence of human schistosomiasis *guineensis* at Edea and Eseka between 1969 and 2024

4. Discussion

This study was an update and an assessment of evolution of the epidemiological features of schistosomiasis transmission level in two semi-urban areas namely Edea and Eseka which has always been identified as hypoendemic and monospecific schistosomiasis *guineensis* foci. Therefore, implementation of praziquantel chemoprevention has never been undergone in the said areas. Investigations undergone through examination of stool samples and urine samples of residents and cercaria test shedding of snails specific Schistosoma intermediate hosts collected in waterbodies. Diagnostic techniques used namely microscopic examination of stools and urine is the gold-standard for detection (diagnosis) of specific *Schistosoma* infection.

Only *S. guineensis* infections were detected in humans at Eseka only and none of *B. forskalii*. Specimens shed cercaria. No human schistosomiasis case was recorded at Edea. Prevalence of human *S. guineensis* infections recorded was lower than previous data from epidemiological studies undergone in 1968 [16] and 1979 [17] indicating a decreasing transmission level of schistosomiasis despite non implementation of mass distribution of praziquantel. The decreasing trend of *S. guineensis* (previously considered as *Schistosoma intercalatum*) has already been noticed in data collected 1979 compared to epidemiological study undergone 10 years ago by Deschiens and collaborators. Such decrease in a monospecific Schistosoma focus might be due to other factors like improvement of sanitation in the areas or

decreased frequentation of running and standing waterbodies. Previous assessment in mixed foci intestinal schistosomiasis due to *S. mansoni* and *S. guineensis* at Nkolmebanga in the center region of Cameroon reported decline of *S guineensis* infections and persistence of *S. mansoni* infections though at decreased prevalence, and attributed decline of *S. guineensis* infections to either increased urbanization or interspecific competition [22]. Such decline of *S. guineensis* infections in absence of praziquantel chemoprevention was earlier reported also in mixed focus with *S. haematobium* at Loum in the Littoral region of Cameroon and attributed to genetic competition [21].

In the case of Edea and Eska monospecific schistosomiasis *guineensis*, the decline of infection could only be attributed to change of habits of the local related to increased urbanization or changes of environmental factors. Environmental factors which can influence the decrease of Schistosoma transmission may include decreased open-air defecation, increase use of latrines, provision of water from wells or pipes. Implementation of water, sanitation and hygiene (WASH) is a key factor in reduction of exposure to transmission through reduction of water contact.

Limitation of the study. A monthly malacological study (snail collection and cercariae shedding test) during a year could have been given better light on the transmission of schistosomiasis in the two sites investigated. Also, use of more sensitive techniques like formol-ether concentration technique could have helped detecting low parasite loads. These limitations will be considered in an upcoming study in the same towns.

5. Conclusion

Eseka is still a monospecific and low transmission schistosomiasis *guineensis* focus with significant decreased prevalence, schistosomiasis was absent at Edea. Infected subjects harbored low to moderate intensities of infection. Being adolescent and attending waterbodies for bathing and fishing or laundry were associated to *S. guineensis* infection. Prevalence of schistosomiasis has decreased in Edea and Eseka, *S. guineensis* remaining the only specie. Of the *B. forskalii* specimens, the only Schistosoma intermediate host collected in streams in both towns none shed cercariae. A schistosomiasis elimination control can be emphasized in the two towns.

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Conflict of Interest

The authors of the manuscript declare that there is no conflict of interest regarding this study. The study was fully financed by the investigators.

Contribution of Authors

TK designed the study, collected and analyzed data, wrote the manuscript. CBM collected and analyzed data, LGL analyzed data and revised the manuscript

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