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Comparison of the Immunoglobulin Levels in Maternal and Cord Blood and Influence of Parity on Maternal Immunoglobulin Concentration in Port Harcourt, Nigeria

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Authors' contributions

This work was carried out in collaboration between both authors. Author SOO conceived the study, designed the protocol and coordinated the experiment while the manuscript writing, statistical analysis and data interpretation were performed by author VZZ. Both authors read and approved the final manuscript.

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ABSTRACT

Aim: This study was carried out to compare the immunoglobulin levels in maternal and cord blood and to find out if parity has any effect on the immunoglobulin concentration of the maternal blood.
Place and Duration of Study: Department of Human Physiology, Faculty of Basic Medical Sciences, University of Port Harcourt, between June 2018 and September 2019.
Methodology: A total of 25 paired maternal and cord serum was used for the study. About 5ml of venous blood was collected from mothers immediately after delivery and cord blood was also collected after the cord has been cut and the clamp released slightly to allow blood flow into a plain bottle. The serum levels of IgA, IgG and IgM were measured using Turbidimetric immunoassay method.
Results: The mean IgA, IgM and IgG levels in maternal blood were 163.20 ± 13.35mg/dl, 88.16 ± 7.74 mg/dl and 351.60 ± 36.83 mg/dl respectively while their corresponding levels in the cord blood were 12.00±1.00mg/dl, 19.36 ± 1.67 and 300.60 ± 27.83 mg/dl respectively. The version 20.0 of

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the statistical package for social sciences (SPSS) and Microsoft Excel 2012 for the statistical analysis were employed for analyzing the various sets of data.
The Mean, standard errors of mean and ranges were determined for the different parameters for the two groups of subjects. The analysis of variance (ANOVA) was used to determine the variations between the subjects. The P-value of less than 0.05 was regarded as significant. The IgA and IgM showed significant variation in maternal and cord blood ($P<0.05$) while IgG showed no significant variation ($P>0.05$). Also, parity had no significant correlation with immunoglobulin concentration ($P>0.05$).
Conclusion: IgA and IgM concentrations were found to be significantly higher in maternal blood than in the cord blood, IgG showed no significant variation. There is a significant variation.

Keywords: Immunoglobulin; maternal; blood; serum and parity.

1. INTRODUCTION

The serum immunoglobulins (Ig) are of great clinical value in the evaluation of immuno-inflammatory diseases and the detection and characterization of immunodeficiency [1]; indeed their uses are extensive, both as diagnostic indicators of disease progression or to monitor therapy, in a variety of hypo- and hyper-gammaglobulinaemic states [2]. Several studies have attempted to establish normative values of the various types of serum immunoglobulin for several ambient populations and determine the effects of a number of physiological and other environmental factors on these values. To date, only few studies have established the correlation between the immunoglobulin concentration in the maternal and cord blood as well as the relationship between the maternal blood concentration of immunoglobulin and parity.

Immunoglobulins, also called antibodies are large, Y-shaped proteins produced mainly by plasma cells in response to foreign substances entering the living body-antigens or Immunogens (viruses, bacteria, or toxins etc), binding to them and forming antigen-antibody complexes resulting in their elimination and protection of the body of the host [3]. They are synthesized with a molecular arrangement that fits the shape of molecules on the antigens or Immunogens, in order to allow effective binding of the Antibodies. Immunoglobulins binding to Antigens basically help to inactivate, weaken or enhance phagocytosis of the antigens. The basic function of immunoglobulins is therefore to protect the body against pathogens [3].

All immunoglobulins have the same basic structural units of 2 identical light chains and 2 identical heavy chains, the heavy and light chains are joined together by inter-chain disulphide bonds and non-covalent interactions. Immunoglobulins include the following three classes, IgG, IgA and IgM. They all have similar antigenic, structural and biological activities but they differ in the amino acid sequence as their antibody functions are highly specific.

2. MATERIALS AND METHODS

2.1 Experimental Subjects

For the experiment, a total of twenty-five (25) apparently healthy pregnant females were recruited for the study. These subjects were made of students, civil servants and business women all from different parts of Rivers State such as Aluu, Trans-Amadi, Aggrey Road and Borokiri, all in Port Harcourt. The parity of the subjects was obtained and recorded.

2.2 Materials for Sample Collection

(a) The materials for sample collection were; laboratory coats, surgical gloves, Tourniquet, Cotton wool, 70% alcohol, syringes, needles, plain sample bottles, forceps and cord scissors.
(b) The materials for centrifugation and storage were; Pasteur pipette, universal 320 laboratory centrifuge, refrigerator and rubber teats
(c) The materials for laboratory analysis were; Normal saline, cuvettes, automated pipettes, Clincheck Plus Spectrophotometer, Centronic Protein Caliberator Sets, Buffer Solution, Antisera Reagents (IgA, IgG and IgM), Recording paper and Graph Sheet, Plain bottles, Distilled water and Racks.

2.3 Experimental Design

Cluster sampling method was used to choose the part of Port Harcourt to conduct the field work of this research while random sampling method

was used to choose the participants. Letters of introduction were sent to all the primary health centres used for the study and their permission secured for the usage of their facilities. Immediately after delivery, the umbilical cord was clamped at two ends-the maternal end and the foetal end with two forceps. Thereafter, a complete transection was made in between the forceps, using the cord scissors. The maternal forceps was then slightly released and the umbilical cord blood was collected with a labelled plain bottle. The collected samples were transported to the Chemical Pathology Laboratory, University of Port Harcourt Teaching Hospital within 24 hours of collection. The samples were freed from the sides of the plain bottles using Pasteur pipettes and allowed to clot properly. The samples were centrifuged at 2000 g and the serum formed were obtained with a Pasteur pipette and a rubber teat and put in a clean plain bottle. The serum formed was then stored at a temperature of -4^0C to 0^0C.

2.4 Laboratory Analysis of Samples

The laboratory analysis was done using Turbidimetric Immunoassay method. The determination of the immunoglobulin concentration (IgA, IgG and IgM) was based on an immuno-turbidimetric antigen-antibody reaction.

2.5 Statistical Analysis

The version 20.0 of the statistical package for social sciences (SPSS) and Microsoft Excel 2012 for the statistical analysis were employed for analyzing the various sets of data.

The Mean, standard errors of mean and ranges were determined for the different parameters for the two groups of subjects. The analysis of variance (ANOVA) was used to determine the variations between the subjects. The P-value of less than 0.05 was regarded as significant.

3. RESULTS AND DISCUSSION

3.1 Results

The results are ether presented in tables as actual value plus minus standard error of mean (SEM) with significant differences at $P<0.05$ or as bar charts.

3.2 Discussion

Table 1 shows the mean levels of immunoglobulins A, G and M (IgA, IgG and IgM) in maternal and Cord Blood in Port Harcourt, Rivers State. The result displays a statistically significant difference between the mean concentrations of IgM and IgA of the maternal and cord blood, whereas, no statistically significant difference was found between the mean concentration of IgG in the maternal and cord blood. It was also found that IgG had the highest concentration in both maternal blood and cord blood whereas IgM had the least concentration in maternal blood while IgA had the least concentration in the cord blood. IgM is the first immunoglobulin to be produced in primary response and it is the first immunoglobulin to be produced by the foetus. The reference range for IgM in the cord blood is between 6.3- 25mg/dl while that in maternal blood is between 40-250 mg/dl. The values of IgM concentrations in both the maternal and cord blood therefore correspond with the normal reference range. The significant variations in the IgM concentration in the maternal and cord blood found in this research correlates with other findings in which a very low concentration of cord IgM was found compared with maternal IgM [4]. This result also agrees with the findings obtained by other authors which revealed that the IgM in the maternal and cord serum were markedly different and suggested placental barrier as been the cause of the marked variation [5].

Table 1. Mean levels of immunoglobulins A, G and M (IgA, IgG and IgM) in maternal and cord blood

Parameters	Maternal blood (n= 25)	Cord blood (n= 25)	Z test significance (P< 0.05)
IgM	88.16±7.74 (32-208)	19.36 ±1.67 (4-36)	0.01 (Significant)
IgG	351.60 ±36.83(150-1025)	300.60 ±27.83 (135-36)	0.07(not Significant)
IgA	163.20 ±13.35 (80-315)	12.00 ±1.00 (5-25)	0.01 (Significant)

∗ *Immunoglobulins M and A are significantly higher in maternal blood than in cord blood (P< 0.05) in women and neonates in Port Harcourt*

Immunoglobulin A (IgA) is an antibody that plays a crucial role in the immune function of mucous membranes. It has two subclasses; IgA1 and IgA2. It is the main immunoglobulin found in mucous secretions such as the saliva, tears, colostrum, vaginal and intestinal secretions. The mean concentration of IgA obtained in this research was found to be significantly higher in the maternal blood than in the cord blood. The reference range for IgA in the cord blood is between 1.4- 3.6mg/dl while that in maternal blood is between 70-374mg/dl. The value of IgA concentration in the maternal blood was within the normal reference range while that in the cord blood was above the normal reference range. The significant difference between the maternal IgA and cord IgA may be due to placental barrier or environmental factors [6]. The marginally high value of IgA in the cord blood may be caused by either viral infection or presence of increasing IgA producing cells in the cord blood [7].

Immunoglobulin G (IgG) is the most abundant immunoglobulin in the human body, representing about 75% of serum antibodies in humans [8]. It is produced in a large amount during immune responses. It is the main type of antibody found in the blood and extracellular fluid, allowing it to control infection of body tissues. Along with IgA secreted in the breast milk, residual IgG is absorbed through the placenta and provides the neonate with humoral immunity before its own immune system develops. Therefore, in the first six months of life, the newborn has the same antibodies as the mother and the child can defend itself against all the pathogens that the mother encountered in her life (even if only through vaccination) until these antibodies are degraded. This immunoglobulin is crucial for the newborns who are very sensitive to infections, especially within the respiratory and digestive systems. IgG has a normal reference value of 636-1606mg/dl in the cord blood and 630-1445mg/dl in the maternal blood. The values of IgG concentration in both the maternal and cord blood obtained from this research were therefore lower than the normal reference range. Our research reveals a statistically non significant variation between the maternal and cord blood concentrations of IgG. The low maternal concentration of IgG obtained from our research may be due to hyperglycaemia as reported by other researchers [9]. It may also be attributable to environmental, healthcare and nutritional factors. The low cord concentration of IgG may be due to a low level of maternal total IgG and the placental integrity [10]. The observation from our result that the mean maternal and cord IgG were almost identical corroborates with other findings that the IgG level in the maternal sera and those in the cord sera of the corresponding offsprings were almost identical in Thais mothers [5].

The results of the relationship between the maternal concentration of the immunoglobulins and parity are presented in Table 2 and Fig. 2.The results showed that there was no significant relationship between parity and the concentration of the maternal immunoglobulins.

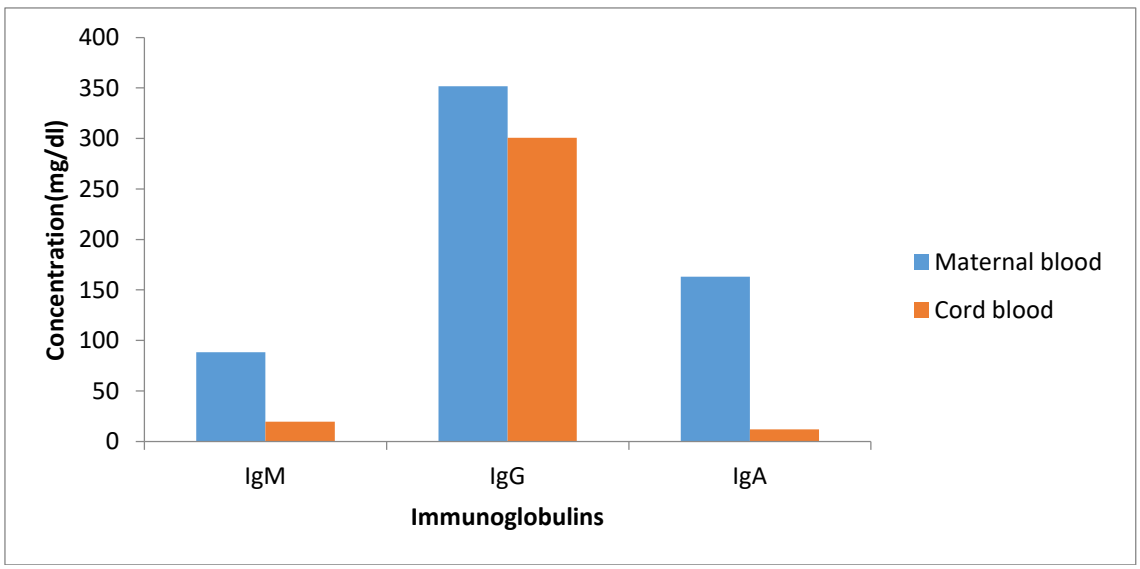

Fig. 1. Graph showing the comparison of the immunoglobulin concentrations in maternal blood and cord blood in Port Harcourt, Rivers State

Table 2. Relationship between the mean levels of immunoglobulins A, G and M (IgA, IgG and IgM) in maternal blood and parity in Port Harcourt, Rivers State

Parameters	PARA 1 (n= 11)	PARA 2 (n= 11)	ANOVA TEST
IgM	76.73 ±8.39 (32-140)	97.33 ±31.86 (56-160)	0.44 (Not Significant)
IgG	380.91 ±42.39 (185-610)	318.33 ±22.05 (285-360)	0.79 (Not Significant)
IgA	177.73 ±16.05 (105-270)	140.00 ±45.37 (85-230)	0.61 (Not Significant)

* *Parity had no effect on immunoglobulins A, G and M concentrations (P>0.05) in the maternal blood of women in Port Harcourt*
* *PARA 1- Primigravid/ primiparous*
* *PARA 2- Multigravid /multiparous*

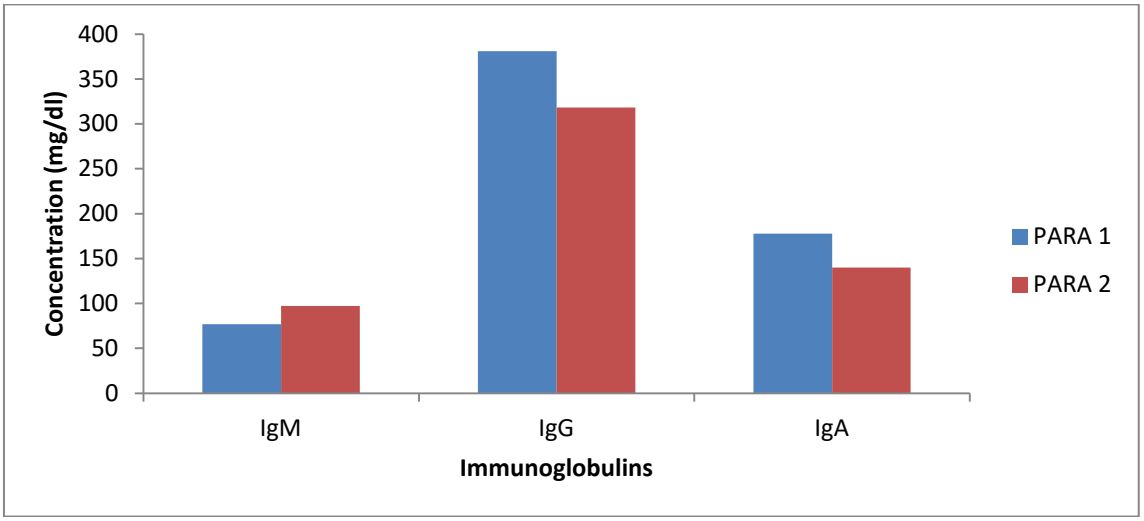

Fig. 2. Graph showing the relationship between the mean levels of immunoglobulins A, G and M (IgA, IgG and IgM) in maternal blood and parity in Port Harcourt, Rivers State

The mean maternal IgA decreased with increasing parity. The mean IgA for primiparous mothers was found to be 177.73 ±16.05 mg/dl, a value which decreased with the second and third child. The difference was however not statistically significant. This result corroborates with that obtained by other researchers, who concluded that there was no significant difference in the IgA concentration in the colostrum in relations to parity [11]. The result however contradicts that obtained by others, who concluded that primiparous women presented a higher concentration of IgA in the colostrum than multiparous women [12]. The mean value of IgM for the women increased with increasing parity. The mean IgM for primiparous women was found to be 76.73 ± 8.39 mg/dl. This value was found to increase slightly with the second and third child. This increase was however not statistically significant. This increase in the maternal IgM of the multiparous women may be as a result of their nutritional and socio-economic status. This can also be caused by malaria infection. The low level of IgM in the sera of primiparous women observed in this research however contradicts other findings, who found an elevated level of the immunoglobulin in the colostrum of primiparous mothers [12].

The mean maternal IgG decreased with increasing parity. The mean IgG for primiparous mothers was found to be 380.91 ±42.39 mg/dl and 318.33 ±20.05 mg/dl for multiparous mothers. The concentration of IgG therefore decreased with an increasing number of births. This increase was however not statistically significant. This result agrees with the findings of other authors, who concluded that the concentration of IgG in the colostrum was insignificantly associated with parity [12].

4. CONCLUSION

This study reveals that maternal blood has statistically significant higher concentrations of IgA and IgM compared with the cord blood. The maternal IgM concentration is also higher than the cord blood concentration, though the

difference is not statistically significant. Again, it has been found that the concentrations of immunoglobulins A, G and M in the maternal blood are not significantly influenced by parity.

CONSENT AND ETHICAL APPROVAL

Both authors hereby declare that this experiment has been examined and approved by the appropriate ethics committee of the university of Port Harcourt and have therefore been performed in accordance with the ethical standards laid down by the University. As per international standard or university standard, respondents' written consent has been collected and preserved by the authors.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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