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SOCIAL HIERARCHY AND ADRENOCORTICAL STRESS REACTIVITY IN MEN

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SUMMARY

Baseline and stress induced salivary cortisol levels were investigated in 63 army recruits at the beginning and the end of six week boot camp training. At the beginning of the training, the recruits were randomly distributed to nine groups, and weekly measurements of the social hierarchy within each group were obtained. Independent of the social position, baseline levels increased over the first weeks of the training period. Under experimental psychological stress, salivary cortisol levels highly increased in socially dominant subjects (14.0 nmol/l), while only a modest elevation was observed in subordinate men (2.9 nmol/l). Similar differences in response patterns were observed under physical stress. At the end of the training, blunted cortisol responses were observed to both psychological and physical stress. The data suggest a close relationship between social status and pituitary–adrenal responsiveness to psychological stress in men.

Keywords—Stress reactivity; Social status; Cortisol.

INTRODUCTION

Social stress has frequently been considered a relevant risk factor for psychiatric (Coyne and Downey, 1991) and psychosomatic disorders (Weiner, 1992). The role of social factors has also been extensively studied in animal models of human pathology: effects of social stressors such as isolation, deprivation, conflict, aggression, defeat, competition, etc. have been investigated in different species (for an overview see Overmier and Burke, 1992).

Social instability is likely to constitute a major source of chronic stress. Recently, Sapolsky (1992) reviewed the literature on animal experiments investigating relationships between social rank and glucocorticoid secretion. Generally, elevated basal glucocorticoid levels were observed in subordinate animals of many species, such as baboons, talapoin and squirrel monkeys, mice, rats, wolves, tree shrews, and salmons. Sapolsky (1992, p. 272), further reported a blunted ACTH response to CRF challenge and a relative dexamethason resistance in subordinate baboons, suggesting 'that sustained stress, via glucocorticoid

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hypersecretion, will lead to corticosteroid receptor down-regulation in the hippocampus and blunting of feedback efficacy'. According to Sapolsky, these endocrine patterns closely resemble alterations in the hypothalamus–pituitary–adrenal (HPA) system observed in clinical depression.

Several other neurochemical, endocrinological, and immunological alterations have been observed in animal experiments (Weiner, 1992), and some of them seem to be related to HPA activity. Raleigh and McGuire (1992) further reported behavioral differences in response to treatment with precursors of brain monoamines in subordinate vervet monkeys. They found blunted responses of subordinate animals to tryptophan in serotonin related behaviors such as affiliation, aggression, and locomotion. These authors suggest that enhanced basal cortisol levels may induce tryptohan pyrrolase, an enzyme, catalyzing the conversion of tryptophan into kynurenine, thus reducing the metabolism from tryptophan into serotonin in subordinate animals.

Social interactions have been extensively studied under experimental conditions in man; however, biochemical variables have rarely been studied within such experiments (Kirschbaum et al., 1995). Although hierarchies can also be examined in some social settings in man, relationships between dominance and biochemical variables are usually studied by correlational analyses (Ely and Mostardi, 1986). Furthermore, it is unlikely that social hierarchies have the same existential significance for animals and man. Thus, one may expect different changes of the pituitary–adrenal system in humans. The present field experiment was designed to study effects of chronic stress and social rank on adrenocortical activity and reactivity in men.

METHODS

Subjects

Sixty-five healthy male army recruits participated in a boot camp training. The subjects participated in the present study during their first six weeks of the training period. One soldier was suspended from training due to medical reasons, and one out of the 64 subjects did not volunteer to participate. The remaining 63 subjects were 18–26 years of age. They were randomly distributed to nine groups. Due to available room size, five groups consisted of seven soldiers, two of eight, and another two groups of six soldiers, respectively. On a total of 12 days, psychological and endocrine data were collected starting at 1800h each night.

Collection of Psychological and Endocrinological Data

On the first day, subjects gave written consent after being informed in detail about the study. Afterwards, personality traits were assessed by two standardized German questionnaires, the 'Freiburger Persönlichkeits-Inventar' (FPI-R; Fahrenberg et al., 1984) and the 'Giessen Test' (GT; Beckmann and Richter, 1968). The questionnaires included scales such as excitability, aggression, extraversion, neuroticism (FPI), and social resonance, dominance, control (GT), respectively. On days 2 and 44, the 'Trier Social Stress Test' (TSST; Kirschbaum et al., 1993) was applied. The TSST is a laboratory stress test, which mainly consists of an anticipation period (10 min) and a test period (10 min), in which the subject has to deliver a free speech and perform mental arithmetics in front of an audience. On days 3 and 42, the Cooper-Test (Cooper, 1980) was performed, a physical stress test, consisting of running as far as possible in a 12-min period. Under both conditions, salivary