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Daily social interactions, close relationships, and systemic inflammation in two samples: Healthy middle-aged and older adults

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ABSTRACT

Objective: Systemic inflammation is thought to be a biological mediator between social relationship quality and premature mortality. Empirical work has yielded mixed support for an association of social relationship variables with systemic inflammation, perhaps due to methodological limitations. To date, research in this literature has focused on global perceptions of social relationships, with limited attention to the covariance of characteristics of daily social interactions with inflammation. Here, we examine whether daily interactions, as assessed by ecological momentary assessment (EMA), associate with peripheral markers of inflammation among midlife and older adults.

Methods: Global social support and integration were measured using the Interpersonal Support Evaluation List (ISEL) and the Social Network Index (SNI), respectively, in older adults from the Pittsburgh Healthy Heart Project (PHHP), and in middle-aged adults from the Adult Health and Behavior Project–II (AHAB-II). Using time-sampled EMA, we assessed the proportion of the day spent in positive and negative social interactions. Systemic markers of inflammation were interleukin (IL)-6 and C-reactive protein (CRP).

Results: Global measures of support and integration did not associate with inflammation in either sample. In older adults, relative frequency of total positive interactions, those with close others (i.e. spouse, friends, family), and those with coworkers predicted lower concentrations of IL-6 in fully adjusted models, accounting for age, sex, race, education, BMI, smoking and alcohol. In middle-aged adults, relative frequency of positive interactions with close others was also inversely associated with IL-6 level and relative frequency of negative marital interactions was unexpectedly inversely associated with CRP level.

Conclusions: Characteristics of daily social interactions among midlife and older adults associate with markers of systemic inflammation that are known to predict risk for cardiovascular disease. Ambulatory measures may better capture health-relevant social processes in daily life than retrospective, global self-report measures.

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1. Introduction

Social relationship characteristics, or the quality and quantity of one's social ties, have been shown to be associated with a variety of health outcomes, including reduced risk of cardiovascular disease (CVD) (Berkman et al., 1992; Brummett et al., 2001), lower incidence of cancer (Ell et al., 1992; Hibbard and Pope, 1993; Welin et al., 1992) and infectious diseases (Lee and Rotheram-Borus, 2001; Patterson et al., 1996), and greater longevity (Holt-Lunstad et al., 2010). Although pathways linking social factors to health outcomes remain unclear, it is widely suggested that the immune system may play a role (Kiecolt-Glaser et al., 2010). Indeed, a growing number of studies have examined the association between social connections and inflammation, including circulating levels of pro-inflammatory cytokines, such as interleukin (IL)-6, and acute phase proteins, such as C-reactive protein (CRP) (Mezuk

Abbreviations: EMA, ecological momentary assessment; SS, social support; SI, social integration; IL-6, interleukin-6; CRP, C-reactive protein; AHAB-II, Adult Health and Behavior Project Phase II (AHAB=II); PHHP, Pittsburgh Healthy Heart Project; ISEL, Interpersonal Support Evaluation List; SNI, Social Network Inventory; BMI, body mass index.

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et al., 2010; Ford et al., 2006). This proinflammatory profile is implicated in the pathophysiology of chronic disease (Black and Garbutt, 2002), suggesting that increased inflammation might mediate associations between relational characteristics and morbidity and/or premature mortality. Social relationship characteristics could be associated with markers of inflammation through engagement in risky health behaviors, such as excessive alcohol intake and smoking, both of which are related to greater inflammation (Imhof et al., 2001; Fröhlich et al., 2003). Alternatively, relational characteristics could also be associated with inflammation through psychophysiological mechanisms, such as dysregulation of the sympathetic-nervous system (SNS) and the hypothalamic-pituitary-adrenal (HPA) axis, both of which are involved in modulation of inflammation (Eisenberger and Cole, 2012).

Social relationship characteristics can be conceptualized within two domains: social integration and social support. Social integration (SI) is considered a structural index of an individual's social ties, reflecting social engagement in diverse social roles, whereas social support (SS) is a measure of perceived availability of material aid and emotional support from others. While there is some evidence that low SI and low functional SS associate with chronic inflammation, findings are inconsistent and may differ by age and gender. A recent study reported only a weak inverse association between SI and CRP and an unexpected positive association between perceived SS and CRP (Glei et al., 2012). Three epidemiological studies reported inverse associations between SI and concentration of CRP in men, but not in women (Loucks et al., 2006a,b; Ford et al., 2006), with some evidence that the association is stronger for older men than younger men (Ford et al., 2006). Similar inverse relationships of perceived SS with CRP among men have been observed in some (Mezuk et al., 2010), but not all (McDade et al., 2006) studies.

In addition to the potential modifying role of sample characteristics, variability in associations across specific relationship domains may also help explain inconsistent findings. Recent evidence suggests that qualitative aspects of social relationships within specific relationship domains may contribute to inconsistent findings across studies (Shor et al., 2013). In this regard, relationship quality may be an important factor to consider given evidence that strain in close relationships (i.e. spouse, friends, family) and total relationship strain associates with higher circulating levels of fibrinogen, an acute phase marker of inflammation, above and beyond the effects of demographic factors, BMI, smoking, and physical activity (Yang et al., 2014).

Similarly, within the context of marriage, lower spousal support, but not general marital strain, associated with higher levels of IL-6 and CRP among women (Donoho et al., 2013). In a separate study, both partner support and partner strain were associated with IL-6 (in the expected directions) in younger women, but not in men, with only partner support emerging as a significant predictor when both measures of marital adjustment were considered simultaneously (Whisman and Sbarra, 2012). Hence, in the context of marriage, positive relationship quality appears to be more consistently associated with inflammatory markers than measures of negative interaction, especially in women.

In addition to demographic and relationship quality issues, limitations in the methodology used to measure social relationship constructs may also contribute to inconsistent association with inflammation. Self-report measures that assess global beliefs about SS and SI behaviors do not assess dynamic and event-specific behavioral mechanisms, such as daily social interactions, that may contribute to disease risk. In this regard, global self-report measures may more strongly reflect beliefs and attributions about relationships than the frequency and quality of social interactions (Conner and Barrett, 2012; Tulving, 1983). It may be the case that actual social events act as triggers of the biological changes that promote inflammation, and that our ratings of the quality of our relationships are only indirect markers of these psychophysiological processes. In response to these limitations, it has been argued that multiple ambulatory assessments in naturalistic settings may provide more accurate representations of event-specific experiences (Conner and Barrett, 2012; Tulving, 1983). Ecological momentary assessment (EMA) is a method designed to capture event-specific information, measuring behaviors, affect, and cognitions in real-time and in the natural environment (Stone and Shiffman, 1994). Thus, EMA may provide greater access to the dynamic biological and behavioral mechanisms that promote disease risk (Shiffman et al., 2008). To support this theory, a separate body of literature reports consistent associations between characteristics of daily social interactions, measured through EMA or daily diaries, with inflammation. For example, greater interpersonal strain in the domains of family, peers, and school, measured through daily diaries, predicted higher levels of CRP in a sample of adolescents (Fuligni et al., 2009), and negative and competitive interactions in daily life predicted elevated levels of sTNFαRII (type II receptor for pro-inflammatory cytokine TNFα) and elevated levels of IL-6, respectively (Chiang et al., 2012).

Social relationships may also be particularly important for the health and well-being of older adults, given that social roles and prioritization of close relationships (Carstensen et al., 1999) may change with age in parallel with increased risk for chronic inflammatory disease of aging. Psychological and biological processes linking social relationships to inflammation may differ by age and gender, qualitative features of social relationships may be particularly important within specific relationships, and the measurement of specific interactions within daily life may be an important consideration in capturing these effects. Therefore, in the two samples studied below, we test cross-sectional associations of both global measures of SS and SI and of EMA measures of social processes (measured by the relative frequency and quality of social interactions) with circulating markers of systemic inflammation, as measured by CRP and IL-6. EMA measurements were used to examine the nature of social interactions across different domains of social relationships, including those with spouses, close friends, and family. Findings from two separate samples are examined: (1) a sample of older adults from the Pittsburgh Healthy Heart Project (PHHP) and (2) a sample of middle-aged adults from the Adult Health and Behavior Phase II (AHAB-II) project. In both cases, it is hypothesized that lower IL-6 and CRP concentrations will associate with, i) greater SS and SI, assessed by global measures, ii) greater relative frequency of interactions across all observations, iii) greater relative frequency of overall positive interactions, especially with spouse, friends and family, and iv) lower relative frequency of negative interactions. By examining quantitative and qualitative aspects of social network characteristics and daily social interactions in the natural environment, across relationship domains, we hope to learn about the role of specific relationships and age-related effects that may account for inconsistent findings in this literature examining the association of social relationship characteristics with inflammation.

2. Method

2.1. Participants

Participants included 306 men and women enrolled in the Pittsburgh Healthy Heart Project (PHHP), a prospective study of healthy, community-dwelling adults aged 50–70 years, and 419 men and women enrolled in the Adult Health and Behavior Project – Phase 2 (AHAB-II), aged 30–54. For both samples, exclusionary criteria included: (a) history of schizophrenia, bipolar disorder,