



Lower cardiovascular reactivity to acute stress in informal caregivers of people with autism spectrum disorder than in non-caregivers: Implications for health outcomes



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ABSTRACT

Caring for offspring with autism spectrum disorder (ASD) is associated with chronic stress. Such a situation could alter body homeostasis, and in turn, physiological systems associated with the stress response and health, such as the autonomic nervous system. The primary aim of the present study was to compare the cardiovascular response with a set of mental tasks in parents of people with ($n = 34$) and without ($n = 36$) ASD. The secondary aim was to explore a potential relationship between cardiovascular response and self-reported health. Caregivers had lower sympathetic activity than non-caregivers, especially during the acute stress period. Higher sympathetic activity was related to more self-reported somatic symptoms in caregivers. Further, caregivers were found to have lower sympathetic reactivity to the stressor, probably due to an adaptation mechanism. Such adaptation could be extremely important for protecting the health of caregivers.

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1. Introduction

Caring for offspring with autism spectrum disorder (ASD) is associated with chronic stress (Lovell et al., 2012; Ruiz-Robledillo and Moya-Albiol, 2013). Although some caregivers cope appropriately and show adaptation in this care context (Bayat, 2007), the majority of studies have found high levels of stress and health disturbances in caregivers of individuals with ASD when compared with the general population (Davis and Carter, 2008; Hayes and Watson, 2013; Ruiz-Robledillo and Moya-Albiol, 2013). ASD is characterized by deficits in communication, altered socialization patterns, and restricted and stereotyped interests and behaviors (American Psychiatric Association, 2013). In addition, behavioral problems are also commonly present, including aggressiveness, hyperactivity, and self-injury, among others (Campbell, 2003). As caregivers may have to cope with multiple challenges associated with behaviors of the person under their care, this core of ASD symptoms could represent a threat to homeostasis in the caregivers. Alterations in homeostasis are mediated by impaired allostasis, the latter being understood as a set of processes that allow organisms to maintain homeostasis while adapting to the demands of the environment. One major system involved in the process of allostasis is the autonomic

nervous system (ANS) (McEwen, 2007). The most studied marker of ANS functioning is cardiovascular response, mainly through the measures of heart rate (HR), blood pressure (BP) and heart rate variability (HRV).

HRV has been shown to be an adequate indicator of morbidity and predictor of mortality in individuals with cardiovascular diseases and in the general population, it being a widely studied marker of health problems in many populations (Montano et al., 2009; Thayer et al., 2012). In the general population the studies of Delaney and Brodie (2000) and Hjortskov et al. (2004), showed that sympathetic activation increased during a stressor, with marked vagal withdrawal. In addition, a recent study, also conducted in the general population, showed a significant association between rumination and greater reductions in HRV in response to an interpersonal acute stressor (Woody et al., 2015). In people under chronic stress, results of research are not consistent, some studies finding higher sympathetic activity during a stressor, while others found blunted sympathetic reactivity during a stressor, especially in people under higher levels of stress than the general population (Gump and Matthews, 1999). Specifically, individuals with a diagnosis of post-traumatic stress disorder showed higher sympathetic activation during laboratory stress than healthy controls (Keary et al., 2009). In contrast, individuals from a disadvantaged background, adolescents with childhood exposure to violence and members of the general population with a larger number of stressful life events had blunted cardiovascular reactivity to acute stress (Carroll et al., 2005; Evans and Kim, 2007; Murali and Chen, 2005).

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In informal care context, several studies evaluating HRV have been conducted. These studies have found, on the one hand, that caregivers of people with cancer showed higher sympathetic predominance at rest than non-caregivers (Lucini et al., 2008; Teixeira and Pereira, 2014); and, on the other, that caregivers of people with schizophrenia without institutional support had lower cardiovascular reactivity to experimentally-induced psychosocial stress than caregivers with institutional support (González-Bono et al., 2013). In older caregivers, similar results have been found. Specifically, caregivers of people with dementia had higher HR, BP and dysfunctional hemostatic reactivity during a speech stressor (Von Känel et al., 2003). Further, cognitive processing and negative life events seem to modulate cardiovascular reactivity (Monin et al., 2012; von Känel et al., 2003). A study in caregivers of people with osteoarthritis of a similar age examined cardiovascular reactivity when they were exposed to patient suffering (Monin et al., 2010), and found that they had higher BP and HR when exposed to suffering of the patient under their care than that of a stranger.

When gender differences in cardiovascular response have been evaluated in informal caregivers, mixed results have been found (Atienza et al., 2001; Foody et al., 2015). In samples of caregivers of people with dementia, one study found higher BP reactivity of an acute laboratory stressor in women than men (Atienza et al., 2001). However, male caregivers of people with ASD showed higher BP and HRV on a typical day than female caregivers (Foody et al., 2015).

However, no studies have analyzed cardiovascular reactivity to acute stress in laboratory settings in caregivers of people with ASD. In a natural context, previous research has found this population to have higher BP during normal days than non-caregivers (Gallagher and Whiteley, 2012). These results point to an alteration in the functioning of the ANS in caregivers, increasing the probability of negative health outcomes, especially in relation to cardiovascular disease. Hence, evaluating the cardiovascular reactivity to experimentally-induced acute stress, as a representation of the usual stress reactivity in real life, could provide useful information to help us understand the biological mechanisms of health disturbances in this population.

Based on the reactivity hypothesis, an autonomic imbalance, characterized by prolonged sympathetic hyperactivity and reduced vagal activity in response to psychological stress, has been related to alterations in homeostasis due to excessive energy demands on the body, and associated increases in allostatic load leading to negative health outcomes (Thayer and Sternberg, 2006; Phillips and Hughes, 2011). A high state of alarm, characteristic of informal caregivers, could significantly increase energy demands through the overactivation of the sympathetic branch of the ANS, disturbing the adaptive balance of the system. Prolongation of this state could trigger increases in allostatic load as described by McEwen (1998) through wear and tear of physiological systems involved in stress response. Recent research in this field has also found that decreased vagal activity and increased sympathetic activity were related to disturbances in endocrine functioning, such as increases in cortisol levels, impairment of glucose regulation, alterations in immune function and elevation of pro-inflammatory cytokine levels (Thayer and Sternberg, 2006). These findings illustrate the regulatory effects of the ANS on endocrine and immune systems, meaning that changes in the ANS could alter endocrine and immune function, resulting in health problems. On the basis of existing evidence, it can be supposed that caring for a relative with ASD alters the activity of the ANS and thereby modulates the stress response and health of caregivers. Consistent with this, a previous study conducted with parents of people with ASD showed a positive relationship between sympathetic activation to acute experimentally-induced stress, measured in terms of electrodermal response, and a high number of self-reported somatic symptoms (Ruiz-Robledillo and Moya-Albiol, 2015).

To our knowledge, no studies have been conducted evaluating the stress response to acute experimentally-induced stress in parents of people with ASD employing both HR and HRV measures. Such studies in the laboratory could contribute to our understanding of the stress

response of caregivers in the care context and the associated risk of health deterioration. Given all this, the main aim of the present study was to analyze the cardiovascular response to acute stress in the laboratory in informal caregivers (parents of people with ASD) compared with non-caregivers (parents of typically developing children). On the basis of previous research in stressed populations, we hypothesized that caregivers would have a lower cardiovascular response to acute stress, showing lower sympathetic activation (Carroll et al., 2005; Evans and Kim, 2007; Murali and Chen, 2005). Moreover, we expected to find a positive association between high sympathetic activation and poorer self-reported health in the case of informal caregivers (Ruiz-Robledillo and Moya-Albiol, 2015; Tak et al., 2010).

2. Methods

2.1. Participants

The sample was composed of 70 participants: caregivers (34 parents of patients with ASD, 24 women and 10 men) and non-caregivers (36 parents of age-matched typically developing children, 20 women and 16 men). Caregivers were recruited from an association of parents of individuals with ASD in Valencia (*Asociación Valenciana de Padres de Personas con Autismo*). Couples or participants caring for the same person were not included in the sample. Offspring of the association members were clinically diagnosed with an ASD by clinical staff following the DSM-IV-TR criteria. Firstly, meetings were held to explain the aim of the research and the inclusion criteria. To be eligible for the caregiver group, individuals had to be a parent of a patient with an ASD, be his or her primary caregiver, and have lived in the same home as the patient for at least 2 years before the study. An interview was scheduled for relatives who were selected and wished to participate in the study. The non-caregiver group was composed of parents of healthy offspring who had not provided special care for any ill relative for at least 2 years before the start of the experiment. This group was recruited using advertisements and flyers, as well as by word of mouth. Participation was voluntary, all participants signing an informed consent form that followed ethical norms for human research (Declaration of Helsinki), and approval was obtained from the local ethics committee.

2.2. Procedure

The participants were instructed to abstain from eating, drinking stimulants (such as tea, coffee, or alcohol), or smoking during the 2-hour period before arriving at the laboratory. The experimental procedure was performed between 4:00 and 7:00 pm, and each session lasted approximately 2.5 h. After the participants arrived at the laboratory, data were collected on anthropometric and socio-demographic characteristics and compliance with the instructions was confirmed. Participants were directed to the stress room, which was sound-attenuated and temperature-controlled (21 ± 2 °C), and had constant lighting during all sessions.

Electrodes were attached and participants were encouraged to make themselves comfortable and relax. After 10 min of habituation, participants completed psychological questionnaires for the evaluation of psychological states (pre-stress anxiety and mood) and then *Baseline* electrocardiogram signals were recorded for 10 min. General information regarding the stress stimuli and the evaluation of their performance during the *Stressor* was then provided to the participants, and after that, participants remained silent for 8 min (*Preparatory*). When this *Preparatory* period finished, participants were exposed to a psychosocial stressor consisting of a session of 20 min in front of a committee of two men and three women performing a set of cognitive tasks (Stroop test, mirror-drawing test and arithmetic tasks). During the *Stressor* period (20 min), a video camera was switched on to heighten the evaluative threat by simulating a recording, as suggested in previous studies (Dickerson and Kemeny, 2004).

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