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Self-Control Protects Against Overweight Status in the Transition from Childhood to Adolescence

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Abstract

Objective—To determine whether more self-controlled children are protected from weight gain as they enter adolescence.

Design—Prospective, longitudinal study.

Setting—Ten sites across the United States from 1991-2007.

Participants—The 844 children in the National Institute of Child Health and Human Development Study of Early Child Care and Youth Development birth cohort who had height and weight information at age 15 (in 2006).

Main Exposure—A composite measure of self-control was created from mother, father, and teacher-report ratings using items from the Social Skills Rating System.

Main Outcome Measure—Overweight status at age 15 years.

Results—Approximately one-third of the sample (n = 262) was overweight at age 15. Compared to their non-overweight peers, overweight adolescents at age 15 were about a half-standard deviation lower in self-control at age 9 (unstandardized difference = 0.15, pooled SD = 0.29, P < .001). Children rated higher by their parents and teachers in self-control at age 9 were less likely to be overweight at age 15 (RR, 0.74; 95% CI, 0.56-0.98), controlling for overweight status at age 10, pubertal development, age, IQ, gender, ethnicity, socioeconomic status, and maternal overweight status.

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Conclusion—More self-controlled boys and girls are less likely to become overweight as they enter adolescence. The ability to control impulses and delay gratification enables children to maintain a healthy weight even in today's obesogenic environment.

Self-Control Protects Against Overweight Status in the Transition from Childhood to Adolescence

Body fat increases during the transition from childhood to adolescence. However, rapid increases in BMI relative to one's gender and age cohort during this period predict a range of negative health outcomes in adulthood, including coronary events, diabetes mellitus, and subcutaneous and visceral adipose tissue.[1-4] Moreover, excessive weight gain in adolescence is particularly prognostic of adulthood weight problems, suggesting adolescence as a critical period for the development of obesity.[5, 6] Previously identified risk/protective factors for excessive weight in adolescence include pubertal development, ethnicity, and socioeconomic status.[7-9] Less is known about relevant psychological variables, including self-control.

Self-control is the ability to override impulses in order to achieve goals and maintain standards. The capacity to resist immediate temptations in order to act in one's best long-term interests is among the most important developmental milestones in the social development of children.[10, 11] Relative to their more impulsive peers, self-controlled children are less likely to engage in delinquent behavior and earn higher report card grades and achievement test scores.[12, 13] Prospective longitudinal studies suggest that self-control in childhood predicts a range of consequential adult outcomes, including life expectancy, career success, and years of education.[14-17]

Two analyses of the 1991-2007 National Institute of Child Health and Human Development Study of Early Child Care and Youth Development birth cohort suggest that more self-controlled preschoolers stay leaner than their more impulsive peers as they enter middle childhood.[18, 19] One analysis did not control for the possible confound of maternal BMI.[18] In a second analysis, when maternal BMI was controlled, the association between self-control and BMI was no longer significant.[19] Thus, while suggestive, prior research has not unequivocally established a causal role for self-control in determining weight gain during development.

One might expect the influence of self-control on weight to increase as children mature and are granted more autonomy from their parents.[20, 21] Indeed, before age 7 years, children are generally quite adept at self-regulating their energy intake,[22, 23] although this ability appears to worsen in later childhood and adolescence.[24, 25] Moreover, the entry into adolescence typically is accompanied by unprecedented independence from parents in lifestyle choices -- including what and how much to eat. In the current obesogenic environment, more self-controlled children would be expected to make decisions that maximize long-term well-being, even at the expense of short-term gratification.

The primary aim of our study was to examine self-control at age 9 as a protective factor against overweight status at age 15. We hypothesize that self-control inversely predicts overweight status in adolescence, controlling for potential confounders shown to be associated with adolescent BMI, including pubertal development, maternal overweight status, socioeconomic status, ethnicity, and intelligence.[7-9, 26, 27]

Methods

Study Population

The participants were 844 children from the National Institute of Child Health and Human Development Study of Early Child Care and Youth Development (NICHD-SECCYD). The NICHD-SECCYD is a longitudinal multisite study originally designed to examine the effects of child care on development. Details of study recruitment and data collection protocols are described on the study's website (https://secc.rti.org/). Data collection was approved by the appropriate institutional review boards for each study site in the NICHD-SECCYD and written informed consent was received from each family. We used data collected between the ages of 9 and 15. Out of the 1,364 total participants in the NICHD-SECCYD, we included the 844 children who had height and weight measured at age 15.

Measures

Self-control—When the children were nine years of age, mothers (or the primary caregiver; *n* = 820), fathers (or another adult if the father was not available; e.g., grandparent; *n* = 565), and classroom teachers (*n* = 730) completed the parent and teacher versions of the Social Skills Rating System (SSRS) questionnaire.[28] The SSRS is a widely used inventory of positive child behaviors which caregivers rate on a 3-point frequency scale ranging from 0 = *Never* to 2 = *Very often*. We followed best practices in personality psychology by using ratings from all three sources to maximize reliability and accuracy.[29] Specifically, we considered content validity and correspondence with previously validated measures of self-control[30, 31] when selecting SSRS items related to self-control (Table 1). Next, we confirmed that observed internal reliability coefficients for mother, father, and teacher scales were acceptable (ranging from α = .73 to .86, with an average of .78) and that scores were significantly correlated (ranging from r = .32 to .52, with an average of .40, all *P-value*s < .001). We averaged the items for each rater and then created a composite measure of self-control by averaging the mother, father, and teacher ratings. The correlations of each rating with the composite measure were about .80, and the internal reliability of this composite was *r* = .87, according to a formula specific to linear combinations of scores.[32] Approximately 59% of participants had mother, father, and teacher ratings, 34% were missing one of these scores, and 7% were missing two of the scores. We averaged the two non-missing scores for participants who were missing one score, and we used the single non-missing score for participants who were missing two scores.

Overweight status—Nurse practitioners or pediatric endocrinologists measured children's height and weight during health and physical development assessments using standardized protocols at ages 10 and 15. Height was recorded to the nearest 1/8 inch and weight was recorded in pounds and ounces. Both height and weight were measured twice. If the height measurements differed by more than ½ inch or if the weight measurements differed by more than 4 ounces, then two new measurements were obtained to verify the respective measures. Height and weight measures were converted to metric units, and BMI scores were calculated. Raw BMI scores were then converted to age- and gender-specific BMI *z*-scores using the Center for Disease Control and Prevention (CDC) 2000 growth reference charts.[33] We classified children with BMI z-scores greater than 1.036 (85th percentile) as overweight.

Pubertal status—During the health and physical development assessments, nurse practitioners or pediatric endocrinologists assessed children's pubertal development using Tanner Stage criterion. Girls were assessed in terms of breast development on a 5-point scale ranging from 1 = *No breast development* to 5 = *Mature adult stage*, and boys were assessed in terms of genital development on a 5-point scale ranging from 1 = *Same size and shape as in childhood* to 5 = *Mature adult stage*. Pubertal status was defined as the Tanner

Stage rating at age 15, or "5" if no Tanner Stage rating was available at age 15 but a previous rating was "5" (i.e., mature adult stage). Because this variable was highly skewed (500 for Stage 5 vs. 105 for Stage 4, 14 for Stage 3, and 1 for Stage 2), we created a binary variable indicating attainment of Stage 5.

Intelligence—We used the Full Scale IQ score from the Wechsler Abbreviated Scale of Intelligence (WASI) administered when the children were nine years old.[34] The four subtests—Vocabulary, Block Design, Similarities, and Matrix Reasoning—measure verbal knowledge, verbal and non-verbal reasoning, and visual information processing. The WASI is highly correlated with the longer Wechsler Intelligence Scale for Children – Third Edition, $r = .87$.[34]

Maternal overweight status—Mothers' self-reported their height and weight when their children were 15 years of age. We computed BMI scores and classified mothers with BMI scores greater than 25 as overweight.

Demographic variables—Data on gender, ethnicity, and birthdate were recorded. Ethnicity—White, Black, Hispanic, Asian, or other—was defined by the mother and was originally collected in the SECCYD because ethnicity is associated with use of child care. Because "Hispanic" was not an exclusive category, we coded Hispanic as its own group with the other groups not including Hispanics (e.g., "White" equals "Non-Hispanic White") for our analyses. As a proxy for socioeconomic status, we used the income-to-needs ratio (assessed in terms of income compared to the US Census Bureau-defined poverty line) at age 9, which we log-transformed to normalize the distribution.

Statistical analysis

We computed summary statistics and examined differences in measures by overweight status at age 15. Self-control, age, log-transformed income-to-needs ratio, and IQ were treated as continuous variables; overweight status at age 10, gender, ethnicity, pubertal development, and maternal overweight status were treated as categorical variables. To test statistical significance of differences, we used *t*-tests for continuous variables and chi-square tests for dichotomous variables. For our multivariable analyses, we conducted poisson regressions with robust standard errors[35] using overweight status at age 15 as the outcome and self-control, overweight status at age 10, gender, ethnicity, age, pubertal development, log-transformed income-to-needs ratio, IQ, and maternal overweight status as predictors. Given that our covariates have been shown to be potential confounds in prior research, we simultaneously forced all predictors into the model. We also examined all variables as potential moderators of the effect of self-control on overweight status at age 15 in separate models using a Bonferroni correction to adjust for multiple comparisons.

Approximately 3.5% of the data were missing; about half of missing values were pubertal development at age 15. To avoid biased estimates, we used multiple imputation to handle missing data.[36, 37] We conducted all analyses in Stata, Version SE 11.0 (StataCorp LP, College Station, TX), used two-tailed tests, and set significance at $P < .05$.

Results

About 77% of participants were White, 12% were Black, 6% were Hispanic, 1% were Asian, and 4% were of other ethnic backgrounds; 50% were female. The median household income, assessed in terms of income-to-needs, was 3.4 times the US Census Bureau-defined poverty line. The mean age of participants in December, 2006 was 15.6 years ($SD = 0.2$).

Table 2 describes the characteristics of participants by overweight status at age 15. Approximately one-third of the sample (n = 262) were overweight at age 15. The average BMI z-score in this sample was 0.53 at age 10 and 0.57 at age 15. Compared to their non-overweight peers, overweight adolescents at age 15 were about a half-standard deviation lower in self-control at age 9 (unstandardized difference = 0.15, pooled SD = 0.29, P<.001). Overweight adolescents were also more likely to be Black (17% vs. 10%; P<.01) or of an "Other ethnicity" (6% vs. 3%; P<.05), to be male (58% vs. 46 %; P<.001), to have a lower IQ (104 vs. 108; P<.001), have an overweight mother (74% vs. 47%; P<.001), and to be from lower socioeconomic backgrounds (log values of income-to-needs .87 vs. 1.30; P<. 001).

Table 2 presents the results of the poisson regression analysis. Children who were rated as being more self-controlled at age 9 were less likely to be overweight at age 15 (RR, 0.74; 95% CI, 0.56-0.98), even when controlling for age, gender, ethnicity, pubertal development, IQ, log income-to-needs ratio, maternal overweight status, and overweight status at age 10. Children who were rated 1-point higher on a 3-point self-control scale were 26% less likely to be overweight as adolescents. Being female (RR, 0.82; 95% CI, 0.70-0.98), belonging to a lower socioeconomic background (RR, 0.86; 95% CI, 0.78-0.96), having a mother who is overweight (RR, 1.32; 95% CI, 1.07-1.62), and being overweight at age 10 (RR, 6.81; 95% CI, 5.11-9.08) were also significant predictors of overweight status at age 15, after adjusting for the other covariates. None of the observed variables moderated the effect of self-control on overweight status at age 15.

A comparable analysis with obese status (i.e., BMI z-score > 1.64) as the outcome showed an effect of similar magnitude for self-control (RR, 0.68; 95% CI, 0.45-1.03) but was not significant (P = .07), likely due to the smaller number of obese (n = 132) compared to overweight individuals in the dataset.

Comment

In a prospective, longitudinal study of 844 participants, we found that children rated higher in self-control by their parents and teachers at age 9 were less likely to become overweight by age 15. This relationship was significant even when controlling for a wide range of potential confounders.

Rapid weight gain during the transition to adolescence is prognostic of poor health outcomes in adulthood,[1, 2, 4, 38] suggesting the importance of identifying risk/protective factors prior to this stage of development. Extant research on weight gain has pointed to several relevant factors, including "obesogenic" environments (i.e., cheap and convenient high-calorie foods offered in large portions),[39] low socioeconomic status,[8] and ethnicity.[7] None of these well-studied risk/protective factors are easily changed. Because excess weight is a behaviorally mediated condition (i.e., excess weight is caused by ingesting more calories than are expended), psychological variables that influence lifestyle choices deserve more attention. The purpose of our study was to explore the protective role of self-control during the transition to adolescence, a period during which children are given increasing latitude to decide what to eat. We expected more self-controlled children to make healthier choices than their more impulsive peers. Our findings are consistent with this prediction.

This study has several limitations. First, while our sample was somewhat diverse in terms of ethnicity, gender, and socioeconomic status, it was not nationally representative. Therefore, our findings may not generalize to all segments of the US population. Second, children's knowledge of healthy eating choices was not measured. We would expect such knowledge to moderate the observed relationship between self-control and weight change: self-control

likely does not protect children from weight gain if they fail to recognize that some foods are more fattening and less healthy than others. Finally, we cannot rule out the possibility that an unmeasured third-variable confounder associated with self-control at age 9 and weight change from age 10 to 15 accounted for the observed findings. To do so would require a randomized controlled trial in which self-control was durably increased in children and subsequent effects on weight assessed. Preschool curricula with demonstrated effects on self-control suggest that such an investigation is now possible.[40]

The wide availability of fatty, sugary, salty foods is unprecedented in human history, explaining much of the recent pandemic increase in obesity.[41] The impulse to consume these fattening foods to excess has strong evolutionary origins, but, so too does the capacity to override such impulses.[39, 41] Indeed, the capacity to regulate impulses to indulge in temptations that feel good momentarily but are detrimental in the long-term is a uniquely human competence. Individual differences in self-control, like every other personality trait, are partly genetic in origin.[42] Nevertheless, the influence of genes does not preclude the importance of self-control strategies children can be directly taught in the context of parent-child and physician-patient interactions. For instance, children can be encouraged to use their attention strategically, putting temptations literally "out of sight and out of mind."[40, 43] Planning in advance what to do when temptation strikes has also been shown to be an effective and teachable self-regulation strategy. Finally, children – and their parents - can be taught to "precommit" to healthy choices (e.g., not keeping junk food in the house or not bringing extra money to school to purchase treats). As Kessler concludes in the *End of Overeating*, fattening temptations in the modern world abound, but "the power to resist ultimately rests with us."[39]

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Table 1

Social Skill Rating System (SSRS) items[a] used to assess self-control at age 9 years

Keeps room/desk clean and neat without being reminded
Responds appropriately when pushed or hit by others
Controls temper when arguing with other children
Finishes tasks within a reasonable amount of time
Receives criticism well
Ends disagreements with you calmly [b]
Controls temper in conflict situation with you [b]
Attends to speakers at meetings [b]
Controls temper in conflict situations with adults [c]
Responds appropriately to teasing by peers [c]
Follows your directions [c]
Attends to your instructions [c]
Ignores peer distraction when doing classwork [c]

[a] Items were paraphrased to generalize across rater (i.e., parent or teacher) and for brevity

[b] Parent-report only.

[c] Teacher-report only.

Table 2

Characteristics of Participants by Overweight Status at Age 15[a] and Adjusted Relative Risks from Poisson Regression with Robust Standard Errors Predicting Overweight Status at Age 15

Characteristic	Not Overweight (*n* = 582)	Overweight (*n* = 262)	*P*[b]	Adjusted RR (95% CI)
Self-control rating, mean (SD)[c]	1.35 (.29)	1.20 (.30)	<.001	0.74 (0.56-0.98)
Overweight at age 10, No. (%)	65/545 (12)	196/246 (80)	<.001	6.81 (5.11-9.08)
Female, No. (%)	315/582 (54)	110/262 (42)	.001	0.82 (0.70-0.98)
Ethnicity				
White, No. (%)	465/582 (80)	186/262 (71)	.004	1.00[d]
Black, No. (%)	60/582 (10)	45/262 (17)	.005	0.86 (0.69-1.08)
Hispanic, No. (%)	35/582 (6)	14/262 (5)	.70	0.89 (0.64-1.23)
Asian, No. (%)	6/582 (1)	2/262 (1)	.71	1.06 (0.32-3.48)
Other ethnicity, No. (%)	16/582 (3)	15/262 (6)	.03	1.01 (0.79-1.29)
Age, mean (SD)	15.6 (.2)	15.6 (.2)	.57	1.09 (0.78-1.53)
Tanner Stage 5 at age 15, No. (%)	332/422 (79)	168/198 (85)	.08	1.15 (0.88-1.50)
Log income-to-needs ratio, mean (SD)	1.3 (.8)	.9 (.9)	<.001	0.86 (0.78-0.96)
IQ, mean (SD)	108 (14)	104 (15)	<.001	1.00 (0.99-1.00)
Maternal overweight status, No. (%)	259/557 (46)	178/241 (74)	<.001	1.32 (1.07-1.62)

[a] Some variable number denominators may not equal group totals because of missing data.

[b] *P*-values for differences between groups based on *t*-tests for continuous variables and chi-square tests for dichotomous variables.

[c] Self-control rating scale ranged from 0-2.

[d] Reference group.