Serum dehydroepiandrosterone sulphate, psychosocial factors and musculoskeletal pain in workers

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Background	The serum level of dehydroepiandrosterone sulphate (DHEA-S) has been suggested as a biological marker of stress.
Aims	To assess the association between serum DHEA-S, psychosocial factors and musculoskeletal (MS) pain in university workers.
Methods	The study population included voluntary workers at the scientific departments of the University of Trieste (Italy) who underwent periodical health surveillance from January 2011 to June 2012. DHEA-S level was analysed in serum. The assessment tools included the General Health Questionnaire (GHQ) and a modified Nordic musculoskeletal symptoms questionnaire. The relation between DHEA-S, individual characteristics, pain perception and psychological factors was assessed by means of multivariable linear regression analysis.
Results	There were 189 study participants. The study population was characterized by high reward and low effort. Pain perception in the neck, shoulder, upper limbs, upper back and lower back was reported by 42, 32, 19, 29 and 43% of people, respectively. In multivariable regression analysis, gender, age and pain perception in the shoulder and upper limbs were significantly related to serum DHEA-S. Effort and overcommitment were related to shoulder and neck pain but not to DHEA-S. The GHQ score was associated with pain perception in different body sites and inversely to DHEA-S but significance was lost in multivariable regression analysis.
Conclusions	DHEA-S was associated with age, gender and perception of MS pain, while effort–reward imbalance dimensions and GHQ score failed to reach the statistical significance in multivariable regression analysis.
Key words	Dehydroepiandrosterone sulphate; low back pain; psychosocial factors.

Introduction

Dehydroepiandrosterone sulphate (DHEA-S) is a corticosteroid hormone, produced by adrenal cortex cells. DHEA is produced by the testicles in men and by ovaries in women and in the central nervous system. The hormone derives from DHEA sulphation and is transformed into androgen and oestrogen compounds [1]. DHEA-S has cardiovascular and immunological effects, as well as anti-inflammatory and antioxidant functions [2]. DHEA-S decreases in stress, pain, rheumatic, cardiocirculatory, immune, osteoarticular and psychiatric disorders [1]. Hasselhorn *et al.* [3] found that low DHEA-S and low beta-endorphin predicted a 6-month prognosis of musculoskeletal (MS) pain in female patient groups. Schell *et al.* [4] found that low DHEA-S predicted pain 12 months later, and individuals with high level of regenerative/anabolic activity had less pain than other subjects.

Considering the need to verify if DHEA-S could be used as marker for well-being in workers, the aim was to study DHEA-S serum levels, in relation to psychosocial factors, mental health and MS pain in a group of workers at the University of Trieste (Italy) without exposure to occupational risks associated with MS disorders.

Methods

The study population included white-collar workers at University of Trieste who underwent periodical health surveillance from 20 January 2011 to 20 June 2012. Participants underwent a medical examination and received a series of anonymous, self-reported, questionnaires: the Effort–Reward Imbalance (ERI) questionnaire to evaluate psychosocial factors [5]; the General Health Questionnaire (GHQ-12) to evaluate mental health [6]; a modified version of the Nordic questionnaire to evaluate MS symptoms [7]; a questionnaire on demographic characteristics; hours dedicated to sport/week and drug intake for pain in the last month. MS pain intensity in the previous 12 months was rated on an 11-point scale, where 0 is 'no pain at all' and 10 is 'pain as bad as it could be' according to the Verbal Numerical Scale (VNS) method. Serum was collected between 8 and 9 a.m. and DHEA-S levels were measured at the clinical laboratory of Trieste University Hospital using 'Access DHEA-S Beckman Coulter' immunoassay. Reference values were 24–690 μg/dl in male, 10–390 μg/dl in pre-menopause women and 7–177 μg/dl in post-menopause women. The Ethics Committee of the University of Trieste approved the study and each participant signed an informed consent. Data analysis was performed using Stata software, version 13.1 (Stata Corporation®, State College, TX, USA, 2013). Continuous variables were summarized by mean and the standard deviation and were compared using the Student's *t*-test and analysis of variance. Categorical variables were expressed as proportions and compared using the χ^2 statistic. Univariate relation between variables was tested by means of the Pearson's correlation. Significant associations were subsequently used in multivariate analysis. DHEA-S level, individual characteristics, perceived pain intensity and GHQ were assessed by multivariate linear regression analysis. Since serum DHEA-S levels had a non-normal distribution, the values were log-transformed. The level of statistical significance was set at a *P* value of <0.05.

Results

Of 212 subjects eligible for the study, 89% (189) agreed to participate to the investigation. The characteristics of the study population are reported in Table 1. As expected, serum DHEA-S was higher in males (223 ± 130 μg/dl) than in females (162 ± 77 μg/dl) ($P = 0.001$). The assessment of psychosocial risk factors using ERI questionnaire suggested a mean condition characterized by high *reward*–low *effort* with *imbalance*, *overcommitment* was very low and GHQ was normal in both genders. MS pain score was very low but females reported pain in the upper back more frequently than males. Univariate Pearson's correlations demonstrated that serum DHEA-S was inversely related to age, drug intake, GHQ score and MS pain perception in all anatomical sites. No association was observed for the dimension investigated by ERI. Multivariable regression analysis (Table 2) confirmed the significant, inverse, relation for serum DHEA-S (expressed in log units) and age, female gender and, to a lesser extent, pain perception in shoulder and upper limbs.

Table 1. Characteristics of the population studied

General characteristics	Males (n = 88)	Females (n = 101)
Age (years, mean ± ds)	38.2 ± 13.3*	34.1 ± 9.5
Job seniority (years ± ds)	14.1 ± 13.8***	8.3 ± 8.8
Marital status [n (%)]		
Married	42 (40)	62 (40)
Unmarried	32 (55)	26 (45)
Divorcee/separate/widower	5 (45)	6 (55)
Children [n (%)]	28 (34)	28 (30)
Smokers [n (%)]	15 (18)	16 (17)
Insomnia [n (%)]	4 (5)	11 (11)
DHEA-S level (μg/dL ± ds)	223 ± 130***	162 ± 77
Job title [n (%)]		
Professors	7 (8)	8 (9)
Technicians	22 (20)	8 (9)
PhD students	20 (24)	30 (33)
Researchers	39 (46)	46 (45)
Psychosocial/psychological indicators (mean ± ds)		
Effort (range 5–25)	8.56 ± 3.4	8.99 ± 3.87
Reward (range 10–50)	28.6 ± 4.9*	26.9 ± 6.60
Imbalance (normal ≤1)	0.66 ± 0.50	0.77 ± 0.45
Overcommitment (range 6–30)	9.20 ± 4.05	9.60 ± 4.40
GHQ (normal <5)	2.88 ± 1.09	2.86 ± 1.08
Musculoskeletal pain (mean ± ds)		
Neck	1.27 ± 2.02	1.81 ± 2.60
Shoulder	0.83 ± 1.72	1.6 ± 2.53**
Upper limbs	0.64 ± 1.60	0.63 ± 1.67
Upper back	0.93 ± 1.90	2.06 ± 2.02*
Lower back	1.33 ± 1.99	1.62 ± 2.34
Days of drug intake ≥4 [n (%)]	6 (7)	9 (9)

*P < 0.05, **P < 0.01, ***P < 0.001.

Discussion

Our study found a negative correlation between serum DHEA-S and pain perception in all body sites. These findings were confirmed by multivariable regression analysis that demonstrated a significant negative relationship between DHEA-S and shoulder and upper limb pain. In our study, as expected, age and gender were the major determinants of serum DHEA-S: the hormone level decreased in older subjects and in females [1,2]. Females reported higher pain perception for neck, shoulder and upper back confirming the findings of other studies. Two follow-up studies showed that individuals with a higher level of anabolic activity (expressed by high levels of DHEA-S) were less likely to be affected with pain, while the reduction of such activity was associated with

Table 2. Multivariable linear regression of log(DHEAS) on pain site, age, gender and GHQ

Variables	Coefficient	95% CI	*P* value
Neck pain	–0.0301	–0.0618; –0.0015	NS
Age	–0.0211	–0.0277; –0.0145	<0.001
Gender (female)	–0.3799	–0.5296; –0.2302	<0.001
GHQ score	–0.0004	–0.0011; –0.0002	NS
Shoulder pain	–0.0378	–0.0720; –0.0037	<0.05
Age	–0.0210	–0.0276; –0.0144	<0.001
Gender (female)	–0.3723	–0.5232; –0.2213	<0.001
GHQ score	–0.0003	–0.0010; 0.0002	NS
Upper limbs pain	–0.0591	–0.1029; –0.0153	<0.01
Age	–0.0207	–0.0272; –0.0141	<0.001
Gender (female)	–0.3931	–0.5405; –0.2456	<0.001
GHQ score	–0.0004	–0.0011; 0.0002	NS
Upper back pain	0.0091	0.0283; 0.0466	NS
Age	0.0210	–0.0277; –0.0144	<0.001
Gender (female)	–0.3966	–0.5470; –0.2462	<0.001
GHQ score	–0.0006	–0.0012; 0.0000	NS
Lower back pain	–0.0064	–0.0401; 0.0273	NS
Age	–0.0209	–0.0276; –0.0142	<0.001
Gender (female)	–0.3928	–0.5435; –0.2422	<0.001
GHQ score	–0.0005	–0.0012; 0.0001	NS

NS, non-significant.

more pain [3,4]. We failed to find an association between ERI dimensions and DHEA-S in accord with Ota *et al.* [8] who reported a negative relationship between social support scores, investigated using a demand–control model, and daytime DHEA secretion in the same group of women. They stated that not all kinds of psychosocial work stressors affect the hypothalamus–pituitary–adrenal axis or DHEA secretion in the same way.

DHEA-S has been suggested as a marker of well-being because of its role as an antagonist of cortisol. A recent study [2] on more than 1000 subjects demonstrated that low DHEA-S and DHEA levels were associated with poorer physical functioning, higher pain perception and more chronic illness conditions in middle-aged and older adults. To the best of our knowledge, our investigation is one of largest ones that studied DHEA-S levels in workers.

In conclusion, our study found that serum DHEA-S level can be a marker of MS well-being and that low level of this hormone may be associated with higher pain perception.

Key points

- The serum level of dehydroepiandrosterone sulphate is associated with age, gender and musculoskeletal pain perception.
- Low levels of dehydroepiandrosterone sulphate can suggest more pain symptoms.
- No relationship was found between dehydroepiandrosterone sulphate level, effort–reward imbalance dimensions and General Health Questionnaire score, after adjustment for confounding factors.

Conflicts of interest

The authors declare no conflict of interest.

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