

PLASMA RENIN ACTIVITY PROFILE IN NORMAL AND HYPERTENSIVE FILIPINOS*

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The more recent improvements in the technique of measurement of plasma renin activity (PRA) has provided a biochemical basis for reclassifying hypertensive patients into low, normal and high renin subgroups. These three subtypes have different physiologic and epidemiologic characteristics as well as natural course of the hypertensive condition. The low renin group is largely volume sustained hypertension, the high renin is mainly vasoconstrictive, and the normal renin segment reflects volume-vasoconstrictor interaction. The clinical implications of renin-grouped hypertension include etiologic, therapeutic and even prognostic considerations. As such, plasma renin and aldosterone profiles are now widely recognized and accepted in most medical institutions all over the world as valuable in the clinical assessment of hypertensive disease.^{1,2}

Cognizant of hypertension as a significant health problem in the Philippines and realizing the useful information provided by this reliable ancillary technique, this study aims to establish a base line definition of renin-aldosterone profile among Filipinos in our local setting which can be of benefit even to the population who may not be able to avail themselves of renin profiling, but for whom the derived statistics can well provide a useful basis for their proper treatment.

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Materials and Methods

One thousand nineteen patients, of various life styles from Metro Manila, were studied at the University of Santo Tomas Hospital. Two hundred forty-eight were normal and seven hundred seventy-one were hypertensive. Of the hypertensive group 711 (92.6%) had essential hypertension and the rest were hypertensive from varied causes. Fig. 1 summarizes our patient population; age and sex distribution are shown in Figures 2 and 3.

TOTAL CASES STUDIED

479 (47.4%) **1019** 540 (52.6%)

MALE 122 49.2%	NORMAL 248	FEMALE 126 50.8%
ESSENTIAL HYPERTENSION		
MALE 329 46.3%	711	FEMALE 382 53.7%
28	OTHER 60 HYPERTENSIVE	32

Fig. 1. PATIENT POPULATION

NORMAL CASES 248	
AGE RANGE: 14 - 89 YRS. MEAN AGE: 46 ± 20	
MALE (122) 49.2%	FEMALE (126) 50.8%
AGE RANGE: 14 - 89 MEAN AGE: 46 ± 21	AGE RANGE: 14 - 89 MEAN AGE: 45.7 ± 19

Fig. 2. NORMAL CASES - AGE AND SEX DISTRIBUTION

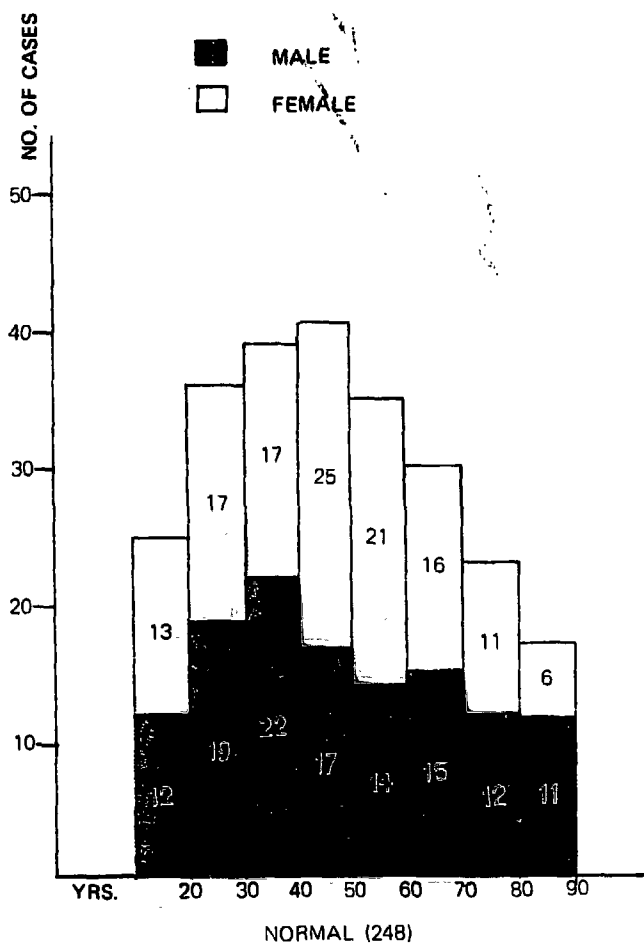


Fig. 3. FREQUENCY DISTRIBUTION AT 10 YRS. INTERVAL

The normal cases were surveyed from homes, schools and business establishments, while the hypertensives were mostly patients who consulted at our out-patient department over a period of 11 months – from April 1978 to February 1979. Each had a thorough history and physical examination together with routine blood and urine examinations. Other laboratory tests and x-rays were performed as indicated.

Two samples of blood were drawn from each of the normal cases, first in the supine position early in the morning at 6-7 A.M., and second in the upright, sitting position after

4 hours ambulation (10-11 A.M.). From the hypertensive patients blood was drawn only in the upright position. All patients were on regular diet and salt intake. More than half of the cases had no previous medications for hypertension. Those who were on treatment were asked to defer all anti-hypertensive drugs for one to three weeks prior to blood extraction.

Each patient was also asked to collect 24 hours urine starting on the day before blood was drawn. The urine volume of each patient was measured and an aliquot was examined for sodium and potassium by flame photometer – SMA 60 at the John F. Cotton Hospital.

Each blood sample was collected in pre-chilled vacutainer tubes containing EDTA (ethylenediaminetetraacetate) and brought to the laboratory in an ice-bath container. The specimens were immediately spun in a refrigerated centrifuge and the separated plasma was kept frozen till time of assay – a few days to two weeks later.

Plasma renin activity (PRA) was determined by radioimmuno assay, using Renin-Riakit (Dainabott-Radioisotope Lab.) supplied by Abbot Laboratories. With an incubation period of 20 hours, the procedure took 2 days to complete. Sample processing and counting were done at the Nuclear Medicine Department, Makati Medical Center.

The last 300 blood samples for PRA were also assayed for Aldosterone, the results and discussions of which shall be incorporated in Part II of this project.

Data were compiled and subjected to currently accepted statistical methods and analyzed at the computer center of De La Salle University.

RESULTS

Normal

The plasma renin activity (PRA) range among normotensives is .2- 3.6 ng./ml./hr. with a mean of $1.64 \pm .81$ in the upright and $1.15 \pm .68$ in the supine position (Table 1, Fig. 4a). The values are significantly higher in upright position than in supine ($P < .02$), also higher in males than females, both upright and supine ($P < .05$). The 24 hr. urinary sodium excretion which is taken as the sodium balance and a reflection of the sodium intake is shown in Table 2, Fig. 4b. These serve as our base line values.

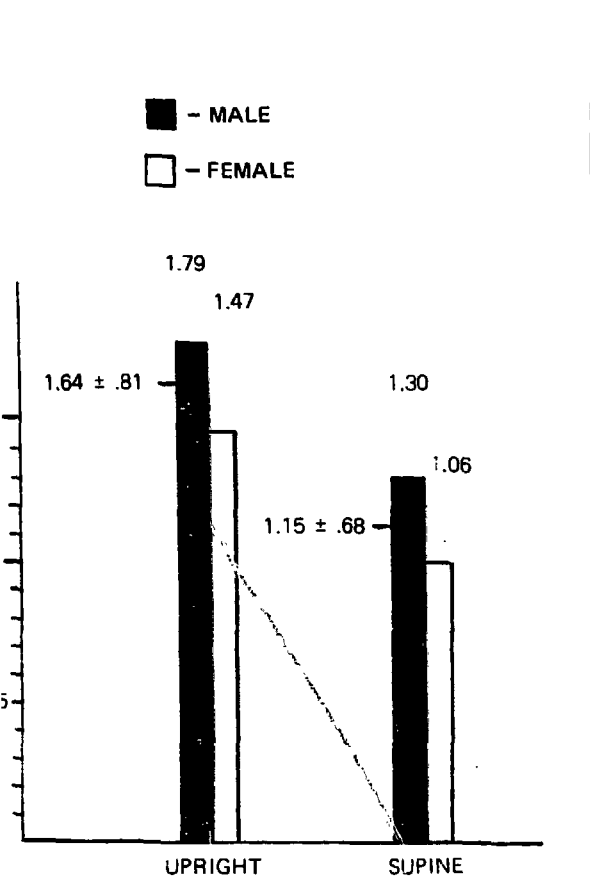


Fig. 4a. MEAN PLASMA RENIN ACTIVITY

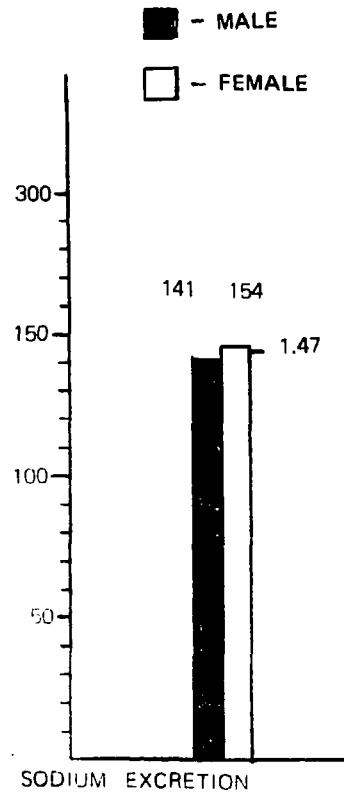


Fig. 4b. MEAN URINE SODIUM EXCRETION

Table 1. PLASMA RENIN ACTIVITY IN NORMAL (ng/ml/hr.)

Cases	Upright Position		Supine Position	
	Range	Mean & S.D.	Range	Mean & S.D.
Male	.3 - 3.6	1.79 ± .81	.3 - 3.0	1.30 ± .69
Female	.2 - 3.3	1.47 ± .81	.1 - 2.9	1.01 ± .64
All	.2 - 3.6	1.64 ± .81	.1 - 3.0	1.15 ± .68

Table 2. URINE SODIUM EXCRETION IN NORMAL (Meq/ml/ 24 hrs.)

Cases	Range	Mean & S.D.
Male	80 - 230	141.0 ± 32.0
Female	80 - 238	153.5 ± 38.4
All	80 - 238	147.4 ± 35.9

The array of values of plasma renin activity and urine sodium excretion is seen in Fig. 5 showing an inverse relation between PRA and sodium excretion, with a good linear correlation coefficient of .69 and a better semi-log correlation coefficient of .72 (Fig. 5). From the semi-log median line, the upper and lower limit of the renin-sodium relationship was derived and shown in Fig. 6. It is seen that the plasma renin value is influenced by the sodium excretion attesting to the value of PRA as meaningful only when the

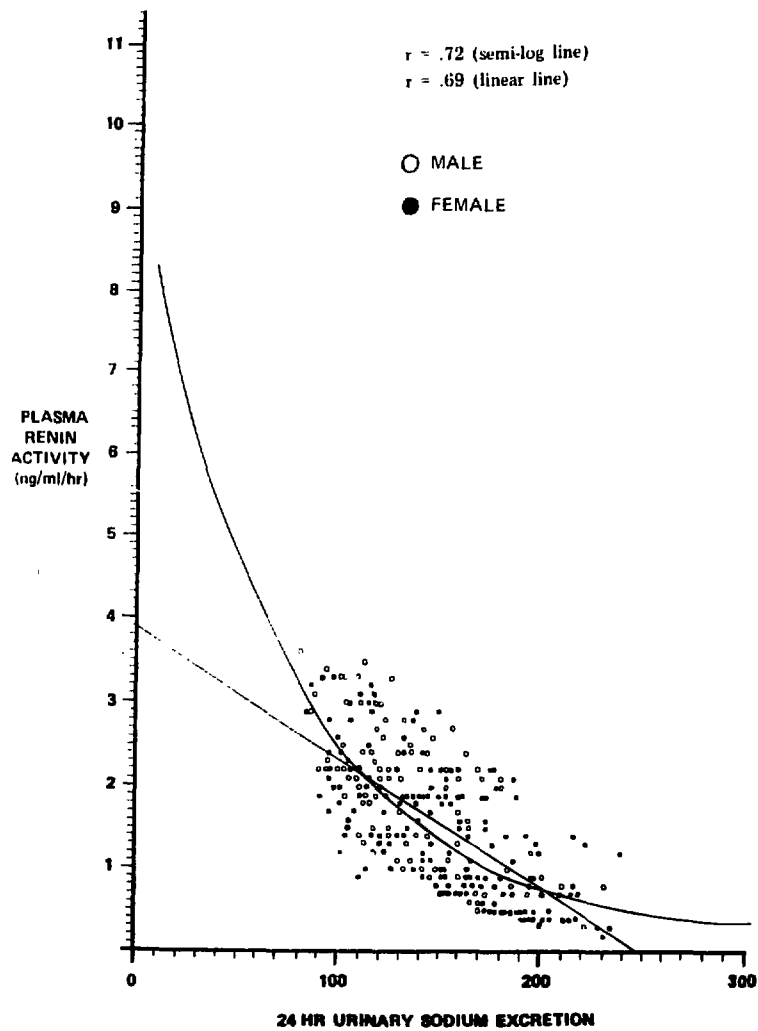


Fig. 5. MEDIAN LINES (SEMI-LOG AND LINEAR)

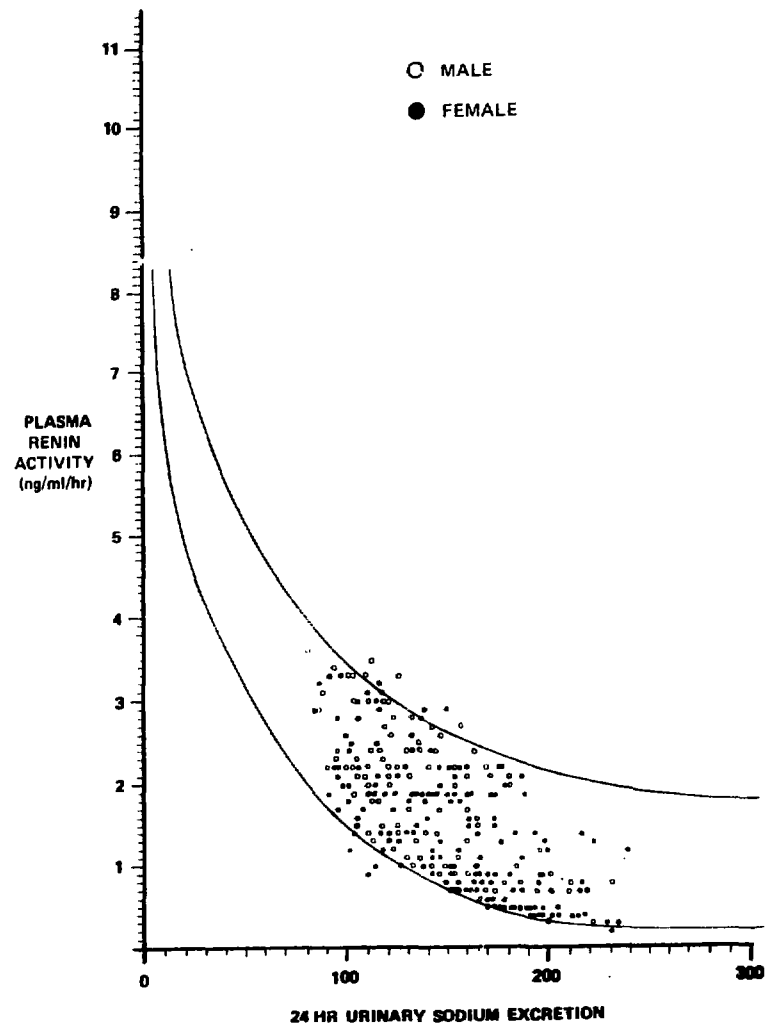
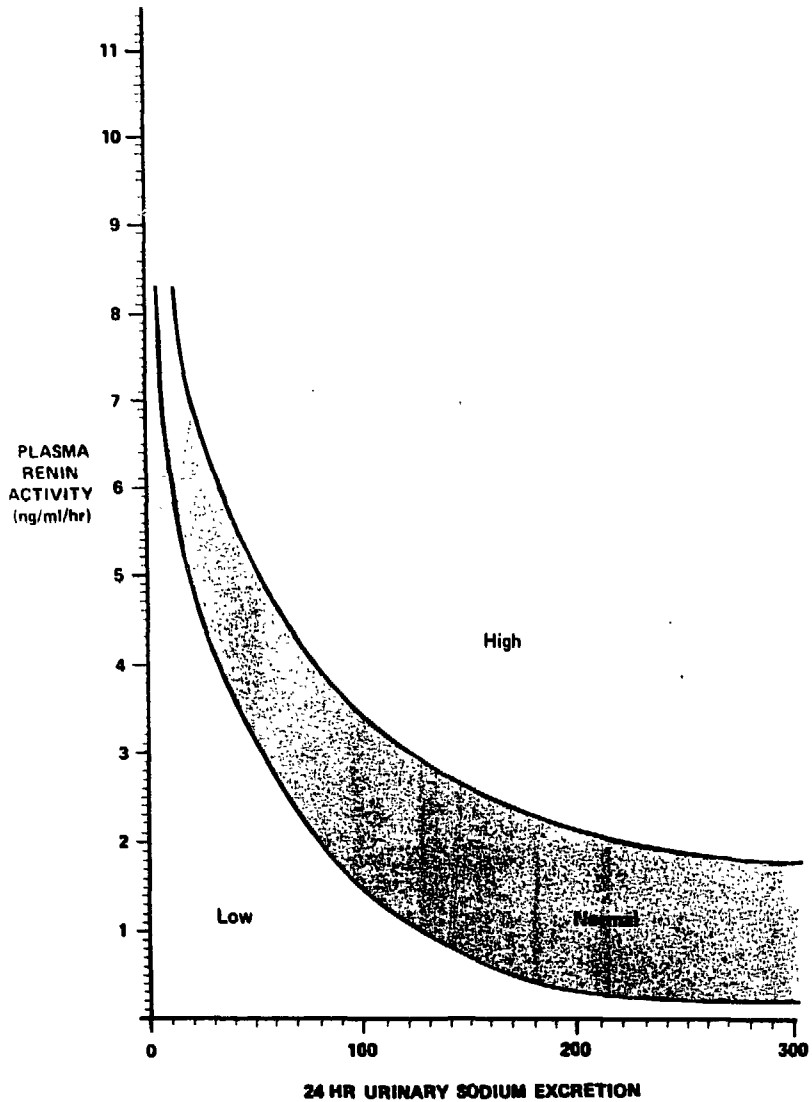


Fig. 6. RENIN-SODIUM NOMOGRAM



**Fig. 7. RENIN - SODIUM NOMOGRAM
(Upper and Lower Limit Lines)**

sodium excretion is taken into account¹. From the above, a nomogram, Fig. 7, is derived which defines the normal range and serves as the basis of classification of the hypertensive values: above the shaded area are "high renin", those below are "low renin" and values within the shaded area are "normal renin".

PRA and sodium excretion in the different age groups at 10 yrs. interval are shown in Tables 3 and 4 and Figures 8a and 8b. It is noted that renin becomes lower with every decade increase in age. The renin age correlation coefficient is .36 (Table 5, Fig. 9). Sodium excretion is higher in the older age group especially in females. The sodium-age correlation coefficient is .32. The normal blood pressure range taken in this study is 90-130/60-80 mm. Hg.

■ MALE
 □ FEMALE
 — MEAN

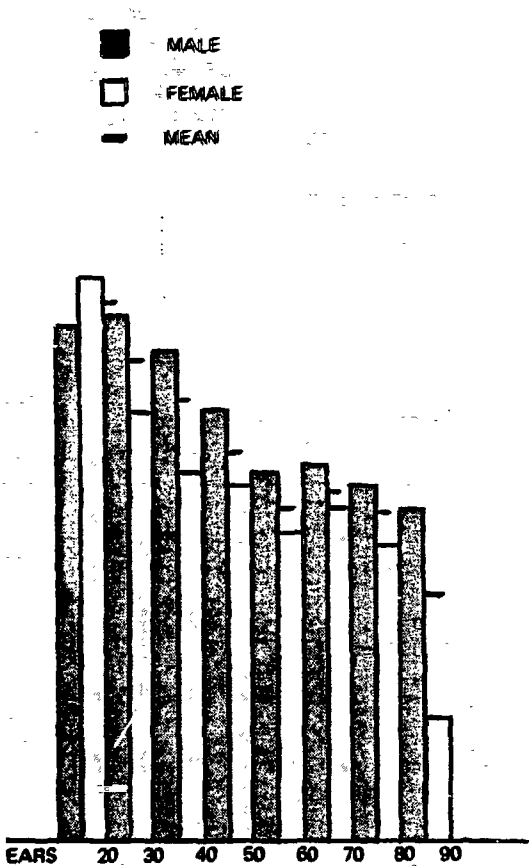


Fig. 8a. PLASMA RENIN AT 10 YRS. INTERVAL IN NORMAL

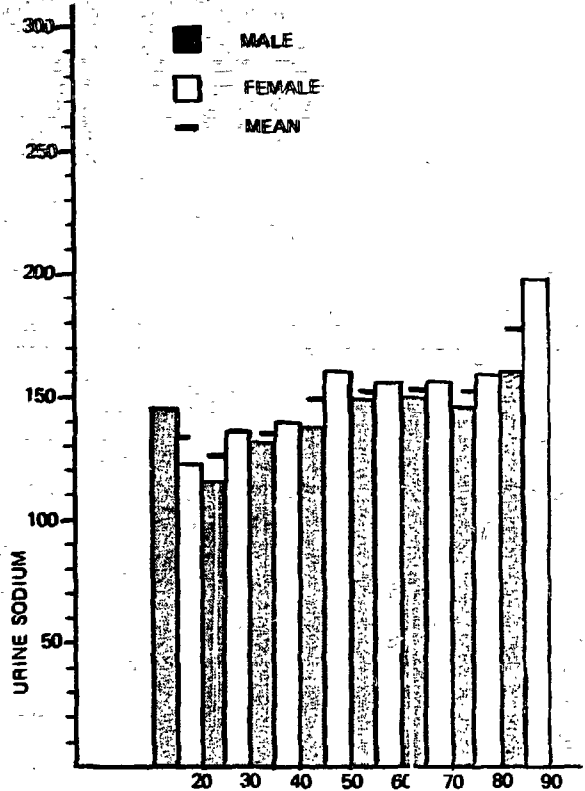


Fig. 8b. URINE SODIUM AT 10 YRS. INTERVAL

Table 3. PLASMA RENIN ACTIVITY (ng./ml./hr.) BY AGE GROUPING (NORMOTENSIVE)

Age Range (Yrs.)	Renin Upright			Renin Supine		
	Male	Female	All	Male	Female	All
10 - 19	2.11±.65	2.29±.60	2.21±.62	1.48±.61	1.57±.53	1.54±.54
20 - 29	2.14±.87	1.75±.79	1.96±.85	1.60±.74	1.22±.57	1.41±.69
30 - 39	2.05±.72	1.49±.88	1.81±.83	1.53±.67	1.11±.79	1.34±.75
40 - 49	1.77±.84	1.46±.80	1.59±.82	1.39±.74	.95±.68	1.09±.71
50 - 59	1.52±.87	1.24±.73	1.36±.79	1.05±.73	.83±.51	.91±.61
60 - 69	1.56±.72	1.38±.69	1.40±.70	1.12±.60	.90±.54	1.00±.56
70 - 79	1.45±.60	1.22±.66	1.34±.61	1.00±.49	.77±.45	.93±.47
80 - 89	1.36±.86	0.50±.23	1.06±.81	1.00±.70	.25±.18	.76±.65

Table 4. URINE SODIUM EXCRETION (Meq./ml./24 Hrs.) BY AGE GROUPING (NORMOTENSIVE)

Age Range (Yrs.)	Number			Urine Sodium Excretion (Mean & S.D.)		
	Male	Female	All	Male	Female	All
10 - 19	12	13	25	145.1 ± 27.1	124.9 ± 22.5	134.6 ± 26.4
20 - 29	19	17	36	126.7 ± 26.7	144.6 ± 27.4	136.2 ± 28.1
30 - 39	22	17	39	131.0 ± 27.1	149.9 ± 31.1	139.3 ± 30.1
40 - 49	17	25	42	138.8 ± 37.6	159.7 ± 41.5	151.2 ± 40.9
50 - 59	14	21	35	148.9 ± 37.8	156.1 ± 37.7	153.3 ± 37.4
60 - 69	15	16	31	148.0 ± 29.3	156.3 ± 44.4	152.3 ± 37.4
70 - 79	12	11	23	146.4 ± 22.4	158.6 ± 46.2	152.2 ± 35.5
80 - 89	11	6	17	159.5 ± 42.6	198.3 ± 30.7	173.2 ± 42.4

Table 5. CORRELATION COEFFICIENT IN NORMAL

Cases	Renin - Sodium	Renin - Age	Sodium - Age
Male	.69	.35	.30
Female	.68	.39	.36
All	.69	.36	.32

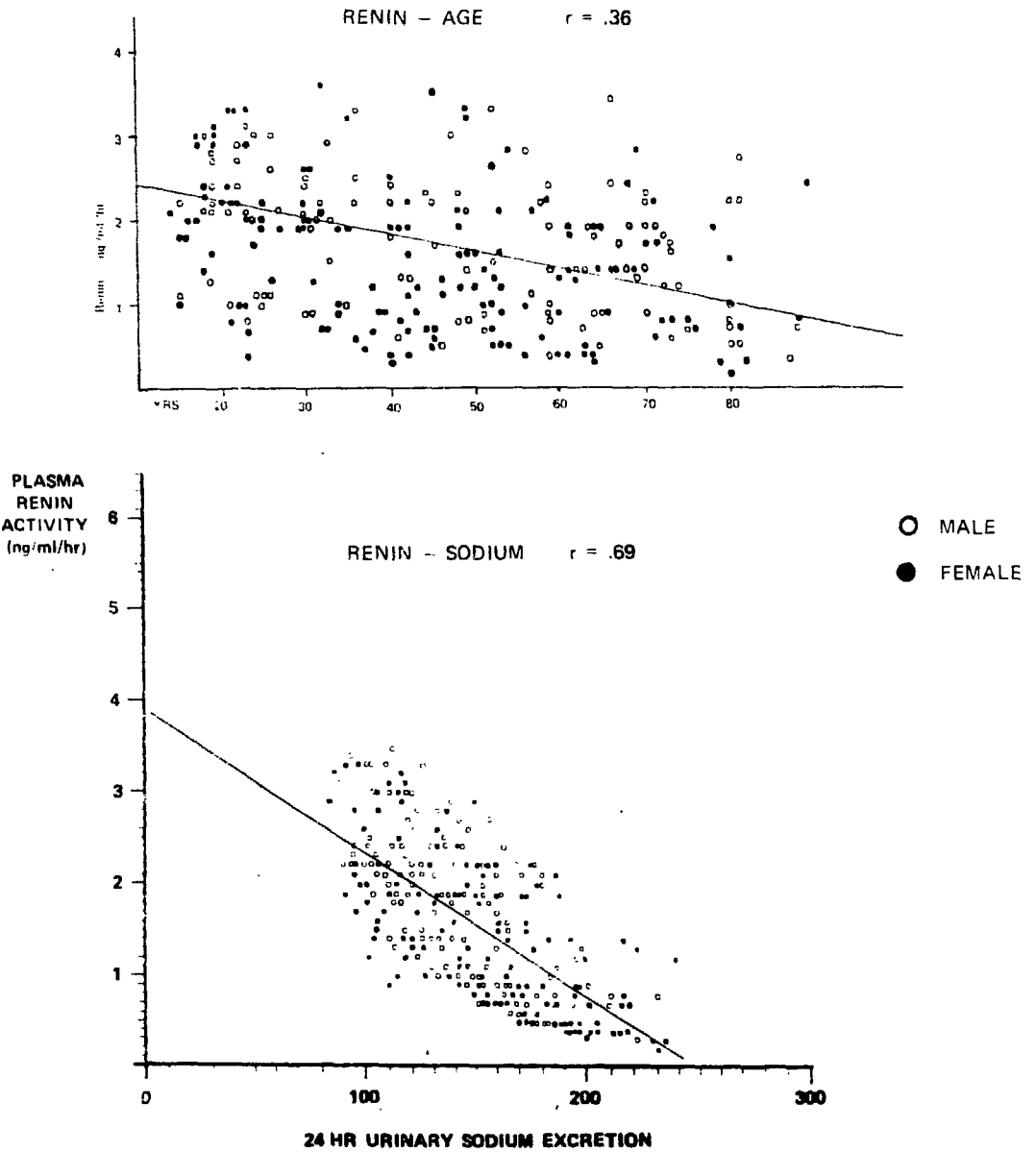


Fig. 9. CORRELATION COEFFICIENT IN NORMAL

Hypertensives:

In this group, females outnumbered males; the females are older than males (Figs. 10, 11). Mean age for females is significantly higher than for males ($P < .05$). Plasma renin activity is lower in females, although sodium excretion is the same for both males and females (Tables 6, 7; Fig. 12, 13).

ESSENTIAL HYPERTENSION 711			
AGE RANGE: 16 - 95 YRS.		MEAN AGE: 53.5 ± 14	
MALES		FEMALES	
329	46.3%	382	53.7%
AGE		AGE	
RANGE	MEAN	RANGE	MEAN
16 - 82 YRS.	51.8 ± 16	16 - 85	55 ± 12

Fig. 10. ESSENTIAL HYPERTENSION – AGE AND SEX DISTRIBUTION

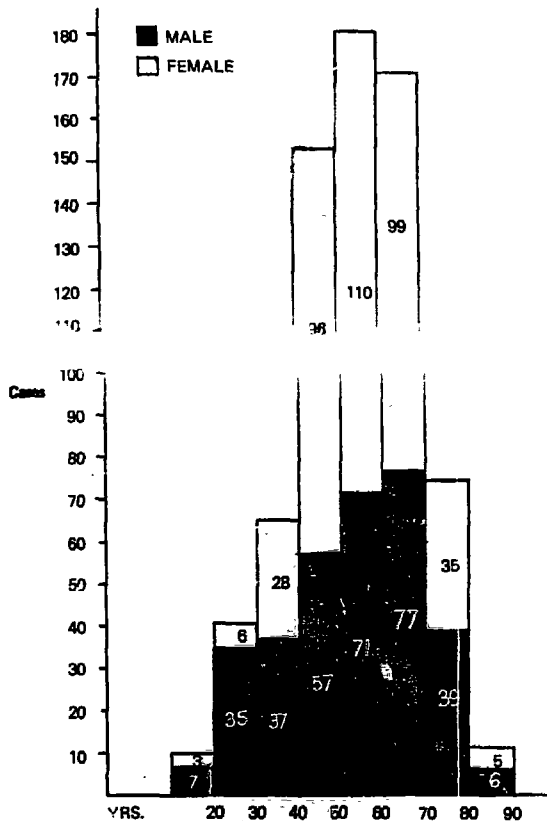


Fig. 11. FREQUENCY DISTRIBUTION AT 10 YRS. INTERVAL HYPERTENSIVE (711)

Table 6. PLASMA RENIN ACTIVITY (PRA) (ng/ml/hr.)

Cases	Essential Hypertension (Upright)			Normal (Upright)		
	Range	Mean	S.D.	Range	Mean	S.D.
Male	.1 - 8.2	1.92	±1.5	.3 - 3.6	1.79	±.81
Female	.1 - 8.2	1.33	±1.2	.2 - 3.3	1.47	±.81
All	.1 - 8.2	1.61	±1.4	.2 - 3.6	1.64	±.81

Table 7. URINE SODIUM EXCRETION (Meq/ml/24 hrs.)

Cases	Essential Hpn Range	Mean & S.D.	Normal Range	Mean & S.D.
Male	84 - 260	143.1 ± 32.6	80 - 232	141.0 ± 32.0
Female	88 - 243	143.7 ± 33.4	80 - 238	153.5 ± 38.4
All	84 - 260	143.4 ± 33.0	80 - 236	147.4 ± 35.9

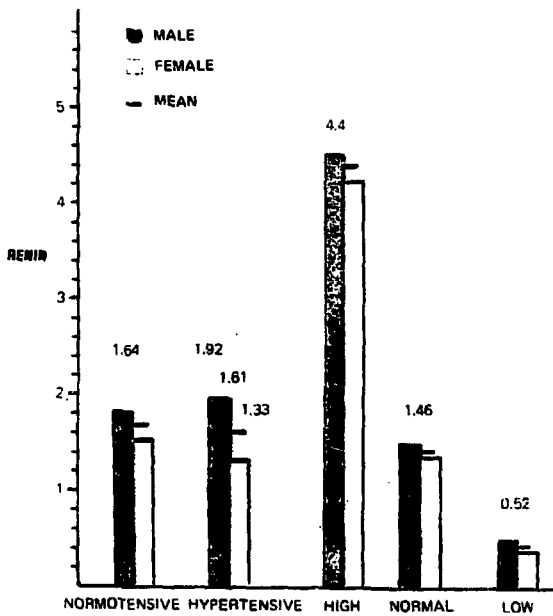


Fig. 12. MEAN RENIN IN ESSENTIAL HYPERTENSION

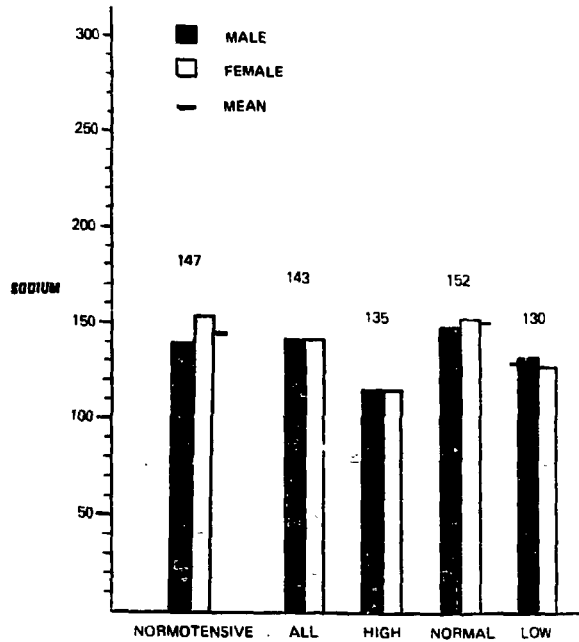


Fig. 13. MEAN SODIUM IN ESSENTIAL HYPERTENSION

The renin values were plotted against the corresponding urine sodium on the renin-sodium index nomogram, (Fig. 7) and the array of values is shown in Fig. 14, where they are grouped into: high renin, 14.3%; normal renin, 56.1% and low renin, 29.6%. (Fig. 15).

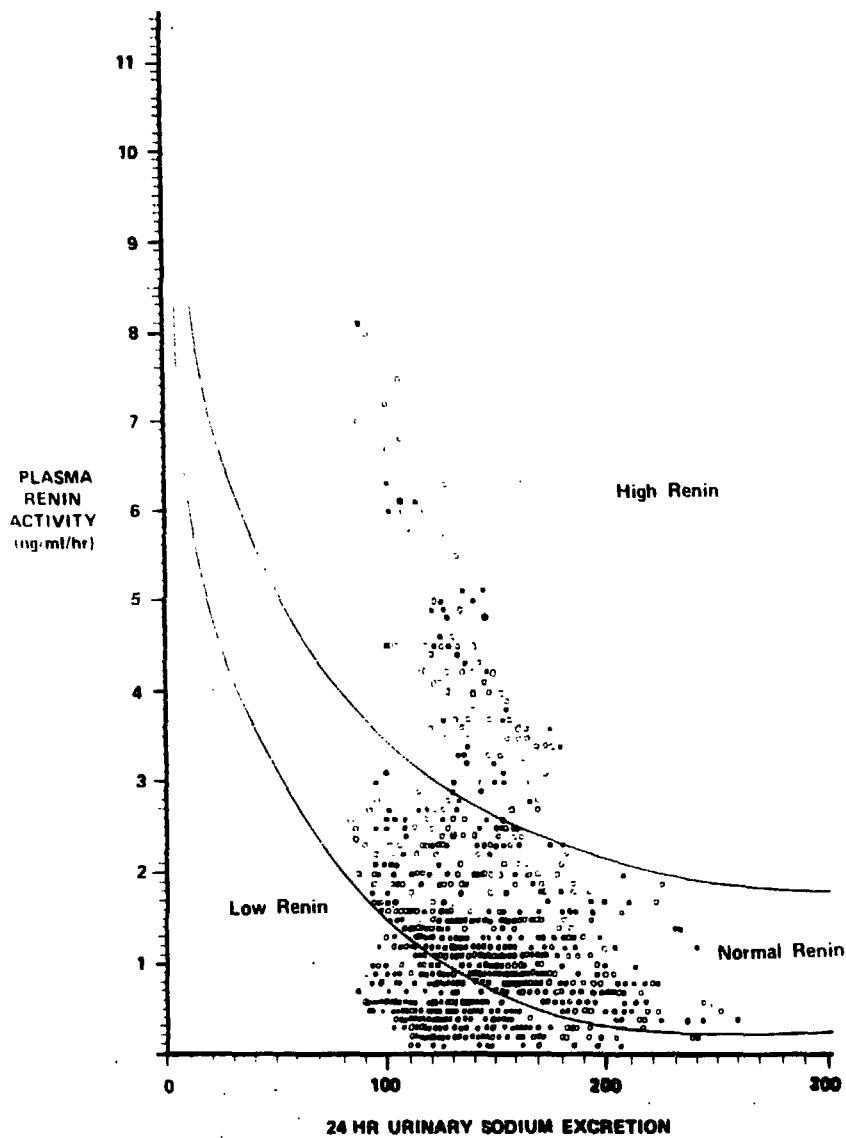


Fig. 14. ESSENTIAL HYPERTENSION SUBGROUPS

MALE (68) 9.5% 17 - 84		HIGH RENIN 14.3% 102 49.5 ± 17	FEMALE (34) 4.8% 16 - 75 51 ± 13	
NORMAL RENIN 56.1% 398				
MALE (188) 26.4% 16 - 85 YRS. 51.5 ± 16		FEMALE (210) 29.7% 16 - 82 YRS 53 ± 12		
MALE (73) 10.3% 20 - 82 YRS. 55 ± 16		LOW RENIN 29.6% 211 FEMALE (138) 19.3% 28 - 82 YRS. 57 ± 13		

Fig. 15. ESSENTIAL HYPERTENSION SUBGROUPS

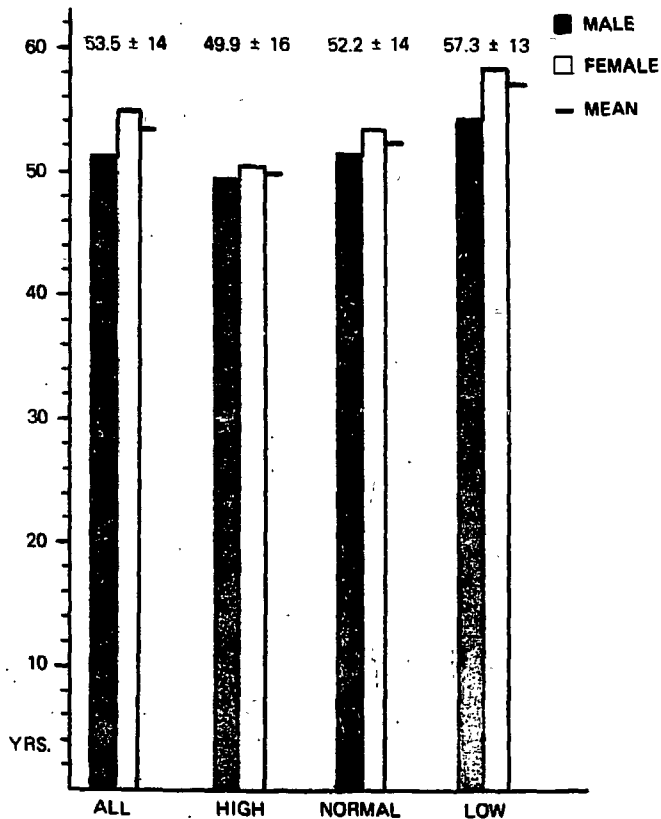


Fig. 16. MEAN AGE IN ESSENTIAL HYPERTENSION

The distribution of cases and the renin sodium values in the different subgroups are shown in Figs. 15-16. It is noticed that in the high renin subgroup, there are more males (2x the females). They are fewer (14.3%) and are younger – mean age 51.8 yrs., the females are older than males. This predominance of females older than males is also observed in the normal and low renin subgroups. The low renin subgroups are the oldest group – Table 8. The plasma renin in the different age groups is shown in Fig. 17a, Table 11. It diminishes with age especially in the higher renin group. Thus, the differences are more noticeable when the hypertensives were classified into the 3 subgroups (Table 18).

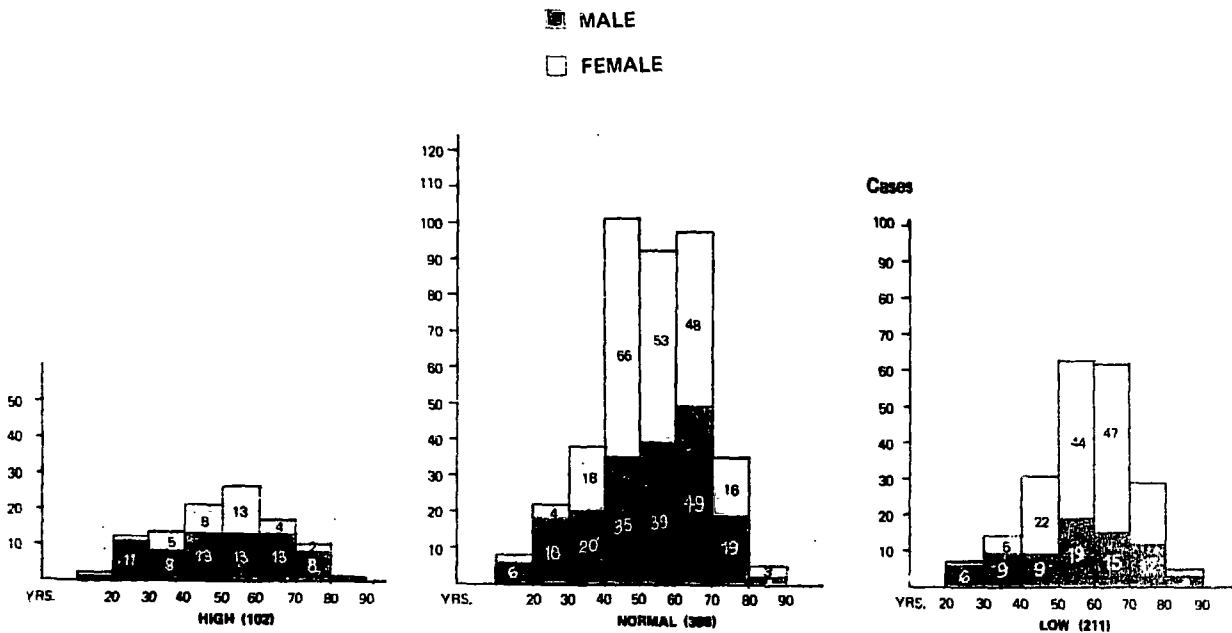


Fig. 17. FREQUENCY DISTRIBUTION IN 3 SUBGROUPS OF HYPERTENSION AT 10 YRS. INTERVAL

Table 8. AGE DISTRIBUTION OF RENIN SUBGROUPS

Cases	High Renin		Normal Renin		Low Renin	
	Range (Yrs.)	Mean	Range	Mean	Range	Mean
Male	17 - 84	49.5 ± 17.3	16 - 85	51.5 ± 16	20 - 82	54.6 ± 16
Female	16 - 75	50.8 ± 12.7	16 - 82	53.3 ± 12	28 - 82	58.7 ± 10
All	16 - 84	49.9 ± 15.8	16 - 85	52.4 ± 14	20 - 82	57.3 ± 13

Table 9. PLASMA RENIN ACTIVITY (PRA) IN THREE SUBGROUPS (ng/ml/hr.)

Cases	High		Normal		Low	
	Range	Mean & S.D.	Range	Mean & S.D.	Range	Mean & S.D.
Male	2.7 - 8.2	4.48 ± 1.3	.3 - 3.1	1.53 ± .63	.1 - 1.3	.55 ± .30
Female	2.8 - 8.2	4.25 ± 1.2	.4 - 3.1	1.39 ± .63	.1 - 1.3	.51 ± .28
All	2.7 - 8.2	4.40 ± 1.25	.3 - 3.1	1.46 ± .63	.1 - 1.3	.52 ± .29

Table 10. URINE SODIUM EXCRETION (Meq/ml/24 hrs.) IN 3 SUBGROUPS

Cases	High		Normal		Low	
	Range	Mean S.D.	Range	Mean S.D.	Range	Mean S.D.
Male	89 - 180	134.8±23.3	84 - 260	150.9±33.8	87 - 238	131.4±32.2
Female	89 - 180	135.2±20.4	94 - 243	154.7±34.8	88 - 240	129.1±26.6
All	89 - 180	135.0±22.2	84 - 260	152.9±34.4	87 - 240	129.8±25.6

Table 11. PLASMA RENIN ACTIVITY (PRA) SUBGROUPS IN AGE GROUPING

Years	All	High	Normal	Low
10 - 19	2.59 ± 1.9	6.15 ± 1.2	1.79 ± .56	.60
20 - 29	2.53 ± 2.0	5.20 ± 1.7	1.73 ± .57	.50 ± .23
30 - 39	1.80 ± 1.4	4.30 ± .85	1.48 ± .51	.65 ± .32
40 - 49	1.60 ± 1.3	4.10 ± 1.2	1.42 ± .64	.48 ± .30
50 - 59	1.49 ± 1.4	4.30 ± 1.1	1.38 ± .68	.47 ± .26
60 - 69	1.41 ± 1.1	4.10 ± 1.1	1.44 ± .60	.60 ± .30
70 - 79	1.50 ± 1.4	4.30 ± 1.2	1.50 ± .72	.48 ± .25
80 - 89	1.21 ± 1.2		1.40 ± .44	.36 ± .16

Table 12. SODIUM AND AGE IN THE RENIN SUBGROUPS

Years	All	High	Normal	Low
10 - 19	146.7 ± 29.0	110.0 ± 11.3	155.5 ± 24.1	140
20 - 29	137.3 ± 28.0	126.0 ± 26.9	147.1 ± 29.3	124.2 ± 14.0
30 - 39	144.0 ± 35.1	137.0 ± 25.8	153.3 ± 38.8	125.3 ± 22.0
40 - 49	151.6 ± 35.4	132.0 ± 21.1	157.9 ± 36.7	144.2 ± 32.9
50 - 59	145.8 ± 33.4	136.1 ± 20.3	155.0 ± 36.4	135.7 ± 29.0
60 - 69	139.2 ± 31.8	141.1 ± 21.3	149.6 ± 33.5	122.5 ± 23.9
70 - 79	135.3 ± 28.6	140.4 ± 19.8	145.0 ± 32.7	121.7 ± 19.7
80 - 89	127.4 ± 21.9	140	129.6 ± 23.3	124.8 ± 25.3

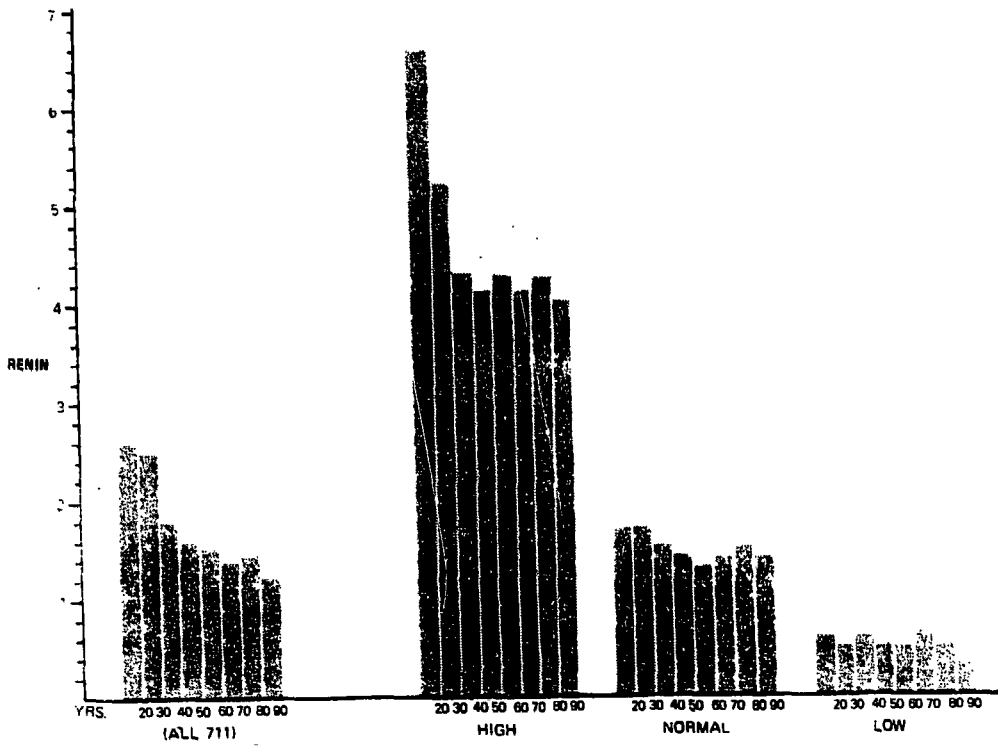


Fig. 17a. PRA AND AGE - 10 YRS. INTERVAL

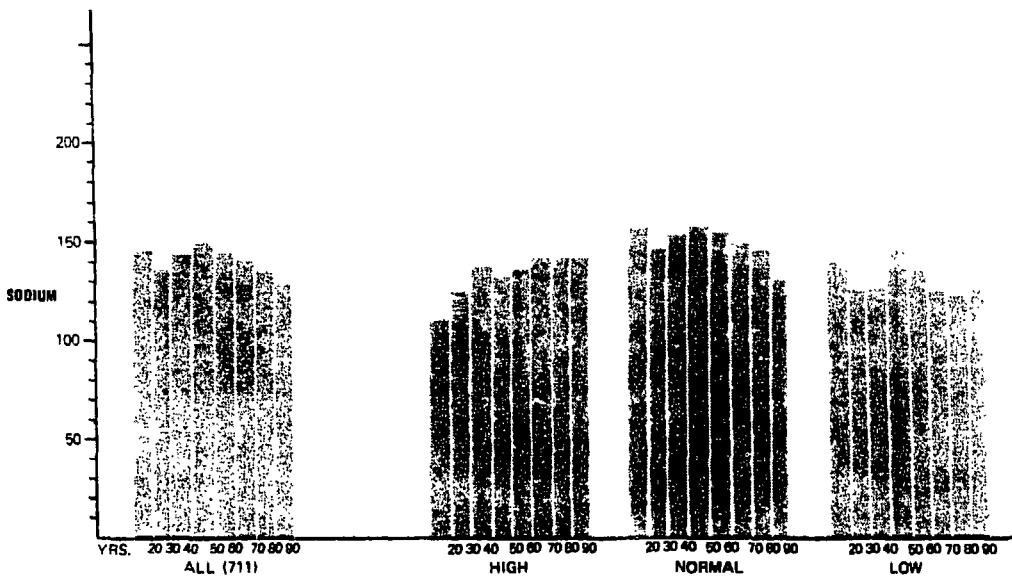


Fig. 17b. URINE SODIUM EXCRETION - 10 YRS. INTERVAL

Table 13. CORRELATION COEFFICIENT IN 3 SUBGROUPS

Cases	Renin - Sodium				Renin - Age				Sodium - Age			
	All	High	Normal	Low	All	High	Normal	Low	All	High	Normal	Low
Male	.30	.82	.56	.54	.13	.26	.03	.03	.05	.25	.07	.18
Female	.19	.74	.61	.51	.19	.10	.07	.06	.14	.15	.07	.14
All	.25	.80	.59	.52	.17	.21	.05	.05	.09	.21	.07	.16

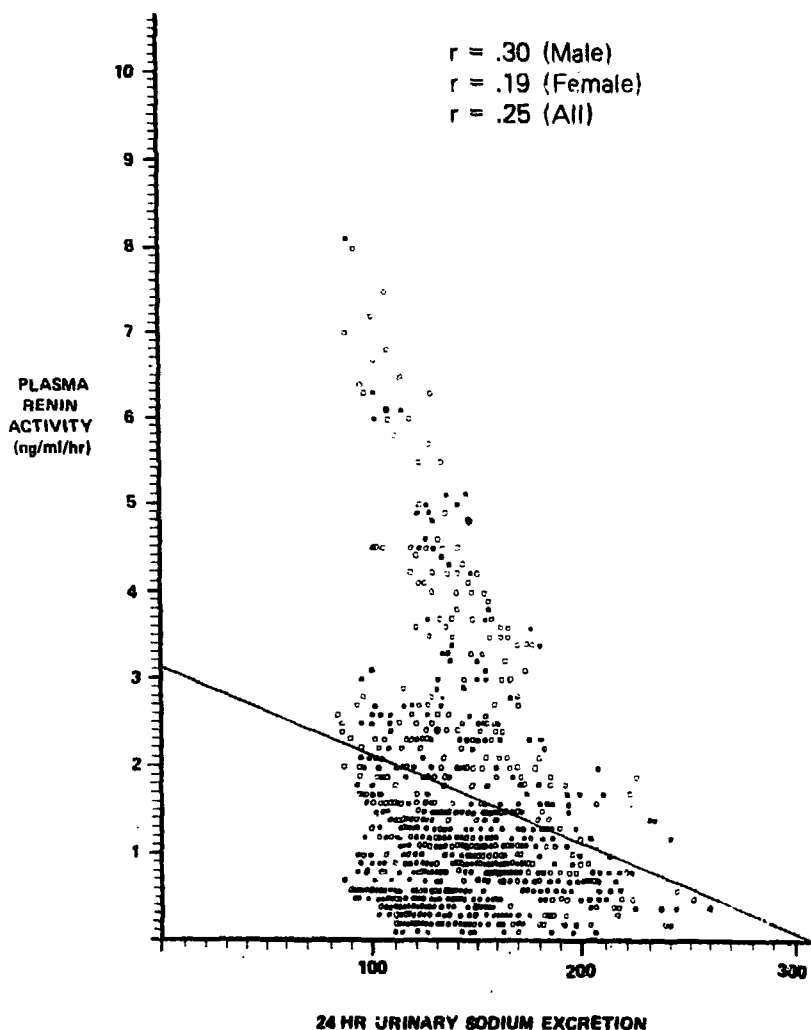


Fig. 18. PRA - SODIUM CORRELATION COEFFICIENT IN ESSENTIAL HYPERTENSION

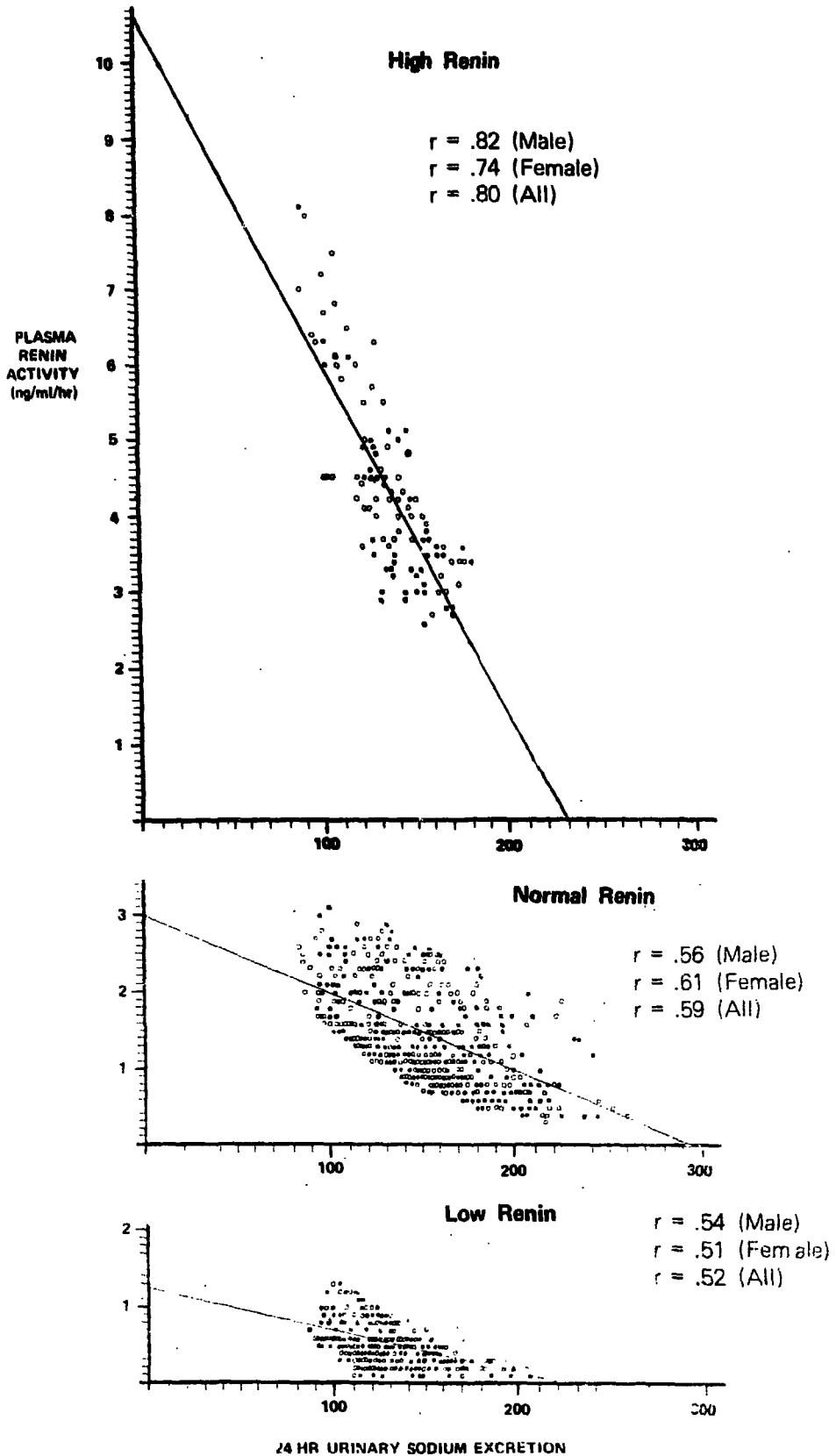


Fig. 19. PRA - SODIUM CORRELATION COEFFICIENT IN 3 SUBGROUPS

The blood pressure in the hypertensives ranges from 140-250/90-130, Table 14. It is noticed that the high renin subgroup has a higher mean diastolic pressure 99 ± 10 than the low renin group which is 96.4 ± 9 . Table 15, and 16).

Table 14. BLOOD PRESSURE (mm. Hg.) - RANGE AND MEAN

Cases	Essential Hypertension			
	Systolic		Diastolic	
Male	140 - 250	161.3 ± 18.0	90 - 130	96.8 ± 9.0
Female	140 - 230	163.5 ± 15.9	90 - 130	96.5 ± 8.4
All	140 - 250	162.5 ± 16.9	90 - 130	96.7 ± 8.8

Table 15. SYSTOLIC BLOOD PRESSURE IN THE RENIN SUBGROUPS

Cases	All	High	Normal	Low
Male	161.3 ± 18.0	164.5 ± 19	160.0 ± 18	162.3 ± 18
Female	163.5 ± 15.9	165.3 ± 16	161.1 ± 15	165.8 ± 16
All	162.5 ± 16.9	164.8 ± 18	160.0 ± 16	164.6 ± 17

Table 16. DIASTOLIC B.P. (mm. Hg.) IN THE RENIN SUBGROUPS

Case	All	High	Normal	Low
Male	96.8 ± 9.0	98 ± 9	96.6 ± 9.0	96.4 ± 10
Female	96.5 ± 8.4	100 ± 11	96.0 ± 8.0	96.4 ± 8
All	96.7 ± 8.8	99 ± 10	96.3 ± 8.5	96.4 ± 9

Table 17. CHARACTERISTIC FEATURES OF THE 3 RENIN SUBGROUPS

Characteristics	High			Normal			Low		
	Male	Female	All	Male	Female	All	Male	Female	All
Incidence (%)	9.50	4.80	14.3	26.4	59.7	56.10	10.20	19.40	29.60
Mean Age (yrs.)	50.00	51.00	50.0	52.0	53.0	52.00	55.00	59.00	57.00
Renin (ng/ml/hr)	4.48	4.25	4.4	1.5	1.4	1.46	.55	.51	.52
Urine Sodium (Meq/24 hrs)	135.00	135.00	135.0	151.0	155.0	153.00	131.00	129.00	130.00
B.P. - Systolic	165.00	165.00	165.0	160.0	161.0	160.00	162.00	166.00	165.00
B.P. - Diastolic	98.00	100.00	99.0	97.0	96.0	96.3	96.00	96.00	96.00
History of Stroke	2	1	3	1	0	1	0	0	0

Table 18. COMPARISON OF MEAN PLASMA RENIN ACTIVITY (ng/ml/hr.) USING DIFFERENT COMMERCIAL KITS

	High	Normal	Low
Present Study	4.4	1.46	.52
Sealey	13.0	3.90	.94 (*)
New England Nuclear	9.2	2.10	.62 (*)
Schwartz Mann	4.8	1.10	.23 (*)
Squibb	3.7	.67	.22 (*)
Dianabot Radioisotope Lab.		1.40	
Mallinckrodt	2.94	1.30	.53

Discussion

It is well known that the normal range of PRA is wide because of a "highly flexible and reactive control system responding to a wide range of physiological circumstances",^{1,8,9,10,11,12,14} the most significant of which is sodium balance. Studies along this line showed that practically and technically, urinary sodium excretion measurement is easier to determine and just as efficient as dietary salt intake and sodium balance calculation.¹ This is more suitable and applicable to our studies of outpatients on random diets. Because of the "diurnal variation in renin release",^{11,8,9} blood was always drawn in the morning when renin activity is highest and also while the patient was ambulatory and on the upright position, "when the renin generating capacity is most challenged".^{6,13} Cognizant of such variations and the many other factors involved like incubation period, room temperature, effect of drugs, etc. we followed in our studies the latest modifications on the original technique that would bring to the fore maximal renin release.^{1,5}

As a result of this study, we now have our normal range of PRA, which enables us to classify essential hypertension into the subgroups as done by many other investigators. Each laboratory is supposed to have its own normal range to begin with, and we hope that others who are doing similar studies locally will furnish more information about base line definition. The only finding we have are from investigators in other parts of the world about their subgroups of essential hypertension: 20-30% are low renin, 10-15% are high renin and the majority are normal renin, which is 55-60%.^{3,4,7}

Our PRA range and mean values although somewhat lower, uncover 3 subgroups of essential hypertension in about the same percentage proportion: High renin is 14%, normal is 56% and low is 30%. In all the subgroups the females are older and the mean

renin is significantly lower ($P < .05$). It would seem that females are better protected than males in the course of their hypertensive condition. Our finding of higher B.P. in the high renin group favors the view that high renin is clinically less benign than the low and normal renin groups.³

Our results are consistent with current findings by other investigators in other parts of the world. We also have the good fortune to have our data statistically analyzed and computerized. We feel that our findings can be of help especially in the choice of treatment of essential hypertension.

We do not advocate renin profiling for widespread or routine application for economic reasons, but whenever available we recommend it for more efficient treatment of hypertension. For a great number who cannot avail of this laboratory aid, our statistics can be a useful guide.

This renin profiling technique using a renin sodium index is now used to identify vasoconstrictor and volume elements and to predict which patients will respond to which type of drug.^{1,2} Thus, low renin essential hypertension is considered volume sensitive subgroup responsive to diuretics and high renin is vasoconstrictive responsive to beta blocker. The big majority group of normal renin can be either of the two.

A new system of treatment is advocated by the proponent of this vasoconstrictor-volume analysis of hypertension — that is, treat first with a beta blocker and add a diuretic if there is no response to the first drug. The combined regimen is claimed to be effective in up to 85% of essential hypertension.¹

In our present study the low renin group is 30% and the normal renin group is 56% which form the larger part of the population. Diuretics can be the first line of treatment and beta blockers can be reserved for the minority group, the high renin subgroup. For the non-

responders to either drug, both can be used. This minimizes the use of 2 or 3 or 4 drugs all at the same time.

A prospective study of which system is more effective will require more time, and will be included in phase II of this project.

Conclusion:

Plasma renin activity determination is feasible, accurate and reliable. It is a very useful guide for more precise treatment of the hypertensive state but even when profiling cannot be done, statistical nomograms can be useful, just as well, as a guide in the treatment of hypertension.

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