PERSONALITY Science

PsychOpen GOLD

Empirical

Check for updates

Body Mass in US Adolescents: Stronger Ties to Socioeconomic Status Than Personality

Sara Weston[1], Magdalena Leszko[2], David Condon[1]

[1] *Department of Psychology, University of Oregon, Eugene, OR, USA.* **[2]** *Institute of Psychology, University of Szczecin, Szczecin, Poland.*

Personality Science, 2023, Vol. 4, Article e7703, https://doi.org/10.5964/ps.7703

Received: 2021-10-20 • **Accepted:** 2022-06-20 • **Published (VoR):** 2023-03-08

Handling Editor: Markus Jokela, University of Helsinki, Helsinki, Finland

Reviewing: *Round 1* - Christian Hakulinen. Open reviews are available. [see Index of Supplementary Materials]

Corresponding Author: Sara Weston, Psychology Department, University of Oregon, 1451 Onyx St, Eugene, OR 97403 United States. E-mail: weston.sara@gmail.com

Supplementary Materials: Data, Materials, Preregistration [see Index of Supplementary Materials]

Abstract

It is unclear whether socio- and individual-factors are uniquely related to adolescent BMI or capture the same underlying process or whether environment amplifies relationships between traits and BMI. We estimated the independent contributions of SES and individual factors to BMI percentile in a sample of 9,481 US adolescents. Across all models, SES was significantly associated with lower BMI percentile scores. Controlling for SES, cognitive functioning was associated with lower BMI percentile (Girls: b = -1.32 [-2.10, -0.54], p = .001; Boys: b = -1.84 [-3.10, -0.53], p = .005). Among adolescent girls, Neuroticism (b = 1.75 [0.94, 2.52], p < .001) and related narrow traits, among others, were associated with BMI percentile. There were no consistent interactions between SES and personality. In holdout samples, the best performing models included SES, cognitive functioning, and narrow traits. While individual differences may contribute independently to BMI, their contribution is much smaller than that of SES.

Keywords

adolescence, body mass index, obesity, personality traits, socioeconomic status, narrow traits, cognitive functioning

Non-Technical Summary

Background

Personality, cognitive functioning and parental socioeconomic status (SES) have been previously linked to obesity in adolescents.

Why was this study done?

It's not clear whether these factors represent unique associations or are capturing the same process from different angles. For example, there are associations between SES and personality. It may be that when we find relationships between personality and obesity, these relationships are reflecting the relationship between SES and obesity. We also don't know the relative size of the contributions of personality and SES—does one have a stronger relationship with obesity than the other?

What did the researchers do and find?

The researchers found that the relationship between traits and BMI percentile in adolescents is, at least partially, unique and not explained by SES. SES too is uniquely associated with BMI percentile. Importantly, when we compare the relative size of these relationships, the SES effect size is substantially larger than the personality effect sizes.

What do these findings mean?

The unique associations between personality and BMI percentile suggest some possible interplay between obesity and personality in adolescents. It may be that adolescent personality leads to obesity-causing behaviors. However, it may also be that personality and obesity have shared genetic causes, or that one's BMI causes personality (e.g., through the way adolescents are treated in society). It is important that we found the association with SES to be substantially larger. If SES and personality cause obesity, then the larger effect size means SES has a bigger role in that process, and we might direct efforts to address obesity at SES rather than personality.

Relevance Statement

SES, cognitive functioning, and broad (Big Five) personality traits are associated with adolescent BMI, but it unclear to what extent these contributions overlap (e.g., whether these different associations result from shared variance between the predictors). This is consequential for understanding the mechanisms driving obesity in adolescents. Moreover, recent work in the field has highlighted the benefits for prediction and theory of examining personality through narrow trait or nuance frameworks. The current study addresses these questions using a large sample of US adolescence. Our findings suggest that while personality does have independent associations with BMI, the relative effect size is dwarfed by that of SES. Greater emphasis may be placed on developing interventions that break the SES-BMI connection, rather than interventions which either try to change personality or intervene on the personality-BMI link. In other words, SES-based interventions have greater potential impact on changing adolescent BMI. Moreover, we find that narrow traits improve prediction compared to broad traits, providing further evidence of the utility of narrow-trait frameworks and informing future work on personality and health.

Key Insights

- Individual factors (cognitive functioning and personality traits) have associations with adolescent BMI independent of SES, and these associations are not moderated by SES.
- Narrow traits contribute to better out-of-sample prediction of adolescent BMI than broad traits.
- The relative independent association of SES to adolescent BMI is substantially larger than the associations of individual factors to BMI.

Obesity is an international public health crisis (The Lancet Gastroenterology & Hepatology, 2021). Prominent social programs focused on this issue consider children and adolescents as populations that are ripe for intervention (Frieden et al., 2010). Adolescence is associated with considerable changes in body composition: all the main components of body composition increase during this period (Loomba-Albrecht & Styne, 2009). Moreover, this period is psychologically challenging. Many adolescents report body dissatisfaction, occasionally to the point of endorsing a profound dislike of one's own body (Neumark-Sztainer et al., 2010).

The primary aim of this work is to evaluate the wide range of individual differences contributing to elevated body mass index (BMI) across both sexes during adolescence. Numerous changes in BMI levels during adolescence are already well-documented, including several pointing to important sex differences, necessitating the use of age- and sex-specific norms (Bibiloni et al., 2013). There is some evidence that socioeconomic status (Anekwe et al., 2020; Claassen et al., 2019), personality (Vainik et al., 2019), and

cognitive functioning (Liang et al., 2014) are each protective factors for obesity; however, the independent variance of these attributes have rarely been considered or compared.

BMI and Socioeconomic Status

"Socioeconomic status" (SES) is an aggregate construct defined according to one's level of resources or prestige in relation to others (Krieger et al., 1997). While the operationalization of socioeconomic status is notably inconsistent, there is a consensus that SES includes education, income, and occupational prestige (Association for Psychological Science, 2022). Because children and adolescents are still in school, researchers typically use measures of parental education, parental occupation, and/or household income as markers of childhood SES (Shrewsbury & Wardle, 2008).

The inverse relationship between SES and BMI has been well-established. Importantly, mechanisms of this link do not appear to be behavioral: one systematic review of found conflicting evidence for the role of diet, activity, and sedentary behavior (Narciso et al., 2019), and interventions aimed at addressing these mechanisms have shown little-to-no impact on the obesity rates of adolescents (Flodgren et al., 2020). This suggests that the SES-obesity relationship among adolescents is largely structural, potentially driven by major differences in housing, transportation, workspaces, recreational activities, and psychological stress (Anekwe et al., 2020; Claassen et al., 2019).

BMI and Psychological Individual Differences

Previous studies found that individuals with lower levels of cognitive functioning have a higher BMI (Liang et al., 2014). Importantly, the association between these constructs has been shown to be independent of education (Kanazawa, 2013).

With respect to the Big Five personality traits, meta-analytic findings have suggested that only conscientiousness is consistently (negatively) associated with obesity across populations (Jokela et al., 2013), though a more recent meta-analysis (Vainik et al., 2019) indicates that BMI is also positively associated with neuroticism. Importantly, this work also provides evidence suggesting that BMI-personality associations are facet-specific and that facets may serve as more fruitful targets for designing personality-specific interventions.

This conclusion is complemented by more targeted investigations of trait neuroticism suggesting positive associations with both obesity (Vainik et al., 2019) and being underweight (Terracciano et al., 2009). Sutin and colleagues (2015) suggested this heterogeneity may result from different aspects of neuroticism contributing to different outcomes. That is, some facets of neuroticism may be associated with behaviors related to over-eating, while others may be associated with restriction or binging. More broadly, the aim of investigating facets and narrow traits aligns with recent calls to better describe personality-outcomes relationships (Mõttus et al., 2020).

Importantly, personality is largely believed to impact BMI through behavior (Sutin & Terracciano, 2016). Given the limited role of behavior described above in relationship to SES, it is unclear whether the impact of personality on obesity is as substantial as the impact of SES.

Relative Contributions of SES and Individual Differences to BMI

As described above, both individual (personality and cognitive functioning) and demographic (SES) factors are linked with adolescent BMI, yet it is unclear to what extent individual factors are associated with BMI independent of SES. This is in part due to substantive associations between these constructs (Shanahan et al., 2014). It should be noted that these associations are likely bidirectional. Certainly, across the lifespan, there is strong evidence of the effects of personality on adult SES. Research shows children's conscientiousness is a strong predictor of income and occupational status, even after controlling for IQ (Damian et al., 2015; Duckworth et al., 2012). Findings on other personality traits are inconsistent (Sutin et al., 2015).

A growing body of research has documented that SES predicts a variety of children's outcomes including physical health, cognitive functioning, and academic achievement (Adler & Rehkopf, 2008). A number of studies have demonstrated that low-SES children performed worse in working memory or executive attention tasks in comparison to high-SES children (C. Hughes et al., 2009; Leonard et al., 2015). SES also seems to have an important influence on children's school performance that is potentially independent of cognitive functioning (Conger & Donnellan, 2007).

In the context of BMI, it is unclear whether associations between individual differences and BMI are merely proxies of the SES-BMI relationship documented elsewhere. To better interpret the potential effect of personality, a comparison of the relative size of effects of personality and SES to BMI is warranted, as this can guide researchers and policymakers to prioritize constructs with the greatest influence.

SES as a Moderator of the Relationship Between Individual Differences and BMI

Further complicating the relationships between SES, individual differences, and BMI are person-situation transactions, which may change the relationship between individual differences and outcomes. SES specifically is known to moderate the relationship of individual differences to outcomes (Beck & Jackson, 2022). In most cases, individual differences matter more in low-SES environments (Damian et al., 2015; Shanahan et al., 2014; Sutin et al., 2013). For some trait-behavior relationships, however, socioeconomic status has no effect (c.f., Weston et al., 2019). A recent study found that personality-BMI associations were not explained by education (Jokela et al., 2013); however, it is unclear

whether SES may moderate the role of more narrow traits or whether a broader measure of SES—one that includes income and prestige—may yield different results.

The Present Study

In this study, we use a large sample of adolescents in the United States to examine the relationship between personality and cognitive functioning to BMI above and beyond the influence of SES; moreover, we examine whether the relationship between individual differences and BMI changes across socioeconomic strata. The current study aims to clarify the relationship between personality traits, cognitive functioning, SES, and BMI through the following methods: 1) examining both broad and narrow traits to better determine the aspects of personality which relate to BMI, 2) utilizing a measure of SES that accounts for both monetary resources and social status, and 3) using percentile assessments of BMI to account for developmental differences in weight. We expected higher SES to be associated with smaller BMI. We expected to find that adolescents with high BMI scores would also be higher in trait neuroticism, anxiety, and impulsivity, while lower in traits conscientiousness, intellect, self-control, adaptability, emotional stability, and cognitive functioning. Finally, we hypothesized that SES would moderate the relationship between cognitive functioning and BMI; we made no predictions regarding the interaction of SES with other individual differences (see Supplementary Materials).

Method

Participants

Data were collected through the SAPA-Project (www.sapa-project.org), a personality assessment website (Condon et al., 2017). Participants were administered up to 250 items assessing temperament (personality), interest, and cognition using a randomized, planned missingness design. As customized personality feedback was the motivation for completing the survey, 135 of the 250 items administered were the same for each participant (see below for more description of the personality measure). The remaining items administered were drawn at random from a larger pool of public-domain items. Participants were allowed to stop the survey at any time; data was only recorded from participants who completed at least 25 items.

Visitors to this website complete between 25 and 250 temperament, interest, and cognition items. Items are semi-randomly administered. For example, all participants during the collection period were presented all 135 items of the personality measure (see below) and items are presented in a random order. As compensation for participation, visitors are given free feedback on their personality, including their relative standing compared to past visitors.

Participants included 616,270 visitors to the website between February 2017 and July 2019. All visitors are volunteers; visitors are most likely to have found the website through a Google search related to personality assessment, although some likely came from referrals from friends and family. The subsample used for these analyses included all 9,481 adolescents between the ages of 11 and 17 (M = 15.88; SD = 1.28) living in the United States who self-reported their height and weight. In other words, all adolescents who provided the required information for BMI were included in this sample. (Supplementary Materials contains analyses investigating the potential bias resulting from height and weight missing not at random). More than half (68.8%) of the sample reported their biological sex as female. Respondents who selected "Other" and "Prefer not to answer" for biological sex were excluded as CDC BMI norms are unavailable for these categories. Descriptive statistics are presented in Table 1. This sample includes adolescents from all 50 states, and 61% of the sample identifies as White (see Supplementary Materials Chapter 2 for exact sample sizes for state and race/ethnicity).

Table 1

Descriptive Statistics of Key Demographic and BMI Variables by Sex

Variable	Female (N = 6,530)	Male (N = 2,951)
Age	15.85 (1.30)	15.95 (1.23)
BMI	23.07 (5.00)	22.84 (4.90)
BMI percentile	62.70 (27.61)	60.00 (30.53)
Height (cm)	163.12 (7.79)	176.01 (9.07)
Weight (kg)	61.39 (14.48)	70.89 (17.25)
Parent 1 Education	15.25 (3.58)	15.19 (3.64)
Parent 1 Income	61,625.23 (21,784.89)	61,476.02 (22,186.39)
Parent 1 Occupational Prestige	60.76 (14.64)	60.19 (15.21)
Parent 2 Education	14.62 (3.66)	14.71 (3.58)
Parent 2 Income	59,058.07 (22,926.91)	57,247.11 (22,364.35)
Parent 2 Occupational Prestige	57.87 (15.76)	57.07 (15.59)

Note. Standard deviations are shown in parentheses. Parent income and occupational prestige are estimated based on the occupational field reported.

Measures

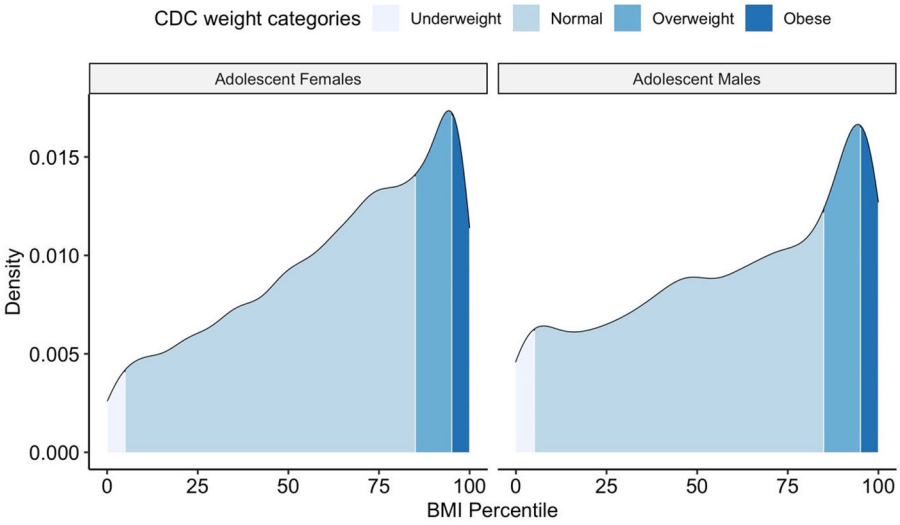
BMI Percentile

Self-reported height in inches (M = 65.80, SD = 4.00) was converted to meters, and self-reported weight in pounds (M = 141.85, SD = 35.29) was converted to kilograms. Participant BMI was then calculated by dividing kilograms to meters squared (M = 23.00, SD = 4.97). We chose not to use BMI score as our outcome, as the distribution of BMI tends to increase with development, meaning there is greater spread in BMI among older

adolescents compared to younger. To account for both sex- and age-related differences in the distribution of BMI, we calculated each participant's BMI percentile score based on the CDC norms for adolescents of that participant's age and self-reported biological sex (Centers for Disease Control & Prevention, 2015). BMI distribution in this sample was negatively skewed, although we have relatively large coverage across the entire range (Figure 1).

Figure 1

BMI Percentile Distributions by Sex



Personality

Personality traits were measured using the 135-item SAPA Personality Inventory (SPI-135; Condon, 2018). This framework can be used to estimate scores on both broad and narrow traits. The current study leverages this feature to evaluate the relationships of both broad and narrow traits to BMI category and compare the predictive validity of each.

Broad (Big Five) trait scores were estimated using a sum-score method, in which all non-missing responses to items in a scale (14 items per scale) were averaged. There was evidence of good reliability for each trait ($\alpha_{Extraversion}$ = .88; $\alpha_{Agreeableness}$ = .83; $\alpha_{Conscientiousness}$ = .81; $\alpha_{Neuroticism}$ = .86; $\alpha_{Openness}$ = .75). Narrow SPI-27 trait scores (5 items each) were estimated using an IRT-scoring approach. Calibration of the IRT parameters was performed using a separate sample (see Condon, 2018). Estimates were scaled using *t*-scoring, resulting in means of 50 and standard deviations of 10 for the entire adolescent sample.

Cognitive Functioning

Participants were administered between 12 and 16 cognitive functioning items assessing Three-Dimensional Rotation, Verbal Reasoning, Matrix Reasoning, and Letter and Number Series from the International Cognitive Ability Resource (ICAR; Condon & Revelle, 2014; Dworak et al., 2021). The ICAR measure has excellent validity, as it correlates highly (r's > .85) with standardized tests, including the subcomponents of the SAT, the ACT, and the GRE (Condon & Revelle, 2014) and with the WAIS-IV (Young & Keith, 2020). Trait scores were estimated using an IRT approach, in which participants' scores were calculating using discrimination and difficulty parameters estimated in a norming sample of more than 96,000 participants (Condon & Revelle, 2014). The reliability of this test is presented in Supplementary Materials Figure S1, which shows that reliability for this scale is above .75 for all scores within 3 standard deviations of the mean.

Parent Socioeconomic Status (SES)

Socioeconomic status is measured as a combination of education, income, and occupation, as defined by APS (Association for Psychological Science, 2022). Participants reported their parents' highest level(s) of education and occupational field(s). From the latter, we estimated income, based on median income for that field, and prestige, based on median prestige values for the field (B. Hughes et al., 2022); information for occupational field income and prestige came from the O*NET system maintained by the US Department of Labor. All estimates were standardized and averaged to create a composite score.[1]

Data Analysis

To assess the degree to which SES and individual differences are uniquely associated with BMI percentile, we used a multiple regression model. We estimated 33 versions of this model, with each model including both SES and either one personality trait or cognitive function. In addition, we fit each of these models with an interaction term, to estimate whether the relationship of personality to SES depends on parental socioeconomic status. Specific hypotheses were preregistered (see Supplementary Materials). Analyses were performed separately for adolescent boys and girls. All prediction variables were standardized within each sex sample prior to analysis, so coefficient estimates can be interpreted as standardized effect sizes.

All analyses described above were performed on a subset of our sample (the training sets) containing a random 75% of each sample, stratified by BMI category.[2] The remain-

1) As sensitivity analyses, we refit all models described using parental education as the single measure of parental SES. Effect sizes were nearly identical, and significance was largely unchanged. Overall, our conclusions are unaffected by including these estimates of occupational prestige and income. See full results in the Supplementary Materials.

ing 25% of the samples (the test sets) were used in exploratory analyses to estimate the total variability in BMI percentile that is accounted for by these variables. For these analyses the training sets were used to estimate lasso regression models containing (1) SES alone, (2) SES and cognitive functioning, (3) SES and personality, or (4) SES, cognitive functioning, and personality (different models were used to estimate the set of Big Five and Narrow 27 traits). Lasso regression—which stands for "least absolute shrinkage and section operator"—is a form of penalized regression that improves out-of-sample prediction by shrinking small coefficients to 0 (Tibshirani, 1996). These models were then used to predict outcomes in the test sets. The fit to the test data, as measured by the residual mean square error (RMSE) and R^2 values, was used to evaluate the relative contributions of SES, cognitive functioning, and personality to BMI percentile.

Results

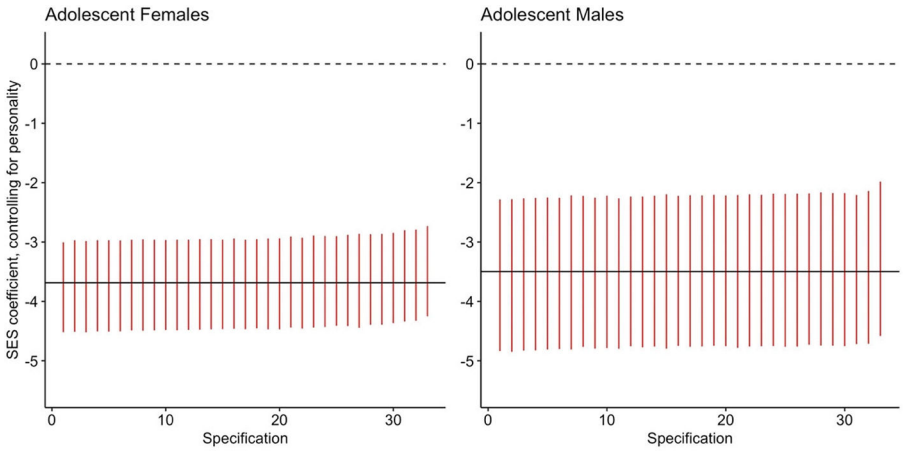
Is Socioeconomic Status Independently Associated With BMI Category?

We examined the partial regression coefficient of SES with BMI after controlling for individual differences. As hypothesized, higher parental SES was consistently significantly associated with lower BMI percentile for both adolescent girls and boys (all $p < .001$). On average, a one standard deviation increase in parental SES was associated with a 3.69 drop in BMI percentile among girls and a 3.50 drop in percentile among boys. This effect size appeared to be relatively homogenous across the models, suggesting that the relationship of SES to BMI was not attenuated or accentuated by controlling for specific personality traits. These results are summarized in Figure 2, which displays the SES coefficient estimate of each model. As a reminder, there are 33 models for each sex: each model regressed BMI percentile variable onto SES and one of the individual difference measures.

2) CDC guidelines specify weight category based on BMI percentile: Underweight (0–5%), Normal (5–85%), Overweight (85–95%), and Obese (95–100%). We use these categories for the purpose of stratifying participants when splitting the samples into testing and training subsets. However, we chose to use the percentile scores as the outcome of interest, as these categories are based on somewhat arbitrary cut-off values and heterogeneity in body fat composition and health outcomes within categories cast doubt on their utility. Supplementary Materials contain analyses using categories as outcomes, modeled using multinomial logistic regressions; few substantive differences in the results between the category outcome and percentile outcome were observed.

Figure 2

Summary of Models Testing the Relationship of SES to BMI Category in Adolescents



Note. SES is negatively associated with BMI percentile regardless of which individual difference measure is included in the model. Bars represent 95% confidence interval of the SES coefficient estimates. Each bar is a different model (i.e., controlling for a different trait).

Which Personality Traits Are Associated With BMI?

Next, we examined the coefficients associated with all traits—here referring to cognitive functioning, the Big Five, and the Narrow 27—in the models described above. In general, more traits had significant associations with BMI percentile for adolescent girls compared to boys. This is in part an issue of statistical power (there were more than twice as many girls as there were boys in the current sample), although we note that the sample of boys had 90% power to detect correlations as small as r = .06 and that effect sizes estimated in the sample of boys was smaller. All results are presented in Table 2 and represented visually in Figure 3.

Table 2

Results From Models Regressing BMI Percentile Onto Trait Scores and SES

	Female			Male		
	Additive Model	Joint Model		Additive Model	Joint Model	
Trait	Trait coefficient	Trait coefficient	Trait x SES coefficient	Trait coefficient	Trait coefficient	Trait x SES coefficient
Cognitive Ability	**-1.22***	**-1.22***	0.03	**-1.48***	**-1.47***	-0.09
	[-1.98, -0.45]	[-2.00, -0.45]	[-0.77, 0.82]	[-2.76, -0.17]	[-2.76, -0.16]	[-1.39, 1.21]
	p = .002	p = .002	p = .944	p = .025	p = .025	p = .893
SPI: Narrow 27						
Compassion	-0.23	-0.22	-0.39	-0.28	-0.27	-0.29
	[-1.02, 0.57]	[-1.02, 0.57]	[-1.17, 0.37]	[-1.61, 1.04]	[-1.60, 1.06]	[-1.61, 0.95]
	p = .564	p = .568	p = .304	p = .661	p = .676	p = .652
Irritability	**1.40***	**1.41***	0.14	**1.41***	**1.42***	0.57
	[0.64, 2.16]	[0.64, 2.16]	[-0.57, 0.87]	[0.12, 2.68]	[0.15, 2.70]	[-0.71, 1.82]
	p < .001	p < .001	p = .709	p = .030	p = .029	p = .385
Sociability	**-1.31***	**-1.31***	0.29	0.46	0.50	0.67
	[-2.12, -0.52]	[-2.12, -0.52]	[-0.48, 1.07]	[-0.84, 1.78]	[-0.81, 1.84]	[-0.64, 1.91]
	p = .001	p = .001	p = .457	p = .478	p = .441	p = .305
Well Being	**-2.77***	**-2.76***	0.85*	0.13	0.13	0.07
	[-3.56, -2.00]	[-3.55, -1.99]	[0.07, 1.61]	[-1.20, 1.46]	[-1.21, 1.47]	[-1.22, 1.35]
	p < .001	p < .001	p = .030	p = .846	p = .842	p = .905
Sensation Seeking	-0.66	-0.64	0.72	0.39	0.40	-0.90
	[-1.46, 0.13]	[-1.43, 0.15]	[-0.04, 1.50]	[-0.89, 1.66]	[-0.89, 1.66]	[-2.19, 0.40]
	p = .093	p = .104	p = .060	p = .548	p = .543	p = .173
Anxiety	**1.31***	**1.37***	-0.57	-0.35	-0.35	1.07
	[0.54, 2.12]	[0.59, 2.18]	[-1.38, 0.24]	[-1.65, 0.91]	[-1.65, 0.91]	[-0.18, 2.34]
	p = .001	p = .001	p = .157	p = .590	p = .588	p = .100
Honesty	**-0.95***	**-0.95***	0.21	-0.49	-0.51	0.68
	[-1.72, -0.19]	[-1.72, -0.19]	[-0.50, 0.92]	[-1.73, 0.80]	[-1.75, 0.78]	[-0.46, 1.80]
	p = .015	p = .016	p = .566	p = .450	p = .436	p = .257
Industry	**-0.77***	**-0.77***	-0.19	0.54	0.54	0.02
	[-1.54, 0.00]	[-1.54, 0.00]	[-0.94, 0.56]	[-0.71, 1.80]	[-0.73, 1.80]	[-1.24, 1.28]
	p = .050	p = .051	p = .622	p = .407	p = .411	p = .970
Intellect	-0.40	-0.41	-0.40	0.70	0.64	-0.92
	[-1.17, 0.37]	[-1.19, 0.36]	[-1.14, 0.32]	[-0.63, 2.04]	[-0.70, 1.96]	[-2.25, 0.44]
	p = .311	p = .292	p = .303	p = .284	p = .332	p = .153
Creativity	-0.24	-0.25	-0.06	0.12	0.12	-0.11
	[-1.03, 0.54]	[-1.03, 0.54]	[-0.83, 0.69]	[-1.19, 1.45]	[-1.20, 1.43]	[-1.46, 1.29]
	p = .533	p = .531	p = .886	p = .850	p = .857	p = .866

	Female			Male		
	Additive Model	Joint Model		Additive Model	Joint Model	
Trait	Trait coefficient	Trait coefficient	Trait x SES coefficient	Trait coefficient	Trait coefficient	Trait x SES coefficient
Impulsivity	0.74	0.74	0.31	0.30	0.30	-0.34
	[-0.04, 1.56]	[-0.05, 1.56]	[-0.47, 1.11]	[-1.02, 1.58]	[-1.02, 1.59]	[-1.69, 0.96]
	p = .060	p = .061	p = .434	p = .648	p = .646	p = .600
Attention Seeking	-0.69	-0.66	0.38	-0.13	-0.05	0.95
	[-1.50, 0.09]	[-1.47, 0.13]	[-0.38, 1.13]	[-1.47, 1.21]	[-1.40, 1.31]	[-0.33, 2.25]
	p = .079	p = .096	p = .334	p = .839	p = .942	p = .133
Order	-2.28*	-2.27*	-0.81*	-1.01	-0.99	-0.53
	[-3.03, -1.53]	[-3.01, -1.51]	[-1.56, -0.06]	[-2.29, 0.32]	[-2.27, 0.35]	[-1.80, 0.74]
	p < .001	p < .001	p = .036	p = .120	p = .129	p = .416
Authoritarianism	0.45	0.46	0.19	-0.08	-0.18	1.73*
	[-0.34, 1.26]	[-0.34, 1.26]	[-0.57, 0.98]	[-1.35, 1.16]	[-1.45, 1.05]	[0.47, 2.98]
	p = .247	p = .246	p = .607	p = .900	p = .785	p = .009
Charisma	0.28	0.28	0.31	**1.34***	**1.34***	-0.35
	[-0.51, 1.05]	[-0.51, 1.05]	[-0.43, 1.06]	[0.01, 2.67]	[0.02, 2.67]	[-1.72, 0.95]
	p = .475	p = .477	p = .425	p = .041	p = .040	p = .595
Trust	-0.30	-0.29	-0.24	-0.29	-0.33	0.35
	[-1.09, 0.51]	[-1.09, 0.50]	[-1.01, 0.53]	[-1.61, 1.02]	[-1.65, 0.99]	[-0.94, 1.60]
	p = .450	p = .453	p = .538	p = .651	p = .618	p = .594
Humor	**0.96***	**0.96***	-0.15	0.86	0.85	0.53
	[0.17, 1.78]	[0.16, 1.77]	[-0.87, 0.58]	[-0.44, 2.14]	[-0.45, 2.14]	[-0.82, 1.88]
	p = .014	p = .015	p = .677	p = .190	p = .195	p = .438
Emotional	-0.59	-0.59	0.07	-0.45	-0.48	0.75
Expressiveness	[-1.40, 0.19]	[-1.40, 0.19]	[-0.70, 0.85]	[-1.74, 0.81]	[-1.77, 0.78]	[-0.57, 2.05]
	p = .134	p = .133	p = .851	p = .487	p = .458	p = .272
Art Appreciation	-0.04	-0.04	-0.38	-0.11	-0.13	-0.65
	[-0.79, 0.71]	[-0.78, 0.71]	[-1.12, 0.34]	[-1.38, 1.13]	[-1.39, 1.11]	[-1.92, 0.58]
	p = .910	p = .915	p = .340	p = .863	p = .844	p = .319
Introspection	**-1.08***	**-1.09***	0.24	-0.38	-0.37	0.29
	[-1.83, -0.35]	[-1.84, -0.36]	[-0.50, 0.98]	[-1.66, 0.90]	[-1.65, 0.90]	[-0.94, 1.57]
	p = .006	p = .005	p = .537	p = .560	p = .570	p = .663
Perfectionism	-0.51	-0.52	-0.42	-1.40*	-1.39*	0.44
	[-1.30, 0.30]	[-1.31, 0.30]	[-1.16, 0.34]	[-2.72, -0.11]	[-2.71, -0.11]	[-0.78, 1.69]
	p = .191	p = .185	p = .269	p = .031	p = .032	p = .482
Self Control	-2.80*	-2.80*	0.02	-2.43*	-2.44*	1.09
	[-3.58, -2.02]	[-3.58, -2.02]	[-0.72, 0.75]	[-3.71, -1.19]	[-3.72, -1.20]	[-0.17, 2.36]
	p < .001	p < .001	p = .949	p < .001	p < .001	p = .094
Conformity	**0.86***	**0.86***	-0.08	0.37	0.37	0.02
	[0.09, 1.66]	[0.09, 1.66]	[-0.85, 0.67]	[-0.92, 1.64]	[-0.92, 1.64]	[-1.26, 1.26]

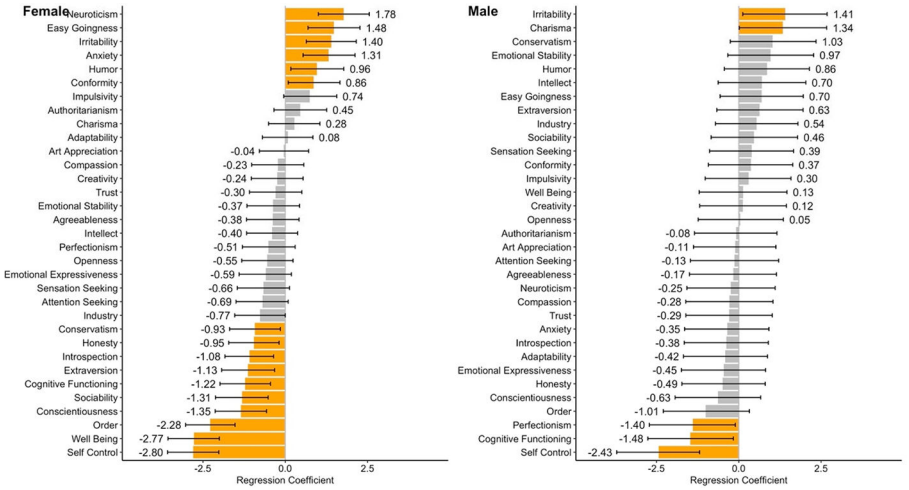
	Female			Male		
	Additive Model	Joint Model		Additive Model	Joint Model	
Trait	Trait coefficient	Trait coefficient	Trait x SES coefficient	Trait coefficient	Trait coefficient	Trait x SES coefficient
	p = .028	p = .028	p = .831	p = .568	p = .567	p = .981
Adaptability	0.08	0.08	0.28	-0.42	-0.42	0.43
	[-0.69, 0.84]	[-0.69, 0.85]	[-0.46, 1.02]	[-1.68, 0.87]	[-1.69, 0.87]	[-0.90, 1.70]
	p = .838	p = .836	p = .470	p = .523	p = .516	p = .520
Easy Goingness	**1.48***	**1.50***	-0.30	0.70	0.74	-0.76
	[0.69, 2.27]	[0.71, 2.29]	[-1.09, 0.46]	[-0.57, 1.96]	[-0.53, 2.01]	[-2.04, 0.52]
	p < .001	p < .001	p = .446	p = .287	p = .259	p = .252
Emotional Stability	-0.37	-0.37	0.38	0.97	0.92	-0.55
	[-1.16, 0.43]	[-1.16, 0.44]	[-0.40, 1.17]	[-0.33, 2.27]	[-0.38, 2.24]	[-1.83, 0.77]
	p = .345	p = .348	p = .329	p = .137	p = .158	p = .398
Conservatism	**-0.93***	**-0.97***	**0.97***	1.03	0.95	**1.61***
	[-1.69, -0.15]	[-1.74, -0.19]	[0.20, 1.74]	[-0.26, 2.35]	[-0.33, 2.26]	[0.31, 2.94]
	p = .018	p = .014	p = .013	p = .116	p = .147	p = .012
SPI: Big Five						
Agreeableness	-0.38	-0.37	-0.56	-0.17	-0.14	-0.24
	[-1.17, 0.42]	[-1.17, 0.43]	[-1.33, 0.23]	[-1.50, 1.14]	[-1.48, 1.17]	[-1.59, 1.03]
	p = .332	p = .345	p = .135	p = .797	p = .825	p = .715
Conscientiousness	**-1.35***	**-1.34***	-0.61	-0.63	-0.64	0.12
	[-2.13, -0.57]	[-2.12, -0.56]	[-1.39, 0.17]	[-1.94, 0.67]	[-1.94, 0.67]	[-1.11, 1.30]
	p = .001	p = .001	p = .119	p = .331	p = .327	p = .848
Extraversion	**-1.13***	**-1.16***	0.56	0.63	0.65	0.70
	[-1.93, -0.32]	[-1.95, -0.35]	[-0.19, 1.32]	[-0.67, 1.95]	[-0.64, 1.96]	[-0.63, 1.99]
	p = .004	p = .003	p = .162	p = .334	p = .320	p = .278
Neuroticism	**1.78***	**1.82***	-0.67	-0.25	-0.21	0.56
	[1.00, 2.55]	[1.04, 2.59]	[-1.43, 0.09]	[-1.58, 1.10]	[-1.54, 1.13]	[-0.73, 1.87]
	p < .001	p < .001	p = .090	p = .704	p = .748	p = .376
Openness	-0.55	-0.55	-0.07	0.05	-0.04	-0.90
	[-1.32, 0.24]	[-1.32, 0.24]	[-0.87, 0.73]	[-1.23, 1.35]	[-1.33, 1.25]	[-2.22, 0.41]
	p = .161	p = .160	p = .865	p = .943	p = .946	p = .167

Note. In the additive models, the trait score coefficient represents the association of personality and BMI above and beyond SES. In joint models, we include an interaction term between personality and SES; the trait coefficient represents the relationship of personality to BMI percentile at average levels of parental SES. Confidence intervals (95%) are bootstrapped (1000 repetitions, quantile method). Bold odds ratios indicate significance at p < .05.

*p < .05.

Figure 3

Associations Between Traits and BMI Percentile Above and Beyond SES



Note. Bars represent the coefficient of the personality trait, that is, controlling for SES. Bars are colored if they reach statistical significance ($p < .05$). 95% confidence intervals are indicated.

Adolescent girls who had larger BMI percentiles tended to be higher in Neuroticism (b = 1.78), as hypothesized. Notably, this corresponded with significant associations of BMI percentile and many narrow traits, such Well-Being (b = -2.77), Irritability (b = 1.40), and Anxiety (b = 1.31). (Only the last of these associations was hypothesized). In addition, adolescent girls with larger BMI percentiles also reported higher Easy-Goingness (b = 1.48), which may reflect a lack of physical activity. Similarly, there was a small association between Extraversion and lower BMI percentile (b = -1.13), corresponding with associations of BMI percentile to Sociability (b = -1.31), although girls with larger BMIs also tended to score higher on Humor (b = 0.96). As hypothesized, Conscientiousness was associated with lower BMI (b = -1.35); similarly, high BMI percentile was associated with lower levels of Industry (b = -0.77), Order (b = -2.28), Self-Control (b = -2.80), and Introspection (b = -1.08). Finally, cognitive functioning was negatively associated with BMI percentile (b = -1.22), as hypothesized.

There were no significant associations between BMI percentile and the Big Five traits among adolescent boys. Among the narrow traits, only Self Control (b = -2.43) and Perfectionism (b = -1.40) were negatively associated with BMI. In addition, boys with larger BMIs tended to score higher on Irritability (b = 1.41) and Charisma (b = 1.34). Again, cognitive functioning was negatively associated with BMI percentile (b = -1.48). Contrary to our hypotheses, the following traits were unassociated with BMI across sex: Impulsivity, Intellect, Adaptability, and Emotional Stability.

Does the Relationship of Personality to BMI Depend on SES?

By adding an interaction term to each of our 33 models, we tested the degree to which the relationship of personality to BMI category changes as a function of parental SES. As depicted in Table 2, the general finding was that the interaction terms were mainly non-significant, including the hypothesized SES-Cognitive Functioning interaction. Given the number of models tested, it is likely that statistically significant effects are due to sampling variability. In other words, when the null hypothesis is true, we expect to see statistically significant coefficients a small proportion (~5%) of the time due to random variability; we have no reason to believe the significant effects found herein are due to anything other than this random chance. However, we note that among both adolescent boys and girls, SES was a significant moderator of the Conservatism-BMI relationship. This finding is in line with the hypothesis that high levels of SES accentuate personality-outcomes associations. However, Conservatism is most strongly associated with BMI among adolescent girls when SES is low (and the direction of the association is negative), which runs counter to this hypothesis. Overall, given the limited number of significant interactions, we conclude that there is little support to suggest that personality-BMI associations are stronger or weaker for different levels of SES.

How Does Personality Contribute to the Accuracy of BMI Prediction Models?

These exploratory analyses make use of lasso regression models and a hold-out sample to evaluate the contributions of individual differences above and beyond SES. These results can be seen in Table 3. Among adolescent girls, SES accounted for approximately 2.2% of the variability (*RMSE* = 29.69) in BMI percentile. This was only slight improved by the inclusion of cognitive functioning (3.2%; *RMSE* = 29.56) but not at all by Big Five traits (2.2%; *RMSE* = 29.73). However, inclusion of the Narrow 27 traits improved prediction to 4.4% (*RMSE* = 29.47), nearly doubling out-of-sample prediction. Similar results were found for adolescent boys, with the exception that SES was slightly more strongly associated with BMI percentile to begin with, and the Narrow 27 provided a more modest increase to the R^2 value—a 22% change from .032 to .038.

Table 3

Accuracy in the Test Set of Models Including Combinations of Variables

	Adolescent Girls		Adolescent Boys	
Model	**RMSE**	**R^2**	**RMSE**	**R^2**
SES	29.69	.022	27.00	.032
SES + Cognitive Ability	29.56	.032	26.94	.036
SES + Big Five	29.73	.022	27.00	.030
SES + Narrow 27	29.47	.044	26.89	.038
SES + Cognitive Ability + Big Five	29.64	.031	26.95	.035
SES + Cognitive Ability + Narrow 27	29.41	.049	26.85	.041

Discussion

The current study examines the relative independent associations of psychological individual differences (cognitive functioning and personality traits) and socioeconomic status to adolescent BMI. We found large and consistent associations between parental SES and BMI, as well as notable associations between traits and BMI, especially for adolescent girls. There was little evidence that SES moderated the association of personality and BMI. Personality and SES independently contribute to the statistical prediction of BMI, although the relative contributions of these variables differed for adolescent boys and girls.

These findings are consistent with prior work documenting the inverse relationship between SES and BMI (Anekwe et al., 2020). We also replicate work linking higher BMI level to lower levels of cognitive functioning (Liang et al., 2014). Moreover, we demonstrate that higher levels of Conscientiousness and Order (adolescent girls), and Self-Control (all participants) are associated with a lower BMI, which is consistent with previous large-scale investigations (Jokela et al., 2013; Vainik et al., 2019). Similarly, we found a relatively strong relationship between a larger BMI and higher levels of Neuroticism, Anxiety, and Irritability among adolescent girls, consistent with work by Vainik and colleages (2019). Neuroticism and related narrow traits were unrelated to BMI among adolescent boys.

Narrow Traits

An important conclusion of our findings is that BMI is more strongly associated with narrow traits over broad ones. For example, only some narrow traits (Well-Being, Irritability, Anxiety) were associated with BMI in girls, while others (Adaptability, Emotional Stability) were not. These findings lends support to the notion that mixed findings for broader traits may reflect different associations of BMI to narrow traits (Sutin et al.,

2015; Vainik et al., 2019). Moreover, within the sample of adolescent girls, use of narrow compared to broad traits doubled out-of-sample prediction.

The current study contributes to a growing body of literature documenting the improved prediction of outcomes with the use of narrower measures including facets, narrow traits, and personality nuances (Mõttus et al., 2020). This improved prediction is complemented by greater potential for explanation: narrow traits more easily suggest mechanisms. For example, the associations of Anxiety and Irritability but not Adaptability among adolescent girls point to the roles of mood and emotion but not an inability to handle change. However, as we will note below, it is unclear whether the effects even of these narrow traits are substantive enough to warrant large-scale investment in interventions.

SES as Moderator

Prior work in other domains suggest that individual differences and cognitive ability play a greater role in outcomes for those who grew up in low-SES households (Beck & Jackson, 2022). However, we found no support for this hypothesis in terms of personality and BMI among adolescents. This extends prior work documenting the lack of moderation by education (Jokela et al., 2013) to a broader measure of SES and to relationships of narrow traits with BMI by adolescents. It is possible that amplified personality-BMI relationships do not manifest until adulthood, at which point people have more control over their lives and livelihood. Indeed, much of the work examining the moderation of SES focuses on adults, rather than children and adolescents (e.g., Shanahan et al., 2014). However, it seems most likely that the relationship to personality and BMI is consistent across social class.

Which Matters More: Individual Differences or SES?

Among our most important results were the findings that SES contributed three times as much to the out-of-sample prediction of BMI as individual differences among adolescent girls, even when many narrow traits were used to assess individual differences. Inclusion of the Big Five did not increase the variance explained relative to SES. These findings suggest that environmental factors play a significant role in body size compared to individual differences in behavior. Overall, we find these effects point to the need to focus on systemic, rather than behavioral, influences on adolescent BMI. This finding is consistent with work in other domains suggesting that personality traits and cognitive ability are not sufficient to overcome disparity due to SES (Damian et al., 2015). However, even this advice should be qualified: in the current study, all variables combined accounted for less than 5% of the variability in BMI, highlighting the limited impact of these variables broadly. This is no surprise, as BMI—much like all indicators of health—is highly multi-determined. But this poses a challenge for those hoping to encourage more

healthy BMI scores among adolescent populations, as it remains unclear to what extent even the variables studied here are quality targets for intervention.

Limitations

Like all models, those tested in this manuscript required simplifications. A primary concern is the use of BMI as a metric of health. BMI has been shown to be a highly imperfect indication of body fat percentage (Agrawal et al., 2021) and the heterogeneity of health outcomes within BMI strata suggest that it should not be used as a diagnostic tool for individuals. However, BMI does potentially play a useful role as a more holistic indicator of general health (Gutin, 2018). Given the limitations of BMI, we chose to focus on percentile, rather than category, in the current manuscript, to limit the likelihood that trait, cognition, or SES levels would be associated with seemingly clinical cut-offs of health. An additional concern is the measurement of parental SES, which relies on adolescents' reports on a broad scale. The use of a more detailed measure of parental occupation likely would not improve this circumstance, as we expect variability in the degree to which adolescents know, understand, and can report on specific job titles or occupations of their caregivers. Future research may integrate both adolescent- and parent-reports of variables to assess the most reliable and accurate source of each construct, as well as test the degree to which other sources provide incremental information.

Finally, we believe these results will generalize to healthy teens living in the United States, given that our demographic data suggests representation across geographic regions and race/ethnicity. However, these results may differ within specific cultural subgroups as well as in different countries.

Conclusion

Overall, we find parental SES has a strong, negative relationship with BMI percentile among adolescents. Cognitive functioning and some personality traits are associated with BMI above and beyond SES, although the size of these effects is relatively smaller than the SES-BMI associations. Together, these findings point to the relative importance of socioeconomic status compared to individual differences for BMI.

Funding: The authors have no funding to report.

Acknowledgments: The authors have no additional (i.e., non-financial) support to report.

Competing Interests: The authors have declared that no competing interests exist.

Author Contributions: *Sara Weston*—Idea, conceptualization | Visualization (data presentation, figures, etc.) | Data analysis | Validation, reproduction, checking | Writing. *Magdalena Leszko*—Idea, conceptualization | Writing | Feedback, revisions. *David Condon*—Idea, conceptualization | Design planning | Resource provision (materials, participants, etc.) | Data collection | Data management (storage, curation, processing, etc.) | Writing | Feedback, revisions.

Data Availability: Cleaned and scored data are available for download on the OSF page associated with this project (Weston et al., 2019).

Supplementary Materials

Supplemental materials contain the data, the code used to clean, score, and analyze the data, as well as output from sensitivity analyses (for access see Index of Supplementary Materials below).

Index of Supplementary Materials

Personality Science. (Ed.). (2023). *Supplementary materials to "Body mass in us adolescents: Stronger ties to socioeconomic status than personality"* [Open peer-review]. PsychOpen GOLD. https://doi.org/10.23668/psycharchives.12505

Weston, S. J. (2019). *Supplementary materials to "Body mass in us adolescents: Stronger ties to socioeconomic status than personality"* [Preregistration]. OSF Registries. https://doi.org/10.17605/osf.io/ypf7r

Weston, S., Leszko, M., & Condon, D. (2019). *Supplementary materials to "Body mass in us adolescents: Stronger ties to socioeconomic status than personality"* [Data, Code, Analyses]. OSF. https://doi.org/10.17605/osf.io/fm3y6

References

Adler, N. E., & Rehkopf, D. H. (2008). US disparities in health: Descriptions, causes, and mechanisms. *Annual Review of Public Health, 29*, 235–252. https://doi.org/10.1146/annurev.publhealth.29.020907.090852

Agrawal, S., Klarqvist, M. D., Diamant, N., Ellinor, P. T., Mehta, N. N., Philippakis, A., Ng, K., Batra, P., & Khera, A. V. (2021). *Association of machine learning-derived measures of body fat distribution in > 40,000 individuals with cardiometabolic diseases.* MedRxiv. https://doi.org/10.1101/2021.05.07.21256854

Anekwe, C. V., Jarrell, A. R., Townsend, M. J., Gaudier, G. I., Hiserodt, J. M., & Stanford, F. C. (2020). Socioeconomics of obesity. *Current Obesity Reports, 9*(3), 272–279. https://doi.org/10.1007/s13679-020-00398-7

Association for Psychological Science. (2022). *Socioeconomic status.* Association Psychological Science. https://www.apa.org/topics/socioeconomic-status

Beck, E. D., & Jackson, J. J. (2022). A mega-analysis of personality prediction: Robustness and boundary conditions. *Journal of Personality and Social Psychology, 122*(3), 523–553. https://doi.org/10.1037/pspp0000386

Bibiloni, M. d. M., Pons, A., & Tur, J. A. (2013). Prevalence of overweight and obesity in adolescents: A systematic review. *ISRN Obesity, 2013*, Article 392747. https://doi.org/10.1155/2013/392747

Centers for Disease Control & Prevention. (2015). *About BMI for children and teens.* https://www.cdc.gov/Healthyweight/Assessing/Bmi/Childrens_bmi/About_childrens_bmi.Html

Claassen, M. A., Klein, O., Bratanova, B., Claes, N., & Corneille, O. (2019). A systematic review of psychosocial explanations for the relationship between socioeconomic status and body mass index. *Appetite, 132*, 208–221. https://doi.org/10.1016/j.appet.2018.07.017

Condon, D. M. (2018). The SAPA Personality Inventory: An empirically-derived, hierarchically-organized self-report personality assessment model. *PsyArXiv.* https://doi.org/10.31234/osf.io/sc4p9

Condon, D. M., & Revelle, W. (2014). The international cognitive ability resource: Development and initial validation of a public-domain measure. *Intelligence, 43*, 52–64. https://doi.org/10.1016/j.intell.2014.01.004

Condon, D. M., Roney, E., & Revelle, W. (2017). A SAPA-Project update: On the structure of phrased self-report personality items. *Journal of Open Psychology Data, 5*(1), Article 3. https://doi.org/10.5334/jopd.32

Conger, R. D., & Donnellan, M. B. (2007). An interactionist perspective on the socioeconomic context of human development. *Annual Review of Psychology, 58*, 175–199. https://doi.org/10.1146/annurev.psych.58.110405.085551

Damian, R. I., Su, R., Shanahan, M., Trautwein, U., & Roberts, B. W. (2015). Can personality traits and intelligence compensate for background disadvantage? Predicting status attainment in adulthood. *Journal of Personality and Social Psychology, 109*(3), 473–489. https://doi.org/10.1037/pspp0000024

Duckworth, A. L., Weir, D. R., Tsukayama, E., & Kwok, D. (2012). Who does well in life? Conscientious adults excel in both objective and subjective success. *Frontiers in Psychology, 3*, Article 356. https://doi.org/10.3389/fpsyg.2012.00356

Dworak, E. M., Revelle, W., Doebler, P., & Condon, D. M. (2021). Using the International Cognitive Ability Resource as an open source tool to explore individual differences in cognitive ability. *Personality and Individual Differences, 169*, Article 109906. https://doi.org/10.1016/j.paid.2020.109906

Flodgren, G. M., Helleve, A., Lobstein, T., Rutter, H., & Klepp, K.-I. (2020). Primary prevention of overweight and obesity in adolescents: An overview of systematic reviews. *Obesity Reviews, 21*(11), Article e13102. https://doi.org/10.1111/obr.13102

Frieden, T. R., Dietz, W., & Collins, J. (2010). Reducing childhood obesity through policy change: Acting now to prevent obesity. *Health Affairs, 29*(3), 357–363. https://doi.org/10.1377/hlthaff.2010.0039

Gutin, I. (2018). In BMI we trust: Reframing the body mass index as a measure of health. *Social Theory & Health, 16*(3), 256–271. https://doi.org/10.1057/s41285-017-0055-0

Hughes, B., Srivastava, S., Leszko, M., & Condon, D. M. (2022). *Occupational prestige: The status component of socioeconomic status.* PsyArXiv.

Hughes, C., Ensor, R., Wilson, A., & Graham, A. (2009). Tracking executive function across the transition to school: A latent variable approach. *Developmental Neuropsychology, 35*(1), 20–36. https://doi.org/10.1080/87565640903325691

Jokela, M., Hintsanen, M., Hakulinen, C., Batty, G. D., Nabi, H., Singh-Manoux, A., & Kivimäki, M. (2013). Association of personality with the development and persistence of obesity: A meta-analysis based on individual–participant data. *Obesity Reviews, 14*(4), 315–323. https://doi.org/10.1111/obr.12007

Kanazawa, S. (2013). Childhood intelligence and adult obesity. *Obesity, 21*(3), 434–440. https://doi.org/10.1002/oby.20018

Krieger, N., Williams, D. R., & Moss, N. E. (1997). Measuring social class in US public health research: Concepts, methodologies, and guidelines. *Annual Review of Public Health, 18*(1), 341–378. https://doi.org/10.1146/annurev.publhealth.18.1.341

The Lancet Gastroenterology & Hepatology. (Ed.) (2021). Obesity: Another ongoing pandemic. *The Lancet Gastroenterology & Hepatology, 6*(6), 411. https://doi.org/10.1016/S2468-1253(21)00143-6

Leonard, J. A., Mackey, A. P., Finn, A. S., & Gabrieli, J. D. (2015). Differential effects of socioeconomic status on working and procedural memory systems. *Frontiers in Human Neuroscience, 9*, Article 554. https://doi.org/10.3389/fnhum.2015.00554

Liang, J., Matheson, B., Kaye, W., & Boutelle, K. (2014). Neurocognitive correlates of obesity and obesity-related behaviors in children and adolescents. *International Journal of Obesity, 38*(4), 494–506. https://doi.org/10.1038/ijo.2013.142

Loomba-Albrecht, L. A., & Styne, D. M. (2009). Effect of puberty on body composition. *Current Opinion in Endocrinology, Diabetes, and Obesity, 16*(1), 10–15. https://doi.org/10.1097/MED.0b013e328320d54c

Mõttus, R., Wood, D., Condon, D. M., Back, M. D., Baumert, A., Costantini, G., Epskamp, S., Greiff, S., Johnson, W., Lukaszewski, A., & Associates. (2020). Descriptive, predictive and explanatory personality research: Different goals, different approaches, but a shared need to move beyond the Big Few traits. *European Journal of Personality, 34*(6), 1175–1201. https://doi.org/10.31234/osf.io/hvk5p

Narciso, J., Silva, A. J., Rodrigues, V., Monteiro, M. J., Almeida, A., Saavedra, R., & Costa, A. M. (2019). Behavioral, contextual and biological factors associated with obesity during

adolescence: A systematic review. *PLoS One, 14*(4), Article e0214941. https://doi.org/10.1371/journal.pone.0214941

Neumark-Sztainer, D., Bauer, K. W., Friend, S., Hannan, P. J., Story, M., & Berge, J. M. (2010). Family weight talk and dieting: How much do they matter for body dissatisfaction and disordered eating behaviors in adolescent girls? *The Journal of Adolescent Health, 47*(3), 270–276. https://doi.org/10.1016/j.jadohealth.2010.02.001

Shanahan, M. J., Bauldry, S., Roberts, B. W., Macmillan, R., & Russo, R. (2014). Personality and the reproduction of social class. *Social Forces, 93*(1), 209–240. https://doi.org/10.1093/sf/sou050

Shrewsbury, V., & Wardle, J. (2008). Socioeconomic status and adiposity in childhood: A systematic review of cross-sectional studies 1990–2005. *Obesity, 16*(2), 275–284. https://doi.org/10.1038/oby.2007.35

Sutin, A. R., Evans, M. K., & Zonderman, A. B. (2013). Personality traits and illicit substances: The moderating role of poverty. *Drug and Alcohol Dependence, 131*(3), 247–251. https://doi.org/10.1016/j.drugalcdep.2012.10.020

Sutin, A. R., Stephan, Y., Wang, L., Gao, S., Wang, P., & Terracciano, A. (2015). Personality traits and body mass index in Asian populations. *Journal of Research in Personality, 58*, 137–142. https://doi.org/10.1016/j.jrp.2015.07.006

Sutin, A. R., & Terracciano, A. (2016). Personality traits and body mass index: Modifiers and mechanisms. *Psychology & Health, 31*(3), 259–275. https://doi.org/10.1080/08870446.2015.1082561

Terracciano, A., Sutin, A. R., McCrae, R. R., Deiana, B., Ferrucci, L., Schlessinger, D., Uda, M., & Costa, P. T., Jr. (2009). Facets of personality linked to underweight and overweight. *Psychosomatic Medicine, 71*(6), 682–689. https://doi.org/10.1097/PSY.0b013e3181a2925b

Tibshirani, R. (1996). Regression shrinkage and selection via the lasso. *Journal of the Royal Statistical Society: Series B: Methodological, 58*(1), 267–288. https://doi.org/10.1111/j.2517-6161.1996.tb02080.x

Vainik, U., Dagher, A., Realo, A., Colodro-Conde, L., Mortensen, E. L., Jang, K., Juko, A., Kandler, C., Sørensen, T. I., & Mõttus, R. (2019). Personality-obesity associations are driven by narrow traits: A meta-analysis. *Obesity Reviews, 20*(8), 1121–1131. https://doi.org/10.1111/obr.12856

Weston, S. J., Hill, P. L., Edmonds, G. W., Mroczek, D. K., & Hampson, S. E. (2019). No evidence of "healthy neuroticism" in the Hawaii personality and health cohort. *Annals of Behavioral Medicine, 53*(5), 426–441. https://doi.org/10.1093/abm/kay055

Young, S. R., & Keith, T. Z. (2020). An examination of the convergent validity of the ICAR16 and WAIS-IV. *Journal of Psychoeducational Assessment, 38*(8), 1052–1059. https://doi.org/10.1177/0734282920943455

eapp

Personality Science (PS) is an official journal of the European Association of Personality Psychology (EAPP).

leibniz-psychology.org

PsychOpen GOLD is a publishing service by Leibniz Institute for Psychology (ZPID), Germany.