

## **Awareness of risk factors of malaria as an element of primary prophylaxis**

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### **ABSTRACT**

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**Introduction:** Malaria is the most common tropical infectious disease caused by parasitic protozoa, affecting every year about 220 million of people with about 1-3 million deaths. It is known that every 30 seconds one African child dies from malaria. Moreover, malaria as the most common imported tropical disease is the most frequent cause of deaths. Currently, in African countries, every year, about 300-500 million people have malaria, and more than a million die from malaria. A high percentage of deaths refers to children under 5 years old, pregnant women and susceptible individuals.

**Materials and methods:** The examination was carried out from July to September, 2011 year in 60 peoplepatients of the Out-patients Clinic f St. Francis Hospital, in Kampala, the capital of Uganda, using the questionnaire created by author.

**Results:** As many as 96.7% of respondents answered that the best method was avoiding

mosquitoes via using bed mosquito nets and protective clothing. A total of 51.7% indicated chemical substances as an effective protective method against malaria. The surveyed named repellents such as liquids, aerosols, creams and sticks. Thirty two people (53.7%) wrote that an effective protective method against malaria was to avoid mosquitoes' incubation sites, to remove garbage frequently and to clear regularly ponds round the houses.

**Conclusion:** Ugandan patients identified the risk factors and groups, non-key symptoms and prophylaxis against malaria. The majority of Ugandan patients indicated there was vaccine against malaria. More than half of Ugandan patients (65%) declared that a mosquito bite is the route of malaria infection, however, more than 50% of those living in rural areas thought on other routes such as, e.g. unboiled water.

**Key words:** Africa, malaria, prophylaxis

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## **INTRODUCTION**

Malaria is the most common tropical infectious disease caused by parasitic protozoa, affecting every year about 220 million of people with about 1-3 million deaths. It has been proved that every 30 seconds one African child dies from malaria [1]. Moreover, malaria as the most common imported tropical disease is the most frequent cause of deaths [2].

The first reports on malaria cases come from the middle 19th century. By then Poland was an endemic malaria country. Known epidemics occurred during 1846, 1854-56, 1873, 1920-1923 and 1946-1949 [2,3].

In the second half of Polish Enlightenment, malaria caused a high mortality rate. It was especially difficult to fight with the disease, because the cinchona tree the most effective treatment against it, was not available in Poland. Malaria was combated with/by means of various herbs like wormwood, southernwood, rue, asarum, gentian and Centaurium erythraea. Drinking vodka with black pepper or swine feces mixed with honey was regarded as folk medication [2,4].

Malaria became a better known disease as medicine developed for past centuries. A significant fall in malaria morbidity and mortality was reported. Currently there are no malaria epidemics in Poland since the last indigenous case reported in 1963 [6,7].

In 2008 year, twenty two cases of imported malaria were reported, all being brought from endemic countries with 59 % from Africa countries. In most of the cases, the disease course was severe with the result of one death [7].

In 2009 year, twenty two cases of malaria were reported, all infectious of endemic countries, with 86% from Africa countries. In seven patients, the clinical course was described as severe and one case as very severe. In 2009 year, no deaths were occurred [7].

In 2010 year, there were 35 cases of imported malaria in Poland. Among all patients, 49% were endemic cases from Africa, but 37% from Asia. The clinical course was severe in seven cases and moderate in three cases. No deaths due to malaria were reported in 2010 year [8,9].

In Poland, morbidity and mortality rates of malaria have decreased due to better knowledge of its causes, symptoms, treatment and prophylaxis [3,9,10].

Currently, no autochthonous malaria cases of malaria are being reported in Poland. There are only imported malaria cases from endemic regions [11]. It is believed that people travelling to Western Africa are at the highest risk of malaria; estimating that 300 in every 100,000 travelers to the countries of this region had malaria infection, whereas in

Southern Africa this risk affects only 46 travelers out of 100,000. It has been proved that severe prodromes of imported malaria affect people returning from short trips to Eastern Africa, with an increasing risk with age [3,12].

A different course of a disease characterizes malaria in Africa. Currently, in African countries, every year, about 300-500 million people have malaria, and more than a million die from malaria. A high percentage of deaths refers to children under 5 years old, pregnant women and susceptible individuals (e.g., tourists) [6,13].

More than 80% of malaria cases are reported in the regions of Sub-Saharan Africa. Constant or periodic transmission of this disease occurs in the regions inhabited by approximately 40 % of the world population. [6].

Apart from Africa, every year, numerous cases are recorded in the following countries: India, Brazil, Sri Lanka, Afghanistan, Vietnam, Columbia and Thailand [14].

### **Antimalarial prophylaxis**

Malaria is the most common disease in the tropical and subtropical regions and the main cause of death in travelers. Lack of vaccination against malaria contributes to the fact that its prevention in people going to these regions consists in application of anti-mosquito repellents and adequately chosen chemoprophylaxis [15].

The WHO recommends using ABCD:

- **A**wareness
- **B**ites of mosquitoes
- **C**hemoprophylaxis
- **D**iagnosis

strategy in people travelling to the tropical regions, including awareness of malaria risk in the destination area, avoiding mosquito bites, pharmacological prophylaxis of malaria, an early diagnosis in case of worrying signs after journey [16,17].

### **Elements of antimalarial prophylaxis**

Developing health awareness consists in presenting to people the health hazard associated with the possibility and consequences of contracting and developing infectious diseases. This can be achieved via a series of meetings and trainings prepared adequately where special attention should be turned to the fact that particular prophylaxis recommendations, breaking a transmission cycle, must be executed without any compromise. Moreover, it is necessary to present symptoms of endemic diseases, which will enable to treat a patient immediately. Health care workers should be educated with regard to diagnosis, treatment and prevention against infections in a given region, which is a very important element of this prophylaxis [18,19].

**Avoiding mosquitoes** consists in application of individual anti mosquito repellents. Since malarial mosquitoes attack at dusk, so adequate clothing (head covers, shirts with long sleeves, long trousers, socks, possibly covered shoes) should be worn and uncovered body parts should be sprayed with anti-mosquito repellents. One should avoid the breeding sites of mosquitoes, wetlands, marshes, backwaters and dumps (e.g., littering) [6,24]. As far as technological solutions referring to antimalarial prophylaxis are concerned, mosquitoes access to rooms should be limited by using window nets and mosquito nets over beds. Apart from that, there are many other methods of fighting with the mosquitoes (UV lamps, devices emitting ultrasounds, joss sticks) of various efficacy. In the air conditioned rooms, windows and doors must be checked whether they are closed. The working ventilator and the fan under the ceiling can work against mosquitoes, since the air flow hinders their movement and targeting [17,22].

**Application of repellants** – insecticides in the form of aerosols, liquids, ointments and creams should be applied in the tourist' locations, especially in bedrooms. In the endemic regions, where malaria predominates, a high risk of contracting and developing malaria necessitates application of repellants to a far greater extent. Clothes, tents, mosquito nets and protective window nets as well as room walls can be impregnated with repellent substances. However, such fragrances as cloves, bergamot, lavender, mint, eucalypts, melissa, garlic have poor repellent efficacy and can hardly be regarded as repellants [15,23].

**Chemio prophylaxis** - prophylactic administration of antimalarial drugs is a basic element of prophylaxis. An individual contraction risk with regard to the route, date, length and type of journey must be taken into consideration. Additionally, a traveler's age, his/her medical history, pregnancy or breast feeding, medications for chronic diseases with their interactions as well as tolerance to antimalarial drugs taken previously pose a significant issue in chemoprophylaxis against malaria [24].

Continuous chemio prophylaxis (short length stay up to 6 months) or SBET - standby emergency treatment administration (long length stay, a low risk factor of malaria), consisting in taking drugs in case of first symptoms appearance, can be introduced depending on the length of stay in the endemic region and the level of malaria endemicity [25]. Prophylactic medications should be taken early enough before departure and continued during stay and for a long enough period after return. If the mosquito bite was reported during last days of stay, prophylaxis should be prolonged by 2-3 weeks. In the regions of *P. vivax* and *P. ovale* occurrence, additional preventive

treatment against liver hypnozoites of these species should be administered. [16,20,21].

At present, the WHO and CDC (Centers for Diseases Control and Prevention) recommend the following medications to prevent malaria:

- **Atovaquone/proguanil (Malarone)** contains 250mg/100 mg specific preparations in the tablets for adults and 62.5mg/25 mg in the tablets for children, respectively. The preparation is administered one tablet daily during meals or washing it down with milk drinks. Children/adolescents with body weight above 40 kg are given tablets for adults. Prophylaxis starts two days before departure and continues during stay and seven days after return. The preparation is contraindicated in children below 11 kg, pregnant women, breast feeding women and people with kidney disorders. The medication is well tolerated and side effects include occasional pain in the abdomen, nausea and vomiting [16,26].
- **Doxycycline** an antibiotic from the tetracycline group. Tablets 100 mg are administered in prophylaxis. The preparation is administered daily in adults and 2mg/kg of the body mass in children above 8 kg. Prophylaxis starts two days before departure, continues during stay and four weeks after return. The side effects of the medication are photo allergy and allergic skin rash, as well as gastric and intestinal ailments [16,25].
- **Chloroquine, hydroxychloroquine** – medications containing 500 mg of chloroquine phosphorane and 400 mg of hydroxychloroquine phosphate. The preparation one tablet is administered once a week in adults. The prophylaxis starts 1-2 weeks before departure to the endemic region, continues during stay and four weeks after return. Both medications rarely cause any side effects or the symptoms subside spontaneously. They are contraindicated in eye diseases [21, 25].

The sensitivity of malaria sporozites/parasites to antimalarial medications becomes more and more frequent phenomenon in the target area [17]. Malarial regions were divided into three spheres with regard to domination of specific species and sensitivity of *Plasmodium* strains to chosen anti malaria drugs, especially, chloroquine [20]:

- hydroxychloroquine phosphate in a dose of 500 mg is administered once a week in a monotherapy, in the region where the falciform sporozoite is not resistant to chloroquine. In case of side effects, the dosage can be divided into 250 mg, administered twice a week. Hydroxychloroquine (phosphate) as alternative is better tolerated in a dose of 400mg once a week. Proguanil, 200mg daily, is recommended additionally in the high risk regions [26].

- in the region, where *P. falciparum* is resistant – Mefloquine is recommended in a dose 250mg once a week, or malarone – once daily [26].
- in the regions, where *P. falciparum* is resistant to mefloquine and chloroquine – **doxycycline** prophylaxis is administered, giving the drug in a dose of 100 mg in 24 hours or Malarone-once daily in an adequate dose [26,27].

Malaria is one of the most potent infectious diseases, which takes its toll mainly in the third world countries.

At present, 220 million people are infected with 1/3 million deaths. Lack of vaccination against malaria as a basic prophylaxis affects significantly mortality rates. The studies revealed that the greater knowledge of the disease, the greater chance of early diagnosis and treatment. Prevention against malaria plays a vital role. Good prophylaxis based on the knowledge enables to avoid contracting malaria.

The aim of the study was to evaluate the level of awareness of Ugandan out-patients regarding causes, course and prophylaxis of malaria, taking into consideration such factors as gender, age, education and place of living.

## MATERIALS AND METHODS

The examination was carried out from July to September, 2011 year in 60 patients of the Out-patients Clinic of St. Francis Hospital, in Kampala, the capital of Uganda, after having obtained the consent R-I-002/35/2013 of the bioethics committee of the Medical University of Białystok.

To achieve the aim, the method of a diagnostic survey was applied using the technique of an interview. This technique was chosen due to illiteracy among some questioned. The research tool was an author's anonymous survey questionnaire comprising four metrical questions referring to personal data of the study groups: gender, age, place of living, education and twelve questions adapted to specificity of the problems associated with causes, symptoms and prophylaxis of malaria.

Statistical analysis was performed using Statistica 10.0 PL. The study results were presented using figures and tables in Microsoft Office 2007.

The independence test of Chi-square ( $\chi^2$ ) was used to analyze quality variables. The results at the level of  $p < 0.05$  were regarded as statistically significant.

Before the examination the respondents were instructed about anonymity and the purpose of the survey. The results obtained were used maximally and analyzed both quantitatively and graphically.

The examination was carried out in 60 patients of the Out-patients Clinic of St. Francis Hospital, in Kampala, the capital of Uganda. Among the surveyed there were 37 women (61.6%) and 23 men

(38.3%). The patients aged 25-35 years (40.7%) and 18-25 years (36.7%) constituted the highest percentage of the study group.

The patients aged 36 years and older equaled 21.7% of the study group. Of the surveyed, 15 (40.5%) women were between 18 and 25 years, 17 (45.9%) aged 26-35 and 5 (13.5%) more than 36 years old. Among the surveyed, there were 7(30.4%) men aged 18-25, 8 (34.8%) aged 26-35 and 8(34.8%) aged more than 36 years.

Respondents declared a various level of education. The highest number of people from the study group declared higher education, which constituted 48.3% of all respondents and secondary education, 33.3%. The fewest respondents opted for primary education (18.3%).

Among city dwellers, 15.2% claimed primary education, 32.6% secondary education and as many as 52.1% higher education. The total of 28.5% of villagers declared primary education, 35.7% secondary education and only few (14.2%) higher education.

## RESULTS

### Evaluation of Ugandan patients' knowledge about malaria

The first question referred to a cause of malaria. The total of 57 people (95%) answered that this was an anopheles mosquito, two persons (3.3%), a tsetse fly, one person (1.7%) did not know the answer.

The next key question was about the vaccination against malaria. The total of 34 people (57%) answered that the vaccination against malaria existed, while the rest, 26 people (43%) answered that the vaccination had not been invented.

Respondents were also asked whether they knew the mode of its transmission and whether there was only one mode of its transmission.

The total of 39 people (65%), answered correctly indicating exclusively a mosquito's bite. Seventeen respondents (28.3%), answered incorrectly, claiming that malaria could be contracted via drinking unboiled water or eating a rotten, dirty fruit.

Four people (6.7%) answered that they did not know the route of infection with malaria.

Respondents were asked about the groups of people especially exposed to malaria infection.

Fifty people (83.3%) answered that such groups existed, two individuals (3.3%) wrote that there were no such risk groups, while eight people (13.3%) did not know how to answer the question (Table 1).

The total of 49 people (81.7%) stated that children under the age of 5 belonged to the high risk group, one person (1.7%) said they did not,

whereas 10 people (16.7%) had no opinion about this issue.

Table 1 shows the results. Thirty eight people (63.3%) indicated that pregnant women belonged to the risk group, 12 respondents (20%) did not indicate this group as exposed to malaria infection. Ten people (16.7%) gave no answer (Table 1).

**Table 1.** Knowledge about the risk groups

Knowledge about risk groups		Number	Percentage
Yes (pregnant women, children under the age of 5		50	83.30%
No		2	3.30%
I do not know the answer		8	13.30%
Risk group	Children under the age of 5		
	not refers	yes	no
Number	10	49	1
Percentage	16.70%	81.70%	1.70%
Risk group	Pregnant women		
	not refers	yes	no
Number	10	38	12
Percentage	16.70%	63.30%	20%

Respondents were asked whether pregnant women infected with malaria could transmit malaria to the fetus. Thirty seven people (61.7%) agreed, twenty (33.3%) answered that it was impossible. Only three people (5%) had no answer to this questions.

Respondents were asked whether they 'knew prophylactic methods against malaria'. All patients answered positively. They were asked to name these methods against malaria infection. As many as 96.7% of respondents answered that the best method was avoiding mosquitoes via using bed mosquito nets and protective clothing (long sleeves and cuffs, socks), especially, during periods of the highest mosquito activity.

A total of 51.7% indicated chemical substances as an effective protective method against malaria. The surveyed named repellents such as liquids, aerosols, creams and sticks. Thirty two people (53.7%) wrote that an effective protective method against malaria was to avoid mosquitoes' incubation sites, to remove garbage frequently and to clear regularly and meticulously hedges and ponds round the houses. Fifteen people (35%) admitted that check-up blood tests were an effective method of prophylaxis and early diagnosis.

The next question referred to a cycle of a parasite. Respondents were asked about the organ where *Plasmodium* developed. Unfortunately, 36 people (60%) did not know the answer to this question, 14 people (23.3%) stated that a parasite developed in the liver. Five people (8.3%) indicated the brain and the same number of people, the kidneys.

Respondents were asked about the incidence of malaria. The majority of patients answered that malaria occurred all over the world (45 people 75%), only 5 people (8.3%) answered the incidence of malaria was limited and 10 people (16.7%) did not know the answer to this question.

The next question was about the climate and the region of the world malaria could be found. The highest percentage of respondents (73.3%) answered that malaria occurred in a moderate climate, 16 patients (7%) indicated an equatorial climate. Three (8.3%) respondents proposed a circumpolar climate and one person (1.7%) did not know the answer.

The surveyed were also asked about the symptoms of malaria. All respondents (100%) indicated agreeably neurological symptoms as these accompanying malaria. They mentioned symptoms, including fever higher than 39 Celsius degrees, headaches, loss of consciousness with coma, hallucinations, and nightmares during attacks of malarial fever. The next set of symptoms the surveyed described referred to the digestive system (96.7%). These included: vomiting, nausea, diarrhea, pain in the abdomen and loss of appetite.

A few more than a half of the surveyed (55%) listed symptoms of the skeletal system, i.e.; pains of muscles and joints and shivers. Only six people (18.3%) answered that the disease was accompanied by dermatological symptoms. They listed rash round the nose, eczema and itchiness. Additionally, 33 people (55%) mentioned symptoms that were significant, according to the surveyed, such as: malaise, congestion of eye balls, taste disorders.

#### Ugandan patients' education and chosen aspects of knowledge about malaria

The three groups of education background were distinguished among respondents. All patients (100%) with primary education and 95% of the surveyed with secondary education declared that the mosquito of *Anopheles* genus was the cause of malaria but 5% of them did not know the answer.

However, 93.1% of the questioned with higher education suggested the anopheles mosquito and 6.9% indicated the tsetse fly (Table 2).

Statistical analysis proved a significant correlation between the education and the knowledge about vaccination against malaria ( $p=0.0001$ ;  $\chi^2 = 22.275$ ). As many as 81.3% of the respondents with primary education answered

positively, while 18.7% contradicted. A total of 60 % with secondary education answered positively and 35% contradicted, whereas in the group with higher education, 13.8% affirmed the presence of vaccination, while 86.2% declared that there was no vaccination (Table 2).

The next question referred to the mode of malaria transmission. A statistical significance was established between the education and the mode of malaria transmission ( $p=0.048$ ;  $\chi^2= 9.123$ ). Respondents with higher education answered that

a mosquito's bite was the only possibility of malaria infection. People with other education claimed that malaria could also be contracted via the alimentary route (Table 2). Ninety percent of respondents with primary and higher education and 70% of these with secondary education answered positively the question regarding people especially at risk of malaria infection, whereas 9% of respondents with primary education and 3.4% with higher education answered negatively (Table 2).

**Table 2.** Respondents' knowledge about vaccination against malaria and education

	Education			
	Primary	Secondary	Higher	Total
<b>What is the cause of malaria? (<math>p=0.382</math>)</b>				
anopheles mosquito	100%	95%	93.10%	57
tsetse fly	-	-	6.90%	2
I do not know	-	5%	-	1
total	11	20	29	60
<b>Does malaria vaccination exist? (<math>p=0.0001</math>)*</b>				
Yes	81.30%	60%	13.80%	25
No	18.70%	35%	86.20%	34
I do not know the answer	-	5%	-	1
Total	11	20	29	60
<b>What is a mode of disease transmission? (<math>p=0.048</math>)*</b>				
A mosquito's bite	36.40%	55%	82.80%	39
Eating dirty fruit	54.50%	35%	13.80%	17
I do not know the answer	9,10%	10%	3.40%	4
Total	11	20	29	60
<b>Are there people especially at risk of malaria infection? (<math>p=0.063</math>)*</b>				
Yes	90.90%	70%	89.70%	50
No	9.10%	-	3.40%	2
I do not know the answer	-	3,40%	6.90%	8
Total	11	20	29	60

No statistical significance was proved between the education background and the risk groups: children under the age of 5.

Respondents with higher education showed the best knowledge among all the surveyed (Table 3).

A statistical relation was proved between the education background and the risk group 'pregnant women' ( $p=0.007$ ;  $\chi^2 = 14.02$ ).

Almost 80% of the questioned indicated this group as a high risk group of malaria infection, while the lowest percentage was found in the respondents with primary education (Table 3).

In the question about malaria transmission on the fetus by pregnant women, 81.8% of respondents with primary education, 55% with

secondary education and 58.6% with higher education regarded this transmission as possible.

However, 9.1% of respondents with primary education, 40% with secondary and 37.9% with higher negated this fact (Table 3).

Regarding the question about methods of antimalarial prophylaxis, all respondents (100%) with primary and higher education answered that the best method was to use mosquito nets and 90% of those with secondary education shared this opinion. Chemical substances, repellants, were another method of protection against malaria infection according to respondents (primary education 27.3%, secondary education 25%, and higher education 79.3%). Respondents with primary education (27.3%), with secondary (45%)

and with higher education (69%) suggested that clearing ponds and hedges was an effective prophylactic method against malaria. Additionally, respondents admitted that check-up blood tests helped to prevent the diseases (Table 4).

**Table 3.** Knowledge about the risk group ‘children under the age of 5’ and education

	Education		
	Primary	Secondary	Higher
<b>Children under the age of 5 (<math>p=0.183</math>)</b>			
Not refers	9.10%	30%	10.30%
Yes	90.90%	65%	89.90%
No	-	5%	-
<b>Pregnant women (<math>p=0.007</math>)*</b>			
<b>It does not refer</b>	<b>9.10%</b>	<b>30%</b>	<b>10.30%</b>
Yes	36.40%	55%	79.90%
No	54.50%	15%	10.30%
<b>Can a pregnant woman transmit infection to the fetus? (<math>p=0.432</math>)</b>			
Yes	81.80%	55%	58.6%
No	9.10%	40%	37.9%
I do not know the answer	9.10%	5%	3.4%
Total	11	20	29

The surveyed were asked to indicate the organ in the human body where the cycle of *Plasmodium* occurred (Table 4).

Respondents with primary education suggested the brain (18.2%) and the kidneys (9.1%) as the site of a parasite’s development. People with secondary education 20% opted for the liver, while 70% did not know the answer (Table 4).

Respondents with higher education suggested the brain (10.3%), the liver (34.5%) and the kidneys (6.9%). About 50% of respondents with higher education did not know the answer to this question (Table 4).

Patients with primary education (36.4%) indicated that malaria occurred mainly in an equatorial climate and 54.4% of them, in a moderate climate and only 9.1% stated that in a circumpolar climate (Table 4).

Respondents with secondary education (15%) stated that malaria spread in an equatorial climate and 70% of them indicated a moderate climate while 15%, a circumpolar climate. The questioned with higher education (10.3%) stated that malaria spread in an equatorial climate, 82.8% of them indicated a moderate climate and 3.4%, a circumpolar climate (Table 4).

**Table 4.** Respondents’ knowledge about the prophylactic methods against malaria

	Education		
	Primary	Secondary	Higher
<b>What are the prophylactic methods?</b>			
Mosquito nets	100%	90%	100%
Repellants	27.30%	25%	79.30%
Clearing ponds and hedges	27.30%	45%	69%
Check-up blood tests	27.30%	45%	31%
<b>Where does the parasite develop after entering the body? (<math>p=0.189</math>)</b>			
Brain	18.20%	-	10.30%
Liver	-	20%	34.50%
Kidneys	9.10%	10%	6.90%
I do not know the answer	72.70%	70%	48.30%
<b>What climate does malaria occur in? (<math>p=0.305</math>)</b>			
Equatorial climate	36.40%	15%	10.30%
Moderate climate	54.50%	70%	82.80%
Circumpolar climate	9.10%	15%	3.40%
I do not know the answer	-	-	3.40%
<b>What are symptoms of malaria?</b>			
Neurological	100%	100%	100%
Alimentary	100%	90%	100%
Osteoarticular	36.40%	40%	72.40%
Dermatological lesions	9.10%	15%	24.10%
Other	45.50%	30%	62.10%

**Ugandan patients’ place of living and chosen aspects of knowledge about malaria**

Among people completing the questionnaire there were both city dwellers and villagers. The first question regarding the cause of malaria was answered by 93.6% of city dwellers pointing to an anopheles mosquito, while 4.3% stated that it was a tsetse fly. Among villagers, 100% claimed that an anopheles mosquito carried malaria (Table 5).

City dwellers (61.7%) claimed that there was no vaccination against malaria, while 36.2% said that there was and 2.1% of respondents did not know the answer. Villagers (38.5%) claimed that vaccination against malaria did not exist, whereas 61.5% believed that there was one. Table 5 shows the results.

In the answers to the question regarding modes of malaria transmission, a statistical correlation was found between the place of living and the route of malaria transmission ( $p=0.054$ ;  $\chi^2 = 5.82$ ).

The surveyed from the city (70%) answered that malaria was contracted via a mosquito bite, 21.3% indicated the other route and 8.5% did not know the answer. Among villagers, 46.2% pointed to a mosquito bite, 53.8% suggested other route of infection (dirty fruit, unboiled water) (Table 5).

Respondents living in the city (80.9%) indicated malaria risk groups. As many as 78.7% of them stated that children under the age of 5 belonged to these groups, 68.1% indicated pregnant women and 29.8%, patients with immune deficiency. Villagers (92.3%) pointed to people especially exposed to malaria infection. As many as 92.3% indicated children under the age of 5, 46.2% suggested pregnant women (Table 5).

Ugandan patients from the city answered the question about methods of prophylaxis as follows: 97.9% mentioned mosquito nets, 51.1%

repellants, 55.3% clearing hedges and ponds around the houses and 34% of respondents believed that check-up blood tests helped in prophylaxis against malaria. Villagers: 92.3% using mosquito nets, 53.8% repellants and other chemical substances against mosquitoes, 46.2% clearing hedges and ponds and 38.5% stated that check-up blood tests were significant (Table 5).

City dwellers thought that malaria was spread all over the world (76.6%), occurred mainly in a moderate climate (76.6%). Only 16.9% of city dwellers said that malaria developed in an equatorial climate. Villagers (69.2%) thought that malaria could be found all over the world and mainly in a moderate climate (61.5%). A total of 23% of villagers suggested an equatorial climate and 15.4%, a circumpolar climate (Table 5).

**Table 5.** Respondents' knowledge about symptoms of malaria and education background

	Place of living		
	City	Village	
<b>Vector of malaria (<math>p=0.646</math>)</b>			
Anopheles mosquito	93.60%	100%	
Tsetse fly	4.30%	-	
I do not know the answer	2.10%	-	
<b>Vaccination against malaria (<math>p=0.244</math>)</b>			
Yes	61.70%	38.50%	
No	36.20%	61.50%	
I do not know the answer	2.10%	-	
<b>Route of malaria infection living (<math>p=0.054</math>)*</b>			
Mosquito bite	70.20%	46.20%	
Eating dirty fruit, drinking unboiled water	21.30%	53.80%	
I do not know	8.50%	-	
Risk groups			
Children under the age of 5	78.70%	92.30%	
<b>Pregnant women (<math>p=0.027</math>)*</b>	<b>68.10%</b>	<b>46.20%</b>	
<b>Prophylactic methods</b>			
Mosquito nets	97.90%	92.30%	0.323
Repellants	51.50%	53.80%	0.859
Clearing hedges ...	55.30%	46.20%	0.558
Check-up blood tests	34%	38.50%	0.767
<b>Climate of malaria incidence</b>			
Equatorial climate.	16.90%	23%	
Moderate climate	76.60%	61.50%	
Circumpolar climate	6.40%	15.40%	
Symptoms of malaria			
Neurological	100%	100%	
Alimentary	97,90%	92,30%	
Osteoarticular	59,60%	38,50%	
Dermatological lesions	17%	23,10%	
Other	53,30%	61,50%	

The surveyed from the city answered the question about symptoms of malaria as follows: 100% listed neurological symptoms, 97.9%

alimentary symptoms, 59.6% osteoarticular symptoms, and 17% dermatological symptoms. More than half the people (53.3%) stated that other

symptoms were significant in the course of malaria. Respondents living in the rural area answered as follows: 100% mentioned neurological symptoms, 92.3% alimentary symptoms, 38.5% osteoarticular symptom, and 23.1% dermatological symptoms. As many as 61.5% of patients emphasized other symptoms in malaria. Details are shown in (Table 5).

**Ugandan out-patients' gender and chosen aspects of knowledge about malaria**

As far as the question about the vector of malaria, 36 women (97.3%) answered that anopheles mosquito was, and one woman (2.7%) had no answer to this question. In men, the results of the survey were the following: 91.3% of men pointed to a anopheles mosquito and 8.7%, a tsetse fly.

Women's opinions about the vaccination against malaria were various 20 of them (54.1%) thought that there was no vaccination, but 17 women (45.9%) stated that it existed. Similarly, in men 34 (60.9%) suggested that there was no vaccination against malaria, while 25 (34.8%)

claimed that there was and only one men (4.3%) did not know the answer to this question.

Comparing the group of women and men, a statistical correlation was proved between the gender and the knowledge about the route of malaria infection ( $p=0.05$ ,  $\chi^2 = 5.842$ ).

Twenty women (54.1%), indicated exclusively a mosquito bite, whereas thirteen women (35.1%) pointed to other routes. Four women (10.8%) did not know the answer to this question. A correct answer was given by 19 men (82.6%), while four men answered incorrectly (17.4%).

Next the groups were asked about the people at a special risk of malaria infection. Women (78.4%) claimed that such groups existed, while 5.4% of women negated this and 16.2% had no answer to this question.

Men (91.3%) indicated the groups of high risk and 8.7% did not know the answer. Table 6 shows the results.

**Table 6.** Knowledge of women and men about the group of a high risk

Knowledge of high risk groups	Gender		
	Women	Men	
Yes	78.40%	91.30%	
No	5.40%	-	
I do not know the answer	16.20%	8.70%	
<b>High risk group</b>			
	Children under the age of ( $p=0.291$ )		
	<b>I does not refer</b>	<b>Yes</b>	<b>No</b>
Women	21.60%	75.70%	2.70%
Men	8.70%	91.30%	0.00%
<b>High risk group</b>			
	Pregnant women ( $p=0.344$ )		
	<b>It does not refer</b>	<b>Yes</b>	<b>No</b>
Women	21.60%	62.20%	16.20%
Men	8.70%	65.20%	26.10%
<b>Prophylactic Method</b>			
	Gender		
	<b>Women</b>	<b>Men</b>	
Mosquito nets	94.60%	100%	
Repellants	45.50%	73.90%	
Clearing ponds and hedges	40.50%	61%	
<b>Gender</b>			
	<b>Women</b>	<b>Men</b>	
Neurological	100.00%	100.00%	
Alimentary	94.60%	60.90%	
Osteoarticular	51.40%	21.70%	
Dermatological lesions	16.20%	73.40%	

Among the questioned women, 75.7% thought that children under the age of 5 belonged to the high risk group, 2.7% of women negated this fact. As many as 21.6% had no opinion about this issue. With regard to men, 91.3% pointed to children under the age 5 as a high risk group, while only 8.7% did not know the answer to this question (Table 6).

Twenty three (62.2%) agreed that pregnant women belonged to the high risk group, six (16.2%) negated this, while eight women (21.6%) could not point to any of the answers. Thirty eight men (65.2%) acknowledged that pregnant women constituted the high risk group, six of them (26.1%) negated this, while two men (8.7%) did know the answer (Table 6).

When asked about the knowledge about the principles of antimalarial prophylaxis, both groups of women and men (100%) answered positively.

A total of 94.6% of women thought that using mosquito nets was the best protective method, 45.5% indicated the repellants, while 40.5% pointed to clearing ponds and hedges as antimalarial prophylaxis.

All the men questioned regarded mosquito nets as the best prophylactic method, while 73.9% of them indicated that frequent disposal of garbage and clearing ponds and hedges protected against malaria.

Nearly 61% of men pointed to chemical substances as a good protective method against malaria. Details are shown in Table 6.

When asked about the symptoms of malaria, 100% of respondents listed the following symptoms: body temperature higher than 39 degrees of Celsius, headaches, consciousness disorders with coma, hallucinations and nightmares.

A total of 94.6% of respondents indicated the symptoms of the digestive system such as: vomiting, nausea, stomachache and diarrhea.

More than half the women pointed to the osteoarticular symptoms and only 16.2% listed dermatological symptoms accompanying the disease.

All men (100%) mentioned also alimentary symptoms, apart from neurological symptoms. Almost 61% of men indicated osteoarticular symptoms, while 21.7% mentioned dermatological symptoms.

Additionally, men (73%) gave other symptoms characteristic of malaria such as: general malaise, congestion of eye balls and impaired taste (Table 6).

When asked whether pregnant women could transmit infection to the fetus, 73% of women answered positively, 24.3% negated and 2.7% had no answer. A total of 43.5% of men answered positively, 47.8% negated, while 8.7% did not know the answer. Both men and women (70%)

answered that malaria occurred all over the world. In the case of women, 10.8% declared that malaria was limited, while only one man shared this opinion (4.3%). Six women (16.2%) and four men (17.4%) had no opinion. When asked, referring to the previous question, about a climatic zone, both women and men (70%) pointed to a moderate climate as the main region of malaria incidence. Seven women (18.9%) and three men (13%) suggested an equatorial climate. Only 8% of women and men proposed a circumpolar climate. Among the questioned, one woman (2.7%) did not know the answer.

### **Uganda citizens' age and chosen aspects of knowledge about malaria**

Various age respondents were qualified to the three age groups. When asked about the vector of malaria, 90% pointed to the anopheles mosquito.

Four percent of the group aged 25-35 and 7.7% of the group older than 36 claimed that a tsetse fly was the vector of malaria (Table 7).

When asked about the vaccination against malaria, 54.5% of the group aged 18-24, 36% of the group aged 25-36 and 30.8% of 36 years and older answered positively. The presence of vaccination was negated by 40% of the group aged 18-24, 64% of the people aged 25-36 and 69.2% of the people older 36 years. Details are shown in (Table 7).

When asked about the route of malaria infection, respondents answered as follows: 68.2% of the group aged 18-24, 56% of the group aged 25-35 and 76.9% of the group aged 36 and older indicated a mosquito bite. Other possibility of malaria infection was mentioned by 27.3% of people aged 18-24, 32% of patients aged 25-35 and 23.1% of the surveyed aged 36 and older (Table 7).

No significant correlations were found between the age and the knowledge about the high risk groups of malaria infection. All the surveyed aged 36 and older declared the knowledge about the high risk groups, though the lowest percentage was revealed in the group aged 18-24 (Table 7).

Statistical analysis proved also a correlation between the age of respondents and the knowledge about the risk of malaria transmission to the fetus in pregnancy (Table 7).

As far as prophylactic methods, 95.5% of the people aged 18-24, 96% aged 25-35 and 100% of the surveyed aged 36 and older suggested mosquito nets, whereas 45.5% of the people aged 18-24, 44% of the patients aged 25-35 and 76.9% of the surveyed aged 36 and older pointed to repellants as the prophylactic method. A total of 40.9% of the respondents aged 18-24, 52% of the aged 25-35 and 76.9% of those aged 36 and older stated that clearing the sites of mosquito incubation was the method of protection against malaria (Table 7).

All the respondents pointed to neurological symptoms. Alimentary symptoms were given by 95 % of the questioned aged 18-24, 96% aged 25-25 and 100% of the examined aged 36 and older. As many as 45.5% of the respondents aged 18-24, 48% of those aged 25-35 and 84.6% of the surveyed aged 36 and older admitted that osteoarticular

symptoms were important. Only 4.5% of the people aged 18-24, 28% of those aged 25-35 and 23.1% of the surveyed aged 36 and older mentioned dermatological symptoms frequently accompanying the disease. Table 7 shows more detailed data.

**Table 7.** Respondents' knowledge about the cause of malaria with regard to the age

	Age		
	18-24	25-35	36 and older
<b>Vector of malaria (p=0.517)</b>			
anopheles mosquito	95.50%	96%	92.30%
tsetse fly	-	4%	7.70%
I do not know the answer	4.50%	-	-
<b>Vaccination against malaria (p=0.316)</b>			
Yes	54.50%	36%	30.80%
No	40.90%	64%	69.20%
I do not know the answer	4.50%	-	-
<b>Mode of malaria transmission (p=0.564)</b>			
Mosquito bite	68.20%	56%	76.90%
Eating dirty fruit	27.30%	32%	23.10%
I do not know the answer	4.50%	12%	-
<b>High risk group (p=0.469)</b>			
Yes	77.30%	80%	100%
No	4.50%	4%	-
I do not know the answer	18.20%	16%	-
<b>Can a woman transmit malaria infection to the fetus? (p=0.049*)</b>			
Yes	54.20%	80%	38.50%
No	40.90%	20%	46.20%
I do not know the answer	4.50%	-	15.40%
<b>Prophylactic method</b>			
Mosquito nets	95.50%	96%	100%
Repellents	45.50%	44%	76.90%
clearing hedges and ponds	40.90%	52%	76.90%
<b>Symptoms of malaria</b>			
Neurological	100%	100%	100%
Alimentary	95.50%	96%	100%
Osteoarticular	45.50%	48%	84.60%
Dermatological lesions	4.50%	28%	23.10%
Other	45.50%	56%	69.20%

## DISCUSSION

Increasing numbers of travelers and business people to tropical countries is a fact in recent years. Tourists more and more frequently travel to destinations where there is a high risk of infectious diseases risk infection [5]. One disease

which is transmitted via mosquito is malaria, which frequently represents a problem for locals and incoming people. Malaria with its morbidity of 500 million annually, is found in the areas inhabited by about 40% of world population in more than 100 countries of Africa, Asia and Oceania. Malaria

when diagnosed early enough is likely fully cured.

Moreover, proper prophylaxis can prevent its development.

The populations acknowledge about its causes, symptoms, treatment and prophylaxis undoubtedly reduces the numbers of human infected. Self-diagnosis of malaria may help the patient to fearness and influence the milder course of the disease. The knowledge about the disease, its course, diagnostic and therapeutic management is the basis of the fight with malaria. [1,28].

So far, researchers have managed to establish the cause of malaria, indicating a protozoan of *Plasmodium*. Scientists have revealed that the parasite is exclusively transmitted by a mosquito of

*Anopheles* family [29]. In our study, it was proved that a significant majority (95%) of the respondents believed that the *Anopheles* mosquito bite was the cause of malaria, while many of the responders believed on other routes of infection. One third (33%) indicated the tsetse fly, while 1.7% could not point to any answer, which led on inconsistent results on this issue.

The literature showed that the researchers are still working on finding a vaccine against malaria, although no progress has been made so far. Due to lack of vaccination, oral medications are the only antimalarial chemoprophylaxis at present [15]. Among respondents, 57% of people claimed that such a vaccination existed, while 43% of people negated this fact. However, such a factor of education background significantly influenced negatively the overall results. People with higher education (86.2%) answered that no vaccine exists, while only a few respondents answered positively (13.8%). On the contrary people with primary education opted for the vaccination against malaria (81.3%), whereas only 1.87% of them negated its existence. When taking the place of living, villagers showed better knowledge, because 60 % of them negated the vaccination against malaria, whereas the same percentage of city dwellers believed in the discovery of the antimalarial vaccination.

The age was a significant factor in this study. Respondents aged 36 years and older showed better knowledge about the disease. Almost 70% believed there was no vaccination against malaria, while respondents aged between 18 and 34 years (55%) affirmed its existence.

In his studies, Kotłowski reports that *Plasmodium* of malaria is carried by the female of the mosquito, which together with the salivary glands secretion injects sporozoites to the human blood flow during its bite. Infection with malaria takes place when parasites together with infected blood (due to blood transfusion or mother-fetus route) enter the organism [28,30]. Among the questioned, more than 60% stated that the bite by

an infected female mosquito of the genus *Anopheles* was the main transmission route, while 28.3% of respondents checked the wrong answer: drinking dirty, unboiled water or eating an infected meal or fruit with mosquito larvae. However, when taking into consideration various factors, the results are different. Among questioned women, 54.1% of them indicated a mosquito bite could cause malaria, and 35.1% answered that consuming infected food could result in malaria. With regard to men, the majority (82.6%) answered correctly, while only 17.4% were wrong. Analyzing the results with regard to education, the majority of people with higher education (82.8%) confirmed that a mosquito bite could cause malaria, and only 13.8% of them chose other answer. Conversely, only 36.4% of people with lower education gave a correct answer, whereas 54.6% checked a wrong answer. City dwellers knew better the routes of malaria infection, because 70.2% of them pointed to a mosquito bite as the only possibility of infection and only 21% opted for the other answer. Almost half of the villagers (46.2%) affirmed a mosquito bite, while more than half (53.8%) suggested that consuming dirty food might cause the disease.

In his writing, Kacprzak maintains that among patients infected with malaria, three high risk groups can be distinguished in the endemic countries [31]. These include: children under the age of 5, pregnant women and patients infected with AIDS [2]. Of the study, as many as 83% of respondents answered that there were high risk groups, indicating mainly children under 5 (81.7%), then pregnant women (63.3%). Both people with higher and primary education (90%) pointed to the same high risk groups. Regarding gender, similar results were determined: 78.7% of women indicated children under 5 years old and pregnant women as high risk groups of malaria infection.

According to the World Health Organization, every year 30 million women living in the regions of Africa, where malaria is an endemic disease, become pregnant [16, 23]. In pregnancy, women's immunity to malaria decreases, which makes them prone to infection. Additionally, there is a higher risk of spontaneous miscarriage, stillborns, preterm newborns and low-birth-weight newborns. It is believed that 200.000 newborn deaths are caused by malaria in pregnant women [2,16,22]. Based on our study carried out in 60 Ugandan out-patients it can be found that 62% of respondents claimed that malaria influenced directly the fetus, while 33% of people negated it. Gender is an important factor, because as many as 73% of women confirmed a negative effect of malaria on the course of pregnancy. Among men, opinions were various: 43% confirmed harmful influence of malaria on the child during pregnancy. However, almost half (47%) men believed that the disease had no effect on the fetus.

According to Kajfasz and Kotłowski, antimalarial prophylaxis should consist of two inseparable elements: procedures protecting from mosquito bites mosquito nets, appropriate clothes, repellants applied on the skin and antimalarial chemoprophylaxis [18,30].

Additionally, in the endemic areas, such sites, where incubation of mosquitoes may take place (jungle, swampland and backwaters) should be avoided [17]. In our study, all respondents answered that they knew prophylactic methods. The opinions about the techniques of prevention against malaria were different. All respondents (100%) with higher education pointed to mosquito nets. The majority of them pointed to repellents and maintaining the area around the house clean as an effective method of prophylaxis. All people with primary education suggested mosquito nets. Though, only few (27%) of them knew other methods of protection against malaria infection. The results of our survey showed that as many as 97% of women pointed to mosquito nets, while nearly half could mention other prophylactic methods. All men (100%) mentioned mosquito nets and the majority of them listed other prophylactic methods against malaria.

Wroczyńska and Kotłowski believe that the development of *Plasmodium* consists of two division cycles: hepatic schizogony, corresponding to the asymptomatic period of the disease incubation and blood stage schizogony, corresponding to clinical symptoms [16]. Krotoski with Garnham proved that dormant hepatic developmental forms of *Plasmodium* were responsible for late relapses of the disease [28]. In our study, 60% of all respondents answered: 'I do not know', 23% indicated to the liver and the rest mentioned other body organs. Among people with higher education, 35% could indicate the site of the parasite cycle – the liver, whereas no one with primary education could answer correctly.

The experts from the Department of Parasitic and Tropical Diseases of the Institute of Microbiology and Infectious Diseases in Poznan are of the opinion that malaria is an acute and/or chronic parasitic disease widespread in the countries with a warm climate, especially in the subtropical and equatorial zone [31]. The results of studies showed that Poland has been free from autochthonous malaria since 1963 year [28]. The results of studies carried in Africans showed significant lack of knowledge with regard to incidence of malaria, because 75% of the surveyed answered that malaria was found all over the world. Moreover, the surveyed, when asked to show the exact region of malaria incidence, indicated (74%) regions of a cold temperature climate. Only 17% of them stated that an equatorial zone was the main region of malaria incidence. Similarly, respondents with higher education proved to be incompetent,

because 82.2% of them suggested a cold temperature climate as typical of malaria. Only 10% of them pointed to an equatorial climate. The same correlation was revealed with regard to the place of living. City dwellers (76.6%), villagers (61.5%) and both females and males (70%) found malaria widespread and a cold temperature climate as typical of malaria.

According to Mrówka and Stefaniak, classical symptoms of malaria include chills, shivers and the temperature rising up to 40 Celsius degrees or higher and falling after few hours as well as sweating. Sometimes prodromal symptoms can be observed, such as headaches, pains in muscles and joints, nausea, diarrhea, weakness and anxiety. The following skin symptoms can be seen: rash or skin lesions [29].

Our study showed that 100% of respondents declared the knowledge of the some malaria symptoms, however the questionnaire missed crucial symptoms such as fever or headache. The first group of symptoms they indicated was associated with the neurological system. All respondents with both primary and higher education mentioned symptoms of the digestive system. A high percentage of the questioned with higher education indicated the symptoms of the osseous system, while 24% of them pointed to dermatological lesions as a common symptom of malaria. Fewer respondents with primary education confirmed these symptoms (36% osteoarticular symptoms, 9% skin symptoms). City dwellers showed better knowledge about malaria symptoms than villagers.

More than half of the city dwellers pointed to osteoarticular symptoms, while 17% checked also skin lesions. As far as villagers are concerned, almost 40 % mentioned osteoarticular symptoms and 23% skin symptoms. Among the study women and men, the results were similar. Though, men were proved to have wider knowledge about symptoms of malaria

## CONCLUSIONS

1. Ugandan patients identified Anopheles mosquito as the vector borne of malaria, whilst more than 50% of those from rural areas thought on other routes such as, e.g. unboiled water.
2. The majority of Ugandan patients pointed there was the vaccine against malaria whiles it does not exist yet.
3. 65% of Ugandan patients declared that a mosquito bite is the route of malaria infection.
4. More than 1/3 of respondents believed that drinking unboiled water or eating infected fruit could cause malaria.

5. Respondents with higher education demonstrated better knowledge on malaria than those with primary education.
6. City dwellers and villagers showed similar knowledge about malaria
7. Men demonstrated a little higher level of knowledge about malaria than women.

### **Conflicts of interest**

There are not conflicts of interest.

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