

Relationship Between Placental Alkaline Phosphatase Activity and Some Biochemical Indices of Foetal Nutrition among the Ethnic Groups in the Western Niger Region of Nigeria

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Abstract: Placental alkaline phosphatase (PAP) increased synthesis has been observed to contribute to the maintenance of foetal health. This study examines the ethnic variations in PAP activity values and the consequent effect on cord blood glucose, albumin and birth weight-the biochemical markers of foetal nutrition. Two hundred and ninety pregnant women in apparent good health and within 30-35 week gestation period were randomly selected from five ethnic groups (Bini, Ibo, Ijaw, Itsekiri, and Urhobo) in Western Niger region of Nigeria. Maternal and cord blood samples were obtained and analyzed using standard procedures. Results show that PAP activity bears positive relationship to cord blood glucose, albumin, and birth weight at term. PAP activity value was highest among the Binis (121 ± 11 IU/L), and lowest among the Ijaws (115 ± 10 IU/L; $P < 0.05$). Cord blood glucose, albumin, and birth weight for Binis vs Ijaws are: 4.36 ± 0.51 mmol/L, 46.2 ± 6.1 g/L, and 3.51 ± 0.52 kg vs 3.69 ± 0.44 mmol/L, 42.2 ± 5.7 g/L and 3.19 ± 0.53 kg. These differences were significant ($P < 0.05$). PAP activity appears to contribute to foetal nutrition but such contribution varies among the ethnic groups. Ethnic variations in PAP activities exist and such variations influenced foetal nutrition parameters.

Key words: Placental alkaline phosphatase • Glucose • Albumin • Nutrition • Binis • Ijaws

INTRODUCTION

The Western Niger Region of Nigeria presently constitutes three states of the thirty-six states in the Federal Republic of Nigeria. The major ethnic groups in this area are the Binis, Basanges, Etsakos, Igbiras, Ososo, Igaras, Esans, Ibos, Ijaws, Isokos, Itsekiris, and Urhobos. The Binis and Esans are in Edo State, while the Ibos, Ijaws, Isokos, Itsekiris and Urhobos occupy the neighbouring Delta State. The Ijaws and Itsekiris inhabit the riverine area of the Niger Delta. The Ibos are in the North Senatorial District of Delta State, while the Urhobos are in the Central. The Isokos, Ijaws and Itsekiris are in the South. The Ibos are mostly farmers, but the predominant occupation of the Itsekiris is fishing. However, the Isokos and Urhobos have mixed occupation: fishing and farming.

All the ethnic groups have varied culture, tradition and customs, though there are overlaps.

It has been observed that increase in the synthesis of placental alkaline phosphatase (PAP) enzyme corresponds to the nutritional demand of the foetus during growth [1], and the activities of placental alkaline phosphatase (PAP) enzyme has been demonstrated to be involved in facilitating the transfer of nutrients across cell membrane to the developing foetus [2].

However, placental alkaline phosphatase (PAP) is a polymorphic enzyme showing differences in gene frequency between ethnic groups [3]. Thus, ethnicity may influence PAP genotypes, and hence, its activity which has been observed to affect birth outcomes [4].

This study reports the influence of ethnicity on PAP activity values and the attendant effect on cord

blood nutrient (glucose and albumin) levels and birth weight at term.

MATERIALS AND METHODS

Subjects: Two hundred and ninety (Binis = 56, Ibos = 63, Ijaws = 48, Itsekiris = 51 and Urhobos = 72) pregnant women in apparent good health and within 30-35 week gestation period were randomly selected from 5 major ethnic groups in the Western Niger region of Nigeria. The consenting subjects were between 20-38 years. The subjects had similar socioeconomic background and comparable body size and weight (65-78 kg). They were randomly selected from clinics and hospitals within the Western Niger region of Nigeria, and their socio-demographic data were obtained by semi-structured questionnaire. The study was conducted between May and December 2007, and subjects' participation was approved by the hospital-based Ethics Committee constituted by the Health Management Board of Delta State.

Collection of Blood Samples: Maternal (placenta) whole blood (3.0 ml for placental alkaline phosphatase assay) and foetal (cord) blood (3.0 ml; for glucose and albumin determinations) samples were collected separately into plain, sterile bottles. The samples were allowed to clot and then centrifuged at 1,200 x g for 5 min at room temperature using Jouan C-400-54 model centrifuge. The maternal and foetal (cord) sera samples obtained were decanted into bijoux bottles and analyzed within the hour of collection.

Analysis of Samples: Maternal (placenta) serum was heated at 65°C for 7 min, and after allowing to cool, placental alkaline phosphatase (PAP) activity was then assayed by the Thymolphthalein Monophosphate method [5]. The thermal treatment denatures other isoenzymic forms of alkaline phosphatase possibly derived from bones, liver, spleen, kidney and intestines, but the placental isotype remain stable to such thermal treatment.

Cord serum glucose concentration was determined by the Glucose Oxidase method [6], and cord serum albumin level was estimated by the Bromocresol Green (BCG) method [7]. The reagents used for each assay were supplied in a commercial test kit by Randox Laboratories, Limited, United Kingdom. The reagents were reconstituted and allowed to stabilize at room temperature (29-31°C) for about 10 min before use.

Birth Weight Measurement: The weights of the infants at term were determined to the nearest 0.01 kg by bathroom weighing scale designed for infants.

Statistics: Paired, two-tailed Student *t*-test was used to determine statistical significance between the various ethnic groups, and differences were considered significant when $P < 0.05$. Statistical Package for Social Sciences (version 7.5) was used.

RESULTS

Results obtained from this investigation are recorded on Table 1. The table shows the relationship between ethnicity and PAP activity values, and foetal nutrients (cord blood glucose and albumin). PAP activity value varies with ethnic group. It was observed to be highest among the Binis and lowest among the Ijaws (121 ± 11 IU/L vs 115 ± 10 IU/L; $P < 0.05$).

The higher the PAP activity value, the higher the levels of cord blood glucose and albumin and this correlates positively with birth weight at term. This was a generalized trend irrespective of the ethnic group. PAP activity values for Binis vs Ijaws, Binis vs Itsekiris, Binis vs Urhobos and Ibos vs Ijaws were significantly different ($P < 0.05$). These significant differences also induced significant differences in cord blood glucose, albumin and birth weight measures between these ethnic groups. In addition, however, the difference in cord blood glucose levels for Ibos vs Itsekiris, Ibos vs Urhobos, Ijaws vs Itsekiris, Ijaws vs Urhobos, and the cord blood albumin concentration for Ijaws vs Urhobos were observed to be statistically significant ($P < 0.05$). Also, the birth weight difference between Ibos vs Itsekiris was demonstrated to be significant ($P < 0.05$).

DISCUSSION

In developing foetus, it has been observed that glucose provides energy for cellular activities, while albumin contributes to the maintenance of good health and hence, proper growth [8].

PAP activity value has been reported to increase as the gestational period advances [9], emphasizing the role of PAP activity in pregnancy maintenance. The rapid increase in PAP activity during pregnancy has been observed to mobilize maternal glucose for foetal metabolism [10] and albumin for proper foetal growth [11]. Present data suggest that this mobilization displays ethnic variation and in some cases to a significant level ($P < 0.05$).

Table 1: Maternal placental alkaline phosphatase (PAP) activity values, cord blood glucose and albumin, and neonatal birth weight at term obtained for Bini, Ibo, Ijaw, Itsekiri and Urhobo ethnic groups in the Niger Delta region of Nigeria.

Parameter	Ethnic groups				
	Bini (n=56)	Ibo (n=63)	Ijaw (n=48)	Itsekiri (n=51)	Urhobo (n=72)
Maternal PAP (IU/L)	121±11	119±14	115±10	116±12	117±13
Cord blood glucose (mmol/L)	4.36±0.51	4.22±0.49	3.69±0.44	3.86±0.46	3.98±0.39
Cord blood albumin (g/L)	46.2±6.1	45.4±5.6	42.2±5.7	43.6±6.4	44.1±6.3
Neonatal birth weight (kg)	3.51±0.52	3.43±0.54	3.19±0.53	3.27±0.51	3.31±0.56

Values are expressed as Mean ±SD of 'n' subjects PAP-Placental alkaline phosphatase

Table 2: Report of the statistical analysis of the experimental data

Parameter	Ethnic groups	t-Test Analysis			
		df	t-calculated	t-table	p-value
Maternal PAP	Bini vs Ibo	117	0.87	1.658	>0.05
	Bini vs Ijaw	102	2.91	1.658	<0.05
	Bini vs Itsekiri	105	2.24	1.658	<0.05
	Bini vs Urhobo	126	1.89	1.658	<0.05
	Ibo vs Ijaw	109	1.76	1.658	<0.05
	Ibo vs Itsekiri	112	1.23	1.658	>0.05
	Ibo vs Urhobo	133	0.86	1.658	>0.05
	Ijaw vs Itsekiri	97	0.45	1.658	>0.05
	Ijaw vs Urhobo	118	0.95	1.658	>0.05
	Itsekiri vs Urhobo	121	0.88	1.658	>0.05
Cord blood Glucose	Bini vs Ibo	117	1.57	1.658	>0.05
	Bini vs Ijaw	102	7.44	1.658	<0.05
	Bini vs Itsekiri	105	5.56	1.658	<0.05
	Bini vs Urhobo	126	4.75	1.658	<0.05
	Ibo vs Ijaw	109	6.63	1.658	<0.05
	Ibo vs Itsekiri	112	4.50	1.658	<0.05
	Ibo vs Urhobo	133	3.43	1.658	<0.05
	Ijaw vs Itsekiri	97	1.89	1.658	<0.05
	Ijaw vs Urhobo	118	4.14	1.658	<0.05
	Itsekiri vs Urhobo	121	1.43	1.658	>0.05
Cord blood Albumin	Bini vs Ibo	117	0.75	1.658	>0.05
	Bini vs Ijaw	102	3.48	1.658	<0.05
	Bini vs Itsekiri	105	2.15	1.658	<0.05
	Bini vs Urhobo	126	1.91	1.658	<0.05
	Ibo vs Ijaw	109	2.96	1.658	<0.05
	Ibo vs Itsekiri	112	1.58	1.658	>0.05
	Ibo vs Urhobo	133	1.27	1.658	>0.05
	Ijaw vs Itsekiri	97	1.16	1.658	>0.05
	Ijaw vs Urhobo	118	1.73	1.658	<0.05
	Itsekiri vs Urhobo	121	0.43	1.658	>0.05
Neonatal Birth weight	Bini vs Ibo	117	0.89	1.658	>0.05
	Bini vs Ijaw	102	3.20	1.658	<0.05
	Bini vs Itsekiri	105	2.67	1.658	<0.05
	Bini vs Urhobo	126	2.22	1.658	<0.05
	Ibo vs Ijaw	109	2.40	1.658	<0.05
	Ibo vs Itsekiri	112	1.78	1.658	<0.05
	Ibo vs Urhobo	133	1.33	1.658	>0.05
	Ijaw vs Itsekiri	97	0.80	1.658	>0.05
	Ijaw vs Urhobo	118	1.20	1.658	>0.05
	Itsekiri vs Urhobo	121	0.44	1.658	>0.05

PAP activity also correlates with birth weight-the index of foetal nutrition, and maternal blood glucose level has been observed to influence birth weight [12].

Table 1 indicates that PAP activity might be significant in foetal nutrition and growth. However, such activity varies among the ethnic groups in the Western Niger region of Nigeria. Differences in PAP gene frequency between ethnic groups may contribute to birth outcomes. This present study did demonstrate significant differences in PAP activity among some ethnic groups sampled. Thus, the trend observed, nevertheless, confirms the polymorphic nature of PAP. Therefore, ethnic variation in PAP genotypes may be associated with differences in the enzyme activity. So, determination of PAP genotypes should be performed among various ethnic groups and results correlated with cord blood markers of foetal nutrition.

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