Do stress, health behavior, and sleep mediate the association between loneliness and adverse health conditions among older people?

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A B S T R A C T

Introduction: Prior research has established an association between loneliness and a variety of negative health conditions among older people. However, little is known about the mechanisms underlying this association.
Objective: Building on the Loneliness Model, Hawkley and Cacioppo (2010) identified possible pathways through which loneliness may affect the development of adverse health conditions. The present study was designed to test the pathways proposed by Hawkley and Cacioppo.
Methods: The sample consisted of 8593 elderly ranging from 65 to 102 years of age participating in the 2013 Public Health Survey "How are you?".
Results: Findings show that loneliness was significantly associated with cardiovascular disease, diabetes, and migraine. In addition high perceived stress, physical inactivity, daily smoking, and poor sleep mediated the association between loneliness and adverse health conditions. Moreover, findings demonstrate several gender differences in the association between loneliness and various adverse condition and the indirect mechanisms affecting these associations.
Conclusion: The findings largely support the pathways proposed by Hawkley and Cacioppo.

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Loneliness is a common, yet painful emotional experience affecting individuals of all ages. It is thought to accelerate the rate of physiological decline, which makes it an important research area among older people (65+ years) (Cacioppo and Cacioppo, 2014; Hawkley and Cacioppo, 2007). Loneliness among older people is well-investigated, and it is a widely held stereotype that it is more prevalent in this age group than among other age groups (Peplau et al., 1982; Pinquart and Sørensen, 2001). Nonetheless, loneliness is generally not more frequent among older people, and 5–15% of older men and woman actually report often being lonely (Pinquart and Sørensen, 2001; Victor et al., 2000). The oldest old (75+ years and above) are, however, more prone to feelings of loneliness (Dykstra et al., 2005; Hawkley and Cacioppo, 2007; Pinquart and Sørensen, 2001), which may reflect that they are faced with a general increase in widowhood, sickness, physical immobility, and limited social opportunities. Large cross-national variations in the prevalence of loneliness in old age have been documented, and among European elderly the prevalence has been found to range from 3 to 34% across different nations (Yang and Victor, 2011). The prevalence of loneliness in northern European nations such as Denmark, Germany, Sweden and The United Kingdom has been found to be low compared to eastern and southern European nations (Yang and Victor, 2011).

1. Loneliness in old age

Loneliness is an unpleasant emotional state and a result of a discrepancy between desired and achieved levels of social contact (Peplau and Perlman, 1982). Loneliness is not synonymous with social isolation, but is related to both the amount of social contact (quantity) as well as the features (quality) defining social relationships, as for instance intimacy and confidentiality. Furthermore, loneliness in old age is associated with a variety of serious health consequences and therefore appears to be an important psychosocial risk factor of relevance for age-related health problems (Hawkley et al., 2008).

Social life changes radically in old age; for some older people,

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widowhood and retirement have large implications for loneliness and overall well-being (de Jong Gierveld, 1998; Victor et al., 2000). For instance, losing a spouse is equivalent to losing an attachment figure (Weiss, 1973) and entail loss of intimacy and closeness, which may explain why widows are more prone to feelings of loneliness. Even though the risk of loneliness in old age seems great, many older people live a satisfying social life where they continue to take part in social activities and maintain social relationships. However, some individuals still experience profound feelings of loneliness in old age, and a large body of research indicates that such individuals are at greater risk of developing poor health.

2. Loneliness and adverse health conditions in old age

The Loneliness Model (Cacioppo and Hawkley, 2009; Hawkley and Cacioppo, 2010) is a highly specific model, which seeks to explain mechanisms that promote and perpetuate feelings of loneliness. Building on the Loneliness Model, Hawkley and Cacioppo (2010) propose that persistent feelings of loneliness are a risk factor for broad-based morbidity and mortality. Based on this proposal, Hawkley and Cacioppo (2010) delineate possible pathways through which loneliness may affect the development of adverse health conditions. Furthermore, the association between loneliness and adverse health conditions is thought to be particularly relevant in old age (Cacioppo and Cacioppo, 2014).

According to the Loneliness Model, hypervigilance for social threats serves as a fundamental agent in the process through which loneliness affects health because it is, among other things, involved in the production of maladaptive cognitive bias regarding social interaction. Cognitive bias causes the lonely individual to perceive the social world as threatening, and patterns of inappropriate social behavior are produced in response to this perception (Hawkley and Cacioppo, 2010). Inappropriate social behavior often evokes negative reactions from peers, which confirms the maladaptive cognitive bias. Hawkley and Cacioppo (2010) have labeled this process "self-reinforcing loneliness loops" and argue that such loops contribute to the development of chronic loneliness. This process is furthermore thought to represent a dispositional tendency which activates a series of neurobiological, physiological, and behavioral mechanisms that are assumed to contribute to the development of adverse health conditions (Hawkley and Cacioppo, 2010). Specifically, through maladaptive hypervigilance, loneliness is assumed to affect health by producing elevated stress, creating patterns of health-compromising behavior, and by affecting physiological repair and maintenance processes such as sleep (Hawkley and Cacioppo, 2007, 2010). As such, Hawkley and Cacioppo (2010) argue that stress, health-compromising behavior (e.g., physical inactivity, smoking and poor diet) as well as sleep may constitute possible pathways between loneliness and adverse health conditions. However, the pathways described by Hawkley and Cacioppo (2010), are generic, and specific mediators and health outcomes still need to be identified. Moreover, studies that have put the theoretical notions into empirical testing are sparse.

Loneliness has been found to predict several adverse health conditions, including poor self-rated health (Luo et al., 2012), increased blood pressure (Hawkley et al., 2008), increased risk of mortality (Holwerda et al., 2012; Perissinotto et al., 2012; Steptoe et al., 2013), decline in activities of daily living and mobility (Perissinotto et al., 2012), the onset of dementia (Holwerda et al., 2014) and cardiovascular disease (Hawkley et al., 2003; Hawkley et al., 2008; Momtaz et al., 2012).

Furthermore, studies suggest that loneliness could potentially affect other diseases such as diabetes and migraine. However, the direct associations have yet to be examined. Poor social relations have been linked to diabetes (Hempler et al., 2013), and loneliness has also been associated with the metabolic syndrome, which refers to a clustering of factors that have been shown to increase the risk of diabetes among others (Whisman, 2010). Likewise, migraine has been associated with psychosocial difficulties such as poor social functioning (Raggi et al., 2012), and frequent headaches have been associated with having few confidants and a small network size (Cohen and Henry, 2011). Together this may suggest that loneliness could potentially affect the development of migraine or frequent headaches.

One previous study has demonstrated that elevated stress, health-compromising behavior, and poor sleep have an indirect effect on the association between loneliness and health. Segrin and Passalacqua (2010) investigated the potential pathways, identified by Hawkley and Cacioppo (2010), and found that the association between loneliness and poor self-rated health was mediated by several factors (high perceived stress, medical adherence, sleep, and exercise). However, their study was limited due to a small sample size ($n = 265$) and the use of a convenience sample. Furthermore, the study provided only a single, self-rated measurement of health status and did not investigate specific disease conditions.

Moreover, gender differences have not previously been a subject of investigation in relation to the loneliness-health association and the mechanisms affecting the association. However, older women tend to be lonelier than older men (Cohen-Mansfield et al., 2009; Dykstra et al., 2005; Rieke and Bird, 2005; Pinquart and Sørensen, 2001), and many health conditions or diseases are more prevalent among one gender than another (National Center for Health Statistics 2012). For instance, gender differences exist in the prevalence of manifestations of cardiovascular disease (Leening et al., 2014). Moreover, men overall have higher rates of diabetes than women (Wild et al., 2004), whereas more women experience migraine and/or frequent headaches than men (Lipton and Bigal, 2005; Lyngberg et al., 2005). Taken together, the investigation of gender as a potential moderator of the loneliness-health association appears to be a relevant research avenue.

3. The aim of the present study

Although loneliness clearly predicts adverse health conditions (Cohen-Mansfield et al., 2009; Luo et al., 2012), the mechanisms through which loneliness may affect health have not been sufficiently investigated. Building on the theoretical foundation of the Loneliness Model, Hawkley and Cacioppo (2010) offers a generic description of the loneliness-health association. However, the proposed pathways has not yet been fully operationalized or examined empirically.

The aim of the present study was to further validate the hypothesized pathways by examining a broad range of mechanism in relation to three disease conditions in old age among Danish elderly (see Fig. 1). Furthermore, the study aimed to investigate the loneliness-health association across gender to determine possible variations.

The investigated health outcomes were cardiovascular disease, diabetes, and migraine. Cardiovascular disease was included in the study on the grounds of results from previous studies (Hawkley et al., 2003; Hawkley et al., 2008; Momtaz et al., 2012). To the best of our knowledge loneliness has not previously been associated with diabetes or migraine. Nevertheless, the two conditions were included in the study because previous research have associated loneliness-related conditions with diabetes (Hempler et al., 2013) and migraine/frequent headaches (Cohen and Henry, 2011; Raggi et al., 2012), respectively. Furthermore, we investigated potential mediators from three domains: stress, health behavior, and