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NEO personality domains and gender predict levels and trends in body mass index over 14 years during midlife ☆

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Abstract

Mixed models were used to examine NEO-PI scores as predictors of body mass index (BMI) over a 14 year period during midlife. Average BMI levels during midlife were positively related to Neuroticism and negatively related to Openness, Agreeableness, and Conscientiousness. Relations for three domains were modified by gender. Neuroticism was significantly related to BMI in females only. Extraversion was positively related to BMI in males, whereas, this relation was non-significant in females. The relation between Conscientiousness and BMI was significant in males and females, however, the magnitude of the negative association was stronger in females. Conscientiousness also predicted change in BMI during midlife such that participants who were lower in Conscientiousness tended to show larger gains in BMI with age.
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1. Introduction

Obesity has recently reached epidemic proportions in the United States (National Institutes of Health/National Heart, 1988), with current estimates suggesting that 55% of the adult population in the US are overweight or obese (Wadden, Brownell, & Foster, 2002). Although genes are currently believed to account for 25–40% of the individual variation in body mass, environmental and behavioral pathways also are important contributors (Bray, 1998; Corsica & Perri, 2003).

Evidence from a large body of research suggests that personality characteristics influence physical and mental health (Smith & Gallo, 2001). A good deal of research has focused on personality as a predictor of weight loss in clinically obese samples (Fontaine & Cheskin, 1999; Holt, Clark, & Kreuter, 2001). Few studies, however, have explored the relation between personality traits and weight in non-clinical population samples. In addition, studies that have used non-clinical samples have often relied on non-standardized or infrequently used measures of personality. Results from the studies that have addressed these concerns suggest that personality and weight are related. For example, findings reported from a subsample of 1081 males from the Normative Aging Study (Ekerdt, 1987), a longitudinal study of community-dwelling men born between 1884 and 1945, have shown that Minnesota Multiphasic Personality Inventory ratings of repression and general maladjustment were associated with BMI (Niaura et al., 2003). Repression was negatively associated with BMI, whereas maladjustment was positively associated with BMI. In addition, results from a cross-sectional study using a British population-based sample (Faith, Flint, Fairburn, Goodwin, & Allison, 2001) found that BMI was related to measures of personality gathered using the Eysenck Personality Inventory. Specifically, Faith et al. found that BMI was positively associated with neuroticism and negatively correlated with extraversion for females, and was positively associated with extraversion and psychoticism for males.

Another important issue with respect to fully understanding associations among personality and health behavior concerns the availability of repeated measures of behavior. Although prediction of health endpoints is an important and useful approach to assessing the relation between behavior and disease, it offers little information regarding the causal order underlying the association. In contrast the use of repeated measures with observational data allows somewhat stronger inference in this regard, although, of course, not as firm as those made based on a fully randomized experiment.

It is also important to study health constructs during relevant periods of the life span (Smith & Spiro, 2002). The period of midlife offers an interesting time to examine the association between personality and BMI, as personality has reached rank-order stability across individuals by middle age (Roberts & DelVecchio, 2000), while

weight generally increases throughout this period (http://www.cdc.gov/nchs/data/hus/tables/2002/02hus070.pdf). Furthermore, midlife is a time when the frequency of chronic illnesses begins to rise and noticeable health-related changes begin to occur (Merril & Verbrugge, 1999; Siegler, Kaplan, Von Dras, & Mark, 1999), such as the detection of clinically significant cardiovascular disease for men and the onset of menopause for women. Because significant changes in weight during midlife may affect the processes underlying the development of such illnesses, the examination of BMI changes during midlife may be particularly important.

Given the associations between the personality characteristics, health behavior, and BMI, it is possible to offer some plausible hypotheses regarding the direction of specific personality and BMI associations. Research conducted by Friedman et al. (1995) on the Terman Life Cycle Study—a longitudinal study spanning seven decades collected on 1528 gifted children who attended public school in California during the 1920s—suggests that childhood unconscientiousness is related to unhealthy behaviors (e.g., smoking and alcohol consumption). Related research on diabetic patients demonstrated that higher conscientiousness scores, measured using the NEO-PI-R, were associated with longer time to renal failure (Brickman, Yount, Blaney, & Rothberg, 1996). Thus, conscientious individuals who are more goal directed, disciplined, and persistent with respect to dietary practices and exercise habits may be expected to have lower levels of BMI. Furthermore, higher levels of competency, a facet of the conscientiousness personality domain, may lead to positive attitudes and behaviors regarding the management and control of one's weight, which in turn would be associated with lower BMI. Finally, the trait of openness to experience might lead an individual along epicurean paths that might result in weight gain in the pursuit of novel gustatory experiences.

There are numerous reasons to examine gender as a moderator of the relation between personality and BMI. For one, menopause may play a role in influencing BMI in woman during middle age, which of course would not be the case for men (Matthews et al., 2001). It has also been shown that the social meaning of body weight is decidedly different between the sexes, with a much greater stigma attached to being overweight among women than men (Brownell, 1991; Friedman & Brownell, 1995). Lastly, prior findings by Faith et al. (2001) demonstrated gender differences. Thus, we broadly hypothesize that gender differences exist with respect to personality and BMI relations. Second, also based on the findings of Faith et al. (2001), we specifically hypothesize that BMI will be positively associated with neuroticism in females and that this relation will be trivial in males. Third, we expect that the greater sociability and activity of high extraversion will be negatively related to BMI in females and positively associated with BMI in males.

The University of North Carolina Alumni Heart Study (UNCAHS) is well-suited to test the above hypotheses and to extend the present literature on the relation between BMI and personality: it includes data from the well-validated NEO-PI (Costa & McCrae, 1985) collected in a non-clinical sample, and contains adequate numbers of males and females to assess the influence of gender. Finally, and perhaps most importantly, it is a prospective study that includes four repeated measures of BMI collected over 14 years during midlife.

2. Methods

2.1. Participants

The UNCAHS is an ongoing prospective study of the associations of psychosocial risk factors with health and disease during midlife. This study started its prospective data collection in 1986–1987 when UNCAHS alumni were in their early forties. Members of the entering classes of 1964–1966 at the University of North Carolina at Chapel Hill (UNC) who had taken the Minnesota Multiphasic Personality Inventory (Hathaway & McKinley, 1943) upon admission to the university were located and invited to join the study. Thus, this sample reflects the sociodemographic characteristics of the UNC student population in the 1960s, i.e., it consists of primarily college educated male Caucasians, with minority enrollment less than 1%. The data for this study were collected by mailed questionnaires. A more detailed description of study and sample characteristics is available in prior publications (Costa, Herbst, McCrae, & Siegler, 2000; Siegler et al., 1992a, 2003; Siegler, Peterson, Barefoot, & Williams, 1992b). Personality was assessed in 1988 (baseline) and BMI in 1989, 1992, 1994, and 2002. UNCAHS respondents were included in the present study if they had complete assessment of personality at baseline and assessment of BMI in 1989. This resulted in a sample of 3401 participants, of whom 95.1% remain in the study to date (2.0% dropped out, 2.7% have died, and 0.2% are lost to follow-up). The available sample size at each assessment period was: 3401, 2995, 2890, and 2402, respectively. The mean age of participants at baseline was 41.6 years (*SD* 1.5; range 39–49). The number of participants who had four complete assessments was 1950, three complete assessments, 837, and two complete assessments, 329.

2.2. Measures

2.2.1. BMI

BMI, an accepted clinical measure for evaluation of obesity, is expressed as weight in kilograms divided by height in meters squared (kg/m^2) (Bray, 1998). Height and weight measurements for calculation of BMI were collected at study waves 3, 5, 6, and 9. Participants were asked to report their current weight in pounds and their height in feet and inches.

2.2.2. NEO personality assessment

The NEO-PI is comprised of 180 items that assess the five personality domains of Neuroticism (N), Extraversion (E), Openness (O), Agreeableness (A), and Conscientiousness (C), (48 items each for N, E, and O, and 18 items each for A and C) (Costa & McCrae, 1992). The NEO-PI contained six facet scales only for the N, E, and O domains. The Revised NEO-PI added six facet scales for A and C (Costa & McCrae, 1992). The following are descriptive characteristics associated with each of the five personality domains: (1) Neuroticism = anxiety, irritability, worry, and low self-confidence, (2) Extraversion = energy, enthusiasm, sociable, and pleasure-seeking, (3) Openness = imaginative, adventurous, imaginative, and spontaneous, (4)

Agreeableness = trusting, gentle, warm, and sympathetic, and (5) Conscientiousness = efficient, thorough, organized, and industrious. NEO-PI items were converted to gender normed *T* scores for each domain, with higher scores reflecting the positive pole of that specific personality construct. The NEO-PI has been shown to be a valid and reliable assessment tool (Botwin, 1996; Leong & Dollinger, 1990; Widiger, 1992).

2.2.3. Gender and age

Age at time of assessment for each participant was represented in years. Gender was coded 0 = female, 1 = male.

2.3. Analytic plan

Individual growth curve models (mixed, or random effects models) were used to quantify the effects of each personality domain on average BMI levels during midlife and on the change in BMI as participants aged. In the present analyses, a continuous measure of BMI (at four time points) served as the repeated outcome. NEO-PI domains of N, E, O, A, and C, were modeled as predictor variables. Gender was included as a covariate in all models. Age was centered at 42 years (the average age at baseline) (Mehta & West, 2000), thus the parameter estimates for models without higher order terms (i.e., interactions) can be interpreted as the effect of the given predictor on the level of BMI at age 42 (the intercept).

Initially, main effects models were estimated. These models examined the effects of predictor variables on the intercept (i.e., the average level of BMI at the intercept). Five main effects models were estimated, with each model containing a measure of one of the five personality domains, gender, and a measure representing age at a given assessment time. Each of the five models were initially fitted with the addition of a quadratic term (age-squared) to examine the potential for a non-linear effect of age on BMI. In models where the quadratic term did not reach statistical significance ($p > .05$), the model was re-estimated excluding this term.

In our second set of analyses, interactions of gender by personality were included in the above models. These models examined the potential of gender to modify the effect of personality on the level of BMI at the intercept.

Our third set of analyses consisted of interaction models that examined the effects of personality and gender as predictors of linear change in BMI (i.e., predictors of the slope of BMI across the aging process). Initial models examined two-way interactions and included (1) effects of age, gender, and personality (either N, E, O, A, or C), and (2) two-way interaction terms of age × gender, and age × personality as predictors of the change in BMI. Finally, the last set of models examined age × gender × personality interaction terms as predictors of change. These models contained all main effects and all two- and three-way terms.

The analyses were carried out using PROC MIXED in SAS version 8.0. Predictors measured as continuous variables were scaled so that the regression coefficients compare a typical participant at the 75th percentile of the distribution with one at the 25th percentile (Harrell, 2001). Scaling the continuous predictors by their interquartile range (i.e., 75th vs 25th percentile) is a growing convention in biostatistical

modeling. It affords not only a convenient set of prediction values for interpreting fitted interactions, but also provides a meaningful scale for interpreting the regression coefficients themselves. The regression coefficient for a main effect of, say, Neuroticism, is the expected difference in BMI for a patient in the middle of the upper half of the Neuroticism distribution compared to a patient in the middle of the lower half of the Neuroticism distribution. Using this approach also guarantees that the scaling will be based on realistic values regardless of the shape of the predictor's distribution. In contrast, a choice such as a standard deviation change can yield unlikely, if not impossible values if the distribution of the predictor is highly skewed. Outliers for BMI were trimmed a priori (i.e., without looking at model results) by replacing their values with the 99th percentile value. Results were similar with and without the trimming.

3. Results

3.1. Descriptive findings

Table 1 presents characteristics of the present sample and shows that for each of the personality domains the means are generally at the level of population norms (i.e., *T*-score of 50, *SD* 10). Table 2 provides information regarding the mean levels of BMI, as well as the percentage of individuals who were underweight, normal weight, overweight, and obese across the four waves of data collection. The present findings replicate current trends that indicate a large percentage of the adult population are overweight or obese. In the current sample, roughly 20% of the females and 45% of the males reported BMI values suggesting they were overweight during midlife. Similarly, approximately 11% of the females and 12% of the males reported values indicating obesity during this time period. As can be seen in Table 2, the means for BMI generally increase across assessment time, with an average of 1.6 kg/m^2 difference from 1989 to 2002 for males, and 2.5 for females. To better understand the magnitude

Table 1
Characteristics of study sample

Characteristic	
Gender, number (%) male	2701 (79.4)
Education, number (%) college degree or beyond	3146 (92.5)
Race, number (%) Caucasian	3387 (99.6)
Marital Status, number (%) married in 1989	2700 (79.8)
Age in 1988 (baseline), mean (*SD*)	41.6 (1.5)
NEO-PI domains, means (SD) by gender	female/male
Neuroticism	51.5 (9.6)/50.7 (10.9)
Extraversion	51.1 (10.8)/54.1 (9.9)
Openness	53.3 (9.7)/53.1 (10.5)
Agreeableness	49.1 (9.6)/49.6 (10.0)
Conscientiousness	49.9 (9.6)/50.9 (10.4)

Table 2
Levels of BMI by gender over follow-up

Time of follow-up	3 (1989) $n = 3401$	5 (1992) $n = 2995$	6 (1994) $n = 2890$	9 (2002) $n = 2402$
Females				
BMI, mean (*SD*)	23.0 (4.0)	23.7 (4.2)	24.1 (4.4)	25.5 (5.0)
Age, mean (*SD*)	42.9 (1.7)	46.2 (1.7)	47.6 (1.7)	54.8 (1.7)
Percent[a]				
Underweight	4.3	3.3	3.5	1.0
Normal weight	73.4	70.8	67.7	54.8
Over weight	15.3	17.3	17.9	28.4
Obese	7.0	8.6	10.9	15.8
Males				
BMI, mean (*SD*)	25.4 (3.2)	25.9 (3.4)	25.9 (3.4)	27.0 (3.9)
Age, mean (*SD*)	42.9 (1.3)	46.3 (1.3)	47.6 (1.3)	54.9 (1.3)
Percent[a]				
Underweight	0.3	0.3	0.4	0.3
Normal weight	49.8	44.5	43.0	32.1
Over weight	42.0	44.2	45.4	49.6
Obese	8.0	11.0	11.2	18.0

Note. National norms (non-Hispanic white), based on data collected from 1988 to 1994: males normal weight 38.1%, overweight 40.7%, obese 20.3%; and females normal weight 49.2%, overweight 24.8, obese 23.1 (http://www.cdc.gov/nchs/data/nhanes/databriefs/adultweight.pdf).

[a] Underweight BMI < 18.5; Normal BMI 18.5–24.9; overweight BMI 25.0–29.9; obese BMI $\geqslant$ 30.0.

of these differences, a 1-point kg/m^2 increase in BMI translates roughly into a gain of 5 pounds of body weight. Thus, on average male participants gained 8 pounds from 1989 to 2002, and females gained 12.5 pounds. The correlation coefficients among the measures of BMI across assessment periods ranged from $r = .83$ to .94.

Table 3 presents the Pearson correlation coefficients of BMI at each assessment period and each personality domain, by gender. Among females, positive and modest to moderate statistically significant correlations were found between BMI and Neuroticism, whereas, BMI was negatively related to Conscientiousness at each assessment time. The remainder of correlations among BMI and personality domains, in females, were non-significant. The pattern of correlations was somewhat different for males, with modest positive associations among BMI and Extraversion, and modest negative associations between BMI and the domains of Agreeableness and Conscientiousness. With the exception of a negative correlation between BMI and Openness in 1989, none of the other relations between BMI and the domains of Neuroticism or Openness were significant.

3.2. Independent effects of age, gender, and personality on average level of BMI

Table 4 presents results from the models conducted to examine the main effects of age, gender, and personality as predictors of the average level of BMI during midlife. We initially included a quadratic term for age in each of our main effects models. This term did not approach significance in any of the models (p's > .45) and thus was removed. With the exception of Extraversion, each of the personality domains was

Table 3
Pearson correlation coefficients among BMI at each assessment and each personality domain, by gender

	BMI			
	1989	1992	1994	2002
Females				
N	0.19**	0.20**	0.17**	0.12**
E	−0.06	−0.06	−0.06	−0.03
O	−0.01	−0.01	0.01	0.01
A	−0.07	−0.04	−0.04	−0.04
C	−0.20**	−0.15**	−0.16**	−0.10*
Males				
N	0.04	0.04	0.04	0.06
E	0.05**	0.05*	0.06**	0.04
O	−0.05*	−0.04	−0.02	−0.01
A	−0.07**	−0.07**	−0.08**	−0.07**
C	−0.06**	−0.07**	−0.09**	−0.10**

Note. Because 79% of the sample are males, correspondence of significance level and magnitude of correlation will vary by gender.

* $p < .05$.

** $p < .01$.

Table 4
Effects for age, gender, and personality as predictors of average level of BMI during midlife

Personality	Intercept β (p)	Age β (p)	Male β (p)	Personality β (p)	Personality × Gender β (p)
Neuroticism	24.23 (.001)	0.15 (.001)	2.37 (.001)	0.30 (.001)	−0.94 (.001)
Extraversion	24.83 (.001)	0.15 (.001)	2.33 (.001)	0.11 (.130)	0.47 (.007)
Openness[a]	26.00 (.001)	0.15 (.001)	2.35 (.001)	−0.19 (.020)	−0.02 (.919)
Agreeableness[a]	26.40 (.001)	0.15 (.001)	2.36 (.001)	−0.26 (.001)	0.02 (.907)
Conscientiousness	26.77 (.001)	0.15 (.001)	2.38 (.001)	−0.36 (.001)	0.75 (.001)

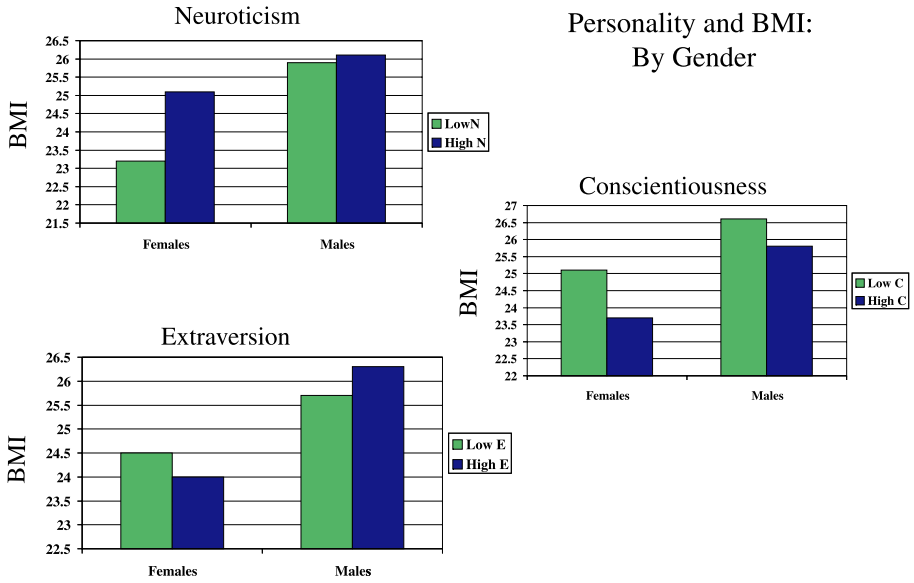
Note. A quadratic term for Age was initially included in each model but in each case this term was non-significant (p's > .45) and therefore was removed. Predictors measured as continuous variables were scaled so that the parameter estimates compare a typical patient at the 75th percentile of the distribution with one at the 25th percentile.

[a] Parameters estimates for columns 1–4 are from main effects-only models, (i.e., the personality × gender interaction term was removed).

significantly related to the average level of BMI. Neuroticism was positively related to BMI, whereas, Openness, Agreeableness, and Conscientiousness were negatively related to BMI. Age was linearly associated with an increase in BMI. Gender was also related to BMI such that females tended to have lower average levels of BMI during midlife, as compared to males.

3.3. Joint effects of personality and gender on average levels of BMI

Table 4 (column 5) also presents the results from models conducted to examine personality × gender interactions as predictors of the average level of BMI during



High and Low Compare Participant at bottom 25% with Participant at top 75% of the Distribution

Fig. 1. Gender as a modifier of the effects of personality on average level of BMI during midlife.

midlife. The relation between personality and BMI differed by gender for the domains of Neuroticism, Extraversion, and Conscientiousness (see Fig. 1). We illustrate these differences in Fig. 1 by displaying the unadjusted mean BMI for men and women at low and high levels of the personality trait. Neuroticism was significantly related to BMI among females, whereas, this relation was smaller and non-significant among men (mean BMI for females low N = 23.2, high N = 25.1; for males low N = 25.9, high N = 26.1). The relation between BMI and Extraversion was negative and non-significant in females (mean BMI low E = 24.5, high E = 24.0), whereas BMI was significantly related to Extraversion in a positive direction in males (mean BMI low E = 25.7, high E = 26.3). Conscientiousness was significantly related to BMI for both males and females, however, the magnitude of this negative association was stronger in females, as compared to males (mean BMI for females low C = 25.1, high C = 23.7; for males low C = 26.6, high C = 25.8).

3.4. Effects of personality and gender on linear change in BMI

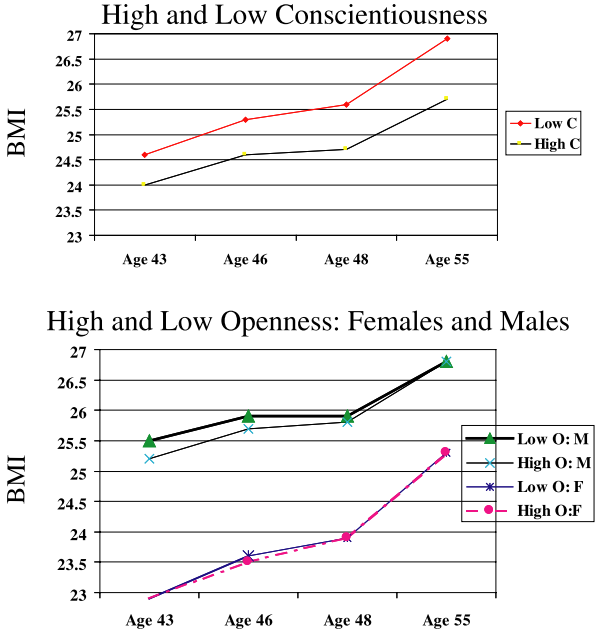
Table 5 presents the results of models that examined personality and gender as predictors of linear change in BMI. With respect to two-way terms for personality, there was a significant conscientiousness × age interaction, such that the effect of Conscientiousness tended to increase as participants aged (see Fig. 2). The remaining personality × age interaction terms were non-significant. Age × gender interaction terms were significant in all models, indicating that females gained more in BMI as they grew older, as compared to males.

Table 5
Predictors of linear change in BMI during midlife

Personality	Age × Personality β (p)	Age × Gender β (p)	Age × Gender × Personality β (p)
Neuroticism[a]	0.001 (.744)	−0.073 (.001)	0.012 (.348)
Extraversion[a]	0.005 (.316)	−0.075 (.001)	−0.015 (.180)
Openness	0.010 (.070)	−0.074 (.001)	−0.040 (.004)
Agreeableness[a]	0.003 (.465)	−0.074 (.001)	−0.010 (.373)
Conscientiousness[a]	−0.010 (.037)	−0.073 (.001)	−0.004 (.723)

Note. Predictors measured as continuous variables were scaled so that the parameter estimates compare a typical person at the 75th percentile of the distribution with one at the 25th percentile.

[a] Parameter estimates for columns 1 and 2 are taken from models without three-way interaction (i.e., the age × personality × gender term was removed).



High and Low Compare Participant at bottom 25% with Participant at top 75% of the Distribution
Note: Ages listed are the mean age at study waves 3, 5, 6, and 9.

Fig. 2. Personality and change in BMI.

Finally, there was a significant age × personality × gender interaction for the domain of Openness (β −0.04, $p < .004$). Plotting this interaction using the unadjusted means (see Fig. 2) revealed that the effect of Openness remained consistently small over time for women. In contrast, for men, the effect of Openness changed as they grew older–men high on Openness at age 42 had lower BMI than those who were low on Openness, but this difference diminished by the end of the follow-up period. The three-way interaction terms for the remaining four domains were non-significant.

4. Discussion

The present results suggest that personality is a predictor of BMI during middle age, findings that are in concordance with the small existing literature in this area. Moreover, our data replicate other results that indicate the importance of examining gender differences in this area. It is known that obesity disproportionately affects people–women in particular—of low income (Wadden et al., 2002). The high levels of overweight and obesity in the present sample, which consisted primarily of individuals who were of upper socioeconomic status, were therefore somewhat unexpected. Also surprising was that in the present sample the rates of overweight and obesity were lower for females than males.

Neuroticism was associated with higher average levels of BMI during midlife in UNCAHS participants. However, this association was modified by gender such that the relationship was only significant in females. An average female in the upper half of the distribution for Neuroticism had a 1.9 kg/m^2 higher level of BMI as compared to an average female in the lower half of the sample, a value that translates into roughly 10 pounds (4.6 kg). These gender differences are quite consistent with results from a cross-sectional population based study conducted in the United Kingdom (Faith et al., 2001) that used the Eysenck Personality Inventory to assess personality. Research has shown that the stigma of obesity is far greater in females than males, and that the vast majority of patients who seek treatment for obesity are female (Brownell & Wadden, 1991). It is possible that the increased feelings of anxiety, irritability, and depression that are core components of Neuroticism may lead to poor health habits in women. For example, these negative feelings may cause individuals to resort to palliative coping strategies such as eating and drinking more in the face of stress or routine demands (Speranza, Corcos, Atger, Paterniti, & Jeammet, 2003) and depressive mood may also affect dieting habits (Williams, Surwit, Babyak, & McCaskill, 1998). Likewise, negative emotions resulting from Neuroticism may result in generalized inactivity and/or failure to routinely exercise (Potgieter & Venter, 1995; Szabo, 1992). In addition, impulsiveness—a trait also associated with Neuroticism—may result in poor dietary control. Finally, although Neuroticism was associated with higher BMI among females in the present sample, this personality characteristic was not significantly related to linear change in BMI.

Men and women also differed with respect to the effect of Extraversion on BMI. Males who were higher in Extraversion tended to have higher BMI. For men, the attributes which characterize Extraversion, i.e., being sociable, adventurous, and pleasure-seeking may result in higher levels of BMI. It is not unreasonable to imagine that men who tend toward pleasure-seeking and gregariousness may have a higher caloric diet and/or may consume more alcohol. For women the opposite relation was true, Extraversion was associated with lower BMI. However, it is possible that this relation was not statistically significant owing to the smaller sample size for women, i.e., lower statistical power. Extraversion did not predict the amount of linear change in BMI for men or women.

Openness was negatively associated with the average level of BMI in the current sample, a finding that is contrary to what we hypothesized. However, further

examination of this relation revealed that this relation was somewhat complex. Openness was also significantly associated with the change in BMI during midlife, and this association with change differed by gender. For men, Openness was negatively associated with BMI at the initial wave of the study and this association decreased over follow-up. In females, however, Openness was only weakly related to BMI during the middle of midlife. Based on the small size of the effects for Openness, and the fact that the findings ran contrary to our expectations, we are hesitant to speculate regarding mechanisms underlying this association. However, there is some evidence that the facets of Openness are positively associated with healthy dietary practices that, in turn, may lead to lower BMI (Goldberg & Strycker, 2002).

Agreeableness was negatively associated with the average level of BMI for both males and females in the present sample. Although we know of no precedent for this finding, it is possible that a trusting and compliant nature may predispose middle-aged individuals to obey suggested guidelines with respect to health behaviors. Thus, these individuals may tend to follow the advice of physicians and relatives with respect to diet and exercise. Related research has shown that individuals who score high on a measure of social conformity self-report lower fat and sodium consumption (Yoe, Treloar, Marks, Heath, & Martin, 1997). In addition, research has shown that individuals who score higher on Agreeableness avoid meat fats and tend toward a generally healthy diet (Goldberg & Strycker, 2002). Finally, a measure of cynicism and aggressiveness—components of agreeableness—has been shown to predict BMI (Siegler et al., 1992b). Agreeableness was unrelated to the changes in BMI during middle age.

Conscientiousness was negatively associated with levels of BMI during midlife for both males and females, with participants in the upper quartile of this domain having an 0.9 kg/m^2 lower BMI level (roughly 4.5 pounds) compared to those in the lower quartile. In addition, higher scores on the domain of conscientiousness predicted less increase in BMI with age. Individuals who score high on this personality trait are characterized as being efficient, orderly, dutiful, and deliberate. A person who is highly conscientious may be more likely to have dietary habits and exercise habits that would help in maintaining a desired weight. For example, Goldberg and Strycker (2002) showed that conscientiousness is correlated with having a generally healthy diet, avoidance of fats, and substitution of low fats.

Apart from associations with personality, our findings also suggest that females in the present sample tended to have larger changes (increases) in BMI over the midlife years, as compared to males. On average, females gained 2.5 kg/m^2 BMI, as compared to 1.6 kg/m^2 for males. As noted earlier, the stigma associated with weight concerns disproportionally affects females (Brownell, 1991), giving added importance to research attempting to understand psychosocial constructs associated with BMI in females. It is also important to stress, however, that the stigma of obesity is associated with bias and discrimination in many important areas of life for both males and females, e.g., employment, and health care (Puhl & Brownell, 2003). Indeed, survey findings have shown that both females and males report that they would be willing to give up three or more years of their lives to be a desired weight (Garner, 1997).

Limitations exist with regard to the present findings. As previously mentioned, the UNCAHS is comprised of 99% Caucasian participants. Thus, because the UNCAHS does not represent a population based sample the present results may not replicate in more diverse populations. In addition, because this study was conducted in a large sample a few of the associations that were of minimal magnitude reached the traditional level of statistical significance (e.g., $r = .05$). Nevertheless, modest results often translate into sizable effects at the public health level. Also, we can not establish the degree to which personality influenced BMI compared to the degree to which BMI influenced personality. For example, Neuroticism in women may lead them to have eating habits that contribute to weight gain. High BMI's could also cause women to have emotional reactions consistent with high Neuroticism.

In conclusion, the current results suggest that personality is a significant predictor of an important health outcome—BMI. Numerous mechanisms may underlie the observed associations between BMI and personality seen in the present sample. The health behavior model suggests that dietary habits and exercise patterns may help explain these findings and extensive research has demonstrated associations between personality characteristics and important weight related health behaviors (Booth-Kewley & Vickers, 1994; Potgieter & Venter, 1995; Siegler et al., 1992b, 1997). Alternatively, genetic predispositions may link personality to weight during middle age (Yoe et al., 1997). Extensive research has been conducted in the area of weight loss intervention, however, what constitutes a highly effective strategy has yet to be determined. While it is clear that factors such as eating and exercise habits are relatively resistant to change, it is possible that improvement in this area may be enhanced by tailored interventions that take into account factors such as individual personality characteristics. In addition, the present findings underscore the notion that interventions aimed at weight loss should also consider the gender of the individual.

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