

BOOK CHAPTER

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Personality and type 2 diabetes

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Abstract

The relationship between personality and physical disease has long been studied. Recent advances in this research include the use of individual-participant-data meta-analyses of longitudinal cohort studies, an approach that is more protected from random error than single studies. Prioritising results from such large-scale pooled datasets, we review the evidence on personality, as defined by the big five traits, and the risk and progression of type 2 diabetes. The big five personality traits, including Openness to experience, Conscientiousness, Extraversion, Agreeableness, and Neuroticism, comprise the most commonly used conceptualisation of personality in psychology. Of these traits, conscientiousness has been consistently associated with type 2 diabetes. Individuals high on conscientiousness are described as dutiful, task-oriented, orderly, and self-disciplined. The results suggest that they are less likely to develop diabetes and also have lower rates of death from this condition compared to those with low levels of conscientiousness. One mediating factor seems to be weight management as indicated by a lower risk of obesity in healthy-weight individuals with high conscientiousness and a higher likelihood of returning to non-obese among those initially obese. The personality-diabetes association is not unidirectional. The onset of chronic conditions, such as diabetes, hypertension, heart disease, stroke, arthritis, respiratory and cancer, is associated with subsequent changes in personality traits. These include decreases in conscientiousness, emotional stability (low neuroticism), extraversion, and openness to experience. Further research is needed to evaluate better understanding of the personality-diabetes association could contribute to individualised prevention and treatment strategies for people with high risk of diabetes or pre-existing type 2 diabetes.

[253 words]

Introduction

Type 2 diabetes is an important cause of disability and death worldwide. It is a timely public health challenge as the number of people with this condition is rapidly increasing due to population ageing and the global rise in sedentary lifestyles and obesity. The Global Burden of Diseases study, the largest epidemiological study on disease trends in the world, estimated that more than 1.5 million people died from diabetes in 2015, over 30% more than 10 years earlier in 2005 (Mortality & Causes of Death, 2016). Much research is therefore focussed on issues to strengthen prevention and treatment of diabetes.

Type 2 diabetes is a progressive condition characterised by chronic hyperglycaemia due to relative insulin deficiency caused by pancreatic β -cell dysfunction and insulin resistance in target organs (Chatterjee, Khunti, & Davies, 2017). Persons with diabetes are at increased risk of cardiovascular disease and dementia, but organs other than the heart and the brain are also affected by the condition. Common microvascular complications include, for example, retinopathy (eye disease), nephropathy (kidney disease) and neuropathy, a nerve damage typically in the long sensory nerves in the feet and the autonomic nervous system (Chatterjee et al., 2017).

In current clinical guidelines, lifestyle factors, such as physical inactivity, unhealthy diet and obesity are acknowledged as key targets of diabetes prevention (UK NICE:

<https://www.nice.org.uk/guidance/ph38>; American Diabetes Association:

<http://www.ndei.org/ADA-diabetes-management-guidelines-strategies-for->

[preventing-or-delaying-type-2-diabetes.aspx.html](#))(American Diabetes Association, 2015). In addition, socioeconomic adversity, high cholesterol and blood pressure levels, smoking, and high alcohol consumption are associated with elevated diabetes risk (Chatterjee et al., 2017). On-going research seeks at identifying additional disease drivers. Given that many of the diabetes risk factors tend to cluster together, it may be important to consider also potential upstream determinants that contribute to the overall adoption of an unhealthy lifestyle predisposing to the development of diabetes. In this framework, personality – that is, individual differences in characteristic patterns of thinking, feeling and behaving – has become an attractive focus for diabetes research.

The purpose of this chapter is to review recent findings on the role of personality in the development and progression of type 2 diabetes (**Box**). In addition, we describe research that has sought to determine the extent to which having type 2 diabetes may alter personality. We concentrate on the Five Factor Model of personality (Costa & McCrae, 1992), because it is a leading taxonomy of personality and much of research on non-communicable diseases, such as diabetes, is based on that model (John, Naumann, & Soto, 2008). In reviewing empirical evidence, we prioritise findings from meta-analyses as they are based on large number of participants increasing data power and precision. Meta-analyses are also better protected from random error than single studies with smaller sample.

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The Big Five Personality Traits

The Five Factor Model, also known as the Big Five Personality Traits, is the most commonly used conceptualisation of personality in academic psychology and psychosocial epidemiology (Costa & McCrae, 1992). The model was developed using factor analysis, a statistical technique that allows identification of independent dimensions from a large pool of responses to survey items on diabetes. Thus, the model was based on associations between words and descriptions rather than any neuropsychological experiments or neurobiological and neuropharmacological data. Big five personality traits are Openness to experience, Conscientiousness, Extraversion, Agreeableness, and Neuroticism. Each of these five factors includes a number of correlated and more specific components (e.g., qualities related to extraversion include gregariousness, assertiveness, excitement seeking, warmth, activity, and positive emotions). In the following section, each of the big five traits are described in a greater detail.

“Openness to experience” dimension ranges from consistent/cautious to inventive/curious. The trait reflects the degree of intellectual curiosity, creativity and a preference for novelty and variety a person has. Sample questionnaire items of Openness to experience include “I am full of ideas”, “I am not interested in abstractions. (reversed scored)” and “I have a good imagination” (Costa & McCrae, 1992).

“Conscientiousness” dimension (efficient/organized vs. easy-going/careless) refers a tendency to be organized and dependable, to show self-discipline, to aim for achievement, and to prefer planned rather than spontaneous behaviour. It can be assessed with items, such as: “I pay attention to details”, “I am always prepared”, and “I follow a schedule” (Costa & McCrae, 1992).

“Extraversion” dimension varying from solitary/reserved (low end) to outgoing/energetic (high end) denotes to energy, positive emotions, assertiveness, sociability and the tendency to seek stimulation in the company of others. Sample items on extraversion include “I don't mind being the center of attention”, “I feel comfortable around people”, and “I think a lot before I speak or act. (reversed)” (Costa & McCrae, 1992).

“Agreeableness” dimension (from challenging/detached to friendly/compassionate) refers to a tendency to be compassionate, trusting, well-tempered and cooperative rather than suspicious and antagonistic towards others. It is measured using items such as “I sympathize with others' feelings”, “I take time out for others”, and “I insult people. (reversed)” (Costa & McCrae, 1992).

Finally, “Neuroticism”, the low end of the dimension referring to secure/confident and the high end to sensitive/nervous, is a tendency to experience unpleasant emotions easily, such as anger, anxiety, depression, and vulnerability, and low emotional stability. Sample items for this personality trait include, for example, “I get irritated easily”, “I get upset easily”, and “I am much more anxious than most people” (Costa & McCrae, 1992).

Of the five personality traits, low conscientiousness and high neuroticism have been associated with various physical illnesses (Deary, Weiss, & Batty, 2010; Smith & MacKenzie, 2006) and mortality risk (Deary et al., 2010; Jokela, Batty, et al., 2013). Other personality traits, such as agreeableness, have also been associated with morbidity (Sutin et al., 2010), although the findings are less consistent (Deary et al., 2010; Smith & MacKenzie, 2006; Sutin et al., 2010).

Mechanisms linking personality to increased risk of developing diabetes

Personality could contribute to the development and progression of diabetes through multiple mechanisms including effects on lifestyle and health-related behaviours, stress response, and self-care. Prognosis of diabetes is strongly dependent on the ability to maintain adequate medication use, symptom management, and regular blood glucose monitoring. Personality may play a role in the ability to cope with the burden of treatment and complications and living with the disease.

Of the lifestyle factors, obesity is probably the most important contributor to type 2 diabetes risk (Knowler et al., 2009). Early studies on personality differences between obese and non-obese individuals found no consistent differences (Fabricatore & Wadden, 2004; Friedman & Brownell, 1995), but these investigations had considerable methodological limitations, including small sample sizes and non-standardized personality measures. Subsequent studies with stronger study designs have reported obesity to be associated with various personality traits (Brummett et al., 2006; Chapman, Fiscella, Duberstein, Kawachi, & Coletta, 2009; Faith, Flint,

Fairburn, Goodwin, & Allison, 2001; Kakizaki et al., 2008; Sutin et al., 2010; Terracciano et al., 2009), although many of these findings have not been replicated across studies (Brummett et al., 2006) (Chapman et al., 2009), and different studies have also reported conflicting findings for the same personality traits, including extraversion and agreeableness (Brummett et al., 2006; Chapman et al., 2009; Kakizaki et al., 2008). Recent individual-participant meta-analyses of up to 79,000 adults have produced more robust evidence (Jokela, Hintsanen, et al., 2013). These findings show a cross-sectional association between high conscientiousness and lower obesity risk across multiple studies (pooled odds ratio = 0.84; 95% CI = 0.80–0.88 per 1 standard deviation increment in conscientiousness). Furthermore, over a mean follow-up of 5.4 years, higher conscientiousness predicted a lower obesity risk in initially non-obese individuals (odds ratio = 0.88, 95% CI = 0.85–0.92) (**Figure 1**). Among initially obese individuals it was associated with a greater likelihood of reversion to non-obese (odds ratio 1.08, 95% CI = 1.01–1.14) (Jokela, Hintsanen, et al., 2013). Other big five personality traits were not consistently related to obesity in cross-sectional or longitudinal analyses.

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In addition to lifestyle, stress is a plausible mechanism linking personality and risk of diabetes because some personality traits, such as neuroticism, are related to an increased likelihood of experiencing stress or distress. There is accumulating evidence to suggest that stress might increase the risk of diabetes. For example, findings from

the British Household Panel Survey of 9000 adults showed that compared to participants reporting a low level of psychological distress, those with a higher level of distress were at a 30% increased risk of developing type 2 diabetes during the 1.5-year follow-up (Mommersteeg, Herr, Zijlstra, Schneider, & Pouwer, 2012). Similarly, a meta-analysis of 5 studies reported a 1.5-fold higher prevalence of diabetes in individuals with posttraumatic stress disorder (PTSD) compared to non-PTSD controls (Vancampfort et al., 2016). Findings from the US Nurses' Health Study confirmed a dose-response association: the greater symptoms of PTSD the person had, the greater the odds of diabetes were (Roberts et al., 2015). Conversely, analysis of prospective data from a national cohort study of 1.5 million male military conscripts in Sweden showed that participants with high stress resilience had a lower risk of diabetes than those not so successful in coping with stress (Crump, Sundquist, Winkleby, & Sundquist, 2016).

In the Whitehall II study of British civil servants the role of distress was examined in relation to aetiological stage. The association between psychological distress and incident type 2 diabetes was dependent on the glycaemic status of the person (Virtanen et al., 2014). Among participants with normal glucose metabolism, distress did not predict incident type 2 diabetes. However, among participants with a high diabetes risk score, more than 40% of those with high distress developed diabetes during the follow-up, compared with 29% of those without distress, a 2-fold difference in relative risk (Virtanen et al., 2014). These findings suggest that people with normal glucose metabolism may be resilient to the effects of psychological distress on diabetes risk, but this is unlikely to be the case for those who already have developed prediabetes.

Finally, a further plausible mechanism linking personality and diabetes is self-care. For example, people with high conscientiousness, by definition, have high self-control, orderliness and adherence to social norms, and conscientiousness has been associated with better adherence to medication (Molloy, O'Carroll, & Ferguson, 2014). This would imply that individuals with high conscientiousness are likely to have a better prognosis compared to their counterparts with low conscientiousness. In a sample of 1474 diabetics in the Health and Retirement Study (Phillips & Guarnaccia, 2015), better self-perceived diabetic control was associated with higher conscientiousness, extraversion, openness, and emotional stability. However, none of the personality traits of the Five Factor Model were associated with diabetic control as measured by levels of glycated haemoglobin (HbA1c). Further studies on personality and the progression of diabetes are needed.

Meta-analyses on personality and incidence diabetes

In the largest individual-participant meta-analysis on personality and diabetes to date, the sample consisted of over 34,000 adults free of diabetes at baseline from 5 prospective cohort studies (Jokela, Elovainio, et al., 2014) (**Figure 2**). Low conscientiousness was robustly associated with an increased risk of incident diabetes at follow-up. The finding was based on a mean follow-up of 6 years and showed a 1.15-fold (95% confidence interval 1.10 to 1.22) increase in the risk of diabetes per 1 standard deviation reduction in conscientiousness. In addition, low conscientiousness also predicted diabetes-related mortality, the odds ratio per 1 standard deviation lower conscientiousness being 1.39 (95% confidence interval 1.02 to 1.89). These

associations were consistently observed across all 5 cohort studies. In contrast, the other four personality dimensions of the Big Five personality traits were not consistently associated with incident diabetes or diabetes-related mortality (Jokela, Elovainio, et al., 2014).

INSERT FIG 2 ABOUT HERE

The above findings are plausible. People with low conscientiousness tend to be careless, unreliable, and disorganised whereas those with high conscientiousness can be described as dutiful, task-oriented, orderly, and self-disciplined. Studies have shown that several health behaviours contribute to the risk of diabetes, and many of these risk factors are associated with conscientiousness (Bogg & Roberts, 2004). In particular, low conscientiousness is associated with a high risk of obesity (Jokela, Hintsanen, et al., 2013) and a comparison of minimally and maximally adjusted analyses suggested that obesity and physical inactivity partially mediated the association between conscientiousness and incident diabetes (Jokela, Elovainio, et al., 2014). The association between conscientiousness and diabetes incidence was attenuated by 60% when adjusted for obesity and by 25% when adjusted for physical activity. In contrast, the role of obesity and physical activity in the association with diabetes-related mortality was more modest (Jokela, Elovainio, et al., 2014). This finding is consistent with the notion that obesity plays a major role in the aetiology of diabetes whereas after the onset of diabetes, self-care plays a crucial role, including adherence to medication therapy, symptom management and regular blood glucose

monitoring in addition to lifestyle changes, such as a healthy, reduced calorie intake and increase physical activity (Kokkinos et al., 2012). Individuals with high conscientiousness may be more likely to implement adequate self-care than those with low conscientiousness (Molloy et al., 2014; Phillips & Guarnaccia, 2015), but we are not aware of large-scale studies that would have tested this hypothesis with diabetes progression.

The finding that other personality traits were not consistently associated with diabetes risk (Jokela, Elovainio, et al., 2014) is also noteworthy as it suggests that when higher-order personality dimensions are considered together, conscientiousness is the only trait independently associated with the risk of developing diabetes.

Evidence linking type 2 diabetes to changes in personality

The effect of personality on disease risk has been a topic of much research. In contrast, comparatively little research has examined the hypothesis that disease may induce personality changes. Indeed, a bidirectional association between personality and disease is appealing.

One of the few studies on this topic is a pooled analysis of four prospective cohort studies from the United States and the United Kingdom (Jokela, Hakulinen, Singh-Manoux, & Kivimaki, 2014). The authors examined whether the onset of diabetes, hypertension, heart disease, stroke, arthritis, respiratory and cancer is associated with subsequent changes in big five personality traits. At follow-up, decreases in conscientiousness, emotional stability (neuroticism), extraversion, and openness to

experience but not in agreeableness were observed. Co-morbid conditions were associated with larger changes in personality than single diseases, suggesting a dose-response association between chronic physical disease and personality change (Jokela, Hakulinen, et al., 2014) (**Figure 3**).

INSERT FIG 3 ABOUT HERE

Of the four personality traits, conscientiousness was the trait that was most affected by deteriorating health (Jokela, Hakulinen, et al., 2014). It is possible that one of the emotional and cognitive costs of chronic physical diseases is a decrease in the ability to organise daily activities and fulfil responsibilities in relation to work, family, and personal life, as expressed by decreasing levels of conscientiousness. It is probably not surprising that the greatest changes in conscientiousness were observed after stroke (Jokela, Hakulinen, et al., 2014), which is a brain disease affecting central nervous system. Stroke and other cardiovascular conditions are also known complications of diabetes.

Conclusions and practical implications

In this narrative review, we have described evidence on the association between personality and diabetes. Individuals with high conscientiousness seem to be at a reduced risk of developing diabetes and dying from diabetes, indicating that this personality trait may affect both the aetiology and prognosis of type 2 diabetes. One

of the mechanisms underlying the protective effect of high conscientiousness was ability to maintain a healthy weight. Studies on later disease stages revealed that the association between conscientiousness and chronic disease is likely to be bidirectional: having multiple chronic conditions, including diabetes, was related to reductions in conscientiousness over time.

In general, the contribution of personality to diabetes risk and prognosis seemed relatively modest compared to conventional diabetes risk factors, such as obesity and physical inactivity. The hazard ratios for the associations of conscientiousness and diabetes did not generally exceed 1.2 while the hazard ratio for a body mass index $>35 \text{ kg/m}^2$ compared to one between 18.5 and 25 kg/m^2 can be greater than 10 (Kivimaki et al., 2017). In light of the small effect size and the overall difficulty to modify psychological features, personality is unlikely to be considered as an important risk factor in universal diabetes prevention strategies. However, in relation to targeted strategies, personality might play a role in the future. Better understanding of the role of personality in diabetes aetiology and progression could help in developing more personalised prevention and treatment strategies for people with high risk of diabetes and those who already have type 2 diabetes.

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DISPLAY ITEMS:

BOX: Key Points:

- Recent advantages in research on personality and physical disease include the use of individual-participant-data meta-analyses of longitudinal cohort studies, an approach that is more protected from random error than single studies.
- The big five personality traits, including Openness to experience, Conscientiousness, Extraversion, Agreeableness, and Neuroticism, have been studied in relation to the development and progression of type 2 diabetes in large-scale pooled datasets.
- Individuals with high conscientiousness, described as dutiful, task-oriented, orderly, and self-disciplined, have a lower risk of developing diabetes or dying from this condition compared to those with low levels of conscientiousness.
- Plausible mediators underlying this association include the lower risk of obesity in healthy-weight individuals with high conscientiousness and a higher likelihood of returning to non-obese among those initially obese.
- The personality-diabetes association is bi-directional as the onset of chronic conditions, including diabetes, is associated with subsequent changes in personality traits. These include decreases in conscientiousness, emotional stability (neuroticism), extraversion, and openness to experience.

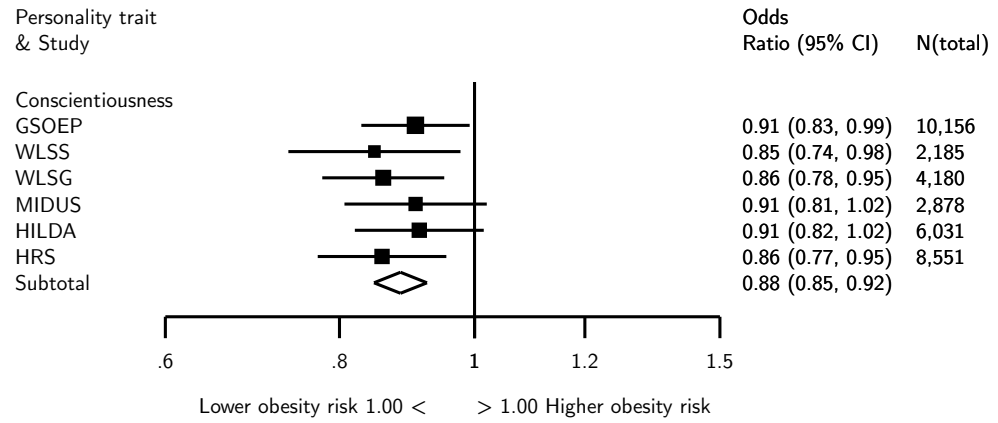


FIGURE 1. Longitudinal associations between baseline conscientiousness and subsequent obesity risk in an individual-participant-data meta-analysis of 6 cohort studies (modified from Jokela, Hintsanen et al. 2012)

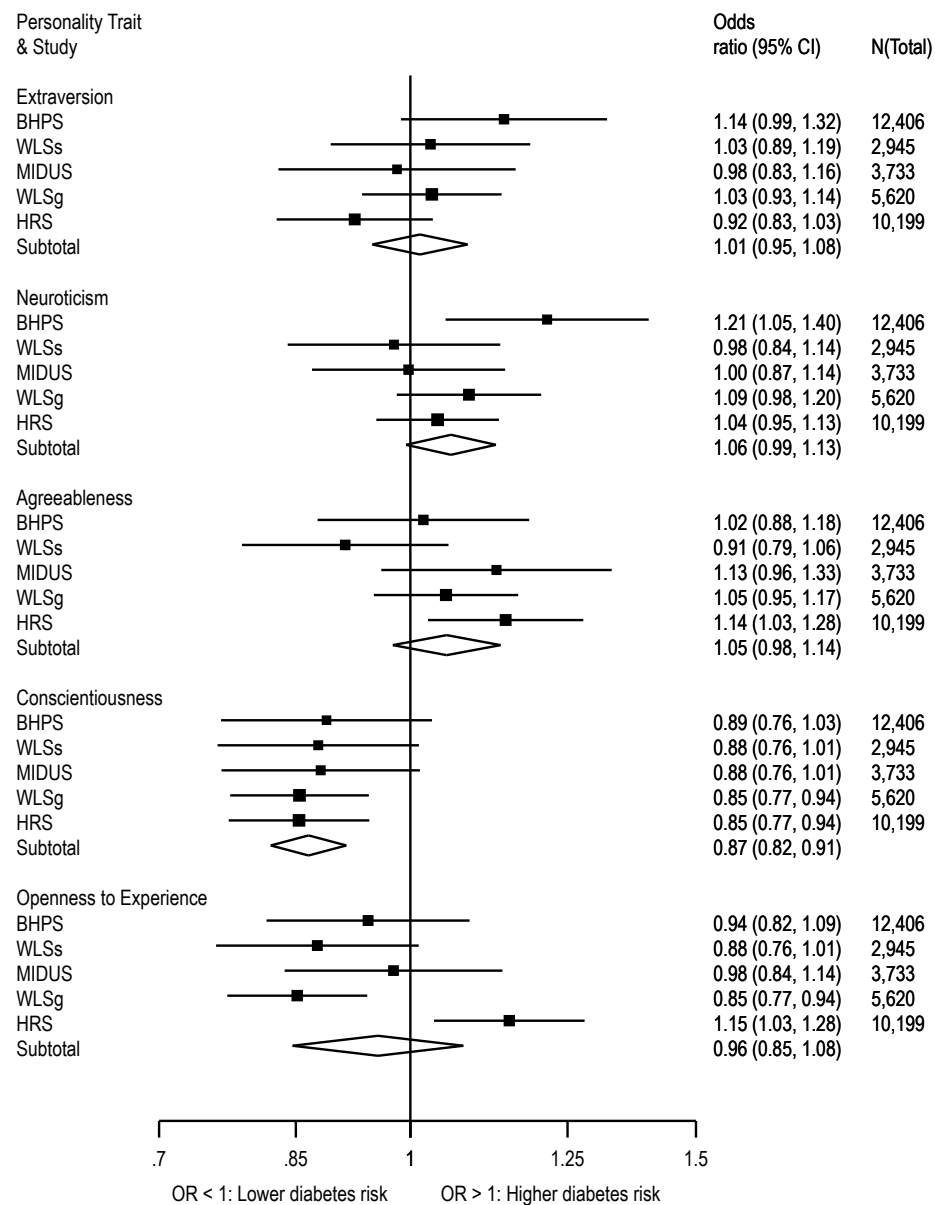


FIGURE 2. Associations between personality traits and risk of incident diabetes during follow-up among participants without diabetes at baseline (n = 34,913, from modified Jokela, Elovainio et al. 2013). Personality traits are mutually adjusted, and the associations are further adjusted for gender, age at baseline, race/ethnicity, and individual follow-up time in months.

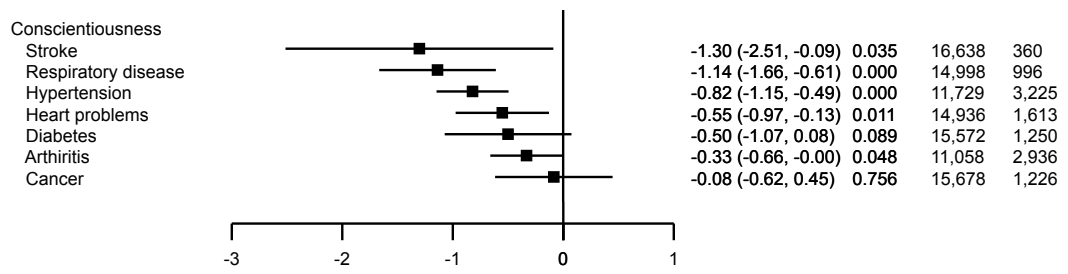


FIGURE 3. Baseline personality predicting change in conscientiousness between baseline and follow-up wave (modified from Jokela, Hakulinen et al. 2014).