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Big 5 personality traits and interleukin-6: Evidence for "healthy Neuroticism" in a US population sample

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ABSTRACT

The current study investigated if the Big 5 personality traits predicted interleukin-6 (IL-6) levels in a national sample over the course of 5 years. In addition, interactions among the Big 5 were tested to provide a more accurate understanding of how personality traits may influence an inflammatory biomarker. Data included 1054 participants in the Midlife Development in the U.S. (MIDUS) biomarkers subproject. The Big 5 personality traits were assessed in 2005–2006 as part of the main MIDUS survey. Medication use, comorbid conditions, smoking behavior, alcohol use, body mass index, and serum levels of IL-6 were assessed in 2005–2009 as part of the biomarkers subproject. Linear regression analyses examined personality associations with IL-6. A significant Conscientiousness*Neuroticism interaction revealed that those high in both Conscientiousness and Neuroticism had lower circulating IL-6 levels than people with all other configurations of Conscientiousness and Neuroticism. Adjustment for health behaviors diminished the magnitude of this association but did not eliminate it, suggesting that lower comorbid conditions and obesity may partly explain the lower inflammation of those high in both Conscientiousness and Neuroticism. Our findings suggest, consistent with prior speculation, that average to higher levels of Neuroticism can in some cases be associated with health benefits – in this case when it is accompanied by high Conscientiousness. Using personality to identify those at risk may lead to greater personalization in the prevention and remediation of chronic inflammation.

1. Introduction

1.1. Inflammation, personality, and health

The public health relevance of inflammatory markers is now well-established (Harris et al., 1999), but the psychosocial conditions associated with inflammation are not yet well understood. Early evidence suggested that personality traits are one such factor. Some of the earliest work focused on how relatively specific personality traits (i.e., dispositional depression, anxiety, hostility) had a positive association with interleuken-6 (IL-6) and C-reactive protein (CRP) in both clinically depressed and community based samples (Coccaro, 2006; Graham et al., 2006; Howren et al., 2009; Ladwig et al., 2003; Marsland et al., 2008).

More recent investigations specifically utilizing the Big 5 taxonomy of broad personality dimensions have extended these earlier findings. For example, in a Sardinian population sample, higher Neuroticism (composed of traits reflecting chronic negative affect such as depression, anxiety, and poor self-esteem) and lower Conscientiousness (composed of traits reflecting self-regulation and goal pursuit) predicted higher levels of both IL-6 and CRP (Sutin et al., 2010). Others have also noted that higher Conscientiousness predicted lower levels of IL-6 over 32 months in older community-dwelling persons (Chapman et al., 2011b), and that higher levels of self-directedness, a trait related to Conscientiousness, were also associated with lower levels of CRP (Henningsson et al., 2008). Other reported Big 5 correlates of higher levels of inflammation include low openness to experience for IL-6 longitudinally (Chapman et al., 2011b), CRP in African Americans cross-sectionally (Jonassaint et al., 2010), and lower levels of extraversion cross-sectionally (Chapman et al., 2009). The Type D personality style, reflecting high Neuroticism and low extraversion, has also been tied to tumor necrosis factor (TNF)-alpha (Dennollet et al., 2008, 2009) in heart disease patients. Importantly, the magnitude of personality–inflammation associations is non-trivial, with a two standard deviation difference in personality linked to odds ratios up to 1.40 (Sutin et al., 2010) for scoring above the high-risk IL-6 cut point of 3.19 pg/ml associated with a doubling of mortality risk (Harris et al., 1999).

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There are many reasons why personality may be associated with inflammation, but one pathway which we test in the current study involves health behaviors. According to the health behavior model of personality, levels of certain personality traits (particularly Conscientiousness and Neuroticism) are associated with either engagement in health promoting or health debilitating behaviors (Bogg and Roberts, 2004; Smith, 2006). In turn, behaviors such as smoking and excessive alcohol use are associated with higher levels of inflammation (Bermudez et al., 2002; Wannamethee et al., 2005). Many such behaviors also influence adiposity levels, which induces inflammation and engenders chronic diseases with inflammatory components, such as cardiovascular disease (CVD) (Dandona et al., 2004; Guzik et al., 2006; Yudkin et al., 2000). Prior investigations support the health behavior model, in that adjusting for BMI and other health behaviors does partially attenuate the personality-inflammation link (Chapman et al., 2011b; Howren et al., 2009; Sesso et al., 2007; Sutin et al., 2010).

1.2. Current study

We tested whether any of the Big 5 personality traits predicted IL-6 levels in a national sample of adults spanning the majority of the adult life span. Based on prior research, we hypothesized that higher levels of Neuroticism and lower levels of Conscientiousness would predict higher levels of circulating IL-6. Moreover, we were particularly interested in the interaction of Conscientiousness and Neuroticism. Although interactions are typically screened as a standard model specification procedure, there was also reason to explore them substantively in this case because recent work has noted several interactions involving Conscientiousness and/or Neuroticism in their relation to health outcomes (Chapman et al., 2010; Friedman et al., 2010; Turiano et al., 2012). Finally, to extend prior findings, medication use, chronic health conditions, health behaviors, and levels of adiposity were included as covariates to test whether they explained personality–inflammation associations. Although personality assessment preceded the measurement of these health factors by approximately 2 years, the chronic conditions, health behaviors, and adiposity were measured contemporaneously with IL-6. Lack of clear temporal sequencing therefore prevented definitive analysis of mediation. Thus, we examine only the general question of whether any health factors statistically explained personality–inflammation associations to some degree – this would be a necessary, but not sufficient condition for concluding that they are mediators.

2. Methods

2.1. Participants

The National Survey of Midlife Development in the U.S. (MIDUS) began in 1995–96 (MIDUS 1) as a national random digit dial sample of non-institutionalized, English-speaking adults living in the United States. A final sample of 7108 participants aged 25–74 completed telephone and mail surveys. A longitudinal follow-up of the original sample was conducted in 2004–06 (MIDUS 2). From MIDUS 1, 4963 (75% response rate adjusted for mortality) were successfully contacted to participate in another phone interview and self-administered questionnaire. A more complete discussion of selective attrition among the full MIDUS longitudinal sample is available elsewhere (Radler and Ryff, 2010).

Participants completing both MIDUS 1 and MIDUS 2 were invited to be part of the biomarker project by completing a detailed clinic-based assessment of health, disease-related biomarkers, and physiological function (see Love et al., 2010 for full study description). Eligible participants were recruited by letter and with a follow-up telephone call. The final sample with complete data relevant to the current study numbered 1054 participants. Data were collected between 2004 and 2009, with an average time of 2.80 years (SD = 1.33) between MIDUS 2 and completion of the biomarker subproject. Consenting participants were invited to stay overnight at one of three regional General Clinical Research Centers (GCRCs) at UCLA, Georgetown, or the University of Wisconsin. The study was approved by the institutional review board at each GCRC and informed written consent was obtained from all participants.

2.2. Study measures

2.2.1. Covariates

All models were adjusted for potential confounds: age, sex, race, and education. Age ranged from 34 to 84 (M = 54.61; SD = 11.67) and the sex distribution of participants was 56% female and 44% male. Educational attainment was assigned a number ranging from 1 (no school/some grade school) to 12 (graduate or professional degree), corresponding to educational milestones or degrees. Mean level of education was approximately some college to college graduate (M = 7.75; SD = 2.46). Approximately 93% of the sample was Caucasian.

2.2.2. Medication use

Since certain medication use can alter inflammation levels, all models were also adjusted for current use of antihypertensive, cholesterol-lowering, and steroid medication usage.

2.2.3. Comorbidity

Participants indicated if they were ever diagnosed with any of 18 chronic conditions in their lifetime: heart disease, high blood pressure, circulation problems, blood clots, heart murmur, stroke, anemia or other blood disorder, cholesterol problems, diabetes, asthma, emphysema, tuberculosis, thyroid disorder, peptic ulcer, cancer, colon polyps, arthritis, or liver disease. A count was created so that a higher score reflected greater level of comorbidity. Due to strong right skew, the number of chronic conditions was capped at 5 (M = 2.16; SD = 1.65).

2.2.4. Personality traits

The key predictor variables were assessed via the self-administered adjectival measures of the Big 5 assessed at MIDUS 2 (Zimprich et al., 2012). The scale was developed from a combination of existing personality trait lists and inventories (Lachman and Weaver, 1997). Respondents were asked how much each of 26 adjectives described themselves on a scale ranging from 1 (*not at all*) to 4 (*a lot*). The adjectives were: moody, worrying, nervous, calm (*Neuroticism*); outgoing, friendly, lively, active, talkative (*Extraversion*); creative, imaginative, intelligent, curious, broad-minded, sophisticated, adventurous (*Openness*); organized, responsible, hardworking, careless, thorough (*Conscientiousness*); helpful, warm, caring, softhearted, sympathetic (*Agreeableness*). The mean was calculated from the adjectives for each trait, after reverse scoring the appropriate items. This scale has good construct validity (Mroczek and Kolarz, 1998) and significantly correlates with the NEO trait scales (Prenda and Lachman, 2001). Reliability alphas are as follows: agreeableness = .80; Conscientiousness = .68; extraversion = .76; Neuroticism = .74; openness = .77.

2.2.5. Interleukin-6

Fasting blood samples were collected from each participant's non-dominant arm at approximately 7:00 am on the second day of their GCRC visit. Samples were frozen and stored in a −60 to −80 °C freezer until shipped on dry ice to the MIDUS Biocore Lab