

Impact of Malaria on The Concentration Of manganese In Pregnant Women In Nnewi (South East Nigeria)

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Abstract: Malaria during pregnancy continues to be a major health problem in endemic countries with clinical consequences including death of both mother and child and attendant derangement in trace elements. This study is aimed at evaluating the relationship between the trace element manganese and malaria density in pregnant women with malaria. The patients were pregnant women attending the ante natal clinic of Nnamdi Azikiwe University Teaching Hospital Nnewi, Anambra, South East, Nigeria. The controls were pregnant women without malaria, non-pregnant women with malaria and non-pregnant women without malaria. The serum level of manganese was determined by atomic absorption spectrophotometry while the malaria density was determined by counting the parasites against white cells. From results, Manganese showed a non-significant increase in pregnant women with malaria $11.43 \pm 4.22 \mu\text{mol/L}$ compared to pregnant women without malaria $6.44 \pm 1.03 \mu\text{mol/L}$, non-pregnant women with malaria $2.14 \pm 0.45 \mu\text{mol/L}$ and non-pregnant women without malaria $4.49 \pm 0.33 \mu\text{mol/L}$ ($F = 2.040$; $p > 0.05$).

Manganese also showed a strong negative correlation with parasite density ($r = 0.48$; $p = 0.001$).

Key Words: Manganese, Malaria, Pregnancy, Antioxidants, Malaria parasite density, Trace elements.

Date of Submission: 05-10-2018

Date of acceptance: 20-10-2018

I. Introduction

Malaria is an important public health problem in developing countries. *Plasmodium falciparum* a pathogenic agent remains a major cause of morbidity and mortality to mother and child (Jeffrey and Pia, 2012). There are about 300 million cases of malaria each year, 9 of 10 cases occur in Africa. Women and children are most at risk (WHO, 2011). About 30 million African women are pregnant yearly, for these women; malaria is a threat both to themselves and their babies (Menendez *et al.*, 2000; WHO, 2011). In Malaria endemic areas, malaria during pregnancy may account for up to 15% of maternal anemia, 5-14% of low birth weight, 30% of preventable low birth weight (WHO, 2011). Pregnant women are particularly vulnerable to malaria as pregnancy reduces a woman's immunity to malaria infection and increasing the risk of illness, severe anemia and death for the unborn child. Maternal malaria increases the risk of spontaneous abortion, still birth, premature delivery and low birth weight (WHO, 2003). Pregnancy is a period of increased metabolic demands with changes in a woman's physiology and requirements of a growing fetus (Broughton, 2007). Insufficient supplies of essential vitamins and micronutrients can lead to a state of biological competition between the mother and conceptus which can be detrimental to the health status of both (King, 2003). Some authors have associated malaria acquisition and its severity to the concentration of micronutrients in pregnant mothers. Deficiencies of specific antioxidant activities associated with the micronutrients iron, selenium, copper, zinc and manganese can result in poor pregnancy outcomes including fetal growth restriction (Fall *et al.*, 2003), pre eclampsia and associated risk of diseases in adulthood, including cardiovascular diseases and type 1 diabetes (Lykkeet *al.*, 2009). Another consequence of oxidative stress resulting from antioxidant deficiency is the development of malaria anemia (Kremsner *et al.*, 2000). Micronutrients are known to be integral part of antioxidants and have been found to influence host cellular and humoral immunological functions (Spallhoizet *al.*, 1990). Cell mediated immunological response to malaria is found to decrease during pregnancy (Riche *et al.*, 2000). These antioxidants have been shown to provide protection against oxidative stress induced by malaria (Adelekan *et al.*, 1997). Manganese is an important factor for a number of enzymes including the antioxidant manganese superoxide dismutase which may protect the placenta from oxidative stress by detoxifying superoxide anions (Fall *et al.*, 2003).

1.1 Background of study

Malaria during pregnancy continues to be a major health problem in endemic countries with clinical consequences including death of both mother and child. Research shows that maternal mortality is twice in pregnant women with malaria than among non-pregnant patients with severe malaria. Trace elements are known to be an integral part of antioxidant and have been found to influence host cellular and humoral immunological functions. These essential factors are very important in the body in order for the immune system to cope with the challenges imposed by infectious agents.

This study is therefore aimed at evaluating the relationship between the trace element manganese and malaria density in pregnant women.

1.2 Aims and Objectives

- To determine the relationship between the trace element manganese and malaria density in pregnant women.
- To determine the level of manganese in pregnant women with malaria.

II. Materials And Methods

Study Site

- This study was conducted at NnamdiAzikiwe University Teaching Hospital, Nnewi.

Ethical clearance

- Ethical approval for this study was issued by the ethics committee of NnamdiAzikiwe University Teaching Hospital, Nnewi.

Subjects

- Four Hundred and sixty women were used for the study, out of this, One Hundred and Sixty pregnant women served as the test subject, One Hundred pregnant women without malaria, One Hundred women without malaria, One Hundred women with malaria served as control. These women were selected using simple random sampling technique. The pregnant women among them were those attending the antenatal clinic while the non-pregnant women were apparently healthy women within Nnewi town. The scope, nature, aims and objectives of the study were explained to the participants for their consent. Women with malaria were later grouped according to parasite density (Melaine *et. al.*, 2010).

Exclusion Criteria

These are women with established medical risk factors for oxidative stress such as AIDS, diabetes, tuberculosis, smoking and alcohol consumers.

Sample Collection

- 6ml of venous blood was collected from each of the participants. 2ml was dispensed into an EDTA container for total white cell count, a drop of blood from the syringe was placed on a clean grease free slide that has been labeled for a thick film while the remaining blood was dispensed into a plain tube. It was allowed to clot at room temperature for approximately one hour and then centrifuged at 2500 RPM for 10 minutes to separate the serum. The serum samples were analyzed for manganese. The thick film was left to air dry before staining.

Statistical Analysis

- This was done using graph pad prism version 5. The results were presented as mean \pm standard deviation. The statistical methods utilized for the analysis were one way analysis of variance, students "t" test, and correlation.

III. Results

1 Level of Manganese in Pregnant Women with Malaria and Control subjects (Mean \pm SD)

The mean serum level of manganese in pregnant women with malaria, pregnant without malaria, non-pregnant women with malaria and non-pregnant women without malaria are $11.43\pm 4.22\mu\text{mol/L}$, $6.44\pm 1.03\mu\text{mol/L}$, $2.14\pm 0.45\mu\text{mol/L}$ and $4.49\pm 0.33\mu\text{mol/L}$ respectively. The result shows no statistically significant difference between the means ($F=2.040$; $p>0.05$). Further analysis shows no significant increased level in pregnant with malaria compared to pregnant women without malaria ($p>0.05$), no significant higher level in pregnant women with malaria when compared with non-pregnant women with malaria ($p>0.05$) and no significant higher level in pregnant women with malaria when compared to non-pregnant women without malaria. ($p> 0.05$), (Table 1).

Table 1 Manganese in Pregnant Women with Malaria and Controls subjects (mean±SD)

	MANGANESE μmol/l
Pregnant women with malaria	11.43±4.223
Pregnant Women Without Malaria n=100	6.44±1.03
Non-Pregnant Women With Malaria n=100	2.14±0.45
Non Pregnant Women Without Malaria n=100	4.49±0.33
F-Value	2.040
p-Value	0.1076

NB: a; p<0.05 compared with pregnant women with malaria
 b; p<0.05 compared with pregnant women without malaria
 c; p<0.05 compared with non-pregnant women with malaria

2 Manganese and Parasite Density in Pregnancy (Mean±SD)

Pregnant women with parasite density of <2000/μl, between 2000-10000/μl and > 10000/μl has manganese level of 9.53±4.17μmol/L, 9.218±4.23μmol/L and 4.53±2.64μmol/L respectively. The result shows no significant difference between the means though there is a progressive decrease in manganese level as the malaria parasite density increases (F=0.4913; p> 0.05), (Table .2).

Table 2 Manganese and parasite density in pregnancy (Mean±SD)

	MANGANESE μmol/l
<2000/μl n=44	9.53 ± 4.17
2000-10000/μl n=96	9.218 ± 4.23
>10000/ μl n=20	4.53 ± 2.64
F-Value	0.4913
p-Value	0.6128

NB: **; significant difference between the means (p<0.05)
 a; p<0.05 compared with parasite density <2000/μl

4.3 Manganese and Parasite Density In Non-Pregnancy (Mean±SD)

Non pregnant women with parasite density of <2000/μl, between 2000 and 10000/μl and >10000/μl has manganese level of 2.057±0.29μmol/L, 2.077±0.303μmol/L and 2.331±0.706μmol/L respectively. The result shows a significant difference between the means (F=3.364; p =0.0387). There is a progressive increase in manganese level as the malaria parasite density increases (Table .3).

Table 3 Manganese and parasite density in non-pregnancy (Mean±SD)

	MANGANESE μmol/l
<2000/μl n=23	2.057 ± 0.2874
2000-10000 n=51	2.077 ± 0.3027
>10000 n=26	2.331 ± 0.7059 _b
F-Value	3.364
p-Value	0.0387**

NB: **; significant (p <0.05) difference between the means
 a; p<0.05 compared with parasite density <2000/μl
 b; p<0.05 compared with parasite density 2000-10000/μl

4 Manganese and Parasite Density in Pregnant and Non Pregnant Women (Mean±SD)

Pregnant women with parasite density < 2000/µl has manganese level of 9.534 ± 4.17 µmol/L while non-pregnant women has 2.057 ± 0.2874 µmol/L. There is a statistically significant higher level of manganese in pregnant women than in non-pregnant (p < 0.0011). At parasite density level between 2000 - 10000/µl, pregnant women (9.218 ± 4.23 µmol/l) has a statistically significant higher level of manganese compared to non-pregnant women (2.077 ± 0.3027 µmol/L), (p < 0.0048). At parasite density level > 10000/µl, pregnant women (4.532 ± 2.643 µmol/L) has a statistically significant higher level compared to non-pregnant women

	< 2000/µl		2000 - 10000/µl		>10000/µl	
	Pregnant women	Non pregnant women	Pregnant women	Non pregnant women	Pregnant women	Non pregnant women
Manganese	9.53 ± 4.17	2.06 ± 0.29	9.22 ± 4.23	2.08 ± 0.30	4.53 ± 2.64	2.33 ± 0.71
p-Value	0.0011**		0.0048**		0.0016**	

(2.331 ± 0.7059 µmol/L), (p < 0.0016).

Table 4 Manganese and Parasite Density in Pregnant and Non Pregnant Women (Mean±SD)

* Probability is significant at 0.05 level

5 Manganese and Parasite Density in Pregnancy

Manganese has a strong negative correlation with parasite density (r= 0.48;P= 0.001), (table 5)

Trace Elements	R	p
Manganese	-0.48	0.001

Table 5. Correlation between Manganese and parasite density in pregnancy

Correlation is significant at the 0.05 level

IV. Discussion

Manganese is an important factor for a number of enzymes including the antioxidant superoxide dismutase which may protect the placenta from oxidative stress by detoxifying superoxide anions (fall *et al.*,2003). Reports on manganese and malaria in pregnancy are limited. Ogbodo *et al.*, (2013) reported an increase in manganese level in pregnancy. From the present study, pregnant women have no significant higher level of manganese when compared with non-pregnant women. Also, pregnant women with malaria have a higher manganese level compared with pregnant women without malaria, non-pregnant women with and without malaria.

V. Conclusion

Manganese levels increase in pregnancy and in malaria infection while a higher increase in malaria parasite density decrease their serum level. This implies that manganese, levels affect the way the body responds to infection especially malaria. They also form the major component of antioxidant superoxide dismutase. Pregnant women with malaria who have deficiency of manganese are at risk of suffering severe malaria attack which according to researchers can result to still birth, spontaneous abortion, premature delivery and low birth weight.

Recommendation

From the results of this study and the conclusion derived therefrom, the following recommendations are necessary for consideration;

- High manganese levels observed during pregnancy means that manganese supplementation should not be undertaken in normal pregnancy except in severe malaria cases.

Conflict of interest: Authors' declare no conflict of interest.

Authors' contributions

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Conception and design, Acquisition of data, Analysis and interpretation of data.
Final approval of the version to be published.

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Drafting of the Article, Critical revision of the article
Final approval of the version to be published.

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Conception and design

Final approval of the version to be published

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IOzougwu, C. P. "Impact Of Malaria On The Concentration Of manganese In Pregnant Women In Nnewi (South East Nigeria)" *IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)*, vol. 17, no. 10, 2018, pp 67-71.