

## Alkaline Phosphatase Activity in Children and Adolescents

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### Summary

**Afonja OA. Alkaline Phosphatase Activity in Children and Adolescents.** *Nigerian Journal of Paediatrics* 1983; 10: 65. Plasma total alkaline phosphatase activity was examined in 992 male and 932 female apparently healthy Nigerian children and adolescents. The male subjects, aged from birth to 20 years had a reference range of plasma total alkaline phosphatase activity of 7.5 to 23 KA units per decilitre. Among the females of similar age group, the range was 6.9 to 22.1 KA units per decilitre. The reference limits were set between the 2½ and 97½ percentile values. This pattern of activity establishes the reference values which should be useful in diagnosis and management of diseases which affect the plasma activity of alkaline phosphatase.

### Introduction

THE elevation of alkaline phosphatase in plasma has been associated with diseases of the liver,<sup>1</sup> bone,<sup>2</sup> or placenta<sup>3</sup> and with malignancies.<sup>4</sup> However, high values of plasma total alkaline phosphatase are found in healthy caucasian<sup>5</sup> and Ghanaian<sup>6</sup> children in whom reference values for the enzyme have been defined. In those populations, the plasma alkaline phosphatase levels varied widely between the different age groups of infants and adolescents.

Although the mean enzyme values have been studied in Nigerian children, a reference population was not selected and the children were not

divided into age groups.<sup>7</sup> The purpose of this study was to establish reference values for different age groups of infants, children and adolescents in Lagos. It is hoped that the values obtained will be useful in the diagnosis and management of diseases in which the plasma alkaline phosphatase activity is higher than the defined reference values for the age group under reference.

### Materials and Methods

Venous blood was obtained from fasting 992 male and 932 female infants, children and adolescents, aged between birth and 20 years, at the Lagos University Teaching Hospital (LUTH) and various Health Centres in Lagos state; they had minor and unrelated complaints such as cuts and wounds. Nevertheless, most of the subjects had reported for routine health screening and blood was taken simultaneously for other

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studies including sickle cell, liver and renal functions. Individuals on drugs or any medication were excluded. Subjects were instructed to report after an overnight fast and venous blood was obtained between 0800 and 0900 hours. The blood was heparinised and the plasma separated within two hours of collection.

Plasma total alkaline phosphatase activity was determined on the same day by the method of Kind and King.<sup>8</sup> The infants were grouped by age at six-monthly intervals, while the other subjects were grouped at two-yearly intervals.

### Results

The distribution of the values of plasma total alkaline phosphatase activity in Nigerian infants, children and adolescents were not symmetrically distributed on either side of the mean; more values were obtained on the higher side of the mean. Non-parametric methods of percentile were therefore, used in the expression of results.

The reference range of plasma total alkaline phosphatase activity of 7.5 to 23 KA units per decilitre was obtained among the male subjects aged between birth and 20 years. Among the females, the range was 6.9 to 22.1 KA units per decilitre. The limits were set between 2.5 and 97.5 percentiles. However, the values were high in infants and varied widely between the age groups as shown in Tables I and II. The highest median value (50 percentile value) occurred before the age of 11 years in the females and before the age of 13 years in the male subjects.

### Discussion

The total plasma alkaline phosphatase activity at birth is generally higher than the adult values. Hilderbrend *et al*<sup>9</sup> reported a mean value of 12.3 KA units per decilitre for the cord plasma alkaline phosphatase activity in term babies and found no significant difference between the values in the term and pre-term babies. The 50 percentile value of 13.8 KA units per decilitre obtained in the present study, though higher than that reported by Hilderbrend *et al*<sup>9</sup> in caucasian babies,

TABLE I

*Alkaline Phosphatase among 992 Male Children and Adolescents*

Age	No. of Subjects	Percentile in KA units/dl		
		2.5	50	97.5
At birth	133	7.2	13.8	21.2
1-6 months	87	11.7	20.6	30.2
7-11 months	65	8.1	16.7	25.6
1-2 years	58	7.2	14.2	22.4
3-4 years	60	7.1	13.5	21.1
5-6 years	72	6.5	12.9	21.5
7-8 years	63	6.1	11.6	18.3
9-10 years	85	6.9	14.9	24.1
11-12 years	78	9.2	18.2	28.2
13-14 years	93	8.8	16.7	25.6
15-16 years	77	6.4	13.7	22.1
17-18 years	62	5.1	10.8	17.8
19-20 years	59	4.5	9.9	17.1

TABLE II

*Alkaline Phosphatase among 932 Female Children and Adolescents*

Age	No. of Subjects	Percentile in KA units/dl		
		2.5	50	97.5
At birth	128	6.6	13.1	21.6
1-6 months	79	10.8	20.0	29.9
7-11 months	68	9.7	16.3	24.3
1-2 years	52	6.6	13.5	21.5
3-4 years	65	6.9	13.3	20.7
5-6 years	68	6.3	12.7	20.7
7-8 years	59	7.1	12.9	19.9
9-10 years	92	8.8	17.1	26.8
11-12 years	70	8.1	16.0	25.3
13-14 years	63	7.6	14.6	22.8
15-16 years	65	5.2	13.2	20.4
17-18 years	69	5.2	10.4	16.8
19-20 years	54	4.4	9.2	15.6

has confirmed the high levels found in babies generally. Balfield and Goldberg<sup>5</sup> found an upper limit value of 25 KA units per decilitre in Caucasian children, aged between 5 and 15 years. In a previous study on Nigerian children aged between 5 and 15 years, an upper limit value of 30 KA units per decilitre was reported.<sup>7</sup> In a recent study on Ghanaian children, aged between birth and 15 years,<sup>6</sup> an upper limit value of 33.6 KA units per decilitre, was obtained. In the present study involving children aged between birth and 20 years, an upper limit value of 31 KA units per decilitre was obtained.

Plasma alkaline phosphatase activity during puberty and adolescence have been shown to be up to seven times the reference values in adults.<sup>10</sup> It is clear therefore, that the reference interval produced for children from birth to 15 years or above, will over-estimate the prepubertal and under-estimate the pubertal values of plasma alkaline phosphatase activity. Even the studies which recognised high activity during puberty<sup>11</sup> did not show the sex differences in the patterns of rise. Some workers<sup>10</sup> found no significant sex difference between the plasma values in West Indian subjects under the age of 10 years, while an increase of about 50 per cent over the prepubertal values occurred in girls between 11 and 12 years and in boys between 13 and 14 years. Round<sup>12</sup> reported peak values in English girls aged 8 to 12 years and boys aged 10 to 14 years. The age intervals used by Bennett, Ward and Daniel<sup>13</sup> were greater; peak values were obtained in girls between 12 and 18 years and in boys between 10 and 18 years; these results showed a later rise in girls than those reported. Clark and Beck<sup>14</sup> could not show any pubertal rise in activity in the girls.

In the Nigerian children, the 50 percentile values of the total plasma alkaline phosphatase activity were similar in both sexes until the age of 8 years. There was a rise in value in both sexes between 9 and 10 years but the rise was more pronounced in girls of this age group. The boys reached the peak levels two years later than the

girls, i.e. between 11 and 12 years. In both sexes, the values fell from the peaks, but remained higher in the boys; adult values were reached between 19 and 20 years.

Although plasma alkaline phosphatase activity within the reference limits in the present study does not completely eliminate the presence of disease, a pattern of activity which is established here among Nigerian infants, children and adolescents will be useful in the diagnosis and management of disease.

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