

Cortisol and Cortisone Excretion from Infancy to Adult Life

By MERLYN C. MINICK

Cortisol and cortisone excretion rates were determined simultaneously in 43 healthy infants, children and young adults. The results are compared to similar studies in 10 adults. A range of normal values is given. In terms of body

weight, young people as compared with adults excrete significantly less free cortisol, but similar amounts of cortisone. (Metabolism 15: No. 4, April, 359-363, 1966)

THE PURPOSE of this communication is to record normal values for the excretion of free cortisol, cortisone and the ratio of cortisol to cortisone (F/E) excreted by infants, children and young adults. The data were obtained from 43 healthy subjects (22 males, 21 females) ranging in age from 3 months to 20 years. Ten additional subjects (all male) from 21 to 30 years of age were similarly studied for comparative purposes.

SUBJECTS AND METHODS

Table 1 gives the age, weight and sex distribution of the young people studied. The table includes the group of adults against which comparisons were made. All subjects were eating normally and had not been exposed to known stressful circumstances prior to or during the collection of urine.

For the determination of cortisol and cortisone an adaptation of the method of Neher and Wettstein¹ was employed. The method of urine collection from infants and data involving recovery of added steroids have been reported previously.² The substances which were measured as cortisol and cortisone were further identified following acetylation by comparing their mobilities with known steroid acetates in various paper chromatographic systems.

4-C¹⁴ cortisol was applied to diapers containing urine and traces of fecal material. The diapers were then stored and processed as described.² Since 4-C¹⁴ cortisone was not found, it was concluded that no significant conversion of cortisol to cortisone occurs during the collection of urine by the diaper method.

RESULTS

Table 1 contains the data from which Figures 1, 2 and 3 have been derived.

Figure 1 shows the excretion rates (mean) of cortisol and cortisone in the various age groups. A good correlation between urinary cortisol, cortisone and age exists between the ages of 3 months and 20 years, ($r = +0.785$) and ($r = +0.760$), respectively. From 21 through 30 years of age no significant correlation was found ($r = -0.342$) and ($r = -0.294$). All groups below

From the Department of Internal Medicine (Division of Endocrinology and Metabolism and the Metabolic Research Unit), The University of Michigan Medical School, Ann Arbor, Michigan.

Received for publication Dec. 30, 1965.

MERLYN C. MINICK, M.S.: Research Associate, Division of Endocrinology and Metabolism and the Metabolism Research Unit, University Hospital, Ann Arbor, Mich.

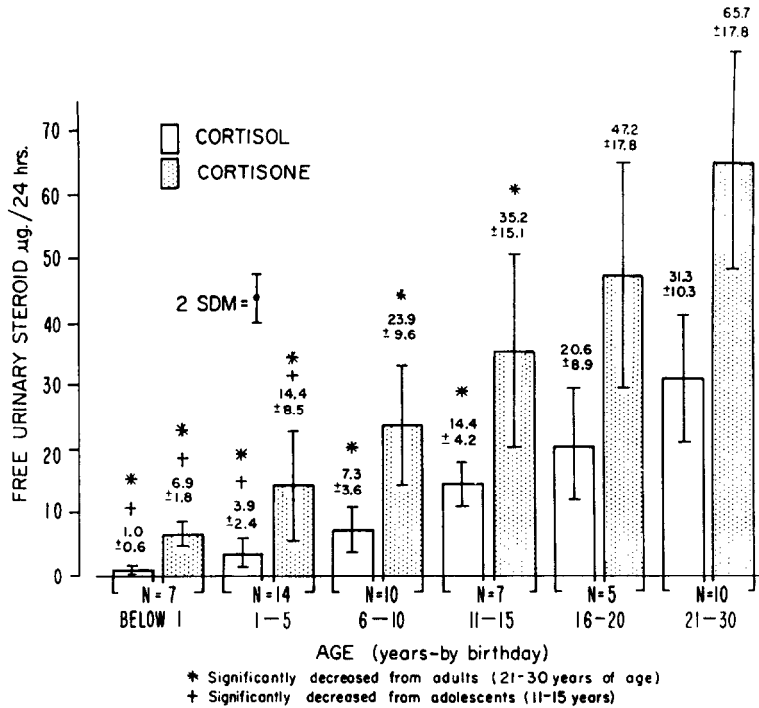


Fig. 1.

age 16 are significantly different from the adult group, the minimum group differences being highly significant ($P < .005$). All groups below age 6 are significantly different from the adolescents (11 to 15 years, $P < .001$), while those from 6 to 10 years of age are not ($P > .05$). The infants excrete significantly less cortisol than any other group ($P < .01$). This observation is in accord with that of Ulstrom et al.³ who found very low levels of cortisol in the urine of newborn infants.

Figure 2 represents the excretion rates expressed in $\mu\text{g./Kg. body weight/24 hours}$. The correlation between cortisol and age is good ($r = +0.532$). Cortisone excretion and age do not correlate ($r = +0.022$). The excretion of cortisol by infants, on a body weight basis, is also significantly less than any other group (min. diff. $P < 0.05$). With respect to cortisol excretion, none of the groups between the ages of 1 and 20 years are statistically different from each other. However, children below age 10 excrete significantly less cortisol than do adults (21-30 years). No significant differences exist between any of the groups with respect to cortisone excretion.

Significant differences in the excretory ratios at various ages are shown in Figure 3 (min. diff. $P < .01$). The children below age 6 have excretory ratios which are different from those of age 11 and above (min. diff. $P < .001$) because they excrete relatively more cortisone than cortisol.

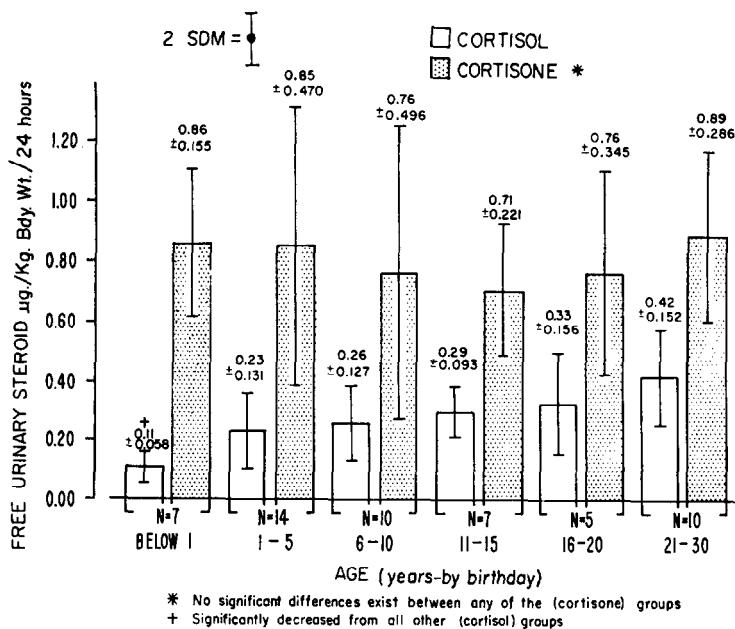


Fig. 2.

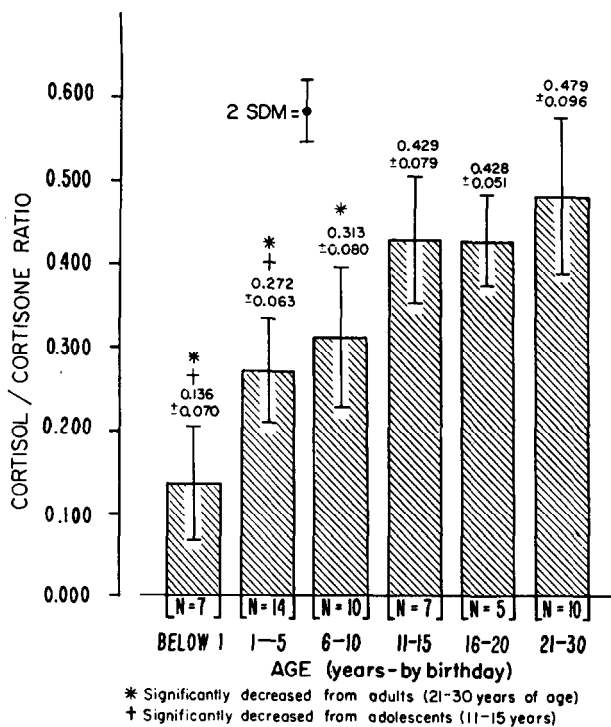


Fig. 3.

Table 1.—Values for Cortisol and Cortisone Excretion on 53 Subjects

No.	Subjects	Age		Sex	Body Weight Kg.	Cortisol ug./24 hrs.	Cortisone ug./24 hrs.	F/E
		yr.	mo.					
1.	C.H.*	—	3	M	5.1	0	5	0.000
2.	C.S.*	—	4	F	5.9	0.6	6	0.100
3.	L.P.*	—	5	F	7.2	0.5	5	0.100
4.	P.J.P.*	—	7	M	8.2	1	7	0.143
5.	D.M.*	—	9	F	10.0	2	7	0.286
6.	B.B.*	—	11	M	10.9	1	8	0.125
7.	B.E.*	—	11	F	9.5	2	10	0.200
8.	E.A.*	1	—	F	10.0	2	7	0.286
9.	D.O.M.	2	3	M	13.6	3	8	0.375
10.	R.F.L.	2	7	M	14.5	7	25	0.280
11.	B.C.	2	8	F	11.8	5	16	0.313
12.	K.E.	2	9	M	13.6	1	7	0.143
13.	K.S.	2	10	F	12.2	1	5	0.200
14.	P.S.	3	6	F	15.0	4	16	0.250
15.	K.M.H.	4	—	M	20.5	1	4	0.250
16.	P.C.	4	6	M	16.8	4	15	0.267
17.	C.D.M.	4	9	F	20.2	2	6	0.333
18.	B.A.M.	4	11	F	23.6	4	16	0.250
19.	A.C.E.	4	11	M	27.2	8	26	0.308
20.	J.H.	5	—	M	18.1	6	30	0.200
21.	H.M.	5	1	M	24.0	7	20	0.350
22.	E.A.L.	6	6	F	22.7	4	9	0.444
23.	E.J.L.	6	7	F	20.0	10	34	0.294
24.	J.C.F.	7	1	M	24.0	6	20	0.300
25.	A.T.	7	4	F	25.0	9	26	0.346
26.	R.C.B.	7	8	F	25.4	5	20	0.250
27.	K.T.	8	6	F	28.4	4	14	0.286
28.	J.F.	9	—	M	40.0	7	24	0.292
29.	A.M.R.	9	5	F	36.3	6	18	0.333
30.	D.E.B.	10	4	M	31.8	6	36	0.167
31.	M.A.B.	10	10	M	36.5	16	38	0.421
32.	M.J.B.	11	10	F	40.0	18	35	0.514
33.	P.F.	12	—	M	43.0	9	20	0.450
34.	M.M.L.	12	9	F	44.2	12	32	0.375
35.	R.H.H.	13	7	F	57.7	10	23	0.435
36.	G.P.F.	13	8	M	45.4	15	28	0.536
37.	J.W.R.	14	1	M	68.6	20	64	0.313
38.	M.I.L.	14	11	F	48.1	17	45	0.378
39.	J.L.R.	16	5	F	59.0	28	64	0.437
40.	G.J.W.	17	—	M	50.9	25	60	0.417
41.	R.D.F.	17	7	M	68.1	12	28	0.429
42.	P.H.	18	—	M	58.1	10	28	0.357
43.	J.C.	18	—	M	80.1	28	56	0.500
44.	J.C.M.	22	—	M	75.0	36	88	0.409
45.	L.J.B.	22	—	M	68.0	32	56	0.571
46.	J.S.B.	22	—	M	79.4	36	72	0.500
47.	J.G.E.	22	—	M	84.0	28	48	0.583
48.	B.A.C.	23	—	M	84.1	20	44	0.454
49.	J.A.S.	25	—	M	68.1	24	80	0.300
50.	J.J.P.	25	—	M	78.6	45	85	0.529
51.	J.S.S.	26	—	M	62.1	28	64	0.437
52.	D.E.M.	27	—	M	67.7	48	80	0.600
53.	M.C.M.	30	—	M	89.0	16	40	0.400

*Analyses from diapers (see text).

REFERENCES

1. Neher, R., and Wettstein, A.: Physiochemical estimation of aldosterone in urine. *J. Clin. Invest.* 35:800-805, 1956.
2. Minick, M. C., and Conn, J. W.: Aldosterone excretion from infancy to adult life. *Metabolism.* 13:681-685, 1964.
3. Ulstrom, R. A., Colle, E., Burley, J. B., and Gunville, R.: Adrenocortical steroid metabolism in newborn infants. I. Urinary excretion of free and conjugated 17-hydroxy corticosteroids in normal full term infants. *J. Clin. Endocrinol. & Metab.* 20:1066-1079, 1960.