



HHS Public Access

Author manuscript

Int J Obes (Lond). Author manuscript; available in PMC 2017 September 10.

Published in final edited form as:

Int J Obes (Lond). 2017 July ; 41(7): 1056–1061. doi:10.1038/ijo.2017.62.

Temperament and Body Weight from ages 4 to 15

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Abstract

Background/Objectives—In adulthood, conscientiousness and neuroticism are correlates of body weight and weight gain. The present research examines whether the childhood antecedents of these traits, persistence and negative reactivity, respectively, are associated with weight gain across childhood. We likewise examine sociability as a predictor of childhood weight gain and whether these three traits are associated with weight concerns and weight management strategies in adolescence.

Subjects/Methods—Participants ($N=4,153$) were drawn from the Longitudinal Study of Australian Children, an ongoing, population-based study of child and family health and well-being. At the baseline assessment, caregivers reported on their child's temperament. At every assessment from ages 4-5 to 14-15, study children were weighed and measured by trained staff; there were up to six biennial assessments of body mass index (BMI) and waist circumference. At age 14-15, study children ($n=2,975$) also self-reported on their weight concerns and weight management strategies.

Results—Study children rated lower in persistence or higher in negative reactivity in early childhood gained more weight between the ages of 4 and 15. Sociability was associated with weight gain among girls but not among boys. Lower persistence and higher negative reactivity at age 4-5 were also associated with greater weight concerns, restrained eating, and use of unhealthy weight management strategies at ages 14-15.

Conclusions—Childhood traits related to conscientiousness and neuroticism are associated with objective weight gain across childhood and with concerns and strategies to manage weight in adolescence. These results are consistent with a lifespan perspective that indicates that trait psychological functioning contributes to health-related markers from childhood through old age.

Keywords

Temperament; Child Weight Gain; Sociability; Persistence; Reactivity; Obesity; Australia; LSAC

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The authors have no conflicts of interest to report.

The complexity of weight is underscored by the numerous factors that contribute to weight gain across the lifespan, from genetics to public policy (1). Among these factors, an individual's characteristic ways of thinking, feeling, and behaving – an individual's personality traits – have been associated consistently with body mass index (BMI) and risk of obesity in adulthood (2, 3). Weight does not start in adulthood, however, and the early correlates of adult personality, temperament, may be associated with weight gain across childhood (4) and set the foundation for adult weight. Further, unhealthy dieting practices and weight concerns in adolescence are associated with greater long-term weight gain (5, 6). Similar to body weight, an individual's trait psychological functioning may shape the way in which individuals approach food and manage their weight (7), a process that may start in childhood (8). The present research takes a developmental approach to address whether dimensions of temperament measured at age 4 are associated with objective weight gain over approximately one decade of childhood and whether these traits predict unhealthy weight perceptions and dieting behavior in adolescence.

Although the specific traits vary somewhat, most models of childhood temperament identify three major domains, negative emotionality, extraversion/surgency, and effortful control (9), that are the childhood antecedents of adult personality (10, 11). Negative emotionality refers to the tendency to respond with negative emotions, especially in response to frustration and anticipation of negative outcomes. It is the childhood antecedent of adult neuroticism, and it encompasses measures such as negative reactivity, distress, and (low) soothability. Extraversion/surgency refers to the general tendency to be sociable and to respond to new situations with positive emotions. It encompasses measures of sociability and pleasure and is the childhood antecedent to adult extraversion. Finally, effortful control refers to the tendency to focus attention and the ability to regulate effectively. It encompasses measures of persistence, self-control, and self-regulation and is the childhood antecedent of adult conscientiousness.

In adulthood, individuals who score higher in conscientiousness tend to have lower BMI (12), lower risk of obesity (3), and gain less weight over time (2). In childhood, temperamental traits that are the precursors to adult conscientiousness have been associated with healthier childhood weight gain. At age 1, for example, children who show more self-regulation skills gain less weight over the next two years (13), and boys who have a longer attention span at one year gain less weight over the next five years (14). Better self-regulation, as coded from an interaction in the lab, has also been associated with healthier weight gain between ages 2 and 10 (8). These associations are not limited to early childhood. Children higher in self-control, for example, gain less weight over the transition to adolescence than those rated lower on this trait (15). These associations are also long lasting. Delay of gratification measured at age 4, for example, is associated with a lower risk of obesity in young adulthood (16).

Although less consistent than conscientiousness, neuroticism has also been associated with higher BMI (17) and risk of obesity (2) in adulthood. Again, there is some evidence that this association may start in childhood. Emotional distress measured during feeding in infancy is associated with greater weight gain in early childhood (18) and a difficult temperament is associated with greater weight gain in the first year of life (19). Also similar to

conscientiousness-related traits, the associations may be long lasting. Negative emotionality measured in mid-childhood, for example, is predictive of greater weight gain by young adulthood (20). Not all, however, find an association between neuroticism-related measures in childhood and subsequent weight gain (13, 21).

There is less evidence that extraversion is associated with weight gain in adulthood (3), but traits related to extraversion, such as sociability, may contribute to weight gain in childhood. Toddlers with higher expression of pleasure, as rated by their parents, for example, gained more weight between ages 2 and 10 than children who scored lower on this dimension (8). Further, cross-sectional research has demonstrated that children who scored higher on sociability at age 5 were more likely to weigh in the overweight or obese BMI category (22). It is unclear, however, whether sociability is related to long-term weight gain in childhood (20).

The association between personality and BMI may vary by gender. In adulthood, for example, conscientiousness is associated with BMI for both genders, but the association tends to be somewhat stronger in women (23). In childhood, some find gender differences in the association between conscientiousness-related traits and weight gain, but in the opposite direction as in adulthood (14). The association between neuroticism and BMI may likewise be stronger among women than men (7), whereas the moderating effect of gender may (14, 19) or may not (18) hold in childhood. Finally, there is mixed evidence that the association between extraversion and BMI is moderated by gender in adulthood (23, 24). Few studies have addressed whether the association between extraversion-related traits and weight gain is moderated by gender in childhood, and a clear picture has yet to emerge (20).

In addition to its association with objective weight gain, personality shapes individuals' perceptions of their bodies and their approach to weight maintenance (7, 23). Again, this process starts early in life. Self-regulation at age 2, for example, is associated with fewer concerns about body image at age 10 (8). Young children who score higher in negative emotionality report a stronger drive for thinness in adolescence than children who scored lower on this dimension (25). A similar, although weaker, pattern has been found for persistence (25). And, across both traits, these associations may be stronger for girls than for boys (25). The relation between personality and weight concerns persist into adulthood. Neuroticism is strongly related to negative body image (26) and is a risk factor for disordered eating (27). Individuals high on extraversion and conscientiousness, in contrast, tend to have more positive perceptions of their bodies (26) and are less likely to engage in unhealthy eating behaviors (7). Less is known, however, about how temperament measured in early childhood is associated with how adolescents subsequently evaluate their weight and their dieting behavior.

Previous research on the relation between child temperament and weight gain and weight concerns has focused primarily on early childhood or has relied on relatively small and select samples. The present research takes a developmental approach with a large, longitudinal sample to examine whether persistence, sociability, and negative reactivity measured at age 4-5 are associated with weight gain from ages 4-5 to 14-15, measured as both BMI and waist circumference. We also test whether temperament measured at age 4-5

is associated with dieting-related behaviors and weight concerns in adolescence and whether any of these associations vary by gender. Given that traits related to higher neuroticism and lower conscientiousness are associated with greater weight gain in adulthood and disordered eating, we expect that higher negative reactivity and lower persistence will be associated with greater weight gain across childhood and with more problematic eating behaviors in adolescence.

Method

Participants and procedure

Participants were drawn from the child (K) cohort of the Longitudinal Study of Australian Children (LSAC), a longitudinal study of child development (28). Families were recruited into LSAC when the study child was four or five years old and were re-assessed every two years. The most recent assessment was in 2014 when the study children were 14-15. The Australian Institute of Family Studies Ethics Committee approved data collection for LSAC and written informed consent for each studied family was obtained before family members were asked any questions. Data from LSAC can be requested through the Australian Institute of Family Studies (<http://growingupinaustralia.gov.au/data/dataaccessmenu.html>). Parents reported on their child's and their own physical, social, and psychological well-being, study children reported on their own well-being and were also weighed and measured by trained staff. The present study used the baseline (age 4-5) parent-reported assessment of the study child's temperament, all staff-assessed adiposity measurements on the study child from ages 4 to 15, and the child's reported body image and weight management behaviors at age 14-15. A total of 4,153 of the 4,983 participants at Wave 1 had the necessary data available to be included in the analysis of weight gain. A total of up to 2,975 (49% female) had the necessary data to be included in the analysis of dieting behaviors and weight concerns at age 14-15 ($n=1178$ did not have relevant follow-up data at Wave 6).

Measures

Adiposity—During each in-home interview, trained staff measured the study child's weight, height, and waist circumference. Weight was measured and recorded to the nearest 50 grams from a glass bathroom scale. Height was measured and recorded to the nearest 0.1cm with a portable stadiometer. Age and sex specific child BMI z-scores were calculated according to the Centers for Disease Control and Prevention (CDC) growth charts (29) with increases in BMI-Z scores indicating weight gain; raw BMI was also analyzed. Waist circumference was measured and recorded to the nearest 0.1 cm with a non-stretch dressmaker's tape horizontally around the navel.

For study children whose parents had reported on their temperament at age 4-5, there were 21,421 valid assessments of BMI derived from measured weight and height (M assessments per participant = 5.16, $SD=1.39$, range 1-6) and 20,388 valid assessments of waist circumference (M assessments per participant = 5.17, $SD=1.39$, range 1-6). For some analyses, BMI was categorized into weight categories based on standards for classifying children's weight (30). Specifically, children with obesity (BMI 95th percentile) were compared to all other children (BMI<95th percentile) and children with overweight (BMI

between the 85th and 95th percentile) were compared with children <85th percentile. Finally, as an alternative measure of clinical risk (31), we examined the waist-height ratio (W:H) at age 14; participants were classified as <.5 W:H and .5 W:H.

Temperament—At baseline (age 4-5), parents (97% mothers) completed a 12-item measure of temperament based on the Childhood Temperament Questionnaire (32). The 12 items measured three dimensions of temperament: sociability (e.g., “goes up to children, joins in play”; $\alpha=.81$), persistence (e.g., “completes task before moving on”; $\alpha=.78$), and negative reactivity (e.g., “is difficult to comfort if upset”; $\alpha=.65$). All alphas are based on the data included in the current study. These items have been found to be valid measures of temperament as young as age 3 (33) and has been used in the Australian Temperament Project (34). Parents rated these items on a scale from 1 (*almost never*) to 6 (*almost always*).

Weight attitudes and behavior—At age 14-15, study children self-reported on several aspects of their attitudes and behaviors. First, study children were asked to rate the relevance of their weight to their self (“how important is your weight in how you feel about yourself?”) on a scale from 1 (*not important*) to 4 (*very important*). Second, participants rated four items on restrained eating (e.g., “leave food at meal times to avoid putting on weight”) on a scale from 1 (*seldom/never*) to 4 (*almost always/always*). The mean was taken across these four items ($\alpha=.83$). Third, participants were asked several questions from the Branched Eating Test (35) about their weight fears and dieting behaviors that occurred specifically within the last four weeks: participants responded (yes/no) to whether they had fear of gaining weight, had gone all day without eating, had exercised to lose weight in the last four weeks, and whether they had lost control over their eating. For each question, participants who responded yes were asked follow-up questions about frequency of the behavior (e.g., “During the last 4 weeks, how often did you feel afraid that you might gain weight (or become fat)?”). Participants rated the frequency items from 1 (*less than one day a week*) to 5 (*six or seven days a week*).

Analytic Strategy

We used Hierarchical Linear Modeling (HLM; (36)) to estimate the trajectory of adiposity from ages 4 to 15. HLM is a multilevel model that makes full use of all available data. That is, it can accommodate missing data because it uses all data available to estimate the trajectory for each participant (Level 1), which is then used for group estimates (Level 2). Even participants with only one assessment can be used to obtain more robust estimates. At Level 1, all available measures of adiposity were used to estimate the trajectory of weight gain from 4 to 15. Age was centered on the mean age across participants and assessments. We estimated the trajectory three times, once each for raw BMI, z-score BMI, and waist circumference. At Level 2, we tested whether each temperament dimension was associated with the average level of adiposity (the intercept) and with change in adiposity over time (the slope), controlling for factors that have been associated with BMI and/or temperament including study child age, child gender, indigenous status (Aboriginal and/or Torres Strait Islander versus white), whether a language other than English was spoken in the home, and mother's education. We also tested for an interaction between each temperament dimension

and gender to examine whether the association between temperament and weight gain varied across boys and girls. The data met the assumptions for HLM.

To test whether temperament at age 4-5 was associated with risk of obesity or overweight at age 14-15, we used logistic regression to predict both obesity status, overweight, and W:H .5 from temperament, controlling for the same set of covariates and baseline BMI. Finally, we used linear and logistic regression to examine the association between temperament at age 4-5 and weight concerns and dieting behaviors at age 14-15. Specifically, we predicted each of the child-reported eating and weight-related outcomes in adolescence from parent-reported temperament in young childhood, controlling for the same set of covariates. Similar to the HLM analyses, we tested whether gender moderated any association between temperament and risk of obesity and weight concerns and dieting behavior. Data were adequate for all statistical tests, and these analyses were done using SPSS version 21.

Results

Descriptive statistics for all study variables are shown in Table 1.

Weight gain

We first modeled the trajectory of adiposity from ages 4 to 15 using HLM (Table 2). The linear and quadratic slopes were both significant, which indicated a curvilinear trajectory such that weight increased more rapidly in early childhood than by age 14-15. The trajectory of weight gain across childhood was similar for BMI and waist circumference. The temperament dimensions were associated with the intercept and linear slope of the adiposity measures. Specifically, children rated higher on persistence weighed less on average (i.e., negative association with the intercept) and gained less weight between ages 4 and 15 (i.e., negative association with the linear slope). Sociability showed the opposite pattern: children rated higher on sociability weighed more on average and gained more weight across childhood. Finally, negative reactivity was unrelated to the intercept, but there was a positive relation with the slope that indicated that children rated higher on negative reactivity at age 4 gained more weight across childhood than children who scored lower on this trait. The pattern of associations was similar across both BMI and waist circumference. Results were similar when parent BMI and income were included as covariates.

Gender moderated the association between sociability and weight gain such that a tendency to be sociable was associated with greater increases in adiposity for girls but not for boys. This gender difference in the slope was apparent across two of the three measures of adiposity: raw BMI ($\gamma=.03$ [.01], $p<.01$) and z-score BMI ($\gamma=.01$ [.00], $p<.01$) but not waist circumference ($\gamma=.01$ [.02], *ns*). There was no gender difference in the association between either persistence or negative reactivity on weight gain across childhood.

We next tested whether the temperament dimensions measured at age 4-5 were associated with clinical weight categories at age 14-15. Persistence in young childhood was associated with a decreased risk of measuring in the obese category (OR=.82, 95% CI=.69-.97), the overweight category (OR=.88, 95% CI=.78-.98), and W:H .5 (OR=.87, 95% CI=.77-.98) in adolescence. Sociability was associated with an increased risk of overweight (OR=1.10,

95% CI=1.01-1.20) and W:H .5 (OR=1.10, 95% CI=1.01-1.21) but not obesity risk (95% CI=1.10, 95% CI=.96-1.26). Negative reactivity was unrelated to risk of overweight, obesity or elevated W:H. None of these associations was moderated by gender.

Weight concerns and dieting behavior

Parent-reported temperament at age 4-5 was associated with adolescent-reported weight concerns and management strategies as age 14-15 (Table 3). First, study children rated higher on negative reactivity in early childhood viewed their weight as more important to their sense of self in adolescence than study children who had been rated lower on this trait in childhood; the other two measures of temperament were unrelated to this measure. Second, all three temperament traits were associated with engaging in restrained eating behaviors used to manage weight. Specifically, study children rated higher on sociability or negative reactivity reported more restrained eating in adolescence, whereas those higher on persistence reported less. Third, temperament was associated with weight-related fears and other weight-control behaviors experienced in the last four weeks. High negative reactivity, for example, was associated with currently being fearful of weight gain, and, of the participants who endorsed this item ($n=1,038$), reactivity was further associated with greater frequency of this fear ($\beta=.10$, $p<.01$). Participants who scored higher in sociability or negative reactivity were also more likely to have gone an entire day without eating in the last four weeks to try to control their weight. These traits were not associated with frequency of this fasting behavior. Participants high in persistence were less likely to exercise to lose weight, and the three temperament dimensions were unrelated to frequency of engaging in this behavior. Finally, participants high in persistence did not often lose control over their eating, whereas those high in negative reactivity were at greater risk of loss of control; negative reactivity was associated with greater frequency of feeling loss of control over eating ($\beta=.07$, $p<.05$) among participants who reported a loss of control ($n=927$). Although there was no main effect of sociability on fear of weight gain, this association was moderated by gender ($OR_{interaction}=1.19$, 95% CI=1.03-1.36), such that girls higher on sociability had a greater fear of weight gain, whereas sociability was unrelated to fear of weight gain among boys. Gender did not moderate any of the other associations between temperament and weight and dieting behaviors.

Discussion

The present research used a large longitudinal sample with up to six repeated assessments of adiposity to examine how temperament measured at age 4-5 was associated with objective weight gain from childhood to adolescence and adolescent-reported weight concerns and weight management behavior at age 14-15. Similar to adult personality, persistence had the strongest protective association with weight gain and lower risk of obesity by age 14-15. In contrast to adult personality, sociability had a slightly stronger association with weight gain than did negative reactivity. Negative reactivity did, however, have consistent and pervasive associations with how adolescents felt about their weight and their use of weight management strategies.

In adulthood, individuals who score higher in conscientiousness tend to weigh less on average (2) and have lower risk of obesity over time (3). Conscientiousness does not start in adulthood and its protective effects start at an early age. Several specific traits related to conscientiousness have been implicated previously in childhood weight gain. Children who score higher in self-regulation (13), self-control (15), and delay of gratification (16), for example, tend to gain less weight over time. The present research indicates that a specific aspect of conscientiousness, the tendency to stay focused on a task until its completion, is also predictive of less weight gain. The present research specifically extends this association to a significant part of childhood and indicates that the protective effect of conscientiousness-related traits starts early and persists until at least young adolescence.

It was somewhat surprising that sociability was associated with greater weight gain among girls. In adulthood, when a gender difference is found, it is typically in the opposite direction (3, 23) (but see (7)). Children who score higher in surgency, a construct related to sociability, ask for food more often and show greater enjoyment in eating food than children lower on this trait, which contributes to higher BMI (37). It may also be the case that more sociable children are more likely to be involved in activities and go out with friends more often and are thus exposed to more opportunities to eat. Since boys are more likely to be physically active in their activities than girls, the risk associated with sociability may be greater among girls. These sociability-related findings, however, should be considered with caution given the contrasting pattern with results from adult samples.

In contrast to persistence and sociability, negative reactivity was unrelated to the average level of adiposity. It was, however, associated with greater weight gain, but the association was more modest than for the other two traits. Although there is some evidence that negative emotionality is associated with weight gain very early in childhood (19), others have not found such an association (21). The present research suggests that this association may build over time. Children who are more reactive may not have a general tendency to weigh more, but weight gain may occur with how the child and parents try to regulate their distress. Infants who score higher on aspects of negative emotionality, for example, are more likely to be given an obesogenic diet at 18 months (38) and eat more sweet drinks and food at 3 and 7 years old (39). Sweet foods and drinks may be one way to help alleviate distress. That is, when children with a proneness to negative emotions become upset, parents may offer sweet treats to calm the child down. This process may teach the child to use food to regulate negative emotions.

By adolescence, children high in negative reactivity perceive their weight to be an important aspect of their sense of self and engage in unhealthy strategies to try to manage their weight. In an attempt to control their weight, these adolescents are more likely to restrain from eating at meals, go an entire day without eating, and also faced greater loss of control and overeating. Such weight management strategies in adolescence are associated with greater long-term weight gain into adulthood (5). Of note, temperament had stronger associations with extreme dieting behavior (e.g., going all day without eating) than with healthier weight management strategies such as exercise. This process may be one that leads to the association between neuroticism and higher body weight in adulthood. Children who have a tendency to experience negative emotions may gain excess weight by adolescence, and, in an

attempt to manage the weight, engage in unhealthy eating behaviors that in turn promote even greater weight gain. Sex did not moderate the association between temperament and any of the weight concerns and behaviors. Although somewhat surprising, it is consistent with evidence from related lines of research that indicate that although there are mean-level sex differences in dieting behaviors and body satisfaction, the correlates tend to be the same across males and females (5, 40).

The present research contributes to a lifespan approach to body weight and shows the importance of trait psychological functioning for weight gain across the lifespan. In adulthood, Neuroticism and Conscientiousness are the two traits that are the most consistently associated with body weight. The current research shows that negative reactivity and persistence, the temperamental traits related to adult neuroticism and conscientiousness, respectively, are associated with weight gain from young childhood to adolescence. Parents recognize individual differences in their children in early childhood, and these are meaningful psychological characteristics that are associated with consequential outcomes. In addition, independent of the child's body weight, these traits measured at age 4 increase risk of eating disorder-related behavior in adolescence.

There have been significant changes in the environment over the last few decades that have led to the current prevalence of obesity (41). In this obesogenic society, the impact of the environment is not distributed equally on the population. The present research suggests that individual differences in psychological functioning make some people more vulnerable and others more resilient and points to the importance of addressing both the individual and the environment in weight gain across the lifespan.

The present research had several strengths, including a large sample, six repeated staff-assessed measurements of adiposity across a large portion of childhood, parent ratings of child temperament, and child-reported outcomes in adolescence. There are also some limitations that could be addressed in future research. First, although our sample covered a significant part of childhood, it did not cover the latter part of adolescence. Adolescent adiposity sets the foundation for adult weight (42), and it is of interest as to whether childhood temperament continues to be associated with weight gain later in adolescence. Second, although we had parent-reported temperament early in childhood, it would be of interest to have the child's own assessment of their temperament. Third, we did not test why temperament is associated with weight gain. Future research should address the mechanisms of this association. Fourth, although the percentage of children in the obese category (7%) matches national estimates in Australia (43), the relatively low prevalence limited the ability to find associations with the psychological factors. Despite these limitations, the present research indicates that temperamental tendencies apparent early in life have long-term correlates with significant objective and subjective weight-related outcomes. Knowledge of the psychological factors that are associated with greater weight gain may help in developing more effective prevention programs to promote healthy weight across the lifespan.

Acknowledgments

The Longitudinal Study of Australian Children (LSAC) is funded by the Commonwealth Department of Families, Community Services and Indigenous Affairs. No direct funds from the LSAC study supported this research. ARS

was supported by a grant from the Eunice Kennedy Shriver National Institute of Child Health and Human Development (1R15HD083947).

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Table 1
Descriptive Statistics of Study Variables

Variable	Percentage or Mean (SD)
Sex (female)	49%
Indigenous Status (yes)	3%
Child spoken to in a language other than English (yes)	19%
Mother's education	
Year 8 or below	2%
Year 9	4%
Year 10	21%
Year 11	13%
Year 12	60%
Adiposity at baseline	
Raw BMI	16.32 (1.70)
BMI z-score	.54 (1.03)
Waist Circumference	54.60 (4.49)
Obesity at age 14-15	7%
Overweight at age 14-15	20%
Waist:Height Ratio .5	15%
Parent-rated Child Temperament at age 4-5 ^a	
Sociability	3.83 (1.23)
Persistence	3.92 (.95)
Negative reactivity	2.69 (.92)
Child-reported Outcomes at age 14-15	
Restrained eating ^b	1.35 (.54) ^e
Importance of weight to self ^c	2.49 (.97) ^f
Fear of weight gain (yes)	35% ^g
Frequency of fear ^d	2.59 (1.38) ^h
All day without eating (yes)	7% ⁱ
Frequency of fasting ^d	1.17 (1.03) ^j
Exercise to control weight (yes)	48% ^k
Frequency of exercise ^d	3.07 (1.09) ^l
Lost control over eating (yes)	31% ^m
Frequency of losing control ^d	2.12 (1.16) ⁿ

N=4,153. SD=standard deviation. BMI=body mass index.

^aRated on a scale from 1 (*almost never*) to 6 (*almost always*)

^bRated on a scale from 1 (*seldom/never*) to 4 (*almost always/always*)

^cRated on a scale from 1 (*not important*) to 4 (*very important*).

^dRated on a scale from 1 (*less than one day a week*) to 5 (*six or seven days a week*)

^eThere was a significant gender difference ($p < .001$): $M_{\text{girls}}=1.48$ ($SD=.64$) versus $M_{\text{boys}}=1.23$ ($SD=.40$)

^fThere was a significant gender difference ($p < .001$): $M_{\text{girls}}=2.76$ ($SD=.93$) versus $M_{\text{boys}}=2.24$ ($SD=.94$)

^gThere was a significant gender difference ($p < .001$): 53% of girls endorsed this item versus 18% of boys endorsed this item

^hThere was a significant gender difference ($p < .001$): $M_{\text{girls}}=2.80$ ($SD=1.40$) versus $M_{\text{boys}}=2.00$ ($SD=1.17$)

ⁱThere was a significant gender difference ($p < .001$): 9% of girls endorsed this item versus 6% of boys endorsed this item

^jThere was a significant gender difference ($p < .001$): $M_{\text{girls}}=1.87$ ($SD=1.10$) versus $M_{\text{boys}}=1.51$ ($SD=.92$)

^kThere was a significant gender difference ($p < .001$): 57% of girls endorsed this item versus 40% of boys endorsed this item

^lThere was a significant gender difference ($p < .001$): $M_{\text{girls}}=3.01$ ($SD=1.04$) versus $M_{\text{boys}}=3.16$ ($SD=1.14$)

^mThere was a significant gender difference ($p < .001$): 43% of girls endorsed this item versus 20% of boys endorsed this item

ⁿThere was a significant gender difference ($p < .001$): $M_{\text{girls}}=2.35$ ($SD=1.20$) versus $M_{\text{boys}}=1.67$ ($SD=.89$)

Table 2
Hierarchical Linear Modeling Analysis of the Association between Temperament and Increases in Adiposity between ages 4 and 15

	Intercept	Linear Slope	Quadratic Slope
	<u>Raw BMI</u>		
Adiposity	19.08 (.22) **	.72 (.02) **	.04 (.00) **
Temperament			
Sociability	.16 (.04) **	.02 (.00) **	--
Persistence	-.15 (.04) **	-.03 (.00) **	--
Negative reactivity	.06 (.04)	.01 (.00) **	--
	<u>Z-Score BMI</u>		
Adiposity	.61 (.08) **	.02 (.01) **	.004 (.00) **
Temperament			
Sociability	.06 (.01) **	.002 (.001) *	--
Persistence	-.03 (.01) *	-.003 (.00) **	--
Negative reactivity	.02 (.01)	.002 (.001)	--
	<u>Waist Circumference^a</u>		
Adiposity	66.42 (.46) **	2.64 (.04) **	.03 (.00) **
Temperament			
Sociability	.36 (.10) **	.04 (.01) **	--
Persistence	-.45 (.10) **	-.07 (.01) **	--
Negative reactivity	.10 (.10)	.04 (.01) **	--

Note. $N=4,153$. BMI=body mass index. All analyses controlled for child gender, indigenous status (Aboriginal and/or Torres Strait Islander versus white), whether a language other than English was spoken in the home, and mother's education.

^aResults were similar when also controlling for child height.

* $p < .05$.

** $p < .01$.

Table 3
Association between Temperament at Age 4 and Adolescent Weight Concerns and Dieting Behavior

Temperament	Importance of Weight	Restrained Eating	Fear of weight gain	All day without eating	Exercise	Lost control of eating
Sociability	-.02	.04**	1.04 (.97-1.11)	1.18 (1.05-1.33)**	1.02 (.96-1.09)	1.06 (1.00-1.14)
Persistence	.00	-.06**	.92 (.84-1.01)	.88 (.76-1.03)	.91 (.83-.99)*	.88 (.80-.96)**
Negative reactivity	.05*	.08**	1.12 (1.02-1.23)*	1.30 (1.11-1.51)**	1.07 (.98-1.16)	1.12 (1.02-1.22)*
Analytic N	2963	2964	2961	2964	2965	2963

Note. Coefficients are either standardized beta (β) coefficients from linear regression (Importance of Weight and Restrained Eating) or odds ratios (95% Confidence Intervals) (Fear of weight gain, all day without eating, exercise, and loss of control of eating). All analyses controlled for child gender, indigenous status (Aboriginal and/or Torres Strait Islander versus white), whether a language other than English was spoken in the home, and mother's education.

* $p < .05$.

** $p < .01$.