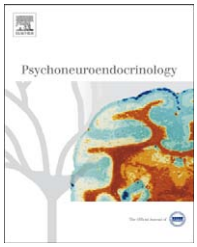
Psychoneuroendocrinology (2007) 32, 1158–1163

Available at www.sciencedirect.com

ScienceDirect

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



SHORT COMMUNICATION

Education modulates cortisol reactivity to the Trier Social Stress Test in middle-aged adults

Alexandra J. Fiocco, Ridha Joober, Sonia J. Lupien*

Centre for Studies on Human Stress, Douglas Hospital Research Centre, 6875 Lasalle Blvd., Verdun, Montreal, Que., Canada H4H 1R3

Received 24 May 2007; received in revised form 24 August 2007; accepted 28 August 2007

KEYWORDS
Education;
Stress-reactivity;
Trier Social Stress Test

Summary
The present study assessed the modulating effect of education level on cortisol reactivity to the Trier Social Stress Test (TSST) in a sample of 101 middle-aged adults (22 males, 79 females) between the ages of 50 and 65. The TSST involves a public speech and mental arithmetic task in front of an audience. No previous studies have assessed whether education level can have an impact on cortisol reactivity to this psychosocial stressor. It is plausible that greater exposure to academia may impact how one perceives and responds to the demands of the speech and arithmetic task. Should education have an impact on cortisol reactivity to the TSST, future studies will be required to control for this factor in order to reduce both statistical error and false interpretations. In addition to completing the TSST, participants were administered a battery of neurocognitive tests and personality questionnaires, including a report on education level (i.e. number of years total and degree: High School, Junior College, Technical, University). Results showed that adults with post-secondary education above Junior College tended to secrete higher cortisol levels overall, as measured by total area under the curve. However, it was the group with lower educational attainment who showed a greater stress response specific to the TSST, as measured by percentage increase in cortisol from pre- to post-TSST. Analyses also found that higher educated adults performed better than their less educated peers on verbal fluency. Considering that the TSST is an oral task, it is suggested that middle-aged individuals with a lower level of education may find the TSST more stressful due to lower verbal capacity, which may lead to an increased cortisol response to the TSST when compared to individuals with a higher level of education.

*Corresponding author. Tel.: +1 514 761 6131x3359.
E-mail address: sonia.lupien@mcgill.ca (S.J. Lupien).

0306-4530/$ - see front matter © 2007 Elsevier Ltd. All rights reserved.
doi:10.1016/j.psyneuen.2007.08.008

1. Introduction

It is well known that psychological stress plays an important role in the development of various psychopathologies, including post-traumatic stress disorder, depression, and anxiety (Blake, 2001; McFarlane et al., 2005; Seidler and Wagner, 2006; Shields, 2006). For over a decade now, research has employed challenge tests in order to assess reactive endogenous activity of the hypothalamic–pituitary–adrenal (HPA) axis in order to delineate reactivity to stress in humans.

The Trier Social Stress Test (TSST) is a standardized experimental protocol that allows for the induction of moderate psychological stress in a laboratory setting while recording physiological responses to the stressor (Kirschbaum et al., 1993a). The TSST provides an estimate for the potential of the HPA axis to respond to a given stressor (Kirschbaum et al., 1993a). The protocol consists of an anticipation period and a test period in which participants must deliver a free speech on a given topic and perform a mental arithmetic task in front of an audience (Kirschbaum et al., 1993a). This task has been found to induce a two- to four-fold increase in salivary cortisol levels, a major stress hormone that reflects HPA reactivity (Kirschbaum et al., 1992a, 1995). This procedure further allows one to compare participants' stress-reactivity levels, allowing for the assessment of individuals differences (Kirschbaum and Hellhammer, 1994).

To date, a plethora of research has found inter-individual variations in the cortisol response to the TSST. Indeed, factors such as age, gender, nicotine consumption, glucose intake, contraceptive use and menstrual phase induce differences in cortisol reactivity to the TSST (Gonzalez-Bono et al., 2002; Kirschbaum et al., 1992a, b, 1993b; Kudielka et al., 2004a).

The role and importance of education level has not been acknowledged in the stress-reactivity literature that utilized the TSST. This may largely be due to the fact that many studies that employ the TSST have done so in a relatively homogenous sample of individuals, such as university students.

Social economic status (SES), which often includes education in its measurement, has been reported as an important factor in health status (Marmot and Shipley, 1996). In terms of stress-reactivity studies, only one study has reported lower stress-reactivity in low SES men, using a stress paradigm that included anger recall, arithmetic, and a cold pressor test (Kristenson et al., 1998). However, not only did this study include a stress paradigm that involved both a psychological and physical stress component, the protocol was carried out in two separate cities, and the samples from each city were compared to one another (i.e. Lituanians compared to Swedish). This type of protocol may call for a number of confounders that are not reported in the study results. Other studies, however, have found no such effect of SES on stress-reactivity in either men or women using various stress paradigms (Adler et al., 2000; Kapuku et al., 2002; Steptoe et al., 2005).

Thus, to this end, it was the goal of the present study to evaluate the influence of education level on stress reactivity to the TSST in a sample of male and female middle-aged adults. Adults between the ages of 50 and 65 are a good sample cohort to investigate the influence of education as variability in education will be higher than that normally tested in the TSST literature (i.e. university students).

2. Method

As part of a larger study, 101 male and female adults between the ages of 50 and 65 years were recruited from the community. Participants were asked to come to the Douglas Hospital Research Centre on two separate occasions. Participants were screened for presence of any Axis I disorders and medications that commonly interact with cortisol secretion (e.g. evothyroxine, glucocorticoids, antidepressants, estrogen replacement therapy). Further, individuals who reported smoking 10 or more cigarettes a day were excluded from the study due to possible effects on cortisol secretion.

During the first session, participants underwent a routine physical exam and blood screening test to ensure that they were healthy and showed no abnormalities such as thyroid dysfunction, which may alter the HPA axis. Participants were then administered a battery of neurocognitive tests, including the verbal fluency task for letters and animals (phonetic vs category) and the digit span task (Wechsler, 1973). As well, personality questionnaires were administered, including a measure for self-esteem (Rosenberg, 1965), a personality trait that has been associated with the TSST stress response (Pruessner et al., 2005). Level of education was acquired through a question that asked for the participant's highest educational attainment (Elementary, High School, Junior College, Technical, University). In addition, participants were asked to give an approximate number of years of education. All participants were tested in their language of proficiency (i.e. French or English).

During the second session, participants were exposed to the TSST between 13 and 15 h. All participants were asked to refrain from smoking, eating or drinking products with caffeine 1 h before the afternoon session. Participants provided a total of nine salivary samples throughout the session using the Salivette. These samples included two samples before the anticipation period (baseline, pre-anticipation), one before the speech and arithmetic task (pre-TSST), and six following the TSST (post-TSST, 5, 15, 25, 35, 45 min). All cortisol samples were stored in a −20 °C freezer until subsequent analyses. At the end of the TSST session, in order to obtain an estimate of subjective stress experienced from the TSST, participants were asked to rate on a 10-point scale, the degree to which they felt the session to be stressful, difficult, unpleasant, threatening, unexpected, novel, and the degree to which they felt a lack of control and personally involved.

This study protocol was approved by the Ethics Board of the Douglas Hospital Research Centre (#03/40) and all participants signed an informed consent before commencing the study protocol.

Salivary samples were assayed by sensitive radioimmunoassay using a kit from DSL (DSL, Webster, TX) with procedures modified to increase the sensitivity of the cortisol assay. Briefly, 50 μl of saliva was incubated with 50 μl of ^{125}I-cortisol and 50 μl of antibody and placed in a waterbath at 37 °C for 2 h. A 500 μl PBS wash was added to