Madonna University Journal of Medicine and Health Sciences Volume 2 issue 1 (2022), Pp. 218-234

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EVALUATIONOF TRACE ELEMENTS IN SICKLE CELL ANAEMIA PATIENTS ATTENDING IMO STATE SPECIALIST HOSPITAL, OWERRI

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ABSTRACT

This work was carried out to evaluate the levels of trace elements among sickle cell anaemia patients attending Imo State Specialist Hospital, Owerri. Thirty subjects were recruited which include fifteen sickle cell anaemia subjects and fifteen apparently healthy individuals which served as control subjects. Five mililitres of blood sample was collected from the ante-cubital vein of each of the subjects, the serum was separated and used for analysis. The samples were analyzed for serum zinc, copper and iron levels using atomic absorption spectroscopy (AAS). The results obtained were statistically analyzed using independent t-test of SPSS version 21. Test with the probability of $P < 0.05$ was considered statistically significant. The study showed that sickle cell anaemia subjects had significantly lower ($P < 0.05$) serum copper level (75.85±6.05 µg/dl) than apparently healthy individuals (87.15±10.84 µg/dl). The serum zinc level of the sickle cell anaemia group (70.95±6.33 µg/dl) was also significantly lower ($P < 0.05$) than that of the control group (78.40±6.49 µg/dl). On the other hand, there was no statistical difference ($P>0.05$) between the serum iron level of sickle cell anaemia subjects (92.65±10.51 µg/dl) and that of the control group (93.10±11.06 µg/dl). In conclusion, lower level found in copper and

Edward, U. Osuorji, V.C., Nnodim, J and Obeagu, E.I. (2022). Evaluation of Trace Elements in Sickle Cell Anaemia Patients Attending Imo State Specialist Hospital, Owerri. Madonna University Journal of Medicine and Health Sciences.2(1):218-234

Madonna University Journal of Medicine and Health Sciences Volume 2 issue 1 (2022), Pp. 218-234

http://madonnauniversity.edu.ng/journals/index.php/medicine

zinc was due to reduced reabsorption and disturbed metabolism due to sickling of red cells which can lead to severe complications.

Key words: Trace Elements, Sickle Cell , Anaemia

INTRODUCTION

Sickle cell anemia is a condition resulting from mutant autosomal gene responsible for the synthesis of haemoglobin S (HbS) (Old, 2013). The amino acid valine replaces glutamic acid in the sixth position of the β- globin chain (Chirico and Pialoux, 2012). These chains are of 146 amino acids long, the fault occurs at the sixth amino in the chains. The homozygous inheritance of this abnormality produces, haemoglobin SS and individuals with this genotype suffer from sickle cell anemia (Erin, 2011). Sickle cell anaemia (SCA), a chronic debilitating disorder of genetic origin, is common in Africans and the Afro Caribbean. The disorder is characterized by varying clinical manifestations, referred to as crises among others (Bolarinwa *et al.,* 2010). Crises could be precipitated by a number of conditions like stress, extremes of temperature, infections - bacteria, viral, protozoa, particularly malaria, and a host of others (Behrens and Cymet, 2010). Sickle cell anaemia is a public health problem in Africa than any other continent in the world and it affects about 2% of Nigerian population. Trace elements are important in red blood cell maintenance, body growth and development (Mahyar*et al.,* 2010). Trace elements are pharmacologically beneficial and toxic, thus the need for monitoring of the dosage (Burtis*et al.,* 2008). People with sickle cell disease suffer from trace elements deficiency and higher rates of nutrients deficiency may be due to increased needs of many nutrients in sickle cell patients (Hyacinth *et al.,* 2010). There is increased turnover of hemopoietic cells due to chronic hemolysis and cell death leading to tremendous red marrow expansion. These conditions lead to hyper-metabolic rate and increase in nutrient and energy demand (Hibbert*et al.,* 2016). The global use of trace elements in health care delivery system has taken central stage due to the realization of their importance in disease management. Protection of red cell membrane from Edward, U. Osuorji, V.C., Nnodim, J and Obeagu, E.I. (2022). Evaluation of Trace Elements in Sickle Cell Anaemia Patients Attending Imo State Specialist Hospital, Owerri. Madonna University Journal of Medicine and Health Sciences.2(1):218-234

Madonna University Journal of Medicine and Health Sciences Volume 2 issue 1 (2022), Pp. 218-234

http://madonnauniversity.edu.ng/journals/index.php/medicine

free radical mediated oxidative stress is crucial to the management of SCD (Obeagu, 2020; Obeagu *et al.*, 2014; Obeagu *et al.*, 2018; Obeagu *et al.*, 2015*;* Obeagu *et al.*, 2018).Trace elements play an important role in maintaining red cell membrane integrity and function (Okpuzor and Okochi, 2009). There is need to study these essential trace elements in sickle cell anaemia.

People with sickle cell disease suffer from micronutrients deficiency but preliminary research on dietary habits, show that food and nutrients intake by sickle cell patients meet or exceed recommendation and is not significantly different from healthy controls. This suggests that higher rates of nutrients deficiency may be due to increased needs of many nutrients in sickle cell patients.

The global use of micronutrients in health care delivery system has taken central stage due to the realization of their importance in disease management. Since (SCD) is among the disease plaguing a sizeable population of the developing world and the cost implication of its management is very high and is characterized by anaemia and immunological disturbances, including the generation of free radicals; a balance between minerals and anti-oxidants is imperative in maintaining red cell membrane integrity and function. There is little available information on the levels of trace elements in sickle cell anaemia subjects attending Imo State Specialist Hospital, Owerri could be lacking. Hence, this study will fill the gap regarding the impact of trace elements on sickle cell anaemia.

MATERIALS AND METHODS

Study Area

The study was carried out in Owerri, Imo State of Nigeria, between June to November, 2019. Owerri is the capital city of Imo state, the eastern heartland. It is transversed by Port Harcourt,

Madonna University Journal of Medicine and Health Sciences Volume 2 issue 1 (2022), Pp. 218-234

http://madonnauniversity.edu.ng/journals/index.php/medicine

Onitsha, Aba, Okigwe and Umuahia high ways. It occupies a geographical Land mass of 58km^2. It lies within latitudes 4º45´N and 7º15´N and longitude of 6º50´E and 7º25´E. It has a provisional census figure of 127, 213 as at 2006 census. The area under study has a tropical climate and two main seasons namely: rainy and dry seasons. The dry season starts from October and end by March. Tropical rainforest is the dominant vegetation in Owerri municipal. The community has various social structures and amenities such as clinics, boreholes, surface water, ditches, e.t.c.It has an average minimum temperature of 22.5ºC. The relative humidity of the area is 74.3%, annual average rainfall is 240.6mm. Apart from farming as a major occupation in the community, a good number of the citizens are traders and few civil servants.

Study Population

A total of thirty subjects between the ages of five to thirty years were recruited for the study. Fifteen subjects were sickle cell anaemia individuals. Fifteen were apparently healthy that served as control subjects.

Collection of Blood Samples

Blood samples were collected aseptically by vein puncture from sickle cell patients and apparently healthy persons, using 5ml sterile disposable syringes and needles and dispensed into a labeled plain dry specimen container. The samples were centrifuged at 3,000pm for 5 minutes to separate and to obtain the serum. The serum was extracted using a pipette and was introduced into another specimen container, and stored at -20ºC until required. The serum samples obtained were taken to the research laboratory of the Department of Medical Laboratory Science, Imo State University for analysis.

Laboratory assay

Madonna University Journal of Medicine and Health Sciences Volume 2 issue 1 (2022), Pp. 218-234

http://madonnauniversity.edu.ng/journals/index.php/medicine

Zinc, copper and iron levels in the samples were determined using the Atomic Absorption spectroscopy (AAS) (Koirtyohann, 2011).

Statistical Analysis

The data obtained was analyzed using the Statistical Package for Social Sciences (SPSS) software computer program version 20.0. All values were expressed as Mean ± standard deviation (SD).The differences in the mean values were analyzed by student independent R-test. A value of $P < 0.05$ was considered statistically significant.

RESULTS

Table 1 shows the mean±standard deviation of serum levels of iron, copper and zinc of sickle cell anaemia subjects in the study population.

Serum iron level of the test group (92.65±10.51µg/dl) was lower which was not significant (P=0.896) when compared with the control (93.10±11.06µg/dl).

Copper level of the test group was (75.85±6.05µg/dl) was lower which was significant (P=0.001) when compared with that of the control (87.15±10.84µg/dl). Zinc concentration was significantly lower (P=0.001) in test subjects (70.95±6.33µg/dl) when compared with control subjects (78.40±6.49 µg/dl).

Madonna University Journal of Medicine and Health Sciences Volume 2 issue 1 (2022), Pp. 218-234

http://madonnauniversity.edu.ng/journals/index.php/medicine

Table 4.1: Mean±standard deviation of serum levels of iron, copper and zinc of sickle cell anaemia subjects in the study population

Parameters	**Paint workers** **n=20**	**Control** **n=20**	**P-value**
Iron (µg/dl)	92.65±10.51	93.10±11.06	0.896
Copper (µg/dl)	75.85±6.05	87.15±10.84	0.001
Zinc (µg/dl)	70.95±6.33	78.40±6.49	0.001

Legend:

$P < 0.05$ = significant.

n= sample size

DISCUSSION

Trace elements are important in red blood cell maintenance, body growth and development and their deficiency have been observed in sickle cell disease (Mahyar*et al.*, 2016). There is increased turnover of hemopoietic cells due to chronic hemolysis and cell death leading to tremendous red marrow expansion. These conditions lead to hyper-metabolic rate and increase in nutrient and energy demand (Hibbert*et al.*, 2016).

Madonna University Journal of Medicine and Health Sciences Volume 2 issue 1 (2022), Pp. 218-234

http://madonnauniversity.edu.ng/journals/index.php/medicine

From this study, the serum copper of the test group (sickle cell anaemia patients) were significantly lower ($P < 0.05$) than that of the control group. This is in agreement with the report of the study by Arinola*et al.,* (2008). However, it is contrary to work done by Bot *et al.,* (2013) and Nnodim*et al.,* (2014) which revealed a significantly elevated level of copper in sickle cell patients. Copper is known to be essential in the proper functioning of different metal enzymes which include ceruloplasmin involved in iron metabolism (Jaiser and Winston, 2010). Deficiency of copper is known to cause anaemia (Halfdanarson*et al.,* 2008).

From the study, there was no statistical difference between the serum iron level of sickle cell anaemia subjects and that of apparently healthy individuals. This is in agreement with the work of David *et al.,* (2018) and Paul *et al.,* (2011).

This work revealed a significantly low serum zinc level in sickle cell anaemia and this is in agreement with the report of Prasad and Cossack (2014) and Prasad (2012), Edamisan*et al.,* (2011), Idonije*et al.,* (2011), Bot *et al.,* (2013) and Manafa*et al.,* (2013). Zinc is known as an important nutrient for growth and development and plays an important role in iron metabolism (Zemel*et al.,* 2012). The mechanism through which zinc exerts its effect in correcting anemia in SCD is not understood (Prasad, 2012), but it is known that the proteins making up the cytoskeleton of cell membranes acquire some abnormal configurations and often get irreversibly damaged. Zinc prevents the formation of such irreversibly damaged sickle cells (Zemel*et al.,* 2012).

In conclusion, the lower level found in the level of copper and zinc suggests that higher rates of nutrient deficiency is due to reduced reabsorption, disturbed metabolism because of sickling of red cells. This can lead to several complications such as growth retardation and delayed wound healing.

In conclusion**,** evaluation of trace elements is suggested in the management of sickle cell anaemia to reduce complications (red cell dehydration, irreversible red cell damage andanaemia) associated with sickle cell anaemia.

Edward, U. Osuorji, V.C., Nnodim, J and Obeagu, E.I. (2022). Evaluation of Trace Elements in Sickle Cell Anaemia Patients Attending Imo State Specialist Hospital, Owerri. Madonna University Journal of Medicine and Health Sciences.2(1):218-234

Madonna University Journal of Medicine and Health Sciences Volume 2 issue 1 (2022), Pp. 218-234

http://madonnauniversity.edu.ng/journals/index.php/medicine

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Madonna University Journal of Medicine and Health Sciences Volume 2 issue 1 (2022), Pp. 218-234

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