

# A STUDY OF SERUM ALKALINE PHOSPHATASE IN HEALTHY INDIANS

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Robinson (14) was the first to discover the presence of alkaline phosphatase in the bone. Schlamowitz (18) showed the presence of alkaline phosphatase from intestine, bone, kidney and liver. Though it was similar but was far from being identical.

The information on serum alkaline phosphatase in normal persons is an essential pre-requisite for a reliable interpretation of disease entity. In spite of the work of Pal *et al* (12) and Singh *et al* (13), information available in literature pertaining to serum alkaline phosphatase value in Indians is rather scanty.

Serum alkaline phosphatase in healthy Indians has been studied in the present investigation.

## MATERIALS AND METHODS

The present study consisted of 189 healthy individuals of both sexes including 15 newly born. They belonged to different socioeconomic status and occupations. Each individual was regarded as healthy only, when thorough history taking, clinical examination and necessary investigations ruled out the presence of any significant illness which he or she might have had either at the time of present study or in the immediate past. Maximum care was taken to exclude all those conditions which are known to alter the values of alkaline phosphatase in the serum, such as skeletal, hepatic and endometrial disorders.

All cases were grouped as under :

Group I	Cord blood	15 cases
Group II	Children (4-12 yrs.)	25 cases
Group III	Males	80 cases
Group IV	Females	69 cases

Group III and IV were further subdivided as under :

Group III	Groups IV	Age range
A	A	13-20 years
B	B	21-30 years
C	C	31-40 years
D	D	Above 40 years.

Blood samples were carefully collected for analysis of serum alkaline phosphatase. The serum alkaline phosphatase estimation was done by the method of King (10).

## RESULTS AND DISCUSSION

In Group I, mean serum alkaline phosphatase value in the cord blood was 7.65 (S.D. 2.9 with a range of 3—13.8 K.A. units/100 ml., Table I). There is no report available in literature pertaining to the cord blood values, hence it is difficult to correlate the present values. However, Stearns and Warwing (17) reported 0.1—0.2 K.A. units/100 ml which rose to 0.3—0.4 units at one month of age. Further Barnes and Munks (5) reported 7.7 Bodansky units/100 ml. at birth and also Clark and Beck (6) reported 5.17 to 12.6 Bodansky units/100 ml. (mean 8.48—1.79) in one years.

TABLE I

*Serum Alkaline Phosphatase : A Comparative Study in Different age Groups*

Groups	Age range in years	Serum Alkaline Phosphatase in K.A. Units/100 ml.		
		Average mean;	Range	S.D.
I Cord Blood	—	7.64	3—13.8	±2.9
II Children	4—12	12.52	2.4—25.5	±5.0
III Males	Above 12 yrs.	8.04	.77—18.6	±3.85
(A)	13—20	9.0	4.2—18.6	±4.0
(B)	21—30	7.72	2.4—14.5	±3.3
(C)	31—40	7.6	.77—18.0	±3.8
(D)	Above 40	6.97	2.47—12.2	±4.2
VI (Females)	Above 12	7.86	13.0—14.5	±2.74
(A)	13—20	6.65	1.2—10.2	±2.5
(B)	21—30	7.55	3.4—12.9	±2.2
(C)	31—40	7.6	4.2—13.2	±2.4
(D)	above 40	9.48	4.8—14.6	±3.0

In Group II, 25 children (4-12 years) were studied. The average value of serum alkaline phosphatase in them were found to be 12.52 (S.D. +5.0 with a range of 2.4 to 25.5 K.A. units/100 ml.. Practically in most of the cases the values remained above 9.0 K.A. units/100 ml.

(Table I), except in one case where it was as low as 2.4 K.A. units/100 ml. The higher values in the present series are in conformity with those of Stearns and Warwig (17), Bodansky (3), Clark and Beck (6) and King, E.J. (9) who reported the values as 12.5 (with a range of 5-28 K.A. units/100 ml.). However Singh *et al* (13) reported higher values as 18.18 (with range of 10-29.5 K.A. units/100 ml., Table III).

The third group consisted of 80 males and the average values of alkaline phosphatase was found to be 8.04 (S.D. + 3.85 with a range of 0.77-18.6 K.A. units/100 ml.). In one case the value was as low as 0.77 K.A. units/100 ml. Probably this case represented a heterozygote in the inherited trait of phosphatasia. Since he was clinically normal, he was included in the present series. Practically in all cases, the serum alkaline phosphatase values were between 4 to 10 K.A. units/100 ml. (Table I and II) The mean value of this group (Table III) are akin to those of Bodansky (3), Janner and Kay (8) and Sewell (16).

In the fourth group, 69 females were studied. Here the average mean values of serum alkaline phosphatase were found to be 7.86 (S.D.+2.74 with a range of 13—14.5 K.A. units/100 ml). The average values in females reported by Dent and Harper (7) were 5.6 (S.D.+1.8 K.A. units/100 ml.). These values are quite low when compared to the present one (Table I and II). In one case it was as low as 1.2 K.A. units/100 ml. while in others mostly the values were 4.12 K.A. units/100 ml.

Statistically, no difference was found between males and females as P value was greater than .05 (Table II). The present findings are contradictory to those of Dent and Harper (7); who reported higher values in males than in females and attributed this to a greater degree of physical activity in males. Clark and Beck (6) also reported lower values in females under 28 years of age.

The values of serum alkaline phosphatase in Group III (A) (Males, 13-20 years) were found to be 9.0 (S.D.+4.0 with a range of 4.2 to 18.6 K.A. units/100 ml.) These values are higher than those of other subgroups of Group III, (Table I and II) and are akin to those of Bodansky and Jafee (4) who reported higher values between 10 and 15 years of age and further found that above 15 years of age, the values declined and coincided with the values in Group III (B & C) males. In Group III (B), males, the average value was 7.72 (S.D.+3.3 with a range of 2.4 to 14.5 K.A. units/100 ml.). In Group III (C), (31-40 years) the average value was 7.6 (S.D.+3.8 with a range of 0.77 to 18.0 K.A. units/100 ml., Table I and II). The average values of serum alkaline phosphatase in Group III (B and C) are practically the same (Table I and II) and there is no significant difference between the two except the range which in Group III (C) was towards higher side than in Group III (B. Table I and II). These findings are similar to those reported by Armstrong (2), Sewll (16) and Singh *et al* (13). In Group III (D) the mean value was 6.97 (S.D. +4.2 with a range of 2.47—12.2 K.A. units/100 ml.). The values in this group were slightly lower than the values obtained in Group III A, B and C). Table I and II).

TABLE II  
*Serum Alkaline Phosphatase in K.A. Units/100 ml.*

Groups	Total Number of cases	Sex	Average mean	Range	S.D.	P value
III	80	Male	8.04	.77—18.6	±3.85	
IV	69	Female	7.86	1.2—14.6	±2.74	> .05
III (A);	20	Male	9.0	4.2—18.6	±4	
IV (A)	19	Female	6.65	1.2—10.2	±2.5	> 0.5
III (B)	15	Male	7.72	2.4—14.5	±3.3	
IV (B)	15	Female	7.55	3.4—12.9	±2.2	> 0.05
III (C)	21	Male	7.5	.77—18.0	±3.8	
IV (C)	16	Female	7.6	4.2—13.2	±2.4	> .05
III (D)	24	Male	6.97	2.47—12.2	±4.2	
IV (D)	19	Female	9.34	4.8—14.6	±3.0	> .05

TABLE III  
*Serum Alkaline Phosphatase series as compared to other workers.*

Name of Authors	Age Groups	Serum Alkaline Phosphatase in		
		Bodansky units/ 100ml.	Shinowara Jones Units	K. Armstrong Units.
Ahmad <i>et al</i> (1)	Adults	2.5		
Armstrong (2)	Adults			7.6 (3-13.0)
	Children			12.5 (5-28.0)
Bodansky (3)	Adults	2.6 (1.5-400)		
	Children	7.7 (3.1-13.1)		
Dent and Harper (7)	Adult (M)			7.6
	Adult (F)			5.6
Pal <i>et al</i> (12)	Adults			9.94 (5.2-15.8)
Shinowara <i>et al</i> (15)			6.06 (2.2-8.6)	
Present Series	Adult (M)			8.04 (.77-18.6)
	Adult (F)			7.86 (1.2-14.6)
	Children			12.52 (2.4-25.5)
	Cord Blood			7.64 (3-13.8)

The present values are in conformity with those reported by Morobitto (11) and Silvestrin (19). But contrary to this Sewell (16) reported a gradual increase of serum alkaline phosphatase activity up to 60 years and there was a decline in its concentration.

Comparing the different sub-groups of IV (Females), it has been found that Group IV (A) showed lower value (I and II). In Group IV (B), the value was 7.55 (S.D. +2.2 with a range of 3.4—12.9 K.A. units/100 ml.) while in Group IV (C) it was 7.6 (S.D. +2.4 with a range of 4.2—13.2 K.A. units/100 ml.). Practically there was no difference in the values of these groups IV(D), the value was 9.48 (S.D. +1.8 with a range of 4.8—14.5 K.A. units/100 ml.) (Table I and II). However as a whole, the values of serum alkaline phosphatase in these groups are contradictory to those of Morobitto (11) who reported a decline in the value after 50 years of age in women.

Comparing the serum alkaline phosphatase values of Groups III and IV of their various age groups (Table I), it has been found that there is an appreciable difference between males and females of same age groups, but statistically this is not significant, as P values were greater than 9.05. The present findings are contrary to those of Clark and Beck (6) who reported values in males as 7.26 (S.D. +2.25 Bodansky units/100 ml. and in females as 4.79 (S.D. +1.71 Bodansky units/100 ml.) and further emphasized that sex difference in values of alkaline phosphatase continued till adult levels are reached.

The values in Group (III) B and IV (B) were almost same (Table I and II), but P values were greater than 0.05. In the present study, no sex difference could be found and this is in accord to those reported by Armstrong (2), Bodansky (3) and Stearns and Warwig (17).

In group III (C) and IV (C), the mean values were identical statistically as P value was greater than .05, but there was no sex difference between them. These findings are contradictory to those reported by Dent and Harper (7). However the range in group III (C) was higher (.77-18 .0 K.A. units/100 ml.) than the range in group IV (C) where it was 4.2-13.2 K.A. units/100 ml. (Table I and II).

In Group III (B) and IV (D) (Table I and II), there was a marked difference in the mean values of serum alkaline phosphatase but sex difference is statistically not significant as P value was greater than 0.05.

#### SUMMARY

In the present study, serum alkaline phosphatase activity has been determined in 189 healthy persons of both sexes including 15 new born. The mean values of serum alkaline phosphatase in cord blood was 7.64 K.A. units/100 ml., while in children it was 12.52 K.A. units/100 ml. In males (13 to 20 years), the mean value was 9.0 K.A. units/100 ml., while in females of the same age group it was 6.85 K.A. units/100 ml. In males (21-30 years) the mean value was 7.72 K.A. units/100 ml. while in females of some age group it was 7.55 K.A. units/100ml. In

males (31 to 40 years) the mean value was 7.5 K.A. units/100ml., while in females of some age group it was 7.6 K.A. < units/100 ml. The value in males above 40 years was 6.97 K.A. units/100 ml., while the value in females of same age group was 9.48 K.A. units/100 ml. The value of serum alkaline phosphatase in healthy adult Indians reported by Pal *et al* and Singh *et al* are 9.9 and 8.85 K.A. units/100 ml. respectively. Statistically there was no variation in the serum alkaline phosphatase values on the basis of sex but variation was observed in relation to age.

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