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Psychoneuroendocrinology 29 (2004) 593–611

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# Loneliness and neuroendocrine, cardiovascular, and inflammatory stress responses in middle-aged men and women

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Received 3 February 2003; received in revised form 7 April 2003; accepted 7 April 2003

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## Abstract

Loneliness is a psychological experience related to social isolation and perceived lack of companionship, and may be relevant to health risk. The revised UCLA loneliness scale was completed by 240 working men and women aged 47–59 years, and related to affective state and neuroendocrine, cardiovascular, and inflammatory responses. Loneliness scores were not associated with gender, age or socioeconomic position, but were lower in married than single or divorced participants, and were positively related to social isolation, low emotional support, ratings of depression, hopelessness and low self-esteem, and to reported sleep problems. Diastolic blood pressure reactions to acute mental stress were positively correlated with loneliness in women but not men, independently of age, socioeconomic status, smoking, body mass and marital status ( $p = 0.014$ ). Lonely individuals also displayed significantly greater fibrinogen ( $p = 0.038$ ) and natural killer cell responses ( $p = 0.042$ ) to stress, independently of covariates. The cortisol response over the first 30 min following waking was positively associated with loneliness after adjusting for waking cortisol value, sex, socioeconomic status, smoking, time of waking, and body mass ( $p = 0.046$ ). We conclude that loneliness is a psychological experience with potentially adverse effects on biological stress processes that may be relevant to health.

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*Keywords:* Loneliness; Social support; Cortisol; Mental stress; Blood pressure; Fibrinogen; Natural killer cells

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## 1. Introduction

Social relationships are significant for health, and both social networks and social support influence mortality and morbidity (Cohen and Syme, 1985; House et al., 1988). There has been considerable interest in the impact of social isolation and social support on neuroendocrine, immune and cardiovascular responses (Uchino et al., 1996). Loneliness is the feeling that emerges when social relationships are perceived to be deficient, and may arise from a perceived lack of intimacy (emotional loneliness) or lack of companionship (social loneliness). A reciprocal relationship between loneliness and social support or social networks has been observed in numerous studies of children, students, community samples of adults, and older cohorts (Wheeler et al., 1983; Mullins et al., 1996; Prince et al., 1997). However, feelings of loneliness exist to some extent independently of objective social experience, and discrepancies between the two have frequently been observed. For example, Fees et al. (1999) showed that loneliness was not correlated with the amount of face-to-face contact with others in an elderly sample, and no relationship between loneliness and social support emerged in a study of mothers of children with life-threatening disease (Florian and Krulik, 1991).

Loneliness is associated with poor emotional well-being and with depression (Prince et al., 1997; Nolen-Hoeksema and Ahrens, 2002). There is also evidence that loneliness is independently related to morbidity and mortality. In the Amsterdam Longitudinal Study of Ageing, loneliness predicted mortality over a 29-month period independently of age, the presence of chronic illness, functional limitations, self-rated health, alcohol consumption, and smoking (Penninx et al., 1997). Russell et al. (1997) reported that loneliness in a community-dwelling old age cohort predicted admission to nursing homes over a 4-year period independently of age, income, education, marital status, physical health, and social contact. Loneliness was found to be an independent predictor of post-operative mortality in a study of coronary artery bypass (Herlitz et al., 1998). It is also related to illness behaviour, and to more frequent consultation with physicians independently of health status (Ellaway et al., 1999).

The purpose of this study was to explore possible mechanisms through which loneliness might influence health, using a larger ( $n = 240$ ) sample of middle-aged men and women than has been analysed before. There are two broad sets of pathways through which psychosocial factors might impact on risk of physical illness: behavioural and psychobiological. Some associations between loneliness and behaviours prejudicial to health have been described, including relationships with problem drinking, poor health practices, and poor diet (Walker and Beauchene, 1991; Mahon et al., 1998; Bonin et al., 2000). However, the association between loneliness and future mortality described by Penninx et al. (1997) was independent of health behaviours, and other studies have shown little relationship between loneliness and health-related behaviour (Cacioppo et al., 2002a). Lonely students were found in a recent study to have poor sleep efficiency, and this might compromise health (Cacioppo et al., 2002b). In the present study, we assessed smoking, alcohol consumption, habitual physical activity, and sleep problems. It was hypothesised that if behavioural path-

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