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Constitutional and Lifestyle effects on Urinary Steroid and Catecholamine Levels

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ABSTRACT An HPLC hormonal analysis of 4-hour urine samples, collected on 5 workdays and 1 restday, was undertaken among staff and students at an academic institute. Inter-individual differences were greater than intra-individual differences for adrenaline, cortisol and cortisone during workdays. In adrenaline personal consistency was maintained even on the restday, indicating a strong constitutional effect. The same was true of cortisone. Personal consistency in cortisol during workdays was not maintained on the restday and seemed to be due to differences in lifestyle between students and staff, specifically at work. Noradrenaline showed no personal consistency and seemed to be responding to changes in daily activity.

It is well established that urinary excretion of catecholamines and corticosteroids is associated with mood, behaviour and lifestyle (Frankenhaeuser, 1975; James et al., 1985 and Mason, 1968). However, in multivariate analyses of excretion rates of these hormones, the proportion of the population variances in these rates which can be explained by such associations is relatively small (Harrison et al., 1981 and Reynolds et al., 1981). Technical factors no doubt contribute to this situation, but it also seems quite likely that there are 'constitutional', if not genetic factors which play a substantial role. The purpose of this study is to estimate the importance of such a role by comparing the magnitudes of within-individual and between-individual variety in adrenaline, noradrenaline, cortisol and cortisone urinary excretion when a group of people behave rather similarly and when they behave differently from one another.

SUBJECTS AND METHODS

Eighteen staff and postgraduate students (9 male, 9 female, age range 21-58) in the Department of Biological Anthropology were used for this study. None of the students were taking examinations. Five urine samples covering an exact 4 hour period (0900-1300 hours) were collected from each individual, on a normal working day, during 5 or 6 weeks (when all subjects were involved in very similar activities). A further urine sample was collected over the same 4 hour period on a non-working or rest day. Samples were frozen within 24 hours of collection. Separate samples were stored for steroid and catecholamine analysis. Approximately 0.25g sodium metabisulphite was added per 50 ml of urine for catecholamine analysis before storage.

The urine samples were analysed in random order for adrenaline, noradrenaline, cortisol and cortisone by high performance liquid chromatography according to previously published methods (Jenner et al., 1981 and Jenner & Richards, 1985). Coefficients of variation for the 4 hormones analysed, using these methods in our laboratory, have been shown to be 7.6% for cortisol, 7.0% for cortisone, 4.7% for adrenaline and

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4.0% for noradrenaline.

RESULTS

Hormone levels over the 4-hour period for 5 working days and one restday are shown in Table 1. A Kruskal-Wallice one way analysis of variance of the individual working day levels (Table 2) showed that interindividual differences were significantly greater than intraindividual differences in adrenaline, cortisone and cortisol, but not in noradrenaline. In the case of cortisol this individual consistency was found to be mainly associated with the age of the subject, student or nonstudent status and the volume of urine excreted. These three factors had considerable independence. Students tended to have higher cortisol levels than non-students. The levels of this hormone decreased with age and increased with urine volume.

For cortisone personal consistency was associated only with consistency in urine volume. In adrenaline personal consistency was still maintained after body-weight, age, urine volume and student status were taken into account.

An analysis of variance comparing differences between workday and restday means for the group as a whole and for each individual revealed that personal consistency on the workdays was carried over into the restday for adrenaline and cortisone (Table 3). Restday levels for these hormones did not significantly differ from level on the workdays, either at the group level or the individual level. A similar analysis of variance for urine volumes indicated a significant decrease in mean urine volumes on the restday for the group as a whole (p. > .0.01). However, when each individual was analysed their restday urine volumes were not significantly different from workday values. In other words personal consistency in urine volume was maintained on the restday but at a lower mean volume.

The results for cortisol showed that, although there were not significant differences between the two types of day for the population as a whole, individuals had significantly different values between workdays and the restday. This shows that people were changing rank between the workdays and the restday, indicating the effect of differences in workday-restday lifestyles on cortisol. This relationship was maintained after removing any variation associated with urine volumes (Table 3).

Noradrenaline levels were significantly higher on the restday compared to workdays.

Table 1: Hormone levels over 5 workdays and one restday (μg) excreted over a 4 hour period (0900-1300 hours)

	Mean	S.D.	n
Workdays			
Adrenaline	2.026	1.118	90
Noradrenaline	7.790	3.124	90
Cortisol	5.453	3.572	90
Cortisone	15.120	10.689	90
Restdays			
Adrenaline	2.43	1.195	18
Noradrenaline	10.581	3.482	18
Cortisol	5.871	3.783	18
Cortisone	12.748	7.821	18

Table 2: Summary of the Kruskal-Wallice analysis of variance in urinary hormones for 9 men and 9 women collected on 5 working days

	χ^2	*Probability*
Adrenaline	36.59	<0.005
(a) Adrenaline	36.25	<0.005
(b) Adrenaline	36.05	<0.005
Noradrenaline	24.92	NS
Cortisol	51.63	<0.001
(a) Cortisol	22.36	NS
(b) Cortisol	24.02	NS
Cortisone	57.31	<0.001
(a) Cortisone	42.12	<0.001
(b) Cortisone	26.85	NS

(a) Analysis of variance carried out on data after removing age, bodyweight and student status factors.
(b) Analysis of variance carried out on data after removing the effect of urine volume.

Degrees of freedom = 17
NS = not significant

Table 3: Summary of analysis of variance comparing workday and restday hormone levels for (1) the group of subjects as a whole and (2) each individual subject

	Differences between workday and restday			
	(1) Group as a whole:		*(b) Individuals*	
	F	*P*	*F*	*P*
Adrenaline	0.92	NS	1.16	NS
Noradrenaline	16.79	<0.0001	2.08	<0.05
Cortisol	0.35	NS	2.13	<0.05
Cortisone	1.49	NS	1.44	NS
Urine Volume	8.14	<0.01	0.99	NS
Cortisol (a)	1.77	NS	2.05	<0.05

(a) After removing any variation due to urine volume
Degrees of freedom = 17
NS = not significant

DISCUSSION

Hormone levels can be affected by three kinds of factors. Firstly there is the constitutional component, made up from genetic characterisiics and previous life experiences. Secondly there is the effect of a person's general lifestyle and thirdly their day to day experiences within this broad lifestyle. Despite the fact that these three factors are interlinked, it is possible to detect the various influences on hormone levels.

This study indicates that variation in noradrenaline was primarily due to the experiences and activities of the day and therefore no personal consistency was detected. This hormone is known to be sensitive to small changes in physical activity (Axelrod & Reisine, 1984; Ganong, 1983). Our results contrast with personal consistency reported by Johansson & Post (1974).

Adrenaline and cortisone levels showed significant personal consistency, which was maintained on the restday. This indicates a strong constitutional effect. Such personal consistency for adrenaline has already been reported (Johans son & Posts, 1974; Lundberg & Forsman, 1980).

Apparent personal consistency can be due to differences in lifestyles. In the case of cortisol, personal consistency on workdays was not maintained on the restday. This showed that a lifestyle effect was contributing to personal consistency, rather than a constitutionl one. An analysis of variance revealed that the only significant measured difference in lifestyle for this hormone was student status. Postgraduate students tended to have higher cortisol than staff, but only on workdays.

Despite the fact that cortisone levels were postively correlated to cortisol within individuls ($F=145.94$, $p < 0.0001$), cortisone ws not affected by student status. Cortisone is less biologically active than cortisol, although the two hormones are interconvertable in the body (Gower, 1984).

The personal consistency in urine volumes is not the cause of consistency in cortisol and cortisone. Firstly any kidney function effect would appear also in adrenaline. This does not occur. Secondly any changes in cortisol and cortisone between workdays and the restday were not exactly paralleled in urine volumes. Finally cortisol is known to suppress antidiuretic hormone and increase glomerular filtration (Baxter & Tyrell, 1981).

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