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Elucidating the links between personality traits and diabetes mellitus: Examining the role of facets, assessment methods, and selected mediators

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ABSTRACT

The aim of this paper is three-fold. First, we identified self- and informant-rated Five-Factor Model (FFM) personality domains and facets associated with diabetes diagnosis. Second, we tested whether the associations were independent of the rater method-specific variance. Lastly, we examined whether the observed associations were mediated by BMI, alcohol intake, dietary habits, and exercise. The participants were members of the Estonian Biobank ($N = 3592$; 1145 men; $M_{age} = 46.6 \pm 7.0$ years). We fit a series of logistic regression models predicting diabetes diagnosis from one self- or informant-rated personality domain or facet at a time, controlling for age, sex, and education. Diabetes diagnosis was significantly associated with the N5: Impulsiveness, E4: Activity, and C2: Order facets. Method-independent variance, estimated by means of bi-factor models, was significantly related with diabetes for two of the facets, E4: Activity ($\beta = -0.106$, $p = .007$) and C2: Order ($\beta = -0.089$, $p = .037$), but not for N5: Impulsiveness. The strongest mediator of the personality–diabetes association was BMI, explaining 30–50% of the observed associations. We discuss implications of the current results.
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1. Introduction

Inconsistent associations between the Five-Factor Model (FFM) personality domains and diabetes have been reported in the literature. Cross-sectional studies have found that low conscientiousness and openness, and higher agreeableness and neuroticism are associated with diabetes diagnosis (Goodwin et al., 2006; Goodwin & Friedman, 2006). Although longitudinal findings have also suggested that lower conscientiousness may be linked with higher risk of developing diabetes (Cheng, Treglown, Montgomery, & Furnham, 2015; Jokela et al., 2014), they have implicated *lower* neuroticism as a correlate of the disease (Čukić & Weiss, 2014) and found no association for openness.

One possible explanation for this inconsistency is that the associations between personality and diabetes might be facet-specific, namely because different brief measures of personality domains used in previous studies may represent underlying personality traits or their specific facets to varying degrees. However, no study to date has considered this possibility despite the fact that facet-specific associations between personality traits and diabetes risk factors such as smoking and body mass index (BMI) have been observed (Terracciano & Costa, 2004; Vainik, Mõttus, Allik, Esko, & Realo, 2015), and that facet-specific associations should not be generalized to the FFM domains (Mõttus, 2015).

Similarly, personality–diabetes associations may depend on assessment methods. For example, self- and observer rated personality traits may have different links with health outcomes (Jackson, Connolly, Garrison, Leveille, & Connolly, 2015), as method-specific biases such as socially desirable responding may drive the observed associations. Although socially desirable responding might reflect substantive variance (McCrae & Costa, 1983), it would not be correct to interpret its associations with health outcomes as pertaining to the FFM traits (McCrae, 2014).[1] All previous studies of the personality-diabetes associations have been conducted using the self-report method. Multi-method studies could help to disentangle the method-specific and trait-relevant associations between personality traits and diabetes.

Lastly, mechanisms of associations between personality and diabetes, currently poorly understood, may involve health behaviours such as unhealthy diet and physical inactivity that are associated with both diabetes (International Diabetes Federation, 2012), and personality traits. Particularly, lower neuroticism and higher extraversion, openness and conscientiousness have all been associated with healthier dietary choices (Mõttus, Realo, Allik, Deary, et al., 2012a, b; Mõttus, McNeill,

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[1] Different traits might reflect socially desirable responding or other biases to a different degree and thereby have distinct associations with outcomes even with the associations being completely driven by method-specific variance.

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Jia, Craig, Starr, & Deary, 2013). Similarly, a meta-analysis of thirty two studies showed associations between higher levels of physical activity and higher extraversion and conscientiousness and lower neuroticism (Rhodes & Smith, 2006). Likewise, higher neuroticism has been associated with diabetes precursors such as metabolic syndrome (Phillips, Batty, Weiss, Deary, Gale, &Thomas, 2010) and heightened BMI (Vainik et al., 2015). Finally, agreeableness and conscientiousness may moderate the expression of diabetes genetic risk, possibly via their associations with behavioural and metabolic risk factors (Čukić, Mõttus, Luciano, Starr, Weiss, & Deary, 2015). However, direct tests of these potential mediating pathways are still lacking.

Using a large national sample of Estonians, the present study expands previous literature in three novel ways. First, it employed both self- and informant-ratings of personality to assess whether the associations with diabetes are method-specific. Second, it explored whether the associations between personality and diabetes are driven by specific personality facets rather than domains. Finally, it tested whether any of these associations is mediated by dietary and drinking habits, physical activity, and BMI.

2. Method

2.1. Sample

The sample was derived from the Estonian Biobank (EB) cohort (approximately 52,000 individuals), a volunteer-based sample of the Estonian resident adult population (Leitsalu et al., 2014). The EB participants were recruited randomly by general practitioners (GPs), physicians, or other medical personnel in private practices and hospitals or in the recruitment offices of the Estonian Genome Center (EGC). Participants signed an informed consent form (available at www.biobank.ee), underwent a standardized health examination, and completed a Computer Assisted Personal Interview (CAPI) on health-related topics such as lifestyle, diet and clinical diagnoses described in WHO ICD-10 (Leitsalu, et al., 2014). The subsample of the cohort used in this study ($N = 3592$; age range: 18–91 years; mean age 43.2 ± 16.3 years; 59.3% females) also completed a self-report personality questionnaire, and asked an informant to rate them using the same instrument. The informants included participants' spouses or partners (47.07%), friends (15.56%), parents (17%), (grand)children (7.36%), siblings (6.34%), other relatives (3.5%) and acquaintances (3.17%). Data collection took place between 2008 and 2014 (see also Allik, Borkenau, Hrebickova, Kuppens, & Realo, 2015; Mõttus, Allik, Hřebíčková, Kööts-Ausmees, & Realo, 2015; Realo, Teras, Kööts-Ausmees, Esko, Metspalu, & Allik, 2015 for the sample description).

2.2. Measures

2.2.1. Personality

Personality traits were assessed using the Estonian translation of the NEO Personality Inventory—3 (NEO PI-3), (De Fruyt, De Bolle, McCrae, Terracciano, & Costa, 2009; McCrae & Costa, 2010). The NEO PI-3 consists of 240 items that tap 30 facets of the five FFM domains. The responses are given on a 5-point Likert scale ranging from *completely disagree* to *completely agree*. Participants completed the self-report form and informants the observer-report form of the NEO PI-3.

2.2.2. Diabetes

Diabetes diagnoses were initially self-reported during the CAPI but the information was combined with objective medical records to increase the reliability of the diagnoses. The International Classification of Diseases (ICD-10) codes E10, E11, E12, E13 and E14 indicated presence of diabetes.

2.2.3. Covariates

Age was treated as a continuous variable. Sex was coded as 0 for males and 1 for females. Highest educational attainment was coded as: elementary (7.7%), secondary (24.0%), secondary vocational (28.3%), and higher education (40.1%).

2.2.4. Mediators

2.2.4.1. Alcohol. Alcohol consumption frequency was assessed using the question "How often do you usually consume alcoholic drinks? — 4 or more times per week (4.4%), 2–3 times per week (14.0%), 2–4 times per month (27.7%), once a month (14.6%), a few times per year (16.1%), less than once a year (3.7%)". The data was not available for 701 (19.5%) participants.

2.2.4.2. Physical activity. Physical activity was assessed using the question "How many hours per week do you on average spend on the following activities outside working hours? — Physical Exercise". The responses quantified the hours that participants engaged in physical exercise in a typical week ($M = 1.09 \pm 1.3$ h).

2.2.4.3. BMI. Height and weight were recorded by the GPs or physicians during the standardized health examination. BMI was calculated using the standard formula: weight (kg) / height^2 (m^2). BMI was log-transformed and used as a continuous variable.

2.2.4.4. Dietary habits. Participants were asked to report the frequency of consumption of 16 food and drink items in the previous week or in a typical week in case the previous week was atypical regarding eating behaviour. The answers were given on a 4-point scale: "never", "1–2 days", "3–5 days" and "6–7 days". The items were residualised for age, sex and education, and subjected to principal components analysis (PCA), followed by oblimin rotation. Similarly to Mõttus, Realo, Allik, Esko and Metspalu (2012), two components were extracted accounting for 25% of the variance. Three items were removed from the analyses due to low loadings (<0.2) on either of the factors ("rice/pasta"), or loading equally on both factors (0.26 and 0.27 — "eggs"; 0.39 and 0.31 — "compote/jam"). The final two-component solution contained 13 items and explained 28% of the variance. Consistently with Mõttus, Realo, Allik, Esko and Metspalu (2012), the two components were interpreted as health aware diet and traditional diet (See Table S1 for the full list of factor loadings). Individual scores on the two components were used in subsequent analyses.

3. Results

One hundred and one participants (4.5%) had a diabetes diagnosis, which is somewhat lower than the national prevalence estimate of 7.5% (Aguirre et al., 2013). Participants with diabetes were significantly older, had a higher BMI, engaged in more physical activity, and reported drinking more alcohol than those without the condition. The full list of descriptive statistics is presented in Table S2 of Supplementary material.

To investigate the associations of personality domains and facets with diabetes diagnosis, we fitted a series of logistic regression models, for one self- or informant-rated domain or facet at a time (cf. Mõttus, Realo, Allik, Esko, & Metspalu, 2012), controlling for age, sex and education (Table 1). Scores of two self-reported personality domains (neuroticism and openness), and four self-reported facets (N5: Impulsiveness, E4: Activity, O6: Values, and C2: Order) were significantly associated with diabetes diagnosis ($ps < .05$). In informant-ratings, none of the personality domains but facets predicted diabetes diagnosis: N5: Impulsiveness, E2: Gregariousness, E4: Activity, and C2: Order. Therefore, the N5: Impulsiveness, E4: Activity and C2: Order facets were significant predictors of diabetes diagnosis in both methods of assessment, with fairly similar effect sizes.

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