ARTICLE

Self-control as a Protective Factor Against Overweight Status in the Transition From Childhood to Adolescence

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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 to 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 15 years of age in 2006.

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

Outcome Measure: Overweight status at 15 years of age.

Results: Approximately one-third of the sample (n=262) was overweight at 15 years of age. Compared with their nonoverweight peers, overweight adolescents aged 15 years were about a half standard deviation (SD) lower in self-control at 9 years of age (unstandardized difference, 0.15; pooled SD, 0.29; $P<.001$). Children rated higher by their parents and teachers in self-control at 9 years of age were less likely to be overweight at 15 years (relative risk, 0.74; 95% confidence interval, 0.56-0.98), controlling for overweight status at 10 years of age, pubertal development, age, intelligence quotient, sex, ethnicity, socioeconomic status, and maternal overweight status.

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.

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BODY FAT INCREASES DURING the transition from childhood to adolescence. However, rapid increases in body mass index (BMI; calculated as weight in kilograms divided by height in meters squared) relative to one's sex 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 to achieve goals and maintain standards. The capacity to resist immediate temptations 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

Table 1. Social Skill Rating System Items Used to Assess Self-control at 9 Years of Age[a]

Variable
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 class work[c]

[a] Items were paraphrased to generalize across raters (ie, parent or teacher) and for brevity.
[b] Parent-report only.
[c] Teacher-report only.

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 7 years of age, 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 9 years of age as a protective factor against overweight status at 15 years. 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 Web site (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 9 and 15 years of age. Of the 1364 participants in the NICHD-SECCYD, we included the 844 children who had their height and weight measured at 15 years of age.

MEASURES

Self-control

When the children were aged 9 years, mothers (or the primary caregiver; n=820), fathers (or another adult if the father was not available, eg, grandparent; n=565), and classroom teachers (n=730) completed the parent and teacher versions of the Social Skills Rating System questionnaire.[28] The Social Skills Rating System is a widely used inventory of positive child behaviors that 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 3 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 Social Skills Rating System items related to self-control (**Table 1**). Next, we confirmed that observed internal reliability coefficients for mother, father, and teacher scales were acceptable (range, α=.73-.86; average, α=.78) and that scores were significantly correlated (range, r=0.32-0.52; average, r=0.40; all $P<.001$). 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 0.80, and the internal reliability of this composite was r=0.87, according to a formula specific to linear combinations of scores.[32] Approximately 59% of participants had mother, father, and teacher ratings, 34% were missing 1 of these scores, and 7% were missing 2 of the scores. We averaged the 2 nonmissing scores for participants who were missing one score, and we used the single nonmissing score for participants who were missing 2 scores.

Overweight Status

Nurse practitioners or pediatric endocrinologists measured children's height and weight during health and physical development assessments using standardized protocols at 10 and 15 years of age. Height was recorded to the nearest one-eighth of an inch and weight in pounds and ounces. Both height and weight were measured twice. If the height measurements differed by more than half an inch or if the weight measurements differed by more than 4 ounces, then 2 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 sex-specific BMI z scores using the Center for Disease Control and Prevention 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 15 years of age, or 5 if no Tanner Stage rating was available at 15 years but a previous rating was 5 (ie, mature adult stage). Because this variable was highly

Table 2. Characteristics of Participants by Overweight Status at 15 Years of Age and Adjusted Relative Risks From Poisson Regression With Robust Standard Errors Predicting Overweight Status at 15 Years of Age[a]

Characteristic	No./Total (%)		*P* Value[b]	Adjusted RR (95% CI)
	Not Overweight (n=582)	Overweight (n=262)		
Self-control rating, mean (SD)[c]	1.35 (0.29)	1.20 (0.30)	<.001	0.74 (0.56-0.98)
Overweight at 10 y of age	65/545 (12)	196/246 (80)	<.001	6.81 (5.11-9.08)
Female	315/582 (54)	110/262 (42)	.001	0.82 (0.70-0.98)
Ethnicity				
White	465/582 (80)	186/262 (71)	.004	1 [Reference]
Black	60/582 (10)	45/262 (17)	.005	0.86 (0.69-1.08)
Hispanic	35/582 (6)	14/262 (5)	.70	0.89 (0.64-1.23)
Asian	6/582 (1)	2/262 (1)	.71	1.06 (0.32-3.48)
Other	16/582 (3)	15/262 (6)	.03	1.01 (0.79-1.29)
Age, mean (SD), y	15.6 (0.2)	15.6 (0.2)	.57	1.09 (0.78-1.53)
Tanner stage 5 at 15 y of age	332/422 (79)	168/198 (85)	.08	1.15 (0.88-1.50)
Log income to needs ratio, mean (SD)	1.3 (0.8)	0.9 (0.9)	<.001	0.86 (0.78-0.96)
IQ, mean (SD)	108 (14)	104 (15)	<.001	1.00 (0.99-1.00)
Maternal overweight status	259/557 (46)	178/241 (74)	<.001	1.32 (1.07-1.62)

Abbreviations: CI, confidence interval; RR, relative risk.
[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 χ^2 tests for dichotomous variables.
[c] Self-control rating scale ranged from 0 to 2.

skewed (500 patients 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 given when the children were aged 9 years.[34] The 4 subtests, Vocabulary, Block Design, Similarities, and Matrix Reasoning measure verbal knowledge, verbal and nonverbal reasoning, and visual information processing. The Wechsler Abbreviated Scale of Intelligence is highly correlated with the longer Wechsler Intelligence Scale for Children–Third Edition (r=0.87).[34]

Maternal Overweight Status

Mothers self-reported their height and weight when their children were aged 15 years. We computed BMI scores and classified mothers with BMI scores greater than 25 as overweight.

Demographic Variables

Data on sex, ethnicity, and birth date 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 Hispanic persons (eg, white equals white, not Hispanic) for our analyses. As a proxy for socioeconomic status, we used the income to needs ratio (assessed in terms of income compared with the US Census Bureau–defined poverty line) at 9 years of age, which we log-transformed to normalize the distribution.

STATISTICAL ANALYSIS

We computed summary statistics and examined differences in measures by overweight status at 15 years of age. Self-control, age, log-transformed income to needs ratio, and IQ were treated as continuous variables; overweight status at 10 years of age, sex, ethnicity, pubertal development, and maternal overweight status were treated as categorical variables. To test the statistical significance of differences, we used *t* tests for continuous variables and χ^2 tests for dichotomous variables. For our multivariable analyses, we conducted Poisson regressions with robust standard errors[35] using overweight status at 15 years of age as the outcome and self-control, overweight status at 10 years of age, sex, 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 15 years of age in separate models using a Bonferroni correction to adjust for multiple comparisons. Finally, we conducted an analysis with obese status (ie, BMI *z* score >1.64) as the outcome.

Approximately 3.5% of the data were missing; about half of the missing values were pubertal development at 15 years of age. 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, Texas), used 2-tailed tests, and set significance at $P<.05$.

RESULTS

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

Table 2 describes the characteristics of participants by overweight status at 15 years of age. Approximately one-third of the sample (n=262) were overweight at 15 years of age. The average BMI *z* score in this sample was 0.53 at 10 years of age and 0.57 at 15 years. Compared

with their nonoverweight peers, overweight adolescents aged 15 years were about a half standard deviation lower in self-control at 9 years (unstandardized difference, 0.15; pooled SD, 0.29; $P<.001$). Overweight adolescents were also more likely to be black (17% vs 10%; $P<.01$), be of another ethnicity (6% vs 3%; $P<.05$), be male (58% vs 46%; $P<.001$), have a lower IQ (104 vs 108; $P<.001$), have an overweight mother (74% vs 47%; $P<.001$), and be from a lower socioeconomic background (logarithm values of income to needs ratio, 0.87 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 9 years of age were less likely to be overweight at 15 years (relative risk [RR], 0.74; 95% confidence interval [CI], 0.56-0.98), even when controlling for age, sex, ethnicity, pubertal development, IQ, logarithm of income to needs ratio, maternal overweight status, and overweight status at 10 years of age. 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 10 years of age (RR, 6.81; 95% CI, 5.11-9.08) were also significant predictors of overweight status at 15 years of age, after adjusting for the other covariates. None of the observed variables moderated the effect of self-control on overweight status at 15 years of age.

The analysis with obese status as the outcome showed an effect of self-control (RR, 0.68; 95% CI, 0.45-1.03) that was similar in magnitude to the model with overweight status as the outcome but was not statistically significant ($P=.07$), likely owing to the smaller number of obese (n=132) compared with overweight individuals in the data set.

COMMENT

In a prospective, longitudinal study of 844 participants, we found that children who were rated higher in self-control by their parents and teachers at 9 years of age were less likely to become overweight by 15 years. 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,[1-4] 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 (ie, cheap and convenient high-calorie foods offered in large portions),[38] 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 (ie, 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, sex, 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 9 years of age and weight change from 10 to 15 years 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.[39]

The wide availability of fatty, sugary, and salty foods is unprecedented in human history, explaining much of the recent pandemic increase in obesity.[40] The impulse to consume these fattening foods to excess has strong evolutionary origins but so too does the capacity to override such impulses.[38,40] 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.[41] 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."[39,42] 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 (eg, 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."[38]

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