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RISK ON INTRODUCED MALARIA TO LIBYA WITH IMMAGRANT WOKERS: BIOCHEMICAL AND HEMATOLOGICAL STUDIES

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Abstract

Malaria has been a fundamental, shape-shifting player in African human and natural landscapes and their history of interactions. Malaria spreads as a result of human contact with female anopheles mosquitos, whose habitat interacts with human populations. Human blood nourishes the mosquitos' eggs and allows larvae to survive to the adult stage. Furthermore, the adults carry the plasmodia protozoan that causes the fever and symptoms in humans, who serve as hosts for the next mosquito vector bites. Biochemical and hematological (RBC, WBC, platelet levels and hemoglobin) parameters were evaluated in this study.

A total of 200 patients with complete biological data were included in analysis with different ages ranged from 15, 25, 35, 45, 55, & 66. Infected participants of both sexes were 12 and uninfected of both sexes were 188. Moreover, 180 lived in Niger and 20 lived in Chad, 131 lived in rural areas and 69 lived in urban areas. 136 of them were uneducated and 64 were educated, respectively. Results from this analysis in the present study showed that the mean RBC value was 5.21cells/µl and the mean WBC value was 6.80cells/µl. The mean platelet count was (262,100 platelets/mm3 of blood) and the average hemoglobin level of the infested participants was observed (13.58 g/dl).

Keywords: Malaria, biochemical, hematological parameters, Niger, Chad

Introduction

Malaria is a preventable and curable disease, but if not treated is a life-threatening one spreads to man by some *Anopheles* vectors, mainly in tropical countries (CDC, 2024). Symptoms can be mild or life-threatening, mild symptoms are fever, chills and headache, but severe ones include fatigue, confusi on, seizures, and difficulty breathing (Gérardin *et al,* 2002). WHO (2023) reported that there were 249 million cases in 2022 compared to 244 million ones in 2021. The estimated number of malaria deaths stood at 608 000 in 2022 compared to 610 000 in 2021. Malaria can be prevented by avoiding mosquito bites and by taking medicines. Talk to a doctor about taking medicines such as chemoprophylaxis before travelling to areas where malaria is common. African ecologies were historically the original source of malaria infection, though the disease has spread worldwide, as *Anopheles* mosquitos have spread to tropical and subtropical areas.

Malaria has many consequences on the humans health. Among these consequences are disturbances of hematological and biochemical parameters. Various modifications of hematological parameters have been notified by Laura et al. when evaluating clinical and hematological indices during malaria (Erhart *et al,* 2004). The most frequent side effects of malaria infection are hematological abnormalities, which affect red blood cells (RBC), white blood cells (WBC), platelets (PLT) and hemoglobin (Hb) (Mohandas and An, 2012). There are malaria influence on hematological parameters and thrombocytopenia (; Lacerda *et al,* 2012). It is one of the hereditary factors that may affect a person's vulnerability to clinical effects of malaria. Anemia, thrombocytopenia, leukopenia, and leukocytosis are hematological abnormalities associated with malaria as one of the distinguishing feature of infection (Das *et al*, 2017).

The cytoadherence and resetting participate to the pathophysiology of malaria by obstructing blood flow, resulting in a shortage

of oxygen in tissues, excessive lactate formation, and a decline in the pH of blood and tissues resulted in severe anemia (Dahlgren *et al,* 2017). It is characterized by hemoglobin (Hb) levels that were below 12g/dl for women and 13g/dl for men (Al-Salahy *et al,* 2016). Studies have shown hematological abnormalities among malaria adult patients (Asmerom *et al,* 2023).

This study aimed to evaluate changes in biochemical and hematological parameters of malaria among immigrant workers, as to nationality, sexes, residence and education.

Materials and Methods

The study consisted of 200 immigrants of both sexes aged from 15 to 66 years old were examined for malaria infections. The informed consent form that was given to the patient to be signed in two copies (one for the authors and one for the patient), the free consent term contained all information about the project, including the name, mobile number and email of the senior author, in cases where the patient has to withdraw from being part of the study. Those who agreed to participate signed an informed consent form after being informed about the nature and objectives of the study through the consent form and clarifying all doubts.

A total of 200 immigrant workers were admitted to Hospital Reference Laboratory in Sebha at end of 2023 year for malaria examination. Data were collected by questionnaire name, sex, aged 15 to 66 years old, and also patients who were hospitalized for more than 5 days were included.

The RBCs were examined on the hospital admission and adjusted for all workers on the minimal value for women and maximal value for men according to the International Specific Standards of Niger and Chad populations.

Laboratory diagnosis was done by rapid malaria anti-gen tests (SD-Bioline Malaria AG Pf/ PAN), and by microscopic examination of the Giemsa-stained thick and thin peripheral blood smears.

Results

Of the 200 workers, 193 (96.5%) were males. The highest 90 (45%) number of participants was found to be within the age range of 15-25 years, while the least number was found to be within the age range of 56-66 years**.** Positive infection rate was higher among males than females between ages of (15-25) compared to other age groups.

Males and females malaria patients according to nationality, was 11 (91.7%) among Niger immigrants and 1(8.3%) among Chad ones, 131 were from rural areas (65.5%) versus 69 (34.5%) from urban ones, and 136 (68%) were uneducated versus 64 (32%) educated ones**.**

RBCs levels was low (5.00±0.06) among those living in urban areas and high (5.27± 0.01) for educated ones**.** RBC was (5.63± 0.09) among healthy educated versus (4.52± 0.22) among females. Mean WBC value of all immigrants was 6.80±0.01 cells/µl ranged from 5.80 to 11.28±0.01 cells/µl. All the immigrants suffered from leukopenia (5.80± 0.38), or leukocytosis (11.28±0.01). In Niger, highest number of leukopenia was among those from rural areas, followed by males and those residing**.** In Chad, highest leukocytosis number was in females, in urban areas, followed by educated and then uneducated. There was significant relation between patients and WBC number, highest WBC was in control persons (7.19±0.83) in females versus (5.63±0.09) in educated ones. The platelet count was (262,100±24.89) among the rural residents in their mother country, and it was lower in patients Niger males who were uneducated, and living in urban areas. High platelets were in educated patients. In healthy ones, lowest number was (222.81±7.34) for those who lived in rural areas, versus (335.67±21.46) among females**.** The hemoglobin level was (13.58±-0.61) among uneducated and in healthy versus (14.82±0.09) among those in urban areas**.**

Details were given in tables (1, 2, 3, 4 &5) and figures (1, 2, 3 & 4)

Table 1: Age group of patients and healthy ones versus age groups in years.

Malaria	Sex	15-25y	26-35y.	36-45y.	46-55y.	56-66 y.	Total
Positive	Male	10 (90.9)	0	1 (9.1)	0	0	11 (92.0)
	Female	1 (9.1)	0	0	0	0	1 (8.0)
	Total	11 (91.7)	0	1 (8.3)	0	0	12 (6.0)
Negative	Male	75 (41.2)	66 (36.3)	26 (14.3)	9 (4.9)	6 (3.3)	182 (97.0)
	Female	4 (66.7)	1 (16.7)	1 (16.7)	0	0	6 (3.0)
	Total	79 (42.0)	67 (35.6)	27 (14.4)	9 (4.8)	6 (3.2)	188 (94)
Total		90 (45.0)	67 (33.5)	28 (14.0)	9 (4.5)	6 (3.0)	200 (100)

Table 2: Nationality of all immigrants

Malaria	Sex	Niger	Chad	Total
Positive	Male	11 (100.0)	0 (0.0)	11 (92.0)
	Female	0 (0.0)	1 (100.0)	1 (8.0)
	Total	11 (91.7)	1 (8.3)	12 (6.0)
Negative	Male	167 (91.8)	15 (8.2)	182 (97.0)
	Female	2 (33.3)	4 (66.7)	6 (3.0)
	Total	169 (89.9)	19 (10.1)	188 (94)
Total		180 (90.0)	20 (10.0)	200 (100.0)

Table 3: Residence of all immigrants

Malaria	Sex	Rural	Urban	Total
Positive	Male	10 (90.9)	1 (9.1)	11 (92.0)
	Female	0 (0.0)	1 (100.0)	1 (8.0)
	Total	10 (83.3)	2 (16.7)	12 (6.0)
Negative	Male	119 (65.4)	63 (34.6)	182 (97.0)
	Female	2 (33.3)	4 (66.7)	6 (3.0)
	Total	121 (64.4)	67 (35.6)	188 (94)
Total		131 (65.5)	69 (34.5)	200 (100.0)

Table 4: Educational level of all immigrants

Malaria	Sex	Uneducated	Educated	Total
positive	Male	10 (90.9)	1 (9.1)	11 (92.0)
	Female	1 (100.0)	0 (0.0)	1 (8.0)
	Total	11 (91.7)	1 (8.3)	12 (6.0)
negative	Male	122 (67.0)	60 (33.0)	182 (97.0)
	Female	3 (50.0)	3 (50.0)	6 (3.0)
	Total	125 (66.5)	63 (33.5)	188 (94)
Total		136 (68.0)	64 (32.0)	200 (100.0)

Table 5: Scio-demographic parameters among malaria patients

Variations	Sex & country	R.B.C		W.B.C		P.L.T		H.G.B	
		Infected	Healthy	Infected	Healthy	Infected	Healthy	Infected	Healthy
Sex	Males	5.22± 0.12	5.56± 0.05	5.81± 0.34**	5.89± 0.13	254.09± 23.89	228.10± 6.84	13.75± 0.57	15.24± 0.13
	Females	5.05± 0.01	4.52± 0.22	11.28± 0.01	7.19± 0.83	315.00± 0.01	335.67± 21.46	11.30± 0.01	12.40± 0.62
Nationality	Niger	5.22± 0.12	5.53± 0.06	**5.81± 0.34	5.90± 0.13	254.09± 23.89	226.80± 6.92	13.75± 0.57	15.11± 0.13
	Chad	5.05± 0.01	5.50± 0.20	11.28± 0.01	6.28± 0.42	315.00± 0.01	273.63± 25.53	11.30± 0.01	15.44± 0.56
Education	uneducated	5.21± 0.12	5.48± 0.07	6.21± 0.60	5.77± 0.15	248.09± 21.32	231.01± 8.91	13.58± 0.61	15.08± 0.17
	educated	5.27± 0.01	5.63± 0.09	6.80± 0.01	5.63± 0.09	381.00± 0.01	232.57± 10.0	13.20± 0.01	15.27± 0.20
Residence	Rural	5.26± 0.13	5.56± 0.07	5.80± 0.38*	5.84± 0.15	262.100 ±24.89	222.81± 7.34	13.80± 0.63	15.33± 0.17
	Urban	5.00± 0.06	5.48± 08	8.592±. 69	6.10± 0.24	244.50± 70.50	247.28± 13.55	12.30± 1.00	14.82± 0.09

*significant differences at 5%, **highly significant differences at 1%.

Discussion

Malaria is a mosquito-borne disease caused by a parasite. Malaria patients often experience fever, chills, and flu-like illness, when left untreated, they may develop severe complications and die (WHO, 2024).

The present study used the hematological associations (RBC, WBC, platelet levels and hemoglobin) parameters as a diagnostic malaria tools. This agreed with Jessica *et al* **(**2020), who adopted this laboratory technique together with traveling to malaria endemic areas.

The present study showed highly significant differences between infection rate and blood parameters (1%). The highest RBCs (5.27±0.0) were in educated immigrants and the lowest lowest value (5.00±0.06) was in those living in urban areas. Most of them suffered from leukopenia (5.80±0.38) or leukocytosis (11.28±0.01). This agreed with Traore *et al.* (2019) in Mali, in Eastern Ethiopia Haftu *et al.* (2023), and even among blood donors (Alemu and Mama, 2016).

The present study showed an association between infection rate with both platelet count and hemoglobin level. The highest platelets level was in educated patients and the lowestone was among those from in urban areas. This agreed with Tine *et al,* **(**2012) in Senegal, reported associations between malaria among children less than 10years old, (low CBCs, malnutrition) and anemia

The malaria biochemical and hematologyical parameters are common in sub-Saharan Africa, have noted that the risk of thrombocytopenia was generally high at inclusion and decrease after treatment with antimalarial drugs **(**Sylla *et al,* 2022). Awoke and Arota **(**2019**)** in Ethiopia found that mean values of Hb, platelets, RBC, and LT were significantly lower in malaria patients as compared to controls, especially thrombocytopenia (84%) and anemia (67%). Besides, the hematological changes such as anemia, thrombocytopenia, leukocytosis and leukopenia showed a significant correlation with malignant malaria **(**Euclides *et al* 2022).

Ramsdale (1990) in Libya didn't find endemic malaria transmission, but suspected to be malignant malaria among Libyan Detainment Camps (Martell *et al,* 2015). Migrants were in close contact with other refugees including migrants from West Africa where malaria transmitted in the centers was *P. falciparum* (8.2%) & *P. ovale* (2.7%) among Eritrean migrants (Snow and Marsh, 2010). Hamid *et al.* (2018) reported that the illegal immigration issue must be treated urgently, side by side with increasing surveillance activities of infectious diseases to prevent malaria re-introduction to Libya. Also, in Libya *Anopheles* species detected were *A. multicolor*, *A. sergentii* and *A. labranchiae* (Ahmed and Daw, 2016). At last the first two species are proved vectors in Egypt (Morsy et al, 2023). Apart from *Anopheles*, nosocomial malarial transmission occurred by the needle stick injury (Abdel-Motagaly *et al,* 2017) or even from blood transfusion from infected donors (Elnakib *et al,* 2018). Al-Agroudi *et al.* (2018) reported malaria among the Egyptian Peace Keeping forces returning back from Central Africa (41), Darfur (38), DR Congo (11), Nigeria (3) Chad (2) and one from to each of Rwanda, Djibouti, Yemen, Kenya, and/or Tanzania where chloroquine resistant *P. falciparum* was the most common species. Saleh *et al.* (2019) reported that some patient from Sub-Sahara African suffered from both malignant malaria & human immunodeficiency virus (HIV) within the same patient preventing malaria treatment

Conclusion

The data showed the importance of blood cell count parameters in diagnosing malaria infection. The presence of introduced malaria and the reported of *Anopheles* mosquitoes must be taken into consideration of the Public health Authorities.

Consequently, the periodical surveillance for *Anopheles* and their immature stages is a must.'

No doubt, antimalarial treatment failure is dangerous for the patients and community, exacerbating sudden malaria transmission or even unsuspected epidemic with spreading of antimalarial drug resistance.

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Explanation of figures

Fig. 1: Infection percentage among males and females according to age group
Fig. 2: Infection percentage among males and females according to nationality.
Fig. 3: Infection percentage among males and females according to residence.
Fig. 4: Infection percentage among males and females according to educational level