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Personality Traits and Body Mass Index: Modifiers and Mechanisms

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Abstract

Objective—To identify how demographic factors (sex, age, ethnicity) modify the association between personality traits and body mass index (BMI) and to test the extent that diet and physical activity account for the personality-BMI relations.

Design—Cross-sectional study with a diverse sample (*N*=5,150, 50% female, 19% African American, 15% Hispanic). Participants completed a measure of the five major dimensions of personality and reported on their physical activity, diet and food intake behavior, and height and weight.

Main Outcome Measures—BMI and obesity (BMI≥30)

Results—High Neuroticism was associated with higher BMI and risk for obesity, whereas Conscientiousness and, to a lesser extent, Extraversion and Openness were protective. These associations were generally stronger among women and older participants; there was less evidence for ethnicity as a moderator. Personality had similar relations with the behavioral factors, and physical activity, diet, and regular meal rhythms accounted for approximately 50% of the association between Neuroticism and Conscientiousness and BMI.

Conclusion—This study supports the links between personality traits and BMI and suggests that physical activity, more than diet, is a key factor in these associations.

Keywords

Five Factor Model; Obesity; Conscientiousness; Behavioral Risk Factors; Exercise; Diet

The etiology of obesity is complex, with determinants that range from genetics to public policy. Several aspects of psychological functioning, such as depressive symptoms, have been implicated in body mass index (BMI; Luppino et al., 2010) and weight gain (Sutin & Zonderman, 2012). There is growing evidence that personality traits – individual differences in our characteristic ways of thinking, feeling, and behaving – also contribute to body weight. Within the Five Factor Model (FFM), personality traits can be summarized along five broad dimensions (McCrae & Costa, 2003): Neuroticism (the tendency to experience negative emotions), Extraversion (the tendency to be sociable and active), Openness (the tendency to be creative and unconventional), Agreeableness (the tendency to be trusting and

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modest), and Conscientiousness (the tendency to be organized and disciplined). The present study builds on previous research to identify demographic moderators of the association between personality and adiposity and to estimate the extent to which behavioral factors (e.g., diet and physical activity) account for the association between personality and BMI.

Overview of Personality and Adiposity

In populations from Western cultures, Conscientiousness tends to be associated with healthier BMI. Across samples from the United States (Chapman, Fiscella, Duberstein, Coletta, & Kawachi, 2009; Sutin & Terracciano, in press), Europe (Mõttus et al., 2013; Terracciano et al., 2009), Israel (Armon, Melamed, Shirom, Shapira, & Berliner, 2013), and Australia (Magee & Heaven, 2011), individuals higher in Conscientiousness tend to be leaner and are at lower risk of obesity (Jokela et al., 2013). The association between the other four personality traits and adiposity is less clear. There is some evidence for a positive association between Neuroticism and BMI (Armon et al., 2013; Magee & Heaven, 2011) and some evidence that there is no relation (Mõttus et al., 2013). Other aspects of psychological functioning that are related to Neuroticism, such as depressive symptoms, also tend to be related to higher BMI (Luppino et al., 2010). Extraversion is associated positively with BMI in some samples (Armon et al., 2013; Magee & Heaven, 2011), negatively in others (Sutin et al., in press), and unrelated in yet others (Mõttus et al., 2013; Terracciano et al., 2009). Finally, Openness and Agreeableness either have a negative relation (Magee & Heaven, 2011) or no relation (Armon et al., 2013) with BMI.

Some of this inconsistency may stem from sex differences in the association between personality and adiposity. For example, there tends to be a stronger relation between Neuroticism and BMI for women than for men (Armon et al., 2013; Brummett et al., 2006; Faith, Flint, Fairburn, Goodwin, & Allison, 2001; Sutin & Terracciano, in press), whereas the opposite pattern tends to emerge for Extraversion (Brummett et al., 2006; Faith et al., 2001; Jokela et al., 2013; Kakizaki et al., 2008; Shim et al., 2014; Sutin & Terracciano, in press). That is, women with a general propensity to experience negative emotions and men who are more sociable and outgoing tend to have higher BMI, whereas there is no association in the opposite sex, respectively. Further, although Conscientiousness is associated with lower BMI in both women and men, the correlation tends to be slightly stronger among women (Jokela et al., 2013; Sutin & Terracciano, in press). These apparent sex differences in the association between personality and BMI may contribute to the inconsistent findings, especially for Neuroticism and Extraversion. In addition to sex, there are significant age and ethnic differences in the prevalence of obesity (Ogden, Carroll, Kit, & Flegal, 2014), and personality may or may not have similar associations across demographic groups. Moderation analyses can help identify for whom the relation between personality and adiposity holds. That is, in addition to the relation between personality and adiposity in the overall sample, identifying associations across diverse groups will indicate whether personality is expressed in similar ways across demographic groups and how psychological factors may contribute to differences in obesity prevalence.

The inconsistency may also stem from the use of different personality measures that emphasize different aspects of the traits. At the domain level, the traits are broad and

encompass a number of more circumscribed traits, or facets. Although facets within a factor share some common variance, facets are also distinct and may have unique correlates with outcomes of interest (Hoyt, Rhodes, Hausenblas, & Giacobbi Jr, 2009). For example, the activity facet of Extraversion has a negative association with BMI, whereas other facets of Extraversion, such as assertiveness, tend to have a positive association with BMI (Sutin et al., 2011; Terracciano et al., 2009). As such, examining the facet-level associations between personality and adiposity may help to detect nuances in associations that may be obscured at the domain-level.

Personality and Behavioral Factors

The relation between personality traits and body weight is likely to be due, in part, to behavioral lifestyle factors. Physical activity, for example, has been linked to personality: Individuals high in Extraversion, Conscientiousness, or Emotional Stability (i.e., low Neuroticism) tend to engage in more physical activity than individuals who score lower on these traits (Allen & Laborde, 2014; Rhodes & Smith, 2006; Wilson & Dishman, 2015). These differences may be due partly to differences in the motives for exercise associated with each of the traits. Individuals high in Extraversion and Conscientiousness both report that they exercise to stay healthy, with extraverts particularly enjoying the social aspects of it, whereas individuals high in Neuroticism are more focused on exercise for their appearance and weight. Individuals high in Neuroticism also perceive more barriers to exercising than individuals high in Extraversion and Conscientiousness (Courneya & Hellsten, 1998). These motives and barriers likely contribute to the personality differences in physical activity.

Personality has also been linked with diet. Somewhat surprisingly, the strongest and most consistent personality correlate of diet is not Neuroticism or Conscientiousness, but Openness. Individuals high in Openness tend to eat more fruits and vegetables and consume less sugar (Keller & Siegrist, 2015; Tiainen et al., 2013) as well as adhere more to a Mediterranean-style diet (Mõttus et al., 2013). Some studies have linked Neuroticism with less healthy diet patterns and Extraversion and Conscientiousness to a more healthy diet (Mõttus et al., 2013; Mõttus et al., 2012; Tiainen et al., 2013), but not all find these relations (Brummett, Siegler, Day, & Costa, 2008; Keller & Siegrist, 2015). In general, the magnitude of the correlations for these two traits with healthy eating tends to be smaller than what is typically found for Openness (Mõttus et al., 2013). This pattern suggests the hypothesis that diet may play less of a role in the association between personality and BMI than physical activity.

In addition to what is actually eaten, when and how much the individual eats are important considerations for a healthy weight. In particular, it has been hypothesized that individuals high in Conscientiousness are leaner, in part, because they eat at regular times each day and tend not to snack (Terracciano et al., 2009). There is some evidence that individuals high in Conscientiousness eat breakfast regularly (Reeves, Halsey, McMeel, & Huber, 2013), but less is known about their regular eating patterns throughout the day. Personality traits have also been linked to eating behaviors, such as restrained and emotional eating. As with physical activity, Neuroticism, Extraversion, and Conscientiousness are the traits most

consistently associated with these behaviors. Individuals with a tendency to experience negative emotions are more likely to use food to help regulate their emotions, whereas Extraversion and Conscientiousness are both associated with better control over eating behavior (Walker, Christopher, Wieth, & Buchanan, 2015). It is unclear the extent to which behaviors related to eating contribute to the association between personality and adiposity.

Present Study

The present study uses a large, diverse sample to address the relation between personality traits and BMI. We build on previous research in three ways. First, we examine the association between BMI and personality and test whether it varies as a function of sex, age, and ethnicity. Second, we examine whether personality is associated with behaviors that are conducive to obesity. Third, we test how much of the association between personality and BMI is due to these behavioral factors. The present research thus aims to address for whom there are associations between personality and BMI and how much behavioral factors account for these associations.

Method

Participants and procedure

A total of 5,150 participants living in the United States (50% female) completed a personality measure (see below) as part of a larger online study on the psychological correlates of health and well-being in 2014. Survey Sampling International (SSI) recruited participants stratified by age, sex, and ethnicity and directed them to a Qualtrics survey administered by the Florida State University College of Medicine. Participants were recruited through SSI's proprietary panel and had to be 18 years or older and living in the United States. Of the 6,303 individuals who clicked on the link provided by SSI, 6,040 consented to participate, and 5,150 completed the personality measure (82% participation rate). The sample was stratified by age such that a roughly equal percentage of participants (20%) were recruited across five age bands: 18–29, 30–39, 40–49, 50–59, and 60+. In addition, African Americans were oversampled. Table 1 shows the demographic characteristics of the sample in comparison to national estimates of the United States from the Census. Participants were, on average, 44.61 (*SD*=15.25; range = 18–91) years old, 55% non-Hispanic European American, 19% African American, 15% Hispanic white, and 11% multiracial/other/unknown. Due to missing data on some of the variables, the analytic sample size ranged from 5,033 to 5,150. The pattern of results was similar if the analyses were restricted to participants with full data.

Measures

Big Five Inventory—Personality traits were measured with the 44-item Big Five Inventory (BFI; John, Naumann, & Soto, 2008), which measures the five broad domains and two more circumscribed facets within each domain (Soto & John, 2009). Participants rated items that finish the sentence stem, "I see myself as someone who…" on a scale from 1 (*strongly disagree*) to 5 (*strongly agree*). Eight items measured Neuroticism (e.g., can be moody; alpha = .85), 8 items measured Extraversion (e.g., is talkative; alpha = .81), 10 items

measured Openness (e.g., has an active imagination; alpha = .78), 9 items measured Agreeableness (e.g., is generally trusting; alpha = .79), and 9 items measured Conscientiousness (e.g., is a reliable worker; alpha = .83). In addition to the broad domains, the BFI measures two facets for each of the five traits: anxiety and depression (Neuroticism), assertiveness and activity (Extraversion), aesthetics and ideas (Openness), altruism and compliance (Agreeableness), and order and self-discipline (Conscientiousness).

Body mass index—Participants reported their height and weight. Although there can be discrepancies between reported and measured height and weight, there is a high correlation between reports and measurements (*r*s > .90; Sutin, 2013). BMI was derived as kg/m^2. For some analyses, BMI was categorized into weight categories, as defined by the World Health Organization (WHO, 2000): underweight (BMI<18.5), normal weight (BMI between 18.5 and 24.9), overweight (BMI between 25 and 29.9), and obese (BMI≥30) and for some analyses BMI was categorized into obese (BMI≥30) and not obese (BMI<30). See Table 1 for descriptive statistics.

Behavioral questionnaire—Participants were asked about their eating and physical activity habits in the last 30 days based on items from the annual Behavioral Risk Factor Surveillance System (CDC, 2015a). These items generally have adequate validity, with moderate correlations with other measures, such as detailed food questionnaires and 24-hour dietary recalls (CDC, 2015b). These questions included nine items related to food consumption in the last 30 days. Factor analysis of the nine items revealed two distinct factors: healthy food (consumption of fruit, beans, dark green vegetables, orange vegetables, and other vegetables; alpha = .81) and convenience food (consumption of sugar-sweetened beverage, diet soda, snack food, and fast food; alpha = .58). The scale scores for these two factors were correlated modestly ($r = .15$, $p = .01$). Participants were also asked about when they eat (i.e., “eat at regular intervals throughout the day” and “eat meals at the same time each day”), the frequency of snacking between meals, and how often they overate (i.e., “eat so much that you felt sick”). Participants rated how often they engaged in these behaviors over the past 30 days on a scale that ranged from 1 (*never*) to 6 (*everyday*). Finally, participants also rated how often they engaged in physical activity over the past 30 days (i.e., “participate in any physical activities or exercises such as running, gardening, golf, or walking for exercise?). This rating was made on a scale that ranged from 1 (*never*) to 6 (*everyday*).

Disease burden—Participants reported whether they had ever been diagnosed with a number of chronic diseases. Specifically, they were asked, has a doctor ever told you that you have: high blood pressure, type 1 diabetes, type 2 diabetes, cancer of any kind (except skin), heart condition, stroke, arthritis. Participants responded yes or no to each disease and the sum was taken as a measure of disease burden.

Analytic Strategy

We examined the association between personality and BMI in three ways. First, we used linear regression to predict BMI from each personality trait (i.e., not adjusted for the other traits) and its two corresponding facets, controlling for age, sex, ethnicity, and education. To

determine whether these associations varied by sex, age, and ethnicity, we tested for an interaction between each of the traits and these demographic factors. Second, we used logistic regression to predict obesity from each trait, again controlling for age, sex, ethnicity, and education. We repeated the linear and logistic regressions excluding the underweight participants and again controlling for disease burden. Third, we examined the mean-level differences in personality across the four BMI categories using multivariate analysis of covariance, controlling for age, sex, ethnicity, and education. Pairwise comparisons were used to contrast the normal weight group with the underweight, overweight, and obese groups.

To examine how personality is associated with the behavioral factors, we used linear regression to predict each the behaviors from the traits, controlling for age, sex, ethnicity, and education. To examine how the behavioral factors contributed to the association between personality and BMI, we included these factors in the linear regression predicting BMI from each of the traits and compared the betas with and without the behavioral factors included in the model. To estimate their indirect effect, we used bootstrapping techniques (Preacher & Hayes, 2008) to test physical activity, healthy food, convenience food, eating at regular intervals, eating at the same time each day, frequency of snacking, and overeating as simultaneous mediators of the personality-BMI relation, controlling for the demographic factors. Although it is not ideal to test for mediators with cross-sectional data, such an approach will still help evaluate which behavioral factors have the strongest indirect effect between personality and BMI. Longitudinal data would provide a stronger test of the behavioral factors as mediators, but mediation can still be used to test the conceptual model of the relation of personality to adiposity through behavior.

Results

BMI

Similar to previous studies, Neuroticism and Conscientiousness had the strongest associations with BMI (Table 2): A general tendency to experience negative emotions was associated with higher BMI, whereas a general tendency to be organized and disciplined was associated with lower BMI. Extraversion and Openness also had negative associations with BMI. With one exception, the facets followed a similar pattern to their corresponding domain. The exception was Extraversion: Participants who scored higher on the facet of Activity had lower BMI, whereas there was no relation between the Assertiveness facet and BMI. Similar to the linear regressions, the logistic regressions revealed that Neuroticism and Conscientiousness were the two traits associated with the strongest risk of obesity: Every standard deviation higher Neuroticism or every standard deviation lower Conscientiousness was associated with a more than 20% higher risk of obesity. Extraversion (mainly the activity facet) was associated with lower risk of obesity. The facets had similar associations with obesity as with BMI. All of these findings held when controlling for disease burden and when unweight participants (n=164) were excluded from the analysis. From the MANCOVA (Table 2), the contrast between the normal and obese groups produced findings consistent with the logistic regressions, with the exception that there were no mean-level differences in altruism. Similar to the obese group, the overweight group was also higher on Neuroticism

and lower on Conscientiousness than the normal weight group. There were no differences between underweight and normal weight participants on any of the traits.

Modifiers

Also similar to some previous research, sex moderated the association between Neuroticism, Extraversion, and Conscientiousness and BMI. Specifically, although apparent for all participants, the associations of Neuroticism ($\beta_{Interaction}$=.05, p=.026) and Conscientiousness ($\beta_{Interaction}$=−.05, p=.010) were stronger for women than for men. For Extraversion, however, the moderating effect of sex was in the opposite direction of what is typically found: Extraversion was protective for women but was unrelated for men ($\beta_{Interaction}$=−.05, p=.018). This difference with previous research may be due to the BFI's emphasis on the activity, rather than the sociability, component of Extraversion. Age moderated the association between personality and BMI in two ways. First, older participants who scored higher in Agreeableness had lower BMI, an association not apparent among younger participants ($\beta_{Interaction}$=−.05, p=.000). Second, similar to sex, the protective effect of Conscientiousness was apparent for all participants, but the association was slightly stronger among older participants ($\beta_{Interaction}$=−.04, p=.002). Finally, ethnicity also moderated the association between personality and BMI. Similar to previous research (Sutin & Terracciano, in press), there was a negative association between Agreeableness and BMI that did not hold for African American participants ($\beta_{Interaction}$=.04, p=.007). And, although apparent in all three ethnic groups, the association between Neuroticism and BMI was slightly stronger for white and African American participants than for Hispanic participants ($\beta_{Interaction}$=−.03, p=.033).

Behavioral factors

A fairly similar pattern emerged across the behavioral factors (Table 3): Participants who were more emotionally stable, extraverted, open, agreeable, and conscientious reported eating healthier food and less convenience food, engaging in more physical activity, and eating at regular intervals at the same time each day. There were two exceptions to this pattern. First, although Openness was related strongly to eating healthy foods, it was unrelated to eating convenience foods. Second, Extraversion was associated with eating at regular intervals throughout the day, but not necessarily at the same time each day. Interestingly, Neuroticism, and to a lesser extent Openness, was associated with snacking more in between meals, but Conscientiousness was unrelated to this behavior.

Also similar to BMI, the facets tended to follow the same pattern as their corresponding domain (Table 3). Not surprisingly, physical activity was the strongest correlate of the activity facet of Extroversion. More notable, however, was that eating a healthy diet had nearly as strong an association with this facet. In addition, participants who scored higher on the depression facet of Neuroticism reported that they tended to eat a convenience diet but were not more likely to report consuming fewer healthy foods. Finally, the depression facet of Neuroticism, the compliance facet of Agreeableness, and the order facet of Conscientiousness had the strongest relations with overeating and were among the strongest behavioral correlates of the facets.

Mechanisms

All of the personality-BMI associations could be accounted for partly by exercise, diet, and eating behavior. These behaviors accounted for approximately 50% of the association between Neuroticism and BMI ($\beta_{adjusted}$=.05, p<.01; $\Delta\beta$ = .05) and approximately 50% of the association between Conscientiousness and BMI ($\beta_{adjusted}$=−.06; $\Delta\beta$ = .05). Of note, the association between these traits and BMI remained significant after inclusion of the behavioral factors (both *p*s < .01). In contrast, the association between both Extraversion and Openness and BMI was reduced to non-significance when the behavioral factors were included in the analysis.

Finally, we used Preacher and Hayes's (2008) methodology for testing simultaneous mediators to examine which of the lifestyle factors had the strongest indirect effects (Table 4). Of the potential mediators, physical activity had the strongest and most consistent indirect effect between the traits and adiposity, followed by eating healthy food, and eating meals at the same time each day. In addition, eating more convenience food mediated the relation between Neuroticism and (low) Conscientiousness and BMI, whereas feeling sick from eating too much mediated with the relation between Openness and BMI. Although eating meals at the same time each day was a significant mediator, neither eating at regular intervals throughout the day nor snacking in between meals mediated any of the personality-BMI relations.

Discussion

We examined the association between personality traits and BMI in a diverse sample of adults. Consistent with the literature (Magee & Heaven, 2011; Sutin, Ferrucci, Zonderman, & Terracciano, 2011), high Neuroticism and low Conscientiousness were the traits with the strongest associations with BMI and obesity. Demographic moderators indicated sex, and to a lesser extent age and ethnic, differences in how personality is related to adiposity. In addition, the association between personality and BMI was due in part to behavioral factors, including diet, eating patterns, and physical activity.

Women with a general proneness to feeling negative emotions tended to have a higher BMI than more emotionally stable women, an association that was weaker among men. This finding adds to the growing literature that suggests a positive association between Neuroticism and adiposity for women (Armon et al., 2013; Brummett et al., 2006; Sutin & Terracciano, in press). Women high in Neuroticism may be more likely to engage in emotional eating that contributes to excess weight (Piquero, Fox, Piquero, Capowich, & Mazerolle, 2010), whereas men may engage in healthier behaviors to manage their negative emotions (Angst et al., 2002). This moderating effect of sex may be one reason for the apparent inconsistencies in the literature on the association between Neuroticism and BMI. A similar pattern has been found for related constructs, including depressive symptoms (Sutin & Zonderman, 2012). In addition to Neuroticism, and consistent with some previous research, the association between Conscientiousness and BMI varied by sex (Jokela et al., 2013): This trait was protective for both sexes, but the association was slightly stronger among women.

Extraversion had a negative association with BMI among women but was unrelated to BMI among men; previous studies have typically found the opposite (i.e., men who score higher in Extraversion tend to weigh more, whereas Extraversion is unrelated to BMI among women; (Brummett et al., 2006; Jokela et al., 2013; Sutin & Terracciano, in press). This difference likely reflects differences in the content of the Extraversion items across the scales used to measure this trait. The current study used the BFI, which has items that measure the activity and assertiveness components of Extraversion. The facet-level analysis indicated that the activity aspect of Extraversion was more strongly associated with BMI than assertiveness. Individuals who score high on activity tend to live fast-paced lives and engage in more physical activity (Hoyt et al., 2009) and have better cardiorespiratory fitness (Terracciano et al., 2013). The present research suggests that activity may be more protective for women than for men. Other scales emphasize different aspects of Extraversion. The mini-IPIP, for example, solely assesses the sociability aspect of this trait, which is not as prominent in the BFI. In contrast to activity, sociability seems to be a vulnerability for excess weight, particularly for men (Sutin & Terracciano, in press). Care should thus be taken when evaluating the association between Extraversion and BMI – differences could emerge based on the scale and/or composition of the sample.

Personality was also associated with behaviors typically implicated in maintaining a healthy weight, including diet and exercise. These behavioral factors accounted for about 50% of the association between Neuroticism and Conscientiousness and BMI. In the present data, of the potential behavioral factors, physical activity had the strongest indirect effect. Individuals high in Emotional Stability, Extraversion, and Conscientiousness tend to exercise more in general (Rhodes & Smith, 2006) and report fewer barriers to engaging in physical activity (Courneya & Hellsten, 1998). Their long-term persistence may pay off in the form of a healthier BMI. Behaviors related to diet and eating patterns were also implicated in the relation between personality and BMI. Consistent with previous research (Keller & Siegrist, 2015; Mõttus et al., 2013), Openness was a stronger personality correlate of healthy eating than either Neuroticism or Conscientiousness. Still, healthy eating habits, both eating healthier food and refraining from convenience food, accounted for part of the association between these traits and BMI.

When an individual eats, not just what he/she eats, is associated with better weight outcomes (Garaulet et al., 2013). Personality may contribute to such eating patterns. It has been hypothesized that eating meals at the same time everyday at regular intervals is one reason that individuals high in Conscientiousness are able to maintain healthier weight (Terracciano et al., 2009). We found support for this hypothesis: Conscientiousness was the trait most strongly related to eating at the same time everyday, which was among the strongest indirect effects for this trait. Conscientious individuals tend to eat breakfast every day (Reeves et al., 2013), and this regularity may extend to other meals as well. Interestingly, the indirect effect of eating meals at the same time each day was not specific to Conscientiousness. Indeed, this behavior also emerged as a significant indirect effect for Neuroticism, Extraversion, and Openness.

Fewer of the behavioral factors accounted for the relation between Extraversion and Openness and BMI. Interestingly, overeating had a small indirect effect on the relation

between Openness and BMI but not the other traits. Despite the strong associations between Neuroticism and Conscientiousness and overeating, it surprisingly had no indirect effect on the relation between these traits and BMI. Individuals high in Neuroticism tend to eat as a way to regulate their emotions and loneliness and are particularly reactive to the sight and smell of food (Elfhag & Morey, 2008). Individuals low in Conscientiousness have similar difficulties with self-control and restraint. These tendencies to overeat, however, may be less problematic for obesity than their lack of physical activity and chaotic meal schedule.

Although behavioral factors accounted for most of the relation between Extraversion and Openness and BMI, they only accounted for about 50% of the association for Neuroticism and Conscientiousness. In addition to behavioral factors, there may be physiological differences associated with the traits that partly account for the association with BMI. For example, leptin, an adipose-derived hormone that regulates satiety by telling the brain to stop eating, has been found to contribute to the personality-BMI relation for Conscientiousness, but not Neuroticism (Sutin, Zonderman, et al., 2013). Other physiological differences that are trait specific may contribute to the relation between these traits and obesity. A better understanding of the pathways through which these traits lead to weight gain and obesity will help identify points of intervention that are the most effective.

Our conceptual model of the relation between personality, behavior, and BMI specifies behavior as one pathway through which personality contributes to adiposity. As such, our hypothesized causal model is that personality leads people to engage in specific behaviors that increases or decreases their risk of obesity and weight gain. The present research, however, could not adequately address the causal relations among these variables because we relied on an observational cross-sectional study. Longitudinal and experimental data are needed to provide stronger support for the proposed connections. Since there are reciprocal relations between personality and behavior, such as physical activity (Stephan, Sutin, & Terracciano, 2014), as well as weight gain (Sutin, Costa, et al., 2013), longitudinal data with multiple, frequent assessments starting from childhood are ideally needed to tease apart the dynamics of personality, behavior, and BMI. Further, all of the measures in the present research were brief self-reports, and there is likely some shared method variance that contributed to the pattern of associations. It is also possible that the associations were attenuated by measurement error. The mediation analyses should thus be interpreted with these limitations in mind.

The present study had several strengths, including a large and diverse sample and information on diet and exercise as well as BMI. Despite these strengths, there are several limitations that could be addressed in future research. First, we relied on self-reported behavioral indicators as well as height and weight, which are vulnerable to reporting biases. However, there is a strong correlation between reported and measured weight and height, and the personality correlates are nearly identical (Sutin & Terracciano, in press). Still, it would be worthwhile to obtain objective measurements of height and weight, as the correlation between self-reported and measured BMI might vary across BMI category, as well as objective measurements of physical activity (e.g., pedometer, accelerometer). Second, this study was cross-sectional, and there are likely to be bi-directional relations between personality and BMI (Sutin, Costa, et al., 2013). Longitudinal data are needed to

test for reciprocal relations between personality and BMI. Third, although our sample was diverse, many ethnicities (e.g., Asian) were not represented. Future research could focus on testing whether these associations hold in other ethnic groups not measured here.

Despite these limitations, the present research indicates that demographic moderators may be one reason for the apparent inconsistencies in the literature and suggests that physical activity and eating-related behavioral factors account for approximately 50% of the association between Neuroticism and Conscientiousness and BMI.

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Table 1

Descriptive Statistics for the Survey Sample and National Estimates

Demographic factor	Survey %	National %
Sex[a]		
Male	50.4	49.2
Female	49.6	50.8
Age[a]		
18–44 years	51.2	36.5
45–64 years	38.3	26.4
65+ years	10.5	13.0
Ethnicity[b]		
Non-Hispanic White	55.9	62.6
African American	18.8	13.2
Hispanic	15.4	17.1
Asian/Native Hawaiian/Pacific Islander	4.8	5.3
American Indian/Alaskan Native	1.0	1.2
Multiracial	2.8	2.4
Not reported	1.3	--
Education[c]		
Less than a high school diploma	3.9	14.7
High school graduate/GED	19.5	28.5
Some college or associate's degree	26.8	28.9
Bachelor's degree or higher	49.8	27.9
Body Mass Index		
Underweight[d]	3.2	1.7
Overweight[e]	30.9	33.9
Obese[d]	32.0	35.1

Note. Survey percentages are unweighted.

[a]National estimates from the 2010 US Decennial Census (Howden & Meyer, 2011).

[b]United States Census Bureau. United States Census Bureau. http://quickfacts.census.gov/qfd/states/00000.html; Retrieved May 30, 2015.

[c]Census estimates derived from the American Community Survey (Ryan & Siebens, 2012).

[d]Derived from NHANES (Fryar & Ogden, 2012).

[e]Derived from NHANES (Ogden et al., 2014).

Table 2

Comparison across BMI groups and Results from Linear and Logistic Regressions Predicting BMI and Obesity from Personality

Predictor	β-BMI	OR-Obesity	Underweight	Normal	Overweight	Obese
Demographics						
Age	.13**	1.14 (1.09–1.19)**	36.11 (3.60)*	41.76 (15.41)	46.86 (15.22)*	46.40 (14.62)*
Sex (Female)	−.01	1.10 (.97–1.24)	65%*	55%	40%*	51%*
Education	−.12**	.84 (.80–.88)**	15.21 (2.72)	15.35 (2.57)	15.21 (2.54)	14.69 (2.53)*
Ethnicity (Black)	.06**	1.25 (1.06–1.47)**	13%	18%	18%	21%*
Ethnicity (Hispanic)	.05**	1.20 (1.01–1.44)*	10%	14%	17%*	16%*
Ethnicity (Other)	−.04*	.77 (.62–.96)*	17%	14%	10%*	8%*
Personality						
Neuroticism	.10**	1.23 (1.15–1.31)**	2.70 (.06)	2.67 (.02)	2.73 (.02)*	2.86 (.02)*
Anxiety	.07**	1.19 (1.11–1.28)**	2.68 (.07)	2.64 (.02)	2.68 (.02)	2.79 (.02)*
Depression	.12**	1.27 (1.20–1.35)**	2.67 (.08)	2.66 (.02)	2.75 (.03)*	2.96 (.03)*
Extraversion	−.06**	0.87 (.82–0.92)**	3.15 (.06)	3.18 (.02)	3.20 (.02)	3.08 (.02)*
Assertiveness	−.01	0.93 (.87–1.00)	2.92 (.06)	2.94 (.02)	3.00 (.02)*	2.91 (.02)
Activity	−.15**	0.73 (.69–0.78)**	3.62 (.07)	3.60 (.02)	3.54 (.02)*	3.31 (.02)*
Openness	−.04**	0.96 (0.90–1.02)	3.58 (.05)	3.57 (.01)	3.54 (.02)	3.52 (.02)*
Aesthetics	−.06**	0.92 (0.85–0.99)*	3.37 (.06)	3.40 (.02)	3.33 (.02)*	3.31 (.02)*
Ideas	−.04*	0.93 (0.84–1.03)	3.62 (.05)	3.59 (.02)	3.57 (.02)	3.55 (.02)
Agreeableness	−.02	0.95 (0.89–1.01)	3.80 (.05)	3.82 (.02)	3.81 (.02)	3.78 (.02)
Altruism	−.02	0.91 (0.83–0.99)*	3.88 (.05)	3.88 (.02)	3.91 (.02)	3.85 (.02)
Compliance	−.01	0.99 (0.91–1.07)	3.72 (.06)	3.73 (.02)	3.71 (.02)	3.71 (.02)
Conscientiousness	−.11**	0.79 (0.74–0.84)**	3.81 (.05)	3.91 (.02)	3.84 (.02)*	3.72 (.02)*
Order	−.07**	0.87 (0.82–0.92)**	3.47 (.08)	3.58 (.02)	3.45 (.03)*	3.36 (.03)*
Self-Discipline	−.12**	0.70 (0.64–0.76)**	3.81 (.05)	3.91 (.02)	3.85 (.02)*	3.72 (.02)*
Sample size	5,067	5,067 (1623 obese)	164	1,713	1,567	1,623

Note. Coefficients are standardized beta coefficients (β-BMI) or standardized odds ratios (95% confidence intervals) (OR-obesity). The means (standard errors) are estimated marginal means from the MANCOVA controlling for age, sex, ethnicity, and education. BMI=body mass index.

* $p<.05$.

** $p<.01$.

Table 3

Results from Linear Regressions Predicting Behavioral Factors from Personality

	Physical Activity	Diet		Eating Behavior			
		Healthy	Convenience	Regular Intervals	Same Time	Snacks	Over eat
Demographics							
Age	−.04**	.00	−.24**	.12**	.13**	−.09**	−.33**
Sex (Female)	−.01	.08**	−.11**	.04**	−.03*	.06**	−.06**
Education	.22**	.22**	−.01	.21**	.19**	.03	.04**
Ethnicity (Black)	.01	−.00	.00	−.08**	−.10**	−.00	−.05**
Ethnicity (Hispanic)	.01	.03*	.00	−.04**	−.02	−.04*	.02
Ethnicity (Other)	−.01	.03*	−.00	−.03*	−.02	.00	.03
Personality							
Neuroticism	−.16**	−.11**	.13**	−.15**	−.14**	.07**	.20**
Anxiety	−.16**	−.13**	.08**	−.14**	−.13**	.04**	.15**
Depression	−.11**	−.02	.20**	−.13**	−.11**	.10**	.25**
Extraversion	.17**	.19**	.02	.10**	−.06**	.01	−.01
Assertiveness	.08**	.10**	.01	.05**	.01	−.01	−.02
Activity	.28**	.26**	.01	.16**	.15**	.03	.01
Openness	.18**	.21**	−.03	.14**	.08**	.04**	−.09**
Aesthetics	.14**	.16**	−.06**	.12**	.08**	.02	−.08**
Ideas	.17**	.18**	−.02	.12**	.05**	.05**	−.08**
Agreeableness	.10**	.06**	−.11**	.13**	.10**	−.01	−.26**
Altruism	.11**	.11**	−.04**	.13**	.11**	.03*	−.15**
Compliance	.03*	−.03*	−.15**	.08**	.04*	−.05**	−.29**
Conscientiousness	.16**	.11**	−.15**	.18**	.17**	−.01	−.30**
Order	.04**	−.04**	−.19**	.07**	.08**	−.07**	−.30**
Self-Discipline	.18**	.14**	−.13**	.19**	.18**	−.01	−.27**

	Physical Activity	Diet		Eating Behavior			
		Healthy	Convenience	Regular Intervals	Same Time	Snacks	Over eat
Body mass index	−.19**	−.12**	.10**	−.08**	−.11**	−.01	.05**

Note. *N*=5,150. Coefficients are standardized beta coefficients.

* $p<.05$.

** $p<.01$.

Table 4

Indirect Effects of the Behavioral Factors on the Relation between Personality and Body Mass Index

	Product of Coefficients	BC 95% CI	
	Point Estimate	Lower	Upper
Neuroticism			
Physical Activity	.21*	.16	.27
Healthy Food	.05*	.02	.08
Convenience Food	.10*	.06	.15
Regular Intervals	−.04	−.09	.01
Same Time	.09*	.04	.14
Snacks	−.01	−.02	.01
Overeat	.04	−.01	.10
Total	.45*	.36	.54
Extraversion			
Physical Activity	−.26*	−.33	−.20
Healthy Food	−.10*	−.16	−.04
Convenience Food	.02	−.01	.04
Regular Intervals	.03	−.01	.07
Same Time	−.05*	−.08	−.02
Snacks	.00	−.01	.00
Overeat	.00	−.01	.01
Total	−.36*	−.45	−.27
Openness			
Physical Activity	−.34*	−.43	−.26
Healthy Food	−.15*	−.23	−.06
Convenience Food	−.02	−.04	.00
Regular Intervals	.04	−.02	.10
Same Time	−.06*	−.11	−.03
Snacks	.00	−.02	.01
Overeat	−.04*	−.08	−.01
Total	−.57*	−.70	−.45
Conscientiousness			
Physical Activity	−.25*	−.33	−.19
Healthy Food	−.06*	−.10	−.02
Convenience Food	−.14*	−.20	−.09
Regular Intervals	.06	−.01	.13
Same Time	−.12*	−.19	−.06
Snacks	.00	.00	.01
Overeat	−.05	−.15	.06

	Product of Coefficients	BC 95% CI	
	Point Estimate	Lower	Upper
Total	−.55*	−.70	−.42

Note. *N*=5,067. Coefficients are standardized estimates from the boot-strap analysis (*n*=5000 samples).

* *p*<.05.

** *p*<.01.