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`Association study of dehydroepiandrosterone sulfate, impulsivity personality traits and moderate alcohol consumption in men

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ABSTRACT

This study focused on inspecting the relationship between impulsivity traits, salivary dehydroepiandrosterone sulfate (DHEA-S) concentrations, and moderate alcohol consumption in healthy subjects. In previous studies, impulsivity has been related to alcohol consumption and androgens. Limited research has focused on the sulfated form of DHEA-S and alcohol consumption or impulsivity. Moderate alcohol consumption can increase DHEA-S levels. Effects of alcohol, impulsivity and androgens levels may depend on age and gender. The participants were 120 healthy men ($M_{age} = 44.39$; $SD = 12.88$). The results showed positive correlations between DHEA-S and alcohol consumption ($r = 0.22$; $p < .01$) and an impulsivity factor ($r = 0.22$; $p < .01$) controlling for age. Regression analysis showed a significant relationship between DHEA-S ($p < .001$), impulsivity factor and AUDIT ($p < .05$). Analyzing the two extreme impulsivity groups, an association is observed between DHEA-S with AUDIT scores ($R^2 = 0.12$; $p < .05$) in the high impulsivity group, but not in the low impulsivity one. It is therefore concluded that the effect of moderate alcohol consumption is cumulative and slightly associated with levels of impulsiveness and DHEA-S.

1. Introduction

Dehydroepiandrosterone (DHEA) is the major precursor of testosterone and estrogens (Whetzel & Klein, 2010). The most active form of DHEA is dehydroepiandrosterone sulfate (DHEA-S), which provides a more reliable measure of DHEA levels. DHEA-S is produced in the zona reticularis of the adrenal cortex in response to adrenocorticotrophic hormone (ACTH). DHEA-S is an additional biomarker of the hypothalamic-pituitary-adrenal axis (HPA) function (Jeckel et al., 2010). DHEA-S, as part of the HPA function, can antagonize the actions of cortisol (Blauer et al., 1991). Production peaks in young adulthood, thereafter the levels decline progressively by 2–4 % per year (Orentreich et al., 1984; Rotter et al., 2015).

Few studies have linked DHEA-S and alcohol consumption. An increase in DHEA-S has also been found after moderate alcohol intake (Dorgan et al., 2001). Some researchers have observed that moderate alcohol consumption can increase DHEA-S levels in females (Frias et al., 2002), with similar changes for men and women (Sierksma et al., 2004). Other studies have identified the influence of alcohol consumption on DHEA-S levels in non-dependent individuals, including interactions with smoking and age (Weinland et al., 2022). In a controlled study, moderate alcohol consumption (15 g/d, 30 g/d) for 8 weeks significantly increased DHEA-S levels in postmenopausal women. DHEA-S levels increased from week 4 to week 8 at both dose levels (Mahabir et al., 2004).

Rinaldi et al. (2006) examined the relationship of alcohol intake and sex steroid concentrations in blood in pre- and post-menopausal women. Consumption of >25 g/day of alcohol in premenopausal women increased DHEA-S, testosterone (free and total), androstenedione, estrone and estradiol levels by 30 % more compared to non-consuming women. Fukui et al. (2005) carried out a study about cardiovascular disease (CVD) morbidity in patients with type 2 diabetes with moderate alcohol consumption and serum concentrations of DHEA-S. Serum DHEA-S concentrations were higher in light-to-moderate drinkers and

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heavy drinkers than in non-drinkers. The authors concluded that high concentrations of DHEA-S in light to moderate drinkers may influence lower CVD mortality.

Do Vale et al. (2011) studied the relationship between DHEA-S and personality using the Minnesota Multiphasic Personality Inventory (MMPI). The authors used different combinations of the MMPI scales. One combination was called the Behavior-Deviant triad (BD) and was made up of the Psychopathic Deviance, Hypomania, and Masculinity+Femininity scales. The first two scales are traditionally used as indicators of impulsivity (Greene, 1991). The results indicated that DHEA-S was directly related to the Deviant Behavior triad (BD). Related with the pattern observed in this study, subjects with borderline personality disorder (BPD) score significantly higher on self-reported measures of impulsivity than controls (Sebastian et al., 2013), and BPD is also related to high concentrations of DHEA-S. In line with this, morning DHEA levels were significantly higher in the borderline patients than in the controls (Jogems-Kosterman et al., 2007).

Sex hormones play a role in alcohol use and impulsivity, although most studies have focused on testosterone (Aluja et al., 2016; Aluja & Torrubia, 2004; Daitzman & Zuckerman, 1980). Testosterone is weakly related to the sensation seeking personality trait (novelty seeking/impulsive sensation seeking) and sociability. These associations remain significant only between testosterone and novelty seeking after controlling for age (Aluja et al., 2016).

Impulsive personality traits have been linked to alcohol use. Impulsivity traits can be found in different personality theories, such as the models of Eysenck, Gray, Zuckerman, and Cloninger, or the Five Factor Personality Model, measured by related traits, such as Sensation Seeking, Novelty Seeking, Psychoticism, Sensitivity to Rewad, negative Conscientiousness, etc. (Aluja et al., 2002, 2019; Ibañez et al., 2010). However, there are specific questionnaires that measure impulsivity and its different manifestations. The two most used questionnaires in the literature are the Barratt Impulsiveness Scale (BIS; Patton et al., 1995) and the UPPS Impulsive Behavior Scale (Whiteside & Lynam, 2001). Impulsivity measured by the BIS-11 scales has been associated with alcohol consumption (Jakubczyk et al., 2013). Different meta-analyses have examined the variability between impulsivity and alcohol use across studies using the UPPS (Coskunpinar et al., 2013). The results showed a general relationship between impulsivity measured by the UPPS scales and alcohol use, with some differences between scales. The lack of perseverance scale was the measure that best predicted alcohol consumption.

Therefore, impulsivity and DHEA-S are associated with alcohol consumption, but as far as we know, no study has analyzed simultaneously the effect of these psychological and biological variables on alcohol consumption. According to the literature reviewed, a significant association is expected between both impulsivity and DHEA-S with alcohol consumption. We expect that more impulsive men with higher levels of DHEA-S would tend to consume more alcohol.

2. Method

2.1. Participants

In this study, 120 healthy men ($M_{age} = 44.39$; $SD = 12.88$) participated voluntarily, recruited among the service administration and teaching staff of the university, who were contacted by email. This study is part of a larger study with different variables. The participants came to our laboratory to perform various experimental tests on human behavior. Additionally, they answered several personality questionnaires online, including the two used in this study. They received written information about the different tasks to be carried out, and signed a written consent. The study was authorized by the ethics committee, and the institution's data protection certificate was made available. The participants received 25 euros as an incentive.

2.2. Impulsivity measures

In this study, two impulsivity questionnaires were used: The BIS-11 (Patton et al., 1995) and UPPS (Whiteside & Lynam, 2001). The Barratt Impulsiveness Scale (BIS-11) is a 30-item questionnaire comprising three scales: Attention (AI), Motor (MI) and Non-Planning (NPI) Impulsiveness. The answer format is a 4-point scale ranging from 1 to 4. The UPPS-P Impulsive Behavior Scale shortened version was developed by Whiteside and Lynam (2001). This version contains 20 items and five scales: Negative Urgency, Lack of Premeditation, Lack of Perseverance, Sensation Seeking and Positive Urgency.

2.3. Alcohol consumption

The Alcohol Use Disorders Identification Test (AUDIT) was used in this study. This is a 10-item screening tool developed by the World Health Organization (WHO) to assess alcohol consumption, drinking behaviors, and alcohol-related problems. Responses to each question are scored from 0 to 4, giving a maximum possible score of 40 (Saunders et al., 1993). The value of 0 indicates an abstainer who has never had any problems with alcohol. A score of **1 to 7** suggests low-risk consumption according to World Health Organization (WHO) guidelines. Scores from **8 to 14** suggest hazardous or harmful alcohol consumption and a score of **15 or more** indicates the likelihood of alcohol dependence (moderate-severe alcohol use disorder) (Reinert & Allen, 2002).

Additionally, information was obtained on weekly alcohol consumption in order to compare it with the score obtained in the AUDIT. To assess alcohol consumption, a standard self-reported test was used, and actual alcohol consumption in one week was recorded through direct questions from one of the researchers using a standard conversion system. The weekly consumption of alcohol was converted into Standard Drinking Units (SDU), equivalent to 10 g of alcohol, which is approximately the average content of a 100 ml glass of 13-proof wine, 1 glass of 300 ml of 4-proof beer or 30 ml of 40-proof liquor. In our study, the mean SDU was 4.32 ($SD = 6.17$) per week. A risky level of alcohol consumption would be one that exceeds 10 g/day (1 SDU) of pure alcohol in the case of women, and 20 g/day (2 SDU) of pure alcohol in that of men (Farran & Segura, 2020).

2.4. Dehydroepiandrosterone sulfate levels in saliva

The subjects who went to the laboratory to carry out the different experimental tests received written instructions on how to collect the saliva samples at home over the following days between 8 and 9 o'clock in the morning via cotton Salivette Sarstedt, analyzed by Reference Laboratory (https://www.reference-laboratory.es/). The saliva sample was obtained 30 min after getting up without having ingested food, liquids or brushing teeth. They were given a portable cooler to transport the refrigerated saliva sample from their home to the laboratory located on the university campus. The samples were frozen and stored in the laboratory at —86C until subsequent analysis. Each sample was analyzed in duplicate. The inter-assay coefficient of variation (CV) was 9.66 %. The normal DHEA-S range level is 2.0–10.0 ng/ml, and the ideal is 7.0–8.0 ng/ml.

2.5. Statistical analysis

Unrotated factor was carried out by adding the factorial loadings of each of the BIS-11 and UPPS scales. Frequency distribution values can be used as a test of normality. Normality is rejected if kurtosis and skewness exceed the range of ±2 (Hair et al., 2010; Muthén & Kaplan, 1985; West et al., 1995). Outlier detection was performed using Tukey's nonparametric fence method (1977), which is based on the interquartile range. The formula $Q3 + k\ (Q3 - Q1)$ was used to calculate the outer fence, where k corresponds to a constant value of 3. Two extreme groups were formed in the impulsivity factor with the criterion of <30 ($n = 40$) and

Table 1
Factor loadings of the impulsivity scales (BIS-11/UPPS) on the Unrotated impulsivity factor.

	Loadings
Lack of premeditation (UPPS)	0.74
Motor (BIS11)	0.73
Positive urgency (UPPS)	0.72
Attention (BIS 11)	0.69
Non-planning (BIS11)	0.62
Negative urgency (UPPS)	0.58
Sensation seeking (UPPS)	0.57
Lack of perseverance (UPPS)	0.47

Table 2
Descriptive and Cronbach's alpha consistency of impulsivity scales (BIS-11/UPPS).

	M	SD	Kurtosis	Skewness	Alpha
Age	44.39	12.88	−0.99	0.11	–
DHEA-S (ng/mL)	6.30	3.60	0.41	1.06	–
AUDIT	3.34	2.72	1	1.07	
Attention (BIS-11)	13.79	4.76	−0.08	0.56	0.62
Motor (BIS-11)	12.52	5.93	0.73	0.83	0.73
No-planning (BIS-11)	15.21	6.82	0.79	0.94	0.72
BIS-11	41.52	13.69	0.59	0.82	0.81
Negative urgency (UPPS)	7.81	2.50	0.11	0.49	0.80
Lack of premeditation (UPPS)	7.76	2.13	−0.34	0.08	0.81
Lack of perseverance (UPPS)	8.74	1.80	−0.41	0.07	0.69
Sensation seeking (UPPS)	8.79	2.84	−0.60	0.07	0.85
Positive urgency (UPPS)	7.18	2.55	0.27	0.77	0.83
UPPS	40.28	7.98	0.87	0.40	0.85
Impulsivity factor	0	1	0.69	0.61	–

>70 ($n = 40$) percentiles. Using a general linear model (GLM), a comparison was made of the mean estimates of DHEA-S and AUDIT based on the extreme scores in the impulsivity factor, controlling for the effect of age. Zero order and partial correlations were made, controlling for age. Relationships between DHEA-S and alcohol consumption (AUDIT) were analyzed based on subjects with extreme scores on the impulsivity factor.

3. Results

3.1. Impulsivity factor

As shown in Table 1, the factorial loadings ranged between 0.47 for Lack of Perseverance (UPPS) and 0.74 for Lack of Premeditation (UPPS). The Kaiser-Meyer-Olkin Measure of Sampling Adequacy was 0.76 and Bartlett's Test of Sphericity obtained a Chi-Square approximation of 289.03 (free degrees 28; $p < .001$). The impulsivity factor was used as an index of impulsivity for some analyses.

3.2. Descriptive variables and internal consistency of psychometric scales

Table 2 shows the means, deviations, kurtosis, skewness of reported age, DHEA-S, AUDIT and psychometric scales. The frequency distribution values can be used as a test of normality. Note that after the Tukey corrector method, AUDIT had three cases with extreme values, which were removed, and kurtosis and skewness descended. Acceptable values of kurtosis and skewness were obtained in all variables. The alpha internal consistency reliability of the impulsive personality variables obtained a range between 0.62 and 0.85.

3.3. Impulsivity extreme groups' comparison

Fig. 1 shows an estimated means comparison after controlling for age of DHEA-S and AUDIT alcohol measure, according to the low and high groups in the impulsivity factor. As can be seen, the high impulsivity group obtained higher and significant scores in DHEA-S ($p < .03$) and AUDIT ($p < .005$).

3.4. Correlation analysis

AUDIT correlated with reported alcohol consumption in a week measured by SDU 0.58 and 0.61 controlling for age ($p < .001$). DHEA-S correlated negatively with age, as expected ($r = -0.44$; $p < .001$). These relationships support the validity of these data. Table 3 shows a zero-order correlation between DHEA-S, AUDIT, and the impulsive personality questionnaires. The DHEA-S correlated significantly with AUDIT ($r = 0.24$; $p < .01$), BIS-11 total score ($r = 0.22$; $p < .01$), UPPS total score ($r = 0.23$; $p < .01$) and impulsivity factor ($r = 0.26$; $p < .01$). AUDIT correlated with BIS-11 total score ($r = 0.34$; $p < .01$) ($r = 0.33$; $p < .001$),

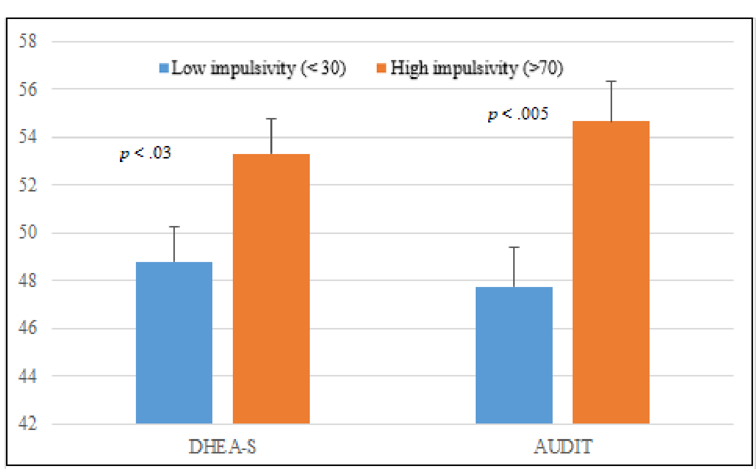

Fig. 1. GLM estimated mean differences by DHEA-A and AUDIT: low (30 percentile) and high (70 percentile) in impulsivity factor controlling for age.

Table 3
Zero-order correlations between age, alcohol consumption (AUDIT) and impulsivity scales.

	Age	DHEA-S	AUDIT	Attention (BIS 11)	Motor (BIS-11)	No-planning (BIS11)	Total BIS-11	Negative urgency (UPPS)	Lack of premeditation (UPPS)	Lack of perseverance (UPPS)	Sensation seeking (UPPS)	Positive urgency (UPPS)	Total UPPS
DHEA-S	−0.44												
AUDIT	−0.07	0.24											
Attention (BIS-11)	−0.05	0.11	0.18										
Motor (BIS-11)	−0.16	0.25	0.31	0.52									
No-planning (BIS11)	−0.07	0.15	0.27	0.43	0.32								
Total BIS-11	−0.12	0.22	0.33	0.79	0.77	0.79							
Negative urgency (UPPS)	0.09	−0.02	0.20	0.26	0.40	0.12	0.32						
Lack of premeditation (UPPS)	−0.14	0.24	0.28	0.37	0.46	0.46	0.56	0.25					
Lack of perseverance (UPPS)	0.05	0.11	0.22	0.27	0.17	0.38	0.36	0.06	0.51				
Sensation seeking (UPPS)	−0.34	0.19	0.15	0.31	0.42	0.23	0.41	0.26	0.29	0.09			
Positive urgency (UPPS)	−0.04	0.26	0.36	0.35	0.42	0.29	0.45	0.65	0.44	0.12	0.38		
Total UPPS	−0.13	0.23	0.37	0.46	0.57	0.43	0.62	0.69	0.71	0.45	0.66	0.80	
Impulsivity factor	−0.13	0.26	0.39	0.69	0.74	0.62	0.87	0.58	0.74	0.47	0.57	0.72	0.92

Note: $r > 0.17$ $p < .05$; $r > 0.22$; $p < .01$; $r > 30$; $p < .001$.

Table 4
Correlations between hormones, alcohol consumption and impulsivity scales controlling for age.

	DHEA-S	AUDIT	BIS-11	UPPS
AUDIT	0.22			
BIS-11	0.19	0.32		
UPPS	0.20	0.36	0.62	
Impulsivity factor	0.22	0.39	0.87	0.92

Note: $r > 0.17$ $p < .05$; $r > 0.22$; $p < .01$; $r > 30$ $p < .001$.

UPPS total score ($r = 0.39$; $p < .001$) and impulsivity factor ($r = 0.39$; $p < .001$). After controlling for age, these correlations decreased slightly (Table 4).

3.5. DHEA-S, AUDIT, and impulsivity extreme groups

Regression analysis showed a significant relationship between DHEA-S ($p < .001$), and the impulsivity factor ($p < .05$) with AUDIT ($R^2 = 0.19$). Analyzing the two impulsivity groups separately, it was observed that in the group with high impulsivity, DHEA-S scores significantly predicted AUDIT levels ($R^2 = 0.12$; $p < .05$), while in the group with low impulsivity, DHEA-S scores did not predict AUDIT levels (Fig. 2).

4. Discussion

This study examined the levels of DHEA-S in a healthy group of middle-aged men and associated them with their scores on two classic impulsivity questionnaires and alcohol consumption. As far as we know, few studies have been carried out associating the levels of DHEA-S and alcohol consumption in men. Some studies indicate that DHEA-S levels and alcohol consumption are higher in men than in women (Sierksma et al., 2004), and others have worked only with women (Frias et al., 2002; Mahabir et al., 2004; Rinaldi et al., 2006). Previous studies have long related impulsivity and alcohol consumption in clinical and non-clinical samples with a higher prevalence in young male subjects (Aluja et al., 2019; Ibañez et al., 2010; Loxton & Dawe, 2001; Mackinnon et al., 2014; Pardo et al., 2007).

Our results, always controlling for age, showed a moderate, but significant correlation between DHEA-S and alcohol consumption (Sierksma et al., 2004). As also expected, alcohol consumption also correlated with the two measures of impulsivity (Aluja et al., 2019); comparing the mean values of DHEA-S and AUDIT between the two extreme groups in the factor of impulsivity, significant differences were observed. Impulsive subjects scored higher than non-impulsive subjects in both variables. The most impulsive subjects got higher scores on DHEA-S and alcohol consumption and, more importantly, impulsive subjects with higher levels of DHEA-S tended to consume more alcohol. Therefore, our data are in line with the studies reviewed in the introductory section, and support our predictions, especially in regard to the effect of impulsivity and DHEA-S in alcohol consumption.

The main androgen, testosterone, has been moderately related to impulsive-disinhibited personality (Aluja et al., 2016; Aluja & Torrubia, 2004; Daitzman & Zuckerman, 1980), but the effect of alcohol reduces testosterone concentrations in people with a strong addiction to alcohol (Emanuele & Emanuele, 2001; Lakićević, 2019). Excessive alcohol consumption has been reported to decrease blood testosterone in men. However, an acute increase in blood testosterone levels after a low dose of alcohol has been observed in women (Sarkola & Eriksson, 2003). In previous studies, DHEA-S and testosterone have been positively related in both men and women, suggesting that adrenal and gonadal secretion are related. Nevertheless, Phillips (1996) reported that DHEA-S did not correlate with testosterone in men but correlated strongly with androstenedione. In women, DHEA-S correlated strongly with testosterone (free and total), and androstenedione. The lack of a correlation between

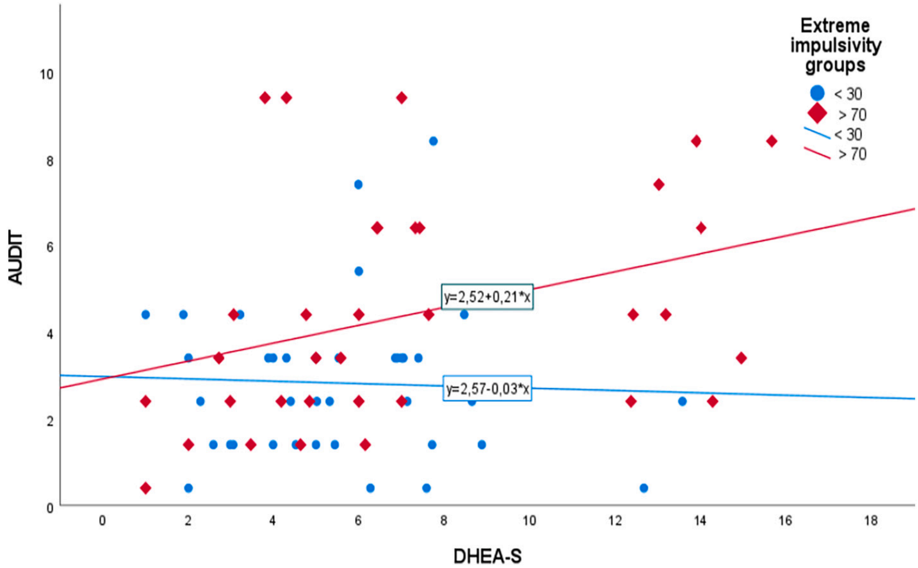

Fig. 2. Regression analysis between DHEA-S and AUDIT in impulsivity factor extreme groups.

DHEA-S and testosterone in normal men is consistent with the independent secretion of these hormones by the adrenal and testis. The DHEAS-testosterone correlation in normal women may be explained by parallel adrenal secretion in response to trophic stimuli (Phillips, 1996).

This study has been conducted with a sample of healthy subjects with very moderate alcohol consumption based on their mean scores. These scores would be in zone 1 (Education about alcohol) and it does not imply a health problem (Bador et al., 2001). Moderate alcohol consumption is inversely associated with cardiovascular diseases (CVD) (Grobbee et al., 1999; Sierksma et al., 2004). Moderate alcohol consumption could be related to a possible prevention of atherogenesis through changes in lipoprotein metabolism (Van der Gaag et al., 1999). Other studies have even suggested a protective effect of high levels of DHEAS against atherosclerosis (Feldman et al., 2001). The relationships between DHEA-S and impulsivity can be linked with the findings of other studies focusing on impulsivity and testosterone when dealing with androgens. As some researchers have observed, after a low dose of alcohol there is an increase in testosterone, at least in women (Sarkola & Eriksson, 2003).

A strength of this study is the relatively high number of subjects with a balanced distribution between 20 and 70 years. Self-reported AUDIT scores were validated with questions about amounts and types of beverages consumed in a week converted in standard drinking units. The AUDIT score was normalized to avoid the presence of outliers, according to Tukey's rule (1977). All variables showed acceptable kurtosis and skewness values. *Some limitations should also be noted, however*. First, this is a cross-sectional study, and no causal conclusions can be drawn from correlational analyses. Second, DHEA-S was negatively correlated with age. To avoid the effect of age as an intervening variable, the different correlational analyses were performed controlling for age. This decreased the statistical significance. Third, the participants were paid volunteers, and this may limit the generalizability of the results to the general population. Finally, women were not included as their DHEA-S levels, impulsivity, and alcohol consumption are lower. Future studies should include women in addition to other covariates, such as nutritional status, including body weight, body mass index (BMI) and waist-to-hip ratio (WHR). Other steroids should also be included with testosterone, androstenedione, or cortisol levels.

CRediT authorship contribution statement

This manuscript complies with the agreement signed by elsevier and the University of Lleida for publications in open access.

Declaration of competing interest

None declared.

Data availability

Data will be made available on request.

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References

Aluja, A., García, L. F., García, Ó., & Blanco, E. (2016). Testosterone and disinhibited personality in healthy males. *Physiology and Behavior, 164*, 227–232. https://doi.org/10.1016/j.physbeh.2016.06.007

Aluja, A., García, Ó., & García, L. F. (2002). A comparative study of Zuckerman's three structural models for personality through the NEO-PI-R, ZKPQ-III-R, EPQ-RS and Goldberg's 50-bipolar adjectives. *Personality and Individual Differences, 33*, 713–726. https://doi.org/10.1016/S0191-8869(01)00186-6

Aluja, A., Lucas, I., Blanch, A., & Blanco, E. (2019). Personality and disinhibitory psychopathology in alcohol consumption: A study from the biological-factorial personality models of eysenck, gray and zuckerman. *Personality and Individual Differences, 142*, 159–165. https://doi.org/10.1016/j.paid.2019.01.030

Aluja, A., & Torrubia, R. (2004). Hostility-aggressiveness, sensation seeking, and sex hormones in men: Re-exploring their relationship. *Neuropsychobiology, 50*, 102–107. https://doi.org/10.1159/000077947

Bador, T. F., Higgins-Biddle, J. C., Saunders, J. B., Monteiro, M. G., & World Health Organization. (2001). *AUDIT: Alcohol consumption disorders identification questionnaire: Guidelines for its use in primary care*. World Health Organization. https://apps.who.int/iris/handle/10665/331321.

Blauer, K. L., Poth, M., Rogers, W., & Bernton, E. (1991). DHEA antagonizes the suppressive effects of dexamethasone on lymphocyte proliferation. *Endocrinology, 129*, 3174–3179. https://doi.org/10.1210/endo-129-6-3174

Coskunpinar, A., Dir, A. L., & Cyders, M. A. (2013). Multidimensionality in impulsivity and alcohol use: A meta-analysis using the UPPS model of impulsivity. *Alcoholism: Clinical and Experimental Research, 37*, 1441–1450. https://doi.org/10.1111/acer.12131

Daitzman, R., & Zuckerman, M. (1980). Disinhibitory sensation seeking, personality and gonadal- hormones. *Personality and Individual Differences, 1*, 103–110. https://doi.org/10.1016/0191-8869(80)90027-6 do Vale, S., Martins, J. M., Fagundes, M. J., & do Carmo, I. (2011). Plasma dehydroepiandrosterone-sulphate is related to personality and stress response. *Neuroendocrinology Letters, 32*, 442–448.

Dorgan, J. F., Baer, D. J., Albert, P. S., Judd, J. T., Brown, E. D., Corle, D. K., Campbell, W. S., Hartma, N. T. J., Tejpar, A. A., Clevidence, B. A., Giffen, C. A., Chandler, D. W., Stanczyk, F. Z., & Taylor, P. R. (2001). Serum hormones and the alcoholbreast cancer association in postmenopausal women. *Journal of the National Cancer Institute, 93*, 710–715.

Emanuele, M. A., & Emanuele, N. (2001). Alcohol and the male reproductive system. *Alcohol Research and Health, 25*, 282–287.

Farran, J. C., & Segura, L. (2020). La actualización de los límites de bajo riesgo del alcohol: Una oportunidad Para mejorar la implementación de las estrategias de identificación precoz e intervención breve en España. [Updating the low-risk limits for alcohol: An opportunity to improve the implementation of early identification and brief intervention strategies in Spain]. *Revista Española de Salud Pública, 94*, 16.

Feldman, H. A., Johannes, C. B., Araujo, A. B., Mohr, B. A., Longcope, C., & McKinlay, J. B. (2001). Low dehydroepiandrosterone and ischemic heart disease in middle-aged men: Prospective results from the Massachusetts male aging study. *American Journal of Epidemiology, 153*, 79–89. https://doi.org/10.1093/aje/153.1.79

Frias, J., Torres, J. M., Miranda, M. T., Ruiz, E., & Ortega, E. (2002). Effects of acute alcohol intoxication on pituitary-gonadal axis hormones, pituitaryadrenal axis hormones, beta-endorphin and prolactin in human adults of both sexes. *Alcohol and Alcoholism, 37*, 169–173. https://doi.org/10.1093/alcalc/37.2.169

Fukui, M., Kitagawa, Y., Nakamura, N., Kadono, M., Hasegawa, G., & Yoshikawa, T. (2005). Association between alcohol consumption and serum dehydroepiandrosterone sulphate concentration in men with type 2 diabetes: A link to decreased cardiovascular risk. *Diabetic Medicine, 22*, 1446–1450. https://doi.org/10.1111/j.1464-5491.2005.01629.x

Greene, R. L. (1991). In R. L. Greene (Ed.), *The MMPI-2/MMPI: An interpretive manual*. Boston: Allyn and Bacon.

Grobbee, D. E., Rimm, E. B., Keil, U., & Renaud, S. (1999). Alcohol and cardiovascular system. In E. I. Mac-Donald (Ed.), *Health issues related to alcohol consumption* (pp. 125–179). Philadelphia: ILSI Europe, Blackwell Science.

Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2010). *Multivariate data analysis: A global perspective*. New Jersey: Pearson Education International.

Ibañez, M. I., Moya, J., Villa, H., Mezquita, L., Ruiperez, M. A., & Ortet, G. (2010). Basic personality dimensions and alcohol consumption in young adults. *Personality and Individual Differences, 48*, 171–176. https://doi.org/10.1016/j.paid.2009.09.017

Jakubczyk, A., Klimkiewicz, A., Mika, K., Bugaj, M., Konopa, A., Podgórska, A., Brower, K. J., & Wojnar, M. (2013). Psychosocial predictors of impulsivity in alcohol-dependent patients. *The Journal of Nervous and Mental Disease, 201*, 43–47. https://doi.org/10.1097/NMD.0b013e31827aaf9d

Jeckel, C. M., Lopes, R. P., Berleze, M. C., Luz, C., Feix, L., Argimon, I. I., Stein, L. M., & Bauer, M. E. (2010). Neuroendocrine and immunological correlates of chronic stress in 'strictly healthy' populations. *Neuroimmunomodulation, 17*, 9–18. https://doi.org/10.1159/000243080

Jogems-Kosterman, B. J., De Knijff, D. W., Kusters, R., & van Hoof, J. J. (2007). Basal cortisol and DHEA levels in women with borderline personality disorder. *Journal of Psychiatric Research, 41*, 1019–1026. https://doi.org/10.1016/j.jpsychires.2006.07.019

Lakićević, N. (2019). The effects of alcohol consumption on recovery following resistance exercise: A systematic review. *Journal of Functional Morphology and Kinesiology, 4*, 41. https://doi.org/10.3390/jfmk4030041

Loxton, N. J., & Dawe, S. (2001). Alcohol abuse and dysfunctional eating in adolescent girls: The influence of individual differences in sensitivity to reward and punishment. *International Journal of Eating Disorders, 29*, 455–462. https://doi.org/10.1002/Eat. 1042

Mackinnon, S. P., Kehayes, I. L. L., Clark, R., Sherry, S. B., & Stewart, S. H. (2014). Testing the four-factor model of personality vulnerability to alcohol misuse: A three-wave, one-year longitudinal study. *Psychology of Addictive Behaviors, 28*, 1000–1012. https://doi.org/10.1037/a0037244

Mahabir, S., Baer, D. J., Johnson, L. L., Dorgan, J. F., Campbell, W., Brown, E. Taylor, P. R., … (2004). The effects of moderate alcohol supplementation on estrone sulfate and DHEAS in postmenopausal women in a controlled feeding study. *Nutrition Journal, 3*, 1–4. https://doi.org/10.1186/1475-2891-3-11

Muthén, B., & Kaplan, D. (1985). A comparison of some methodologies for the factor analysis of nonnormal likert variables. *British Journal of Mathematical and Statistical Psychology, 38*, 171–189. https://doi.org/10.1111/j.2044-8317.1992.tb00975.x

Orentreich, N., Brind, J. L., Rizer, R. L., & Vogelman, J. H. (1984). Age changes and sex differences in serum dehydroepiandrosterone sulfate concentrations throughout adulthood. *The Journal of Clinical Endocrinology & Metabolism, 59*, 551–555. https://doi.org/10.1210/jcem-59-3-551

Pardo, Y., Aguilar, R., Molinuevo, B., & Torrubia, R. (2007). Alcohol use as a behavioural sign of disinhibition: Evidence from J.A. Gray's model of personality. *Addictive Behaviors, 32*, 2398–2403. https://doi.org/10.1016/j.addbeh.2007.02.010

Patton, J. H., Stanford, M. S., & Barratt, E. S. (1995). Factor structure of the barratt impulsiveness scale. *Journal of Clinical Psychology, 51*, 768–774. https://doi.org/10.1002/1097-4679(199511)51:6<768: aid-jclp2270510607>3.0.co;2-1

Phillips, G. B. (1996). Relationship between serum dehydroepiandrosterone sulfate, androstenedione, and sex hormones in men and women. *European Journal of Endocrinology, 134*, 201–206. https://doi.org/10.1530/eje.0.1340201

Reinert, D. F., & Allen, J. P. (2002). The alcohol use disorders identification test (AUDIT): A review of recent research. *Alcoholism, Clinical and Experimental Research, 26*, 272–279. https://doi.org/10.1111/j.1530-0277.2002.tb02534.x

Rinaldi, S., Peeters, P. H. M., Bezemer, I. D., Dossus, L., Biessy, C., Sacerdote, C.Kaaks, R., … (2006). Relationship of alcohol intake and sex steroid concentrations in blood in pre-and post-menopausal women: The European prospective investigation into cancer and nutrition. *Cancer Causes and Control, 17*, 1033–1043, 0.1007/s10552-006-0041-7.

Rotter, I., Kosik-Bogacka, D., Dołęgowska, B., Skonieczna-Żydecka, K., Pawlukowska, W., & Laszczyńska, M. (2015). Analysis of relationships between the concentrations of total testosterone and dehydroepiandrosterone sulfate and the occurrence of selected metabolic disorders in aging men. *The Aging Male, 18*, 249–255. https://doi.org/10.3109/13685538.2015.1077507

Sarkola, T., & Eriksson, C. P. (2003). Testosterone increases in men after a low dose of alcohol. *Alcoholism: Clinical and Experimental Research, 27*, 682–685. https://doi.org/10.1097/01.ALC.0000060526.43976.68

Saunders, J. B., Aasland, O. G., Babor, T. F., De la Fuente, J. R., & Grant, M. (1993). Development of the alcohol use disorders identification test (AUDIT): WHO collaborative project on early detection of persons with harmful alcohol consumption-II. *Addiction, 88*, 791–804. https://doi.org/10.1111/j.1360-0443.1993.tb02093.x

Sebastian, A., Jacob, G., Lieb, K., & Tüscher, O. (2013). Impulsivity in borderline personality disorder: A matter of disturbed impulse control or a facet of emotional dysregulation? *Current Psychiatry Reports, 15*, 1–8. https://doi.org/10.1007/s11920-012-0339-y

Sierksma, A., Sarkola, T., Eriksson, C. J., van der Gaag, M. S., Grobbee, D. E., & Hendriks, H. F. (2004). Effect of moderate alcohol consumption on plasma dehydroepiandrosterone sulfate, testosterone, and estradiol levels in middle-aged men and postmenopausal women: A diet-controlled intervention study. *Alcoholism Clinical and Experimental Research, 28*, 780–785. https://doi.org/10.1097/01.alc.0000125356.70824.81

Tukey, J. W. (1977). *Exploratory data analysis*. Mass. — Menlo Park, Cal., London, Amsterdam, Don Mills, Ontario, Sydney, XVI, 688 S: Addison-Wesley Publishing Company Reading.

Van der Gaag, M. S., Van Tol, A., Scheek, L. M., James, R. W., Urgert, R., Schaafsma, G., & Hendriks, H. F. J. (1999). Daily moderate alcohol consumption increases serum paraoxonase activity; a diet-controlled, randomized intervention study in middle-aged men. *Atherosclerosis, 147*, 405–410. https://doi.org/10.1016/s0021-9150(99)00243-9

Weinland, C., Mühle, C., von Zimmermann, C., Kornhuber, J., & Lenz, B. (2022). Sulphated dehydroepiandrosterone serum levels are reduced in women with alcohol use disorder and correlate negatively with craving: A sex-separated cross-sectional and longitudinal study. *Addiction Biology, 27*, Article e13135. https://doi.org/10.1111/adb.13135

West, S. G., Finch, J. F., & Curran, P. J. (1995). Structural equation models with non normal variables: Problems and remedies. In R. H. Hoyle (Ed.), *Structural equation modeling: Concepts, issues, and applications* (pp. 56–75). Thousand Oaks: Sage.

Whetzel, C. A., & Klein, L. C. (2010). Measuring DHEA-S in saliva: Time of day differences and positive correlations between two different types of collection methods. *BMC Research Notes, 3*, 1–5. https://doi.org/10.1186/1756-0500-3-204

Whiteside, S. P., & Lynam, D. R. (2001). The five factor model and impulsivity: Using a structural model of personality to understand impulsivity. *Personality and Individual Differences, 30*, 669–689. https://doi.org/10.1016/S0191-8869(00)00064-7