Psychoneuroendocrinology 69 (2016) 41–49

Contents lists available at ScienceDirect

Psychoneuroendocrinology

journal homepage: www.elsevier.com/locate/psyneuen

Unemployment is associated with lower cortisol awakening and blunted dehydroepiandrosterone responses

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ARTICLE INFO

Article history:
Received 17 December 2015
Received in revised form 16 March 2016
Accepted 16 March 2016

Keywords:
Chronic stress
Cortisol
DHEAS
Employment
Stress
Unemployment

ABSTRACT

Previous research has investigated the endocrinological consequences of unemployment as a likely pathway behind chronic stress and negative health outcomes. Despite these early attempts at delineating the neuroendocrine consequences of the chronic stress experienced by the unemployed, identifying a consistent and stable effect has remained elusive. Here we sought to strengthen existing knowledge into the effect of the stress of employment status on cortisol by improving on the methodological weaknesses of earlier studies and extend this line of enquiry by measuring the steroid hormone Dehydroepiandrosterone-Sulfate (DHEAS). Saliva samples were collected from unemployed and employed participants at four time points across two days. As expected, unemployed people reported higher stress, lower social support and lower self-esteem. Unexpectedly, the unemployed showed lower overall cortisol output, a likely consequence of a higher cortisol awakening response (CAR) in the employed. However, they also had a higher DHEA output across the day, albeit the diurnal pattern across the day was more dysregulated compared to that seen in those employed with a blunted response evident in the evening; the cortisol:DHEAS ratio was also lower in the unemployed group. Further, these hormone differences were correlated with self-esteem and stress. Taken together these results suggest that the relationship between employment status and endocrine responses is far more complicated than previously thought. We have shown for the first time that unemployed people have a lower CAR, but also show a blunted DHEA response relative to those employed and we suggest that this may be a feature of chronic stress exposure or perhaps dependent on the prevailing socio-economic context.

1. Introduction

Chronic stress causes negative health outcomes via its dysregulation of autonomic, endocrine, and immune system functioning (Segerstrom and Miller, 2004; Morey et al., 2015). Despite decades of research, an established and consistent model of chronic stress in humans has remained elusive, necessitating more detailed and precise measurements of individual and contextual factors that may either mask or define relationships between chronic stress and health (Gallagher et al., 2009; Lovell and Wetherell, 2011; Segerstrom and O'Connor, 2012). Unemployment is one source of chronic stress that has received comparatively little endocrinological research, particularly in recent years, despite the rising unemployment figures globally due to the latest economic crisis. Unemployment has been shown to be damaging to health, but has inconsistent associative patterns with health outcomes (McKee-Ryan et al., 2005; Roelfs et al., 2011), including cortisol (Claussen, 1994; Ockenfels et al., 1995). To date, evidence in this area has focussed largely on assessing overall cortisol, or diurnal rhythm differences only; with no assessment of the awakening response, which has been specifically related to a range of sources of chronic stress (Fries et al., 2009). Even with the assessments that have been undertaken, suggestions are that unemployment does affect cortisol secretion; however the methods employed by previous studies were not standardised and very broad (e.g. lack of control for gender, medication, and cortisol collection) making the results difficult

Abbreviation: DHEA-S, dehydroepiandrosterone-sulfate.

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http://dx.doi.org/10.1016/j.psyneuen.2016.03.011
0306-4530/

to interpret. The present study aims to build upon and extend on these earlier studies.

Dehydroepiandrosterone (DHEA) is a steroid hormone of adrenal origin that has been receiving attention in recent years, as its role in health and disease is still being uncovered (Maninger et al., 2009). It and its sulphated form, DHEA-Sulfate (DHEAS), are measured similarly to cortisol – with salivary assessment – providing accurate comparability to circulating serum levels (Hucklebridge et al., 2005). It is immunoprotective (Bauer, 2005; Buford and Willoughby, 2008), has been related to higher levels of resilience (Morgan III et al., 2009; Petros et al., 2013), and is a protective factor against the damaging effects of excessive cortisol excretion (do Vale et al., 2011). Further, the ratio of cortisol to DHEAS has also been associated with health and disease outcomes, with a higher ratio being associated with a greater risk of mortality (Phillips et al., 2010). Circulating DHEA/DHEAS levels decline naturally over time with ageing (Bauer, 2005; Maninger et al., 2009), however they also decline after both brief and prolonged exposure to stress (Izawa et al., 2012; Lennartsson et al., 2012). Using the chronic stress model of caregiving, DHEAS has been shown to be higher in non-caregivers; even in a young population where immunosenescence does not confound findings (Vedhara et al., 2002).

To date no assessments of DHEA/DHEAS have been carried out using unemployment as a model of chronic stress, and only very limited data is available on cortisol in the same (Arnetz et al., 1991; Ockenfels et al., 1995; Dettenborn et al., 2010) implying that further investigation of dysregulation of the hypothalamic-pituitary-adrenal axis endocrinology is needed. Moreover, given that unemployment has been associated with immunomodulation (Hughes et al., 2015), cardiovascular disease (Gallo et al., 2004), and all-cause mortality (Browning and Heinesen, 2012), it implies that there is likely a mechanistic relationship between this status and health decrements. Further, as previous research examining cortisol in unemployment has been fraught with methodological issues, it is possible that clearer differences may be uncovered with more controlled methodology. The present study sought to advance previous findings of cortisol dysregulation in unemployed participants, by comparing employed and unemployed participant groups. Moreover, the assessment of DHEAS in these participants was also undertaken to understand this important element of stress-induced health decrement. Based on the premise that chronic stress is damaging to the body and existing literature on unemployment, we hypothesised that unemployed participants would have lower cortisol awakening response, higher cortisol output and a higher cortisol to DHEAS ratio (cortisol:DHEAS) relative to those who were employed. Further, given that stress, social support, and self-esteem are important psychological mediators of unemployment stress, health and endocrine function (Segerstrom and Miller, 2004; Pruessner et al., 2005; Uchino, 2006; O'Donnell et al., 2008) we also wanted to confirm that our unemployed group were highly stressed and also tested whether they were associated with cortisol and DHEAS responses in these groups.

2. Methods

2.1. Participants

As part of a larger study, participants both employed and unemployed were recruited from across Ireland in a convenience sample using government agencies providing services to the unemployed, recruitment agencies, social media and print media advertising, and were offered € 10 for participation. A total of 110 participants (69.1% female; 59% employed) that satisfied the inclusion criteria and were enrolled to take part completed the saliva testing and survey. Inclusion criteria were: being of working age (i.e. 18 > < 65 years), being resident in Ireland and healthy i.e. not taking medications such as glucocorticoids or immunosuppressant's. Exclusion criteria were based on physiological and employment status parameters. Candidates were excluded in the case of: pregnancy, chronic illness (immune, endocrine, psychological/psychiatric, cardiovascular, or neurological), or oral/periodontal disease. Additionally, those candidates that self-identified as home-makers, were retired, or who were unemployed and receiving disability/incapacity benefit were also excluded. This was to ensure that the unemployed sample was comprised of individuals who would self-identify as being unemployed and without vocational roles, and that were unemployed but otherwise able to work. The project was approved by our University's Research Ethics Committee, and was conducted in accordance with the Declaration of Helsinki. Each participant gave informed consent before participation.

2.2. Procedure

Prior to saliva collection, participants were asked to complete an internet-based or postal survey for demographic information, health behaviours (e.g. smoking, alcohol consumption, sleeping), and psychological questionnaires. After considering best practice guidelines on cortisol collection, and in particular attending to reducing bias on the assessment of the cortisol awakening response (Clow et al., 2010; Dockray et al., 2008; Stadler et al., 2016) participants were provided with eight saliva collection tubes (Sarstedt Ltd., Leicester, UK), and a diary log to note the date and time the samples were taken and a general written guide on how to collect their samples, along with a link to a video showing saliva collection specific to the protocol; they were also provided with a stamped addressed envelope for returning the samples. For example, the importance of the first awakening sample was emphasised by providing the following textual information 'Awake' is the first sample you take when you immediately wake in your usual way (alarm or natural waking): This should be when your eyes are wide open and you are ready to get up. This sample must be taken when you are lying down in bed. 'As shown in the YouTube video clip, it is very important that sampling and timing are done with accuracy.' Further, the YouTube clip not only showed how to collect the sample, it again emphasised accuracy and timing and the implications if not done correctly; the clip also showed a visual graph displaying the cortisol diurnal rhythm to reiterate the importance of adhering to the protocol. Participants were instructed to take four samples each day for two days; immediately upon waking (T1), thirty minutes after waking (T2), at midday (T3), and at eight in the evening (T4). As per the recommended guidelines above, two days of collection were implemented to ensure a more reliable assessment of the hormones. Participants were instructed to put the cotton swab in the salivette in their mouth for two-minutes and let the saliva collect naturally, *but* also not to eat or drink anything during taking the first two samples, and to avoid eating and drinking for at least 30 min before each other collection. Participants were provided with new tubes upon request if the procedure was not adhered to ($n = 8$, with no differences between groups). Samples were refrigerated by participants upon collection, and, after returning to the laboratory, were frozen at −20° C until centrifugation and assay.

2.3. Psychological materials

As part of the participant survey, the following psychological scales were administered. The short Perceived Stress Scale (PSS-4) (Cohen et al., 1983) which assessed perceived stress over the previous month; a single-item self-esteem scale (SISE), that has