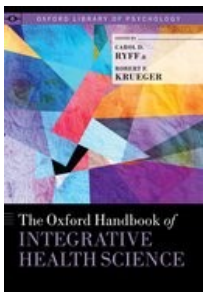

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CHAPTER

23 Personality as a Determinant of Health Behaviors and Chronic Diseases: Review of Meta-Analytic Evidence

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Abstract

This chapter reviews the meta-analytic evidence on how personality traits of the Five-Factor Model (extraversion, neuroticism, agreeableness, conscientiousness, and openness to experience) are associated with health behaviors (e.g., smoking, physical activity); chronic physical diseases (e.g., Type 2 diabetes, coronary heart disease); and all-cause mortality. A systematic literature identified 22 meta-analyses investigating the topic. The evidence suggests multiple associations between personality traits and health behaviors. By contrast, only conscientiousness was systematically associated with chronic diseases and mortality across multiple studies and disease end points, including all-cause mortality. While associations between personality and health outcomes are well established, the pathways connecting them remain largely unknown. Future studies need to focus on study designs that can better address the developmental patterns, mediating pathways, and causality in explaining why personality traits are associated with health.

Keywords: personality traits, Five-Factor Model, extraversion, neuroticism, agreeableness, conscientiousness, health behaviors, all-cause mortality, chronic diseases, health outcomes

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Introduction

This chapter reviews the accumulated evidence on the associations of personality traits with health behaviors, chronic diseases, and mortality risk. After first outlining the conceptual background for personality as a risk factor for health, a systematic literature review is provided of all the available meta-analyses addressing personality, health behaviors, and physical health. I then discuss the empirical findings of these meta-analyses in light of potential pathways that connect personality to health outcomes and consider some methodological strengths and limitations of the available studies. Finally, priorities for future research are detailed. The overall focus of this chapter is on associations of personality with physical diseases and their risk factors, including findings that have culminated in a published meta-analysis. Mental health outcomes and more specific personality associations investigated only in individual studies are not systematically covered.

Background Literature

Chronic diseases account for the majority of deaths and disability worldwide (Lozano et al., 2012). Ischemic heart disease, stroke, respiratory diseases, diabetes, and hypertensive heart disease are among the top 10 leading causes of death. Other chronic diseases (e.g., cancers and dementia) further contribute to mortality and morbidity particularly in high-income countries, while communicable diseases (e.g., malaria and HIV/AIDS) remain major determinants of early mortality in low-income countries (Lozano et al., 2012).

p. 318 Most chronic conditions take several years to develop into diagnosable diseases (Lynch & Smith, 2005). The clinical disease onset is preceded by adverse changes in various physiological measures. For example, the risks of coronary heart disease (CHD) and stroke increase with increasing levels of blood pressure; Type 2 diabetes develops with increasing insulin resistance; and chronic obstructive pulmonary disease progresses with declining lung capacity. The adverse physiological changes, in turn, are influenced by people's health behaviors. Smoking, alcohol consumption, and lack of physical activity are some of the crucial health behaviors that predispose to development of many illnesses and early mortality (Loef & Walach, 2012). The broader social environment, including environmental hazards, stressful life events, and access to medical treatment, also contribute to the course of chronic diseases (Cable, 2014).

Personality represents individual differences in ways of behaving, feeling, and thinking (Denissen & Penke, 2008). Some individuals are social, others are timid; some worry about unlikely but dangerous events, others live by the moment; some are organized, others disorganized; and so on. Personality is also important in determining how individuals respond differently to environmental circumstances (Denissen & Penke, 2008; Denissen, van Aken, Penke, & Wood, 2013). Some individuals become anxious and strained when they encounter difficulties, while others remain calmer; some are able to derive happiness from positive experiences, while others fail to see the good sides in life; and so on. Individual differences in emotional and behavioral dispositions can be reliably measured already in early childhood (Eisenberg, Duckworth, Spinrad, & Valiente, 2014). These childhood dispositions later develop into adolescent and adult personality, with more cognitive components added on with increasing maturity (Denissen et al., 2013).

Personality traits have been shown to predict a broad range of important life outcomes, such as probability of having children (Jokela, 2012); occupational success (Roberts, Kuncel, Shiner, Caspi, & Goldberg, 2007); earnings (Graham, Mroczek, & Elleman, 2015); residential mobility (Jokela, 2009); and risk of divorce (Roberts et al., 2007); among other outcomes (Ozer & Benet-Martínez, 2006). The magnitude of these associations often parallels that of other important characteristics influencing people's life chances, such as socioeconomic status and intelligence (Roberts et al., 2007). The breadth of life outcomes predicted by personality traits underlines the relevance of personality to social behavior (Ozer & Benet-Martínez, 2006).

For health, personality can be viewed as an upstream risk factor in the chains of causation that lead to the development of chronic diseases. First, personality begins to develop already in childhood (Eisenberg et al., 2014), so the development of personality precedes the development of most diseases and health behaviors (Shanahan, Hill, Roberts, Eccles, & Friedman, 2014). Second, personality differences are expressed in multiple domains of behavior, emotion, and cognition. This provides personality traits many pathways to influence health and adoption of health behaviors (Murray & Booth, 2015). Third, personality may act as a modifier of other health risk factors (Smith, 2006). For example, in the MIDUS biomarker project (Elliot, Turiano, & Chapman, 2016), socioeconomic status was more strongly related to levels of inflammatory markers (i.e., interleukin 6 [IL-6] and C-reactive protein) among participants with lower conscientiousness and higher neuroticism. This study illustrates how personality traits can be used to identify individuals who are particularly vulnerable to, or resilient against, health risks.

The links between personality and health are studied primarily by personality psychologists, but the relevance of these links goes beyond the discipline of personality psychology. Understanding the personality dynamics of health and health-related behaviors helps us better understand the psychological nature of health (Jokela & Keltikangas-Järvinen, 2011). For example, a finding that smoking is most common among individuals who are curious and sociable would give a very different view on the psychological and social nature of smoking behavior compared to a finding suggesting that smoking is most common among individuals who are emotionally unstable and disagreeable. Thus, studies of personality and health not only can identify important psychological risk factors for poor health but also can provide a better understanding of the psychology of health more generally.

From Early Specific Constructs to General Models of Personality

Many early theories of personality and health were based on the assumption that the emotional components
p. 319 of personality are crucial in exposing people to illnesses (Smith & MacKenzie, ↳ 2006). Health psychologists devised many specific personality measures to assess the hypothesized psychological characteristics. For example, the impatience, irritability, and competitiveness associated with *Type A behavior* was assumed to increase the risk of cardiovascular disease, possibly by increasing blood pressure and other physiological risk factors. Similarly, the negative emotions and stress-proneness related to *pessimism* were assumed to predispose people to illnesses via a chronic activation of the stress response system. Other theories emphasized the role of people's beliefs and health-related attributions. For example, the personality trait *locus of control* was suggested to represent how people attribute achievements and setbacks to their own behaviors in contrast to uncontrollable external events (Cheng, Cheung, & Lo, 2016). A more internal, self-directed locus of control was suggested to promote health.

In more recent studies of personality and health, there has been a shift away from a narrow research focus on specific personality traits, such as Type A behavior, that were developed for a particular health-related hypothesis. Most studies on personality and health today tend to use more comprehensive measures of personality that cast a wide net on personality variation without committing to specific hypotheses beforehand. Other studies focus on specific personality traits, such as conscientiousness, that are derived from the general models of personality (Roberts, Lejuez, Krueger, Richards, & Hill, 2014). This has opened a broader perspective on how different personality domains may be important for different health outcomes, as the narrow focus on specific traits may leave important domains of personality unexplored.

The Five-Factor Model is one of the most widely used models of personality structure (Costa & McCrae, 1992; Denissen & Penke, 2008). The model identifies five main dimensions that constitute the core organizing domains of personality structure. People can differ from each other on all of these dimensions. *Extraversion* is related to sociability, positive emotionality, and assertiveness. *Neuroticism* is expressed as

low emotional stability, anxiousness, and heightened psychological vulnerability. *Agreeableness* reflects the person's level of empathy, trust in other people, and cooperativeness. *Conscientiousness* characterizes the degree of self-discipline, self-efficacy, and orderliness. *Openness to experience* can be observed in the person's intellectual adventurousness, curiosity, flight of imagination, and artistic interests.

Systematic Review of Personality and Health

As the number of studies on a topic begins to accumulate, meta-analysis becomes a useful method of pooling all the available evidence (Cooper & Patall, 2009; Curran & Hussong, 2009). Meta-analysis allows researchers to overcome the limitations of small samples and idiosyncrasies of individual studies by harnessing the combined strengths of multiple studies that address the same research question. Of course, meta-analysis cannot overcome any methodological limitations that are inherent to all the studies included in the meta-analysis. Meta-analysis does not solve problems of study designs, such as the limitations of cross-sectional studies in determining temporal order between variables; the potential biases related to self-reported measures; or the difficulty of making causal inferences with nonexperimental data. But, meta-analysis does allow one to test which of the associations are the most robust and consistent across individual studies (Curran & Hussong, 2009). Such information can be used to guide further research in the most promising directions.

The purpose of meta-analysis is not only to produce a single effect size estimate that summarizes the average result across all available studies but also to evaluate the degree of variation—or heterogeneity, as it is often called in meta-analysis—between individual studies and to investigate the sources of such variation (Borenstein, Hedges, Higgins, & Rothstein, 2011). This is particularly valuable when a hypothesis suggests that an association should be observed in one group but not in another group of people. For instance, personality might be expected to be differently associated with health in older compared to younger individuals or in a specific cultural or social context but not in others. Such hypotheses can be tested with metaregression, which is the analysis of how study-level characteristics modify the effect sizes of individual studies.

One of the earliest and most influential meta-analyses in the field of personality and health was carried out by Bogg and Roberts in 2004. The study examined the health correlates of conscientiousness, and it showed robust associations between low conscientiousness and a wide range of poor health behaviors, from smoking and unhealthy diet to risky driving and drug use. Depending on the outcome, the number of studies included in the meta-analysis ranged between 17 and 65, with total sample sizes ranging between 6,087 and
p. 320 46,725 (other sample characteristics were not described in detail). Of ↳ all the 194 studies included in the meta-analysis, only 10 used a longitudinal study design in which personality was measured before the assessment of health behaviors.

After the meta-analysis of conscientiousness by Bogg and Roberts (2004), there have been several other meta-analyses examining how some or all of the traits of the Five-Factor Model are related to health outcomes. The meta-analysis of Kern and Friedman (2008) is particularly important, as this meta-analysis demonstrated an overall association between lower conscientiousness and higher mortality risk when estimated across 19 samples with a total number of 8,942 participants. These data provided some of the strongest evidence on how personality differences can be particularly important in determining people's health. The meta-analysis did have some limitations. The samples were relatively small, with the largest sample being only n = 1,532 individuals; the studies included both samples of healthy participants and samples of patients who suffered from serious illnesses; and the personality measures of conscientiousness were very heterogeneous, including not only standard measures of Big Five conscientiousness but also

measures of psychopathic deviance and psychoticism, which tap into the more antisocial tendencies of low conscientiousness.

In order to provide an inclusive overview of the current meta-analytic evidence on personality and health, I carried out a systematic review using the Scopus database (https://www.scopus.com/home.uri). Scopus is run by the publishing company Elsevier and contains records of over 22,000 peer-reviewed journals and over 7 million conference papers across all scientific disciplines. I first carried out a search of all the meta-analytic studies that examined some or all of the Five-Factor Model traits by using the following search criteria:

> (TITLE-ABS-KEY (meta-analysis OR meta-analytic) AND TITLE-ABS-KEY (extraversion OR neuroticism OR agreeableness OR conscientiousness OR openness OR "big five" OR "five factor")).

This broad literature search of all meta-analytic studies involving personality traits of the Five-Factor Model yielded 450 studies (August 9, 2016). After reviewing the titles and abstracts of these studies, I retrieved 38 health-related studies for a more detailed scrutiny. These 38 studies had been cited by 2,364 subsequent studies, but a review of these citations did not add any more studies to the original search. Sixteen of the 38 meta-analyses did not address physical health outcomes or health behaviors, which left 22 meta-analyses to be included in the present review.

Table 23.1 and Table 23.2 summarize the results of 22 meta-analyses of Five-Factor Personality traits and different health outcomes. Two kinds of meta-analyses are included. First, there are the traditional meta-analyses based on analysis of previously published studies. Second, there are the individual-participant meta-analyses, also known as integrative data analysis (Curran & Hussong, 2009). These are carried out by identifying multiple datasets in which the research question can be addressed, fitting the same statistical models in each dataset, and finally pooling the results using meta-analysis. The increasing number of publicly available datasets of large-scale studies has made the individual-participant meta-analysis a compelling approach in psychological and social sciences.

In the meta-analyses of published studies, the data are often derived from relatively small and selected samples (i.e., not population based), with sample sizes of individual studies rarely exceeding 1,000 participants. The individual-participant meta-analyses, by contrast, are often based on a longitudinal analysis of population-based cohort studies, such as Midlife in the United States (MIDUS), with individual studies of around 5,000 to 10,000 participants. In addition to MIDUS, other major studies having contributed data to individual-participant meta-analyses of personality include the Health and Retirement Study (HRS); Survey of Midlife in Japan (MIDJA); Wisconsin Longitudinal Study (WLS); the US National Longitudinal Study of Adolescent to Adult Health (AddHealth); UK Household Longitudinal Study (UKHLS); German Socioeconomic Panel Study (SOEP); UK National Child Development Study (NCDS); and the Household Income and Labour Dynamics in Australia (HILDA). These studies have used slightly different personality measures of the Big Five traits, but the differences between these inventories are not substantial as they all measure the same core personality dimensions.

Most of the meta-analyses of published studies have reported their findings using correlation coefficient as the metric for effect size. For studies reporting odds ratios, I converted the odds ratios to correlation coefficients to make the findings comparable across all meta-analyses (Borenstein et al., 2011). ↳

Table 23.1 Associations Between Personality and Health Behaviors in Meta-analytic Studies

Meta-analysis	Health Behavior	E	N	A	C	O
Published data						
Malouff et al. (2006)	Smoking	.06(–.04, .16)	**.11**(.03, .18)	**–.12**(–.18, –.06)	**–.16**(–.27, –.05)	.04(–.02, .11)
Munafo et al. (2007)[a]	Smoking	**.06**(.02, .10)	**.10**(.07, .12)			
Bogg & Roberts (2004)	Smoking				**–.14**(–.15, –.13)	
Wilson & Dishman (2015)	Physical activity	**.11**(.09, .12)	**–.07**(–.09, –.06)	.00(–.02, .02)	**.10**(.08, .12)	**.03**(.01, .06)
Rhodes & Smith (2006)	Physical activity	**.23**(.08, .38)	**–.11**(–.02, –.20)	.01	**.20**(.06, .34)	.08
Bogg & Roberts (2004)	Physical activity				**.05**(.04, .07)	
Malouff et al. (2007)	Alcohol	.03(–.01, .08)	**.15**(.08, .22)	**–.17**(–.21, –.13)	**–.22**(–.28, –.17)	–.01(–.07, .06)
Bogg & Roberts (2004)	Heavy alcohol use				**–.25**(–.25, –.24)	
Bogg & Roberts (2004)	Unhealthy eating				**–.13**(–.16, –.11)	
Molloy et al. (2014)	Medication adherence				**.12**(.09, .15)	
Individual-participant data						
Hakulinen, Hintsanen, et al. (2015b)[b]	Smoking	**.04**(.02, .06)	**.05**(.03, .06)	–.01(–.03, .01)	**–.04**(–.05, –.02)	.00(–.02, .01)
Sutin et al. (2016)	Physical activity	**.11**(.08, .14)	**–.07**(–.09, –.05)	**.04**(.03, .06)	**.10**(.07, .12)	**.09**(.08, .11)
Hakulinen, Elovainio, Batty, et al. (2015)[b]	Heavy alcohol use	**.04**(.02, .05)	**.05**(.02, .09)	**–.04**(–.05, –.03)	**–.03**(–.05, –.01)	.00(–.03, .03)

Note. Values are correlation coefficients (and 95% confidence intervals) of pooled meta-analytic associations. Statistically significant correlations ($p < .05$) are printed in **bold** font. A = agreeableness; C = conscientiousness; E = extraversion; N = neuroticism; O = openness to Experience.

a Correlation coefficient was obtained from standardized mean difference.

b Correlation coefficients were obtained from odds ratios.

 Table 23.2 Associations of Personality With Chronic Diseases and Mortality in Meta-analytic Studies

Meta-analysis	Health Outcome	E	N	A	C	O
Published data						
Terracciano et al. (2014)[a]	Alzheimer disease	−.01(−.05, .03)	**.08**(.05, .10)	**−.04**(−.06, −.01)	**−.07**(−.10, −.04)	**−.04**(−.07, −.01)
Low et al. (2013)[a]	Dementia	−.01(−.04, .01)	**.03**(.02, .05)	−.02(−.05, .00)	**−.04**(−.07, −.02)	**−.04**(−.06, −.01)
McKenna et al. (1999)[b]	Breast cancer	−.02(−.06, .02)				
Kern & Friedman (2008)	All-cause mortality				**−.11**(−.05, −.17)	
E. Ferguson & Bibby (2012)	All-cause mortality					**−.06**(−.04, −.09)
Individual-participant data						
Jokela, Hintsanen, et al. (2013)[a]	Obesity	.01(−.01, .02)	.01(−.01, .02)	.01(−.01, .02)	**−.05**(−.06, −.04)	−.01(−.03, .00)
Jokela, Pulkki-Råback, et al. (2014)[a]	Stroke[c]	**.09**(.03, .16)	−.01(−.07, .04)	−.04(−.11, .03)	**−.07**(−.13, −.01)	−.04(−.12, .03)
Jokela, Pulkki-Råback, et al. (2014)[a]	CHD[c]	−.02(−.05, .01)	**.04**(.01, .07)	−.01(−.06, .05)	**−.08**(−.11, −.06)	.00(−.03, .03)
Jokela, Elovainio, et al. (2014)[a]	Diabetes[d]	.00(−.01, .02)	.02(.00, .03)	.01(−.01, .04)	**−.04**(−.05, −.03)	−.01(−.04, .02)
Jokela, Batty, et al. (2014)[a]	Cancer[d]	.01(−.01, .02)	.01(−.01, .02)	−.01(−.03, .01)	.00(−.02, .02)	.00(−.01, .01)
Jokela et al. (2013)[a]	All-cause mortality	−.01(−.03, .00)	.01(−.01, .02)	.01(−.01, .02)	**−.04**(−.05, −.02)	.00(−.02, .02)

Note: Values are correlation coefficients (and 95% confidence intervals) of pooled meta-analytic associations. Statistically significant correlations ($p < .05$) are printed in **bold** font. A = agreeableness; C = conscientiousness; CHD = coronary heart disease; E = extraversion; N = neuroticism; O = openness to Experience.

a Correlation coefficients were obtained from odds ratios.

b Correlation coefficient was obtained from standardized mean difference.

c Cause-specific mortality.

d Associations are reported for incidence, but the results were the same with cause-specific mortality

Results

Health Behaviors

The meta-analyses show that there are several associations between personality traits and health behaviors (Table 23.1). Smoking and heavy alcohol consumption were both associated with higher extraversion, higher neuroticism, and lower conscientiousness (Hakulinen, Hintsanen, et al., 2015; Malouff, Thorsteinsson, Rooke, & Schutte, 2007). Alcohol use was additionally related to lower agreeableness (Hakulinen, Elovainio, Batty, et al., 2015; Malouff et al., 2007). The association between smoking and agreeableness was not consistent. The meta-analysis of published studies suggests an association between smoking and lower agreeableness ($r = -.12$; Malouff, Thorsteinsson, & Schutte, 2006), but individual-participant meta-analysis suggests no association ($r = -.01$; Hakulinen, Hintsanen, et al., 2015). Physical activity was associated with higher extraversion, lower neuroticism, and higher conscientiousness (Rhodes & Smith, 2006; Sutin et al., 2016; Wilson & Dishman, 2015). Except for the meta-analysis of Bogg and Roberts (2004) showing a poorer dietary pattern among people with lower conscientiousness, there are no meta-analyses of personality and diet.

The meta-analytic findings on health behaviors indicate that high conscientiousness has been associated with better health behaviors in all the meta-analyses shown in Table 23.1, demonstrating the robust and consistent health associations of conscientiousness. Several complementary pathways have been suggested to explain the protective role of conscientiousness (Friedman, Kern, Hampson, & Duckworth, 2014; Reiss, Eccles, & Nielsen, 2014). First, highly conscientious individuals are more likely to have higher socioeconomic status, which is known to be beneficial for health (Chapman, Fiscella, Kawachi, & Duberstein, 2010). Higher conscientiousness may also improve other aspects of the social environment that promote healthy behaviors, such as more likely being married and having friends who follow healthy lifestyles (Bogg & Roberts, 2013; Hill, Nickel, & Roberts, 2014; Shanahan et al., 2014). Second, high conscientiousness is related to more adaptive styles of responding to stress (Javaras et al., 2012) and difficult life circumstances, such as unemployment, financial difficulties, and personal conflicts (Carver & Connor-Smith, 2010). With the aid of more adaptive styles of coping with stress, highly conscientious individuals are less likely to suffer from long-term problems that they are unable to solve. Third, keeping up healthy habits often requires persistence and an ability to resist temptations, which is characteristic of high conscientiousness (Eisenberg et al., 2014). Conscientiousness has also been associated with higher adherence to medication (Molloy, O'Carroll, & Ferguson, 2014), which promotes physical health among those suffering from chronic conditions.

The associations of neuroticism are also very consistent across meta-analyses. These associations may arise from the psychological vulnerability and sensitivity to negative emotions associated with neuroticism and people's difficulties in dealing with these experiences. For people with high neuroticism, alcohol consumption and smoking may be ways to suppress negative emotions (Hakulinen, Elovainio, Batty, et al., 2015). They may also respond more negatively to the physical exhaustion and strain caused by exercise (Sutin et al., 2016). The role of negative emotions in guiding health behaviors of highly neurotic individuals was also suggested by the meta-analysis Hakulinen et al. (Hakulinen, Hintsanen, et al., 2015), in which high neuroticism was the only personality trait to predict lower probability of quitting among current smokers. This is probably because individuals with high neuroticism are more sensitive to the withdrawal symptoms of smoking cessation and therefore less likely to quit. Interestingly, high conscientiousness was not associated with likelihood of quitting to smoke (Hakulinen, Hintsanen, et al., 2015), even though one would expect individual differences in conscientiousness-related traits, such as self-discipline and self-efficacy, to be important in smoking cessation. However, this meta-analysis did not include specific measures of people's attempts to quit smoking.

Extraversion appears to have associations that are both unhealthy (i.e., smoking and heavy alcohol use) and healthy (i.e., more frequent physical activity). These differential associations may reflect the multidimensional nature of extraversion. The extraversion facets of sociability and gregariousness may lead people with high extraversion to drink more alcohol during social occasions (Hakulinen, Hintsanen, et al., 2015). Highly sociable individuals may also be more likely to start smoking due to social influences, as they are more likely to meet other people who smoke, or they may start smoking for the purpose of socializing. By contrast, the extraversion facets of activity and excitement-seeking may drive people with high
p. 324 extraversion to become more physically active, as ↳ these facets are likely to guide extraverted health behavior quite differently from the sociability-related facets (Sutin et al., 2016).

The evidence for agreeableness is more limited and mixed, with a consistent association observed only between lower agreeableness and higher probability of heavy alcohol use (Table 23.1). Openness to experience is related to higher physical activity but not with other health behaviors. In fact, of all the health behaviors physical activity is most broadly related to personality, as all the personality traits are associated with differences in physical activity (Table 23.1). This suggests that efforts of promotion and prevention for physical activity may be particularly dependent on the person's personality characteristics, perhaps requiring multiple public health strategies to target individuals who are physically inactive due to very different psychological and social reasons. It would be interesting to see a more detailed analysis of personality and physical activity, for example, whether personality traits are differently related to group versus solo forms of physical activity or whether there are systematic patterns with specific sports, such as running, swimming, or going to the gym.

Chronic Diseases

Table 23.2 summarizes the meta-analytic findings between personality and chronic diseases. Based on published studies (Low, Harrison, & Lackersteen, 2013; Terracciano et al., 2013), openness to experience appears to be protective against Alzheimer disease and other dementias. This may be due to the cognitive content of the trait, as high openness to experience is characterized by curiosity, cognitive flexibility, and having broad interest in the world. High openness to experience might have a causal role in protecting from development of dementia, for example, by increasing people's engagement with cognitive activities that help to postpone or prevent the onset of dementia (Low et al., 2013). Alternatively, high openness to experience might be a noncausal marker for lower dementia risk. For example, high openness to experience might reflect a well-functioning nervous system that is less vulnerable to degenerative brain diseases (Deary, 2012). If this is the case, cognitive engagement and other behaviors associated with openness to experience would not necessarily *cause* a lower risk of dementia but only reflect an underlying neurobiology influencing both openness to experience and risk of dementia. At present, there is insufficient evidence to evaluate whether the association is causal.

Higher neuroticism, lower conscientiousness, and lower agreeableness have also been associated with higher risk of dementia (Table 23.2). Except for dementia, there are no meta-analyses of published studies examining personality and chronic diseases. Meta-analyses based on individual-participant data, on the other hand, have examined longitudinal associations with CHD and stroke (Jokela, Pulkki-Råback, Elovainio, & Kivimäki, 2014); Type 2 diabetes (Jokela, Elovainio, et al., 2014); and cancer (Jokela, Batty, et al., 2014). These studies included only participants without the disease at baseline and then followed them over several years to test whether baseline personality traits predicted the onset of disease (or cause-specific mortality) during the follow-up period. Results from these meta-analyses suggest that low conscientiousness is the only personality trait predicting the onset of multiple chronic diseases; lower conscientiousness is associated with the incidence of diabetes in adulthood and with higher risk of CHD and stroke mortality (Table 23.2).

Besides conscientiousness, the only findings for the other personality traits include an association between higher neuroticism and increased risk of CHD mortality and an association between higher extraversion and elevated risk of stroke mortality (Jokela, Pulkki-Råback, et al., 2014). The finding for neuroticism and CHD provides support for the hypothesis that negative emotions may be relevant specifically for cardiovascular risk, which has been one of the most studied personality associations in health psychology (Friedman & Kern, 2014; Smith & MacKenzie, 2006). The elevated risk of stroke mortality associated with higher extraversion is more unexpected. The authors of the study suggested that the higher activity and excitement-seeking related to extraversion might increase the risk of head injuries, which are known to increase the risk of future stroke, but this hypothesis remains to be tested. However, these associations need replication as they were based only on three studies.

Obesity is often included among indicators of health-related behaviors as a proxy measure of diet and physical activity. But, according to the current guidelines of the American Medical Association, obesity should be considered a disease (Kyle, Dhurandhar, & Allison, 2016). An individual-participant meta-analysis of nine cohort studies found that lower conscientiousness was the only personality trait of the Five-Factor Model associated with higher obesity risk in both cross-sectional and longitudinal analysis
p. 325 (Jokela, Hintsanen, et al., ↳ 2013). Higher openness to experience was also related to lower obesity risk, but this association was completely explained by the correlation between educational level and openness to experience.

Cancer incidence and cancer mortality are not associated with any of the personality traits of the Five-Factor Model (Jokela, Batty, et al., 2014). This was observed also more specifically for six site-specific cancers, including lung, colon, breast, prostate, and skin cancer and leukemia/lymphoma. The lack of personality associations with all the Five-Factor Model extends the findings of many earlier studies that have found cancer not to be associated with extraversion and neuroticism (McKenna, Zevon, Corn, & Rounds, 1999; Nakaya et al., 2005, 2010). The risk factors for cancer appear to be quite different from those for most other chronic diseases. For example, lower cognitive ability and low socioeconomic status have been associated systematically with a wide variety of chronic diseases, but the associations between cognitive ability and cancer risk have been mixed (Deary, Weiss, & Batty, 2010), even suggesting higher cancer risk among individuals with higher cognitive ability and high socioeconomic status (Jokela, Batty, Deary, Silventoinen, & Kivimäki, 2011).

All-Cause Mortality

The risk of early mortality is the ultimate measure of poor health, as all-cause mortality represents the combined effects of all adverse health factors to which the person is exposed. Kern and Friedman (Kern & Friedman, 2008) published the first meta-analysis of conscientiousness and all-cause mortality. Lower conscientiousness predicted higher mortality rate with an effect size of $r = -.11$. Another meta-analysis of published studies (E. Ferguson & Bibby, 2012) focused on openness to experience and found an overall protective association between higher openness to experience and lower mortality risk ($r = -.06$). There are no meta-analyses of published studies of all-cause mortality that have examined all personality traits of the Five-Factor Model.

An individual-participant meta-analysis (Jokela, Batty, et al., 2013) examined associations between the Five-Factor Model and all-cause mortality in seven cohort studies ($n = 76{,}150$) with an average follow-up time of 6 years. This meta-analysis replicated the previously reported association with conscientiousness, although the effect size ($r = -0.04$) was less than half of that estimated by Kern and Friedman (2008) based on the published studies ($r = -.11$). The previously reported association between mortality and openness to experience was not confirmed in the individual-participant meta-analysis ($r = .00$). Extraversion,

neuroticism, and agreeableness were not associated with mortality, which left low conscientiousness the only personality trait to predict elevated mortality risk across studies.

Methodological Issues With Meta-Analyses

Meta-analysis produces overall estimates across multiple studies, but the overall estimate can be considered as a reliable and sufficient summary only if the estimates of the studies are not too heterogeneous (Higgins, Thompson, Deeks, & Altman, 2003). The more uniform the association is across studies, the more confident we can be of the accuracy of the overall estimate. Many of the meta-analytic associations between personality and health have shown moderate-to-high heterogeneity, which indicates that many of the health associations of personality are not uniform across studies. Indeed, in some meta-analyses, the same personality trait has been associated with higher risk in some studies, lower risk in others, and with no association in the rest of the studies (e.g., Jokela, Batty, et al., 2013; Jokela, Hintsanen, et al., 2013).

It is plausible that personality traits are differentially related to health behaviors and outcomes in diverse social and cultural circumstances, which would be observed as heterogeneity in meta-analysis. For example, whereas a meta-analysis of nine Western cohort studies found only lower conscientiousness to be associated with obesity (Jokela, Hintsanen, et al., 2013), a study of two Asian cohort studies (Sutin et al., 2015) found no association with conscientiousness but an association with higher extraversion and higher agreeableness in men. Although these different personality patterns might be related to cultural differences, a convincing cultural explanation would require a systematic assessment of the specific cultural factors (e.g., customs, social norms, gender roles) that account for the differences between studies. In the absence of such assessment, other study-level differences (e.g., differences in measures of health of the participants) might equally well explain the heterogeneous findings from different countries.

It is yet unclear whether the observed heterogeneity between individual studies represents true variability in how personality is related to health in different populations, or whether the heterogeneity is a random
p. 326 product of methodological artifacts, chance associations, and idiosyncrasies ↳ related to specific studies. This remains an important issue for future research. Metaregression and subgroup-specific associations can be used to empirically test whether estimates of individual studies are systematically related to study characteristics, such as country of origin, mean age, or educational level of the sample (Borenstein et al., 2011). Many individual-participant meta-analyses have examined potential sources of heterogeneity and have found little evidence for robust moderator effects. For example, in the meta-analysis of all-cause mortality, only 2 of the 40 tested interaction effects were statistically significant, which is what one would expect to occur by chance with 40 tests at the statistical significance level of $a = .05$. However, most tests of heterogeneity have not been driven by any particular hypotheses; theoretically oriented work may help to identify more consistent moderator effects. For example, there is some evidence from the MIDUS Biomarker project (Turiano, Mroczek, Moynihan, & Chapman, 2013) and other studies (Weston & Jackson, 2015) to suggest that high neuroticism may be related to better health when combined with high conscientiousness —a form of healthy neuroticism.

In many cases, the effect sizes of the individual-participant meta-analyses are considerably smaller compared to traditional meta-analyses of published studies. For example, in the meta-analysis of Kern and Friedman (2008), lower conscientiousness was associated with mortality twice as strongly compared to the individual-participant meta-analysis of Jokela, Batty, et al. (2013). This might be related to publication bias, where statistically significant and stronger associations are more likely to be published than null findings (C. J. Ferguson & Heene, 2012). Individual-participant meta-analyses are not affected by publication bias because the datasets are gathered before the results of the individual studies are known. Similar differences

in effect magnitudes between literature-based and individual-participant meta-analyses have been reported also in other disciplines, such as epidemiology (Kivimäki et al., 2015). This bias might be amplified by the inclusion of small samples in the literature-based meta-analyses; compared to large population-based samples, smaller samples are more likely to produce spurious associations (C. J. Ferguson & Heene, 2012). However, the individual-participant meta-analyses do not always produce smaller effect sizes compared to literature-based meta-analyses. For example, the literature-based meta-analysis of Wilson and Dishman (2015) and the individual-participant meta-analysis of Sutin et al. (2016) produced quite similar estimates for associations between personality and physical activity (Table 23.1).

Finally, most studies of personality and health have used nonoptimal measures of health outcomes. For example, self-reported physical activity and alcohol consumption are unlikely to accurately capture people's actual habits of exercise and drinking (Del Boca & Darkes, 2003; Prince et al., 2008). The same holds for self-reported measures of chronic diseases that may produce underestimates (Dwyer-Lindgren, Mackenbach, Lenthe, Van Flaxman, & Mokdad, 2016) or overestimates (Woodfield et al., 2015) of disease prevalence. However, self-reported disease measures do not necessarily produce unreliable or biased associations with personality traits. For example, in the individual-participant meta-analyses of diabetes (Jokela, Elovainio, et al., 2014) and cancer (Jokela, Batty, et al., 2014) the results were essentially the same when predicting self-reported disease status and cause-specific mortality. In addition, studies of objective health measures, such as lung function (Terracciano, Stephan, Luchetti, Gonzalez-Rothi, & Sutin, 2016), provide additional evidence with less biased measures. A meta-analysis of Five-Factor Model traits and inflammatory markers found that only lower conscientiousness was related to higher levels of both C-reactive protein (CRP) and IL-6 that have been examined in multiple studies (Luchetti, Barkley, Stephan, Terracciano, & Sutin, 2014). This further supports the conclusion that conscientiousness is the main personality trait of the Five-Factor Model that is associated with poor health outcomes.

Missing Pathways From Personality to Health and Disease

Considering the developmental pathways from personality traits to ill health, one can draw two important interim conclusions from the meta-analytic findings reviewed. First, the results of the individual-participant meta-analyses of chronic diseases and all-cause mortality suggest that conscientiousness is the only personality trait that systematically predicts the onset of multiple chronic diseases and elevated mortality risk across studies. This is in contrast to findings on health behaviors, for which several associations have been observed with most of the personality traits. At first sight, it may seem odd that personality traits would predict health behaviors but not disease end points that are strongly influenced by these health behaviors (Loef & Walach, 2012). However, most associations of personality traits with health
p. 327 behaviors may not ↳ be strong enough to carry over to influence the development of chronic diseases. The implication from these findings is that psychological characteristics of multiple personality dimensions may be important to consider when attempting to modify people's health behaviors. But, for the prevention of the development of chronic diseases, behaviors and cognitions related to conscientiousness (self-discipline, planning, persistence, impulse control, industriousness, among others) should be considered most crucial.

Second, it is well known that smoking, physical inactivity, alcohol consumption, and dietary patterns account for a large proportion of the variation in early mortality and onset of chronic diseases (Loef & Walach, 2012). Given that conscientiousness is associated with health behaviors (Bogg & Roberts, 2004; Molloy et al., 2014), it is natural to expect that these health behaviors would explain why low conscientiousness increases the risk of morbidity and mortality. In the individual-participant meta-analysis of all-cause mortality, adjusting for smoking, physical inactivity, heavy alcohol use, and obesity attenuated the odds ratio of conscientiousness only by 21% (Jokela, Batty, et al., 2013). Further adjusting for

education and marital status increased the proportion of attenuation to 31%, suggesting incremental importance of the social environment. Similar modest attenuations by covariate adjustment have been reported for chronic diseases. Adjusted for smoking, physical activity, diabetes, and hypertension at baseline, the association of conscientiousness attenuated only by 16% for CHD mortality and by 18% for stroke mortality (Jokela, Pulkki-Råback, et al., 2014). Of the association between lower conscientiousness and diabetes risk, 60% was explained by baseline obesity, while health behaviors increased the attenuation proportion only by 15 percentage points to 75% (Jokela, Elovainio, et al., 2014). Thus, it seems that measures of health behaviors account for only a modest—though not insignificant—part of the associations between conscientiousness and chronic diseases or mortality.

Unanswered Questions for the Future

As discussed, the detailed pathways from personality traits to health behaviors, chronic diseases, and mortality remain poorly understood. Health behaviors seem to account only for a modest proportion of the associations between personality and disease end points or mortality. Of course, it is possible that the modest attenuations by health behaviors are due to imprecision in their measurement (e.g., measured only at one time point and inaccuracies of self-reports). More comprehensive and accurate assessment of health behaviors, as well as inclusion of social risk factors, could reveal more accurate estimates of mediator effects for targeted health behaviors. In the most recent analysis of personality and mortality with the MIDUS data, heavy drinking, smoking, and greater waist circumference were found to mediate 42% of the association between conscientiousness and early mortality (Turiano, Chapman, Gruenewald, & Mroczek, 2015). It is also possible that the associations between personality and health are largely mediated via other factors besides the usual health behaviors (Hampson, 2012; Friedman et al., 2014). For example, recent studies of personality and biomarkers (e.g., inflammation; Turiano et al., 2013) may provide novel clues regarding how personality traits become expressed as disease outcomes.

There are two more issues not yet addressed by the majority of longitudinal studies to date. First, most of the studies have examined the associations between personality and health in adulthood, with most participants over the age of 30. This is a reasonable focus for many chronic diseases that begin to develop in adulthood, but may be problematic for health behaviors that tend to be adopted already in adolescence or early adulthood (Hampson, Goldberg, Vogt, & Dubanoski, 2006, 2007). For example, more than half of young adults who smoke started smoking before age 18 (Freedman, Nelson, & Feldman, 2012). Therefore, associations between adult personality and adult smoking provide a limited view on how personality may influence smoking behavior throughout the life course. Other health behaviors also show moderate stability over time (Jones, Hinkley, Okely, & Salmon, 2013), suggesting that many people have already adopted stable health behaviors by adulthood. This implies a need for studies that measure both personality and health behaviors at different ages and life circumstances to better characterize similarities and differences across the life course (Friedman et al., 2014; Shanahan et al., 2014).

The second major limitation of current evidence is the lack of studies evaluating causal versus noncausal explanations in the associations between personality and health. As discussed in the case of openness to experience and dementia risk (Low et al., 2013), it is possible that even longitudinal associations are
p. 328 noncausal because these can also be confounded by unobserved third variables (Deary, ↳ 2012). If personality is causally related to health behaviors and disease development, one would expect a change in a person's personality to lead to changes in the person's health behaviors and disease risk. Quasi-experimental study designs, such as sibling comparison (Kim, 2016), could be used to provide evidence to support or contradict causal interpretations.

It would also be valuable to study how illnesses may influence personality development—rather than personality influencing the risk of illnesses. An individual-participant meta-analysis with data from the MIDUS, WLS, and HRS showed that the incidence of chronic diseases was associated with decreasing extraversion, increasing neuroticism, decreasing conscientiousness, and decreasing openness to experience (Jokela, Hakulinen, et al., 2014). The largest personality changes were observed among individuals who suffered a stroke during the follow-up, which is to be expected given the damage to the brain. Thus, the association between personality and health is likely to be bidirectional, with personality predicting later health development and health predicting later personality development. Personality change may also be a marker of health risks, as several studies from the MIDUS have shown personality change to be associated with various poor health outcomes, including self-rated health, cognitive performance, and worse metabolic health (Graham & Lachman, 2012; Human et al., 2013; Turiano et al., 2012).

This review focused on health behaviors and chronic physical diseases, although personality is important also for mental health (Malouff, Thorsteinsson, & Schutte, 2005). Meta-analytic evidence has demonstrated robust associations of personality traits with psychiatric disorders such as attention deficit hyperactivity disorder (Gomez & Corr, 2014); depression (Hakulinen, Elovainio, Pulkki-Råback, et al., 2015; Kotov, Gamez, Schmidt, & Watson, 2010); eating disorders (Farstad, McGeown, & von Ranson, 2016); and schizophrenia (Ohi et al., 2016), among other disorders. Some of the risk factors and mechanisms related to mental health may thus be the same as for health behaviors and chronic diseases, but many of the mediating pathways are likely to be specific to mental health.

Conclusion

Current evidence from meta-analyses of personality and health suggest that individual differences in various health behaviors are related to many core personality traits of the Five-Factor Model. This implies that different kinds of psychological processes are involved in determining health behaviors. In contrast to the multitude of associations between personality traits and health behaviors, chronic disease morbidity and mortality are almost exclusively related to lower conscientiousness, but not systematically to other personality traits. As this review of meta-analyses demonstrated, the broad associations between personality traits and health have been established in a number of studies. Future research needs to focus on the personality-related mechanisms and processes that connect personality differences to important health outcomes.

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