Intestinal parasitic infections in Sub-Saharan population illustrated with an example of inhabitants of the Central African Republic

Zarażenia pasożytami jelitowymi w populacji subsaharyjskiej na przykładzie mieszkańców Republiki Środkowej Afryki

Alina Augustynowicz[1], Krzysztof Korzeniewski[1]

[1] Department of Epidemiology and Tropical Medicine in Gdynia, Military Institute of Medicine in Warsaw;
Head: Col. Assoc. Prof. Krzysztof Korzeniewski MD, PhD

Abstract. Aim. The article presents the results of a research study into the prevalence of intestinal parasitic infections in residents of the Central African Republic. Material and methods. Parasitological examination was performed in December 2014 on stool samples obtained from 44 patients treated in a municipal hospital for internal diseases and 54 asymptomatic workers employed in the food processing and dining facilities in the multinational military base UCATEX in Bangui, the country's capital. The samples were examined with direct smear, decantation and flotation techniques in the Department of Epidemiology and Tropical Medicine MIM in Gdynia, Poland. Results. The study found that 9 (20.5%) of 44 hospital patients and 6 (11.1%) of 54 asymptomatic workers employed on the military base were infected with pathogenic intestinal parasites. The most commonly detected pathogens included *Entamoeba histolytica sensu lato* and *Schistosoma mansoni.* None of the 54 employees working in the base was found to be infected with nematodes, which might be explained by the fact that they had regularly received antiparasitic treatment (a single dose of 400 mg albendazole once a year), in contrast to the hospital patients, who had not received antihelminthic therapy. Conclusions. A wide variety of intestinal parasites found in Sub-Saharan Africa requires regular screening of the local populations in order to implement a targeted antiparasitic therapy instead of deworming recommended by WHO which is effective only in elimination of some nematode species.
Key words: Central African Republic, deworming, intestinal parasites

Streszczenie. Cel. W pracy przedstawiono wyniki badań w kierunku występowania zarażeń pasożytami jelitowymi wśród mieszkańców Republiki Środkowej Afryki. Materiał i metody. Badania parazytologiczne kału wykonano w grudniu 2014 r. u 44 pacjentów leczonych w szpitalu miejskim z powodu chorób wewnętrznych oraz u 54 bezobjawowych pracowników bloku żywnościowego międzynarodowej bazy wojskowej UCATEX w stolicy kraju, Bangui. Badania wykonano metodą rozmazu bezpośredniego, dekantacją i flotacją w Zakładzie Epidemiologii i Medycyny Tropikalnej WIM w Gdyni. Wyniki. Wśród 44 pacjentów szpitalnych zarażenia patogennymi pasożytami jelitowymi wykryto u 9 osób (20,5%), wśród 54 bezobjawowych pracowników bazy wojskowej u 6 osób (11,1%). Do najczęściej diagnozowanych patogenów należały *Entamoeba histolytica sensu lato* oraz *Schistosoma mansoni*. Zwracał uwagę brak zarażeń helmintami obłymi w grupie pracowników bloku żywnościowego, którzy w ramach działań prewencyjnych otrzymywali co roku dawkę 400 mg albendazolu, w przeciwieństwie do pacjentów szpitala miejskiego, którzy takiego leczenia nie otrzymywali. Wnioski. Występowanie różnorodnych typów pasożytów jelitowych w populacji subsaharyjskiej wymaga prowadzenia badań przesiewowych w celu ukierunkowanego leczenia zarażonych, w miejsce dewormingu zalecanego przez WHO, który jest skuteczny jedynie w eliminacji niektórych gatunków helmintów obłych.
Słowa kluczowe: Republika Środkowej Afryki, deworming, pasożyty jelitowe

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Adres do korespondencji
płk dr hab. med. Krzysztof Korzeniewski, prof. nadzw. WIM
Zakład Epidemiologii i Medycyny Tropikalnej
Wojskowy Instytut Medyczny,
ul. Grudzińskiego 4, 81-103 Gdynia
tel. 665 707 396
e-mail: kkorzeniewski@wim.mil.pl

Introduction

The Central African Republic (CAR) is located in Sub-Saharan Africa in the tropical climate. Across the country, there is a significant risk of developing infectious and invasive diseases and this risk especially applies to food- and water-borne infections. It is mostly associated with widespread soil and water pollution, limited access to uncontaminated drinking water, lack of hygiene at all stages of food production and sale, a limited number of healthcare providers, severe shortages of basic medicines and medical equipment, low vaccination rates for infectious diseases, a large number of asymptomatic carriers and mass migration of the local population. Diarrheal diseases are also endemic across the whole country and occur all year round. Treatment difficulties frequently arise from limited availability of laboratory diagnostics. One of the most common etiological factors for diarrheas in the CAR is *Escherichia coli* (a study carried out during the outbreak of diarrheal diseases in 1996 demonstrated that 108 of the patients examined were infected with ETEC, four of them died). A study into a group of outpatients treated for diarrheal diseases in the country's capital, Bangui between 2004 and 2005, showed that 3% of the subjects were infected with salmonellosis.

A population-based study into children demonstrated shigellosis prevalence of 9.7%. In 2005, an outbreak of hepatitis E was reported from Bangui (213 confirmed cases, the source of infection being contaminated water). In 2016, an outbreak of cholera was reported; the disease was confirmed in 265 patients, 21 of whom died [1]. Food- and water-borne diseases of parasitic etiology are also widespread in the Central African Republic. Screening tests conducted in 3,352 Bangui residents in the 1980s, revealed that as many as 46.8% subjects were found to be infected with intestinal parasites, of which 26.7% were infected with ancylostomiasis, 20.8% with schistosomiasis (*Schistosoma mansoni*), and 18.2% with amebiasis. The authors of the study emphasized that polyparasitism was widespread among study participants [2]. Over the last 30 years, the CAR has been experiencing serious civil unrest which led to the outbreak of a civil war. As a consequence, the level of medical care, including screening for infectious and invasive diseases, has deteriorated considerably. Owing to limited diagnostic and therapeutic capabilities of the local healthcare providers, treatment is often administered without laboratory confirmation of the etiological agent and the infections are managed with a limited range of pharmaceutical products. Between 2014 and 2015, a multinational UN-mandated military operation was conducted in Bangui, the capital of the Central African Republic. Soldiers from the Polish Military Contingent participated in the mission. The Head of the Department of Epidemiology and Tropical Medicine of the Military Institute of Medicine, responsible for epidemiological surveillance in the area, decided to perform parasitological examination among residents of the area where Polish troops were deployed. The examination was possible thanks to the cooperation with the missionaries from the Society of African Missions who run the public hospital in Bangui, and the managers of the *Ecolog* company employing workers at the food processing and dining facilities in the UCATEX base in Bangui. Biological material was obtained from two study groups.

The aim of the study was to assess the prevalence of intestinal parasites in residents of the Central African Republic.

Material and methods

Study population

Parasitological stool examination was conducted in December 2014. Samples were collected from 44 patients treated for internal diseases in the municipal hospital in Bangui as well as from 54 asymptomatic workers from the food processing and dining facilities in the UCATEX base in Bangui (EUFOR RCA military operation).

The group of hospital patients involved 21 children aged 1–14 and 23 adults aged 18–65; 28 females and 16 males. The group of asymptomatic workers consisted of 10 females and 44 males aged 18–52. Single fresh stool samples obtained from the study participants (both groups) were fixed in 10% formalin and then transported by air from the Central African Republic to the Department of Epidemiology and Tropical Medicine of the Military Institute of Medicine in Gdynia, Poland where coprological examinations were performed.

Parasitological examination

The diagnostics of intestinal parasites was performed by means of three stool testing methods using a light microscopy [3,4].

Direct smear in Lugol's solution

Approximately 2 mg of stool is collected with a glass rod and applied onto a slide, a drop of Lugol's solution is added and the material is smeared over a 4 cm^2 surface. Then, a cover slide is placed on top of the preparation and the material is examined microscopically under adequate magnification objective (first × 10, then × 40).

Preparation from decantation in distilled water

Approximately 2 g of stool specimen is mixed thoroughly with a small amount of water in a test tube. Next, water is added to the top of the tube. After 30 minutes the supernatant is decanted and another portion of water is added. This procedure is repeated until clear supernatant is obtained, generally three to four times. The sediment is

Table 1. Intestinal parasitic infections in patients hospitalized in Bangui, CAR in December 2014 (n=44)
Tabela 1. Zarażenia pasożytami jelitowymi u pacjentów hospitalizowanych w Bangui, RŚA w grudniu 2014 r. (n=44)

parasite infections		number of infections	% of tested patients (n=44)
single parasite infections	**pathogenic parasites**		
	Entamoeba histolytica sensu lato	3	6.8
	Schistosoma mansoni	2	4.5
	Giardia intestinalis	2	4.5
	Ancylostoma diodenale/ Necator americanus	2	4.5
	Strongyloides fuelleborni	1	2.3
	Enterobius vermicularis	1	2.3
	non-pathogenic parasites		
	Entamoeba coli	9	20.5
	Blastocystis sp.	4	9.1
	Iodamoeba bütschlii	2	4.5
	Endolimax nana	2	4.5
co-infections	Sm, AN, B	1	2.3
	Ib, Ec, B	1	2.3
	Sf, Ev	1	2.3
	Eh, B	1	2.3
	Eh, En	1	2.3
	Ec, En	1	2.3

AN – Ancylostoma duodenale/Necator americanus, B – Blastocystis sp.*, Eh – Entamoeba histolytica sensu lato, En – Endolimax nana, Ec – Entamoeba coli, Ev – Enterobius vermicularis, Ib – Iodamoeba bütschlii, Sf – Strongyloides fuelleborni*

then placed on a slide and stained with Lugol's solution for microscopic examination (×40 magnification).

Preparation from Fülleborn's flotation

Approximately 2 g of stool specimen is mixed with saturated NaCl solution in a test tube. Then, water is added to the top of the tube. A cover slide is placed gently on the top of the tube and in contact with the suspension. After 30 minutes the cover slide is gently removed with tweezers and placed the wet side down on a slide. The preparation is ready for microscopic examination (×10 magnification).

Results

The present study carried out to assess the prevalence of intestinal parasites among the residents of Bangui found intestinal parasitic infections in 20.5% of the hospital patients (9/44; 5/21 children and 4/23 adults; 7/28 females and 2/16 males) and in 11.1% of the asymptomatic workers (6/54 adults; 2/10 females and 4/44 males). The most commonly detected pathogens included *Entamoeba histolytica sensu lato* and *Schistosoma mansoni*. Apart from pathogenic parasites, non-pathogenic protozoan infections were also found in both study groups (Table 1–2).

It is worth noting that none of the 54 employees working in the base was found to be infected with nematodes; this was associated with the implementation of appropriate preventive measures, i.e. the administration of a single dose of 400 mg albendazole once a year, a medication which proved to be effective in eliminating nematode infections. In contrast, nematode infections, including *Ancylostoma duodenale*/*Necator americanus* (Figure 1), *Strongyloides fuelleborni*, *Enterobius vermicularis*, were detected in the group of hospital patients, none of whom had received antiparasitic treatment. Infections caused by protozoa and trematodes were present in both groups, as these must be managed with different doses or different types of drugs (Table 3). Apart from infections caused by cosmopolitan pathogens, the study revealed infections with tropical parasites, including *Schistosoma mansoni* (Figure 2), an etiological factor for schistosomiasis, a neglected tropical disease which is endemic in the Central African Republic.

Table 2. Intestinal parasitic infections in workers of UCATEX base in Bangui, CAR in December 2014 (n=54)
Tabela 2. Zarażenia pasożytami jelitowymi u pracowników bazy UCATEX w Bangui, RŚA w grudniu 2014 r. (n=54)

parasite infections		number of infections	% of tested workers (n=54)
single parasite infections	**pathogenic parasites**		
	Entamoeba histolytica sensu lato	3	5.6
	Schistosoma mansoni	2	3.7
	Giardia intestinalis	1	1.8
	non-pathogenic parasites		
	Entamoeba coli	9	16.7
	Endolimax nana	7	13.0
	Blastocystis sp.	3	5.6
	Iodamoeba bütschlii	1	1.8
co-infections	*Eh, Ec*	1	1.8
	Sm, Ec	1	1.8
	Gi, Ec, En	1	1.8
	Ec, En, Ib	1	1.8

Eh – Entamoeba histolytica sensu lato, En – Endolimax nana, Ec – Entamoeba coli, Gi – Giardia intestinalis, Ib – Iodamoeba bütschlii, Sm – Schistosoma mansoni

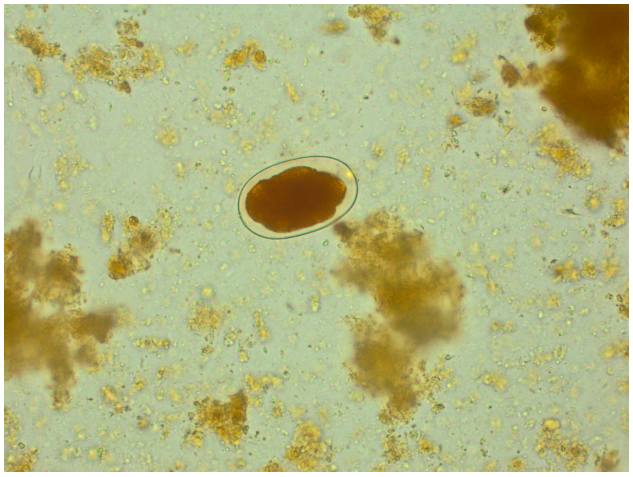

Figure 1. Ancylostoma duodenale/Necator americanus egg. Source: Zakład Epidemiologii i Medycyny Tropikalnej WIM

Rycina 1. Jajo *Ancylostoma duodenale/Necator americanus.* Źródło: Zakład Epidemiologii i Medycyny Tropikalnej WIM

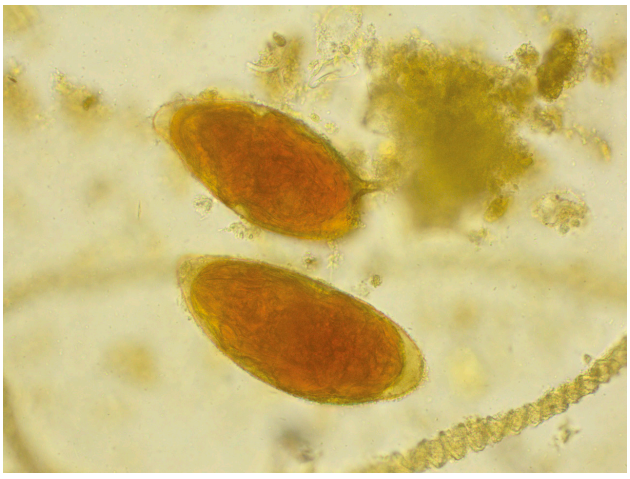

Figure 2. Schistosoma mansoni eggs. Source: Zakład Epidemiologii i Medycyny Tropikalnej WIM

Rycina 2. Jaja *Schistosoma mansoni.* Źródło: Zakład Epidemiologii i Medycyny Tropikalnej WIM

Discussion

In the developing countries, mass deworming is usually carried out by administering the WHO-recommended drugs [5]. As a rule, the World Health Organization recommends the administration of single doses of albendazole or mebendazole; this strategy is primarily aimed at the eradication of roundworm infections [6]. Unfortunately, sometimes it proves ineffective. For example, parasitological examination of more than 8,000 children from 30 districts of Rwanda, Sub-Saharan Africa, found that 66% of the subjects were infected with soil transmitted helminths. A study conducted one year after the administration of the WHO-recommended antihelminthic drugs demonstrated that the prevalence rates of ascariasis and trichuriasis fell only by 14%, while the prevalence of *Ancylostoma duodenale/Necator americanus* infections increased by 72% [7]. A successful infection

Table 3. Treatment of intestinal parasitic infections
Tabela 3. Leczenie zarażeń pasożytami jelitowymi

intestinal parasite	treatment
protozoa	
Entamoeba histolytica	
intestinal colonisation (asymptomatic carrier)	paromomycin – 8–12 mg/kg orally 3 times a day for 7 days
amebic colitis	metronidazole – 750 mg orally 3 times a day for 10 days (adults and children >12 years) children <12 years 30–50 mg/kg in 3 doses for 10 days
amebic liver abscess	metronidazole – 750 mg orally or *i.v.* 3 times a day for 10 days (adults and children >12 years) children <12 years 30–50 mg/kg in 3 doses for 10 days
Giardia intestinalis	metronidazole 250 mg orally 3 times a day for 5–7 days or 500 mg orally 2 times a day for 5 days (adults and children >12 years) 250 mg orally 2 times a day for 5 days (10–12 years) 125 mg orally 3 times a day for 5 days (6–10 years) 125 mg orally 2 times a day for 5 days (2–5 years)] children <2 years 1 × 5 mg/kg for 5 days
non-pathogenic protozoa: *Iodamoeba bütschlii, Entamoeba coli, Endolimax nana* *Blastocystis hominis*	in case of intestinal symptoms (nausea, vomiting, stomachache, diarrhea) – metronidazole 250 mg orally 3 times a day for 5–7 days or 500 mg orally 2 times a day for 5 days (adults and children >12 years) dosage in younger children similarly to *Giardia intestinalis* infections
nematodes	
Necator americanus/Ancylostoma duodenale	albendazole 400 mg orally once (>2 years) 200 mg orally once (children 1–2 years)
Enterobius vermicularis	albendazole 400 mg orally once (>2 years) 200 mg orally once (children 1–2 years) treatment to be repeated after 2 weeks
Strongyloides fuelleborni	ivermectin 200 μg/kg orally once a day for 2 days or albendazole 400 mg orally 2 times a day for 10–14 days
trematodes	
Schistosoma mansoni	praziquantel 20 mg/kg orally 2 times for one day

Source: Kappagoda S, Singh U, Blackburn BG. Antiparisitic therapy. Mayo Clin Proc, 2011; 86 (6): 561–583

control strategy to prevent transmission of intestinal parasitic infections should be based on prevention and regular chemotherapy aiming at lowering the morbidity in local populations [8].

In South Korea, for example, a drastic decrease in the prevalence of parasitic infections was possible thanks to the introduction of the nationwide epidemiological surveillance and regular administration of targeted antihelminthic chemotherapy. The first study conducted in 1971 presented the overall helminth egg positive rate of 84% among Koreans. Regular preventive measures (diagnostics and antiparasitic treatment) led to a dramatic decrease in the overall helminth egg positive rate down to 2.4% in 1997 [9]. The deworming programs run by the World Health Organization are primarily aiming at selected population groups, especially pre-school and school children and women of the reproductive age [8]. Owing to a large diversity of pathogens found in the Third World countries, it seems that the preventive deworming with single dose chemotherapy (albendazole 400 mg or 500 mg mebendazole) may not prove very effective in eradicating intestinal parasites. If mass deworming should become successful, a more comprehensive treatment is needed (albendazole 400 mg one dose, metronidazole 250 mg three times a day for five days, and praziquantel 5–25 mg/kg one dose), especially for the management of a large number of infections or infections caused by a variety of different pathogens (nematodes, cestodes, trematodes or protozoa).

Conclusions

A wide variety of intestinal parasites found in Sub-Saharan Africa requires regular screening of the local population in order to implement a targeted antiparasitic therapy instead of the WHO-recommended deworming

strategy, which is only effective in eliminating some nematode species.

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