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SERUM ALKALINE PHOSPHATASE IN APPARENTLY HEALTHY KARACHI POPULATION

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ABSTRACT

Serum alkaline phosphatase (AP) was estimated in a total of 786(418 males and 386 females) apparently healthy people aged between 1-75 years selected randomly from a sample of the Karachi population. Reference ranges for AP level were obtained for the males and females stratified into ten successive age groups. The study population was also divided into two main age groups, a paediatric aged between 1-14 years and an adult group aged between 15 to over 50 years to see if the mean AP levels differ significantly between the two groups. Mean AP level for the male paediatric age group was 225 lU/L, significantly higher (P <0.005) than those of the male adult mean level of 83 lU/L Similarlythe mean AP levels for the paediatricfemale age group was 205 lU/L significantly higher (P <0.005), compared to the mean AP level of 67 lU/L obtained for the female adult age group (JPMA 40: 182, 1990).

INTRODUCTION

Estimation of serum AP activity is frequently used in the diagnosis and monitoring of hepatobiliary disorders and of bone diseases associated with enhanced osteoblastic activity[1]. So far four major serum isoenzymes of AP have been reported, their origins being liver, bone, intestine and placenta. The latter two isoenzymes exhibit tissue-specific characteristics and are derived from distinct structural genes but bone, liver and kidney isoenzymes are thought to be derived from a single gene which has undergone different modification processes for differential operation[2]. Serum from healthy subjects was found to contain more than one form of AP detectable by electrophoretic or selective inactivation techniques. Both the liver and bone AP are the main isoenzymes present in healthy serum; however a substantial amount of the normal adult activity in serum was found to be of bone origin. The activities of both the isoenzymes were found to be markedly dependent on age[2]. The effect of bone growth on the total amount of bone AP and, therefore, On totalAP in the serum of children is well known[3]. Liver AP activity in healthy serum is known to increase steadily throughout life[2]. The intestinal AP component was found in about 25% of normal sera and the concentration of this enzyme was found to increase in the same individuals after eating[4]. Placental AP is detectable in the serum of pregnant women between the 16th to 20th weeks of pregnancy, the activity increases progressively upto the onset of labour and then disappears after 3 to 6 days of deliver[2]. Alkaline phosphatase of renal origin was not obtained in healthy serum but was noted in individuals with renal transplant undergoing rejection[2]. Two studies were conducted earlier in Karachi to investigate the relationship between serum phosphorus and AP levels and also to determine the reference ranges for the above two chemistries. Two groups of (200 and 378 respectively) apparently healthy subjects aged from 0 to over 60 years were included in the above two studies[5,6]. The sample size of these studies however was relatively small to give representative reference ranges for the population. The purpose of the present study was to determine the total serum AP reference ranges for apparently healthy Karachi males and females utilizing an autoanalyzer method supported by the Wellcome International Quality assessment programme for

clinical chemistries. The study was carried out at the Clinical Laboratories of the Aga Khan University Hospital (AKUH), Karachi, from 1986-1988.

MATERIALS AND METHODS

Informed consent was obtained from each .of the adult volunteers aged between 18 to over 60 years. Children aged 3 to 18 years, mostly from a local school, whose parents had given consent, were selected for the study. The adult volunteers were employees, staff and students of AKUH and their relatives. Some of the selected children aged 1 to 3 years were of the employees of AKUH. All study subjects fasted overnight before blood collection in the morning. About 5ml blood was collected in neutral tubes, centrifuged and the serum stored at 4°C until the estimation of AP was done. The analysis was always carried out on the same day. Serum AP was estimated using a Beckman Astra autoanalyzer utilizing theAP enzyme reagent kit deveioped for use with the Astra system according to Bessey et al[7]. A statistical packaged programme SPSS was used in the IBM PC computer system to analyze the data. A Hewlet Packard 85 microcomputer was used for plotting the histograms. 'Reference ranges (mean ± 2SD) were calculated following the recommendation of the International Federation of Clinical Chemistry (IFCC) and International Committee for Standardization in Hematology (ICSH) [8]. To find out if there was any significant difference between the levels of paediatric and adult populations, the student's 't' test was performed.

RESULTS

The study population was primarily stratified into 10 age groups within the range from 1 to over 60 years. The number of people over 60 years was relatively small and thus treated as a single age group. The mean, standard deviations and reference ranges for AP levels obtained for males and females for other different age groups are presented in Table I.

TABLE I. Total serum alkaline phosphatase reference ranges for apparently healthy males and females of different age groups.

Age (yrs)	Males				Females			
	Mean	(No.)	SD	Ranges	Mean	(No.)	SD	Ranges
1–4	213	(17)	51	111–315	184	(18)	36	112–256
5–9	217	(111)	35	147–287	214	(82)	44	126–302
10–14	242	(124)	57	128–356	208	(87)	77	54–362
15–19	97	(34)	26	45–149	64	(28)	11	42–86
20–24	69	(22)	17	35–105	49	(20)	12	25–73
25–29	67	(16)	18	31–99	56	(24)	10	36–76
30–39	75	(26)	19	37–113	63	(31)	14	35–91
40–49	77	(24)	23	31–123	65	(40)	18	29–101
50–59	72	(26)	20	32–123	79	(25)	14	51–107
>60	79	(18)	16	47–111	83	(13)	21	41–125

It clearly demonstrates that for the younger males and females upto 14 year of age, the AP levels are higher compared with those of over 14 years of age. Similar results were obtained when the data was calculated for the two main age groups: paediatric 144 years and adult 15— over 60 years respectively

(Table II).

TABLE II. Total serum alkaline phosphatase reference ranges for paediatric and adult apparently healthy males and females.

Age (Yrs)	Males				Females			
	Mean	(No)	SD	Ranges	Mean	(No)	SD	Ranges
1–14	225	(252)a	67	91-359	205	(187)b	70	64–346
15–>60	83	(166)c	32	19–146	67	(181)d	21	24–109

a vs c: P < .005 b vs d: P < .005
a vs b: P < .005 c vs d: P < .005

This shows that both the paediatric male and female mean A? levels were significantly higher (P < . 005) in comparison with their adult counterparts. The male mean paediatric AP level was significantly higher (P < .005) when compared with the female paediatric mean AP. Similarly the male mean adult A? level was also significantly higher (P < .005) compared to the female adult mean AP.

TABLE III. Number of subjects with serum alkaline phosphatase level above the upper normal limit.

Age (yrs)	Males		Females	
	No.	Percentage	No.	Percentage
1–4	0	0	1	5.5
5–9	7	6	7	8.5
10–14	11	8.8	3	3.4
15–19	3	8.8	2	7.1
20–24	1	4.5	2	10
25–29	1	6.2	2	8.3
30–39	3	3.8	0	0
40–49	1	4.1	5	12.5
50–59	2	7.6	1	4
> 60	0	0	1	7.6

Table III shows the number of subjects with a level of serum A? above the upper normal limit (outliners) in each age group of males and females.

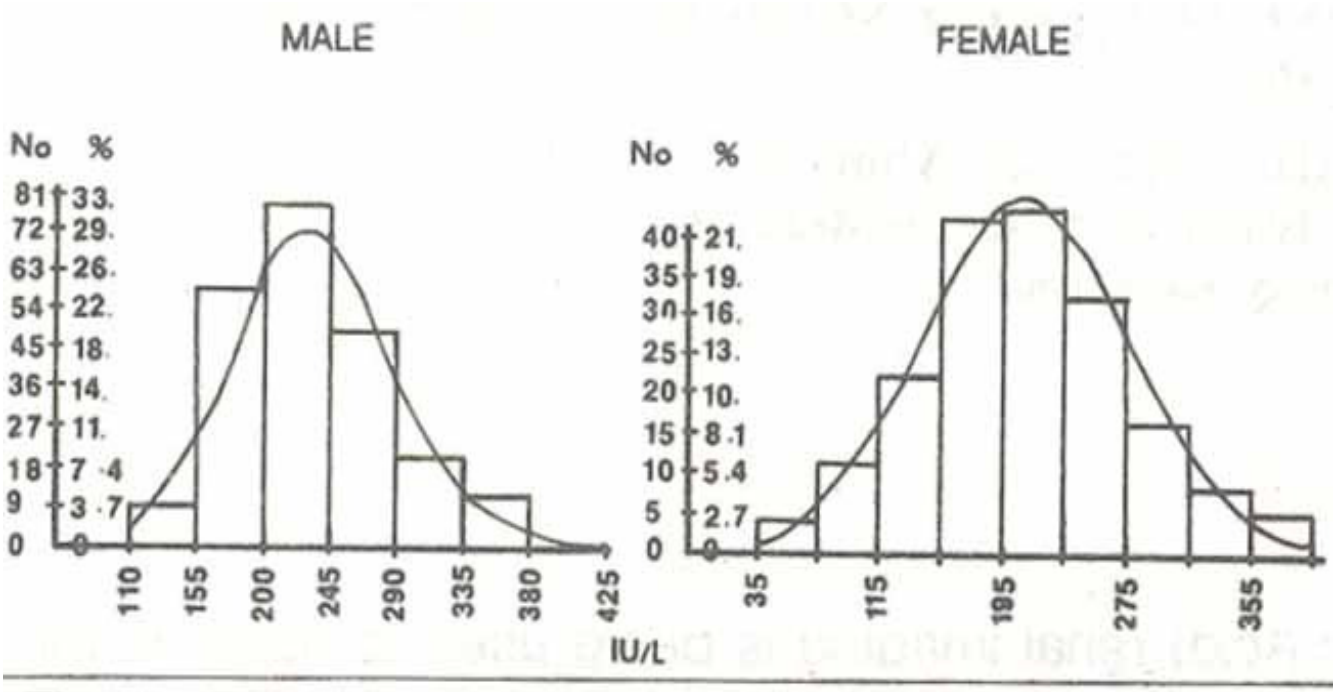

Figure 1. Distribution patterns for serum alkaline phosphatase for paediatric males and females aged 1–14 years.

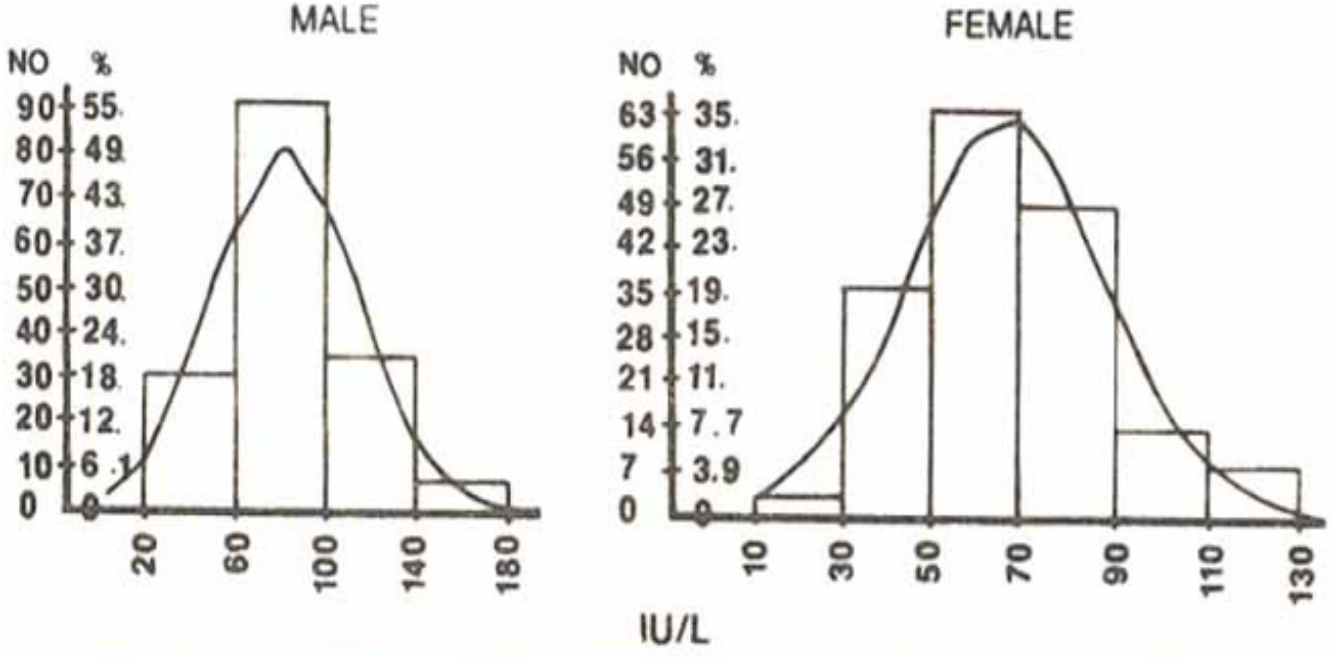

Figure 2. Distribution patterns for serum alkaline phosphatase for adult males and females aged 15- > 60 years.

Figures 1 and 2 show that distribution patterns of the AP values obtained for paediatric and adult males and females respectively. Both figures represent typical normal Gaussian distribution patterns, suggesting that the serum AP are uniformly distributed among both the paediatric and adult apparently healthy males and females of Karachi.

DISCUSSION

The importance of the estimation of serum AP for the diagnosis of bone and liver diseases has already been established by various workers[9,10]. Recently emphasis has been given to quantify different isoenzymes to find out if any particular isoenzyme activity is enhanced in diverse diseases[11]. In an attempt to establish the reference ranges for the apparently healthy population of Karachi, we estimated the total A? level in a reasonably large number (786) from different age groups. Our AP reference range for the male paediatric age group was between 91-359 lU/L (mean 225) (Table II) as against a reference range of 189-622 IU/L (mean 338). for the Western children of the same age group[12]. Hence serum AP level of Western children are higher suggesting greater osteoblastic activity than that of Karachi children. However this Western values were obtained from a study involving only 20 children, whereas we studied a total of 439 children of the same age group. We obtained the highest A? activity of 242 lUlL for males aged 10-14 years and 214 lUlL for the females among the age group of 5-9 years (Table 1). We found a total serum AP reference range for adult males of 19-146 lUlL (mean 83) and for females. 24—109 lU/L (mean 67) (Table II). Somewhat higher values were reported for Westerners: for males 50-137 IU/L (mean 102) and for females 53—155 IU/L (mean 96) [12]. These western values were derived from a sample size of 80 whereas we have studied a total of 347 adults. Western reference ranges similar to these values were also quoted by other workers[11]. Previously in Pakistan reference ranges for serum AP from both the studies were found to be lower[5,6] than that of our present values. The reason is almost certainly partly due to the different modes of estimation, the former workers used the manual methods whereas in our laboratory a Beckman Astra autoanalyzer was used for all the estimations. Moreover our results were biweekly monitored by the External Quality Control Programme. Haemolysis and zinc deficiency (not expected to be present in normal healthy people) are known to reduce AP activity[13,14]. It is rather difficult now to speculate which factors affected the AP activity in the previous studies. We have not seen any definite trend towards higher values (outliners) neither in the sexes nor in any of the age groups (Table III). However the highest percentage (12.5%) of females in the age group 40-49 were found to have serum AP level higher than 101 lUlL (upper normal limit). One of the reasons might possibly be due to high bone AP levels due to higher bone resorption known to occur in menopausal females of this age group[15] In the present study the AP values for both the paediatric and adult population had normal Gaussian patterns (Figures 1 and 2). The previously reported study failed to obtain a normal or a log-normal distribution, possibly due either to the small number of study subjects or to the more heterogeneous population[12]. We conclude that from the data obtained, serum AP reference ranges were obtained for an apparently healthy Karachi population. The values obtained appear to be somewhat lower to those of the reported values for a Western population and that our values are normally distributed among the Karachi population.

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