Body Mass Index Mediates the Effects of Low Income on Preschool Children's Executive Control, with Implications for Behavior and Academics

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Abstract

Background: Children from low-income backgrounds are more likely to have cognitive impairments, academic problems, and obesity. Biological mechanisms for the relationship between adiposity and neurocognitive functioning have been suggested, but the direction of effects is unclear.

Methods: The relations among income, BMI, and cognitive-behavioral functioning were modeled longitudinally. Children ($n=306$) were assessed at 36–39 months (Time 1; T1) and 63–67 months (Time 4; T4) through anthropometry, measures of executive control (EC), delay ability (DA), and questionnaires on academic readiness, social competence, and behavioral adjustment.

Results: Income was positively related to T1 EC and DA and negatively related to T1 BMI. T1 BMI was negatively related to T4 EC, after controlling for T1 EC, but was unrelated to changes in DA. Neither T1 EC nor DA was related to changes in BMI. T4 EC predicted greater academic readiness and social competence and lower adjustment problems at T4. T4 BMI was related to higher T4 adjustment problems. There was an indirect effect of income on T4 EC through T1 BMI. There were indirect effects of T1 BMI on academic readiness, social competence, and adjustment through T4 EC. Children who were obese at T1 had a 19% lower rate of growth of EC, compared to nonobese children.

Conclusions: BMI mediates the effect of income on children's EC and has negative implications for academic readiness, social competence, and behavioral adjustment. The dual impact of obesity and cognitive-behavioral problems underscores the importance of early identification of and intervention for overweight children which could have neurocognitive and social-emotional benefits.

What's New: BMI mediates the effect of income on preschoolers' executive control (EC) and has negative implications for academic readiness and behavioral adjustment. EC and delay ability did not predict changes in BMI. Early identification of, and intervention for, overweight children may have neurocognitive and social-emotional benefits.

Introduction

Children in low-income settings are faced with a myriad of harmful income-related disadvantages across physical, social-emotional, and mental health domains.¹ Nearly one third of low-income preschoolers are overweight or obese,² which is of concern given the burden of obesity-related childhood comorbidities, later disease, and premature mortality.^{3,4} Children in low-income contexts also tend to demonstrate neurocognitive and behavioral

impairments and have a greater likelihood of academic problems, school dropout, and emotional and behavior problems.⁵ There is evidence that increased adiposity in children is associated with poorer neurocognitive functioning, academic performance, and social-emotional outcomes,^{6–8} although the directionality of that relationship is not well understood.

Children living in low-income households are often exposed to multiple risk factors, the accumulation of which can be captured using cumulative risk indices that incorporate

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demographic, psychosocial, and environmental factors into a single risk indicator.⁹ Cumulative risk, such as income, relates to higher child BMI,¹⁰ neurocognitive impairments, and adjustment problems.¹¹ This study examined the possibility that the effects of income and cumulative risk on academic and social-emotional outcomes might be accounted for by the bidirectional contributions of adiposity and children's neurocognitive-based effortful control as assessed by executive control (EC) and delay ability (DA).

Effortful control involves the voluntary regulation of one's attention and behavior and calls upon the ability to inhibit a dominant response for a nondominant response.¹² Effortful control includes EC, the ability to regulate attention and implement cognitive and behavioral inhibition, and delay of gratification or DA, the ability to refrain from approach in a reward context. Although they are often combined into a single indicator of effortful control, research suggests that they stem from different underlying brain regions, have different developmental courses, and show specificity in their relation to adjustment, particularly social competence.¹³ In this study, we examine the dimensions independently to explore the possibility of their differential relations to BMI.

Researchers have proposed multiple models to conceptualize the relations between obesity and neurocognitive function. Research has demonstrated an association between obesity and abnormalities in brain tissue composition and function. These relations suggest that parts of the developing brain may be sensitive to the metabolic changes associated with excess adipose tissue.¹⁴ Other models contend that obesity influences chronic conditions that limit neurocognitive function. Alternatively, poor neurocognitive function could lead to behaviors that increase risk of obesity. Finally, higher-order neurophysiological processes could impact both the development of obesity and neurocognitive dysfunction.

Few studies have examined the longitudinal relations between BMI and specific aspects of self-regulation, such as EC and DA, especially in younger children. The preponderance of existing studies testing these theoretical models relied upon cross-sectional designs and therefore could not disentangle the direction of effects among these variables.

The known relations among income and cumulative risk, children's effortful control, BMI, and behavioral outcomes raise the possibility that BMI might be one pathway through which low income and cumulative risk affect preschool children's effortful control and behavioral and academic outcomes. Using a longitudinal design, and a community sample that oversampled lower income families, the relations among income and cumulative risk, BMI, effortful control, and adjustment outcomes spanning academic, social, and behavioral domains were examined. This study used a cross-lagged panel model to test for bidirectional effects between children's BMI and effortful control, and further, to test whether BMI and/or effortful

control mediated the relations of low income and cumulative risk to preschool children's behavioral and academic functioning.

Methods

Participants

Study participants were 306 mothers and their 36- to 39-month-old children (mean = 37; standard deviation [SD] = 0.84 months) recruited from daycares, health clinics, and community organizations serving low-income families. The sample was evenly distributed across income levels, with 29% of the sample at or near poverty ($N = 90 \leq 150\%$ federal poverty threshold), 28% lower income ($N = 84 > 150\%$ poverty threshold and $<$ local median income of \$58K), 25% middle to upper income ($N = 77 >$ median income to \$100K), and 18% affluent ($N = 54 > \$100K$). Additional details regarding recruitment and inclusion/exclusion criteria have been previously published.¹³

Procedures

Families were assessed in research offices at four time points separated by 9 months. Data for this study were taken from the first and fourth assessments when children were 36–40 (Time 1; T1) and 63–67 (Time 4; T4) months, respectively. At T4, there was complete BMI data for 93% of study participants and complete EC data for 94% of study participants. Following the Social and Behavioral Sciences Institutional Review Board guidelines, parental consent and child assent were secured. Children completed neuropsychological measures while mothers completed questionnaires.

Measures

Descriptive statistics are presented in Table 1.

Income

At T1, mothers reported on household income on a 14-point Likert scale. The scale afforded a fine-grained breakdown of income that facilitated the identification of families at the federal poverty cutoff using an income to means ratio (e.g., 1 = \$14,570 or less, 2 = \$14,571–\$18,310, 3 = \$18,311–22,050, and so on).

Cumulative Risk

A cumulative risk score captures the burden of risk experienced by children in low-income families.⁹ Although each of these factors might individually relate to outcomes, research suggests that the burden of stress associated with the co-occurrence of risk is relevant in accounting for children's development. In the present study, cumulative risk included the sum of eight factors: low maternal education ($<$ high school completion); single parent; adolescent parent; residential instability (family changing households ≥ 3 times in the previous 3 years); family structure transitions (mothers

Table 1. Child, Mother, and Household Characteristics (n = 306)

Characteristic	
Household	
Household income, mean (SD), range	8.75 (3.93), 0.50–14.00
Cumulative risk, mean (SD), range	1.02 (0.83), 0.00–4.59
Mother	
Educational attainment, %	
Some high school	3
Completed high school	6
Some college/technical school	34
Completed college	30
Postgraduate	27
Marital status, %	
Married/long-term relationship	81
Never married	12
Separated/divorced/widow	7
Child	
Gender, % female	50
Race/ethnicity, %	
European American	64
African American	9
Asian American	3
Latino/Hispanic	10
Native or American Indian	2
Multiple or other	12
T1 BMI, mean (SD), range	16.33, (1.74) 13.35–24.34
T4 BMI, mean (SD), range	15.06, (2.09) 8.06–27.18
T1 Executive control, mean (SD), range	0.29, (0.15) 0.00–0.77
T4 Executive control, mean (SD), range	0.79, (0.15) 0.18–1.00
T1 Delay ability	0.62 (0.25) 0.09–1.00
T4 Delay ability	0.75 (0.21) 0.17–1.00
T4 Academic readiness, mean (SD), range	38.69, (3.81) 22.17–42.00
T4 Social competence, mean (SD), range	43.07, (10.15) 5.00–60.00
T4 Total problems, mean (SD), range	9.05, (7.06) 0.00–30.00

SD, standard deviation; T1, Time 1; T4, time 4.

Continuous risk factor scores were converted into proportions so that they ranged from 0 to 1.

Effortful Control

Effortful control was assessed with two dimensions: EC and DA at both T1 and T4. EC was assessed using six tasks measuring attention regulation, and cognitive and behavioral inhibitory control administered. Tasks were drawn from well-established neuropsychological measures and batteries for this age group. The Auditory Attention subtest of the NEPSY-II was used as a measure of attention regulation. Cognitive inhibitory control was assessed using the Inhibition task on the NEPSY-II and two Stroop-like tasks, Day/Night¹⁷ and Dimensional Change Card Sort.¹⁸ Behavioral inhibitory control was assessed using the Bear-Dragon task,^{19,20} a simplified version of Simon Says. Head, Toes, Knees, Shoulders,²¹ also an inhibitory control measure, requires children to follow the instructions of the experimenter, but to enact the opposite of what the experimenter directs (e.g., touch toes when asked to touch head). Twenty percent of all EC tasks were independently rescored to assess inter-rater reliability. Intraclass correlation coefficients (ICCs) on all tasks ranged from 0.72 to 0.98. Total scores for each task were the proportion correct out of the total possible. Consistent with previous research, an overall EC score was computed as the mean of the proportion scores of the individual tasks. Internal consistency of the composite EC measure was 0.67, and the inter-rater reliability was 0.83.

Children's DA was assessed using a gift delay, in which the child was told that he or she would receive a present, but that the experimenter wanted to wrap it. Children's peeking (frequency, degree, latency to peek, and latency to turn) and difficulty with delay (e.g., fidgeting, getting out of seat, and grimacing) were rated. Latencies and behavior scores were converted to proportions of total possible times/scores and averaged, with higher delay scores reflecting better DA. ICCs were 0.91 and internal consistency was 0.77. Additional details regarding administration and scoring of each task have been previously published.^{13,22}

Academic and Behavioral Functioning

At T4, teachers rated children's academic readiness, social competence, and adjustment problems. Teachers rated children's academic readiness using the nine-item School Readiness Survey that assesses children's ability to identify colors, recognize letters, count, write own name, hold a pencil, intelligibility of speech, and so on.²³ Teachers rated children's social competence and total adjustment problems using the Social Skills Rating Scale.²⁴ Social competence measured cooperation, assertiveness, and self-control (composite alpha = 0.91). Total adjustment problems assessed externalizing problems, internalizing problems, and hyperactivity (composite alpha = 0.87).

reporting being divorced in the child's lifetime); household density (number of individuals living in the home divided by the number of rooms in the home); negative events (parent report on the General Life Events Schedule for Children)¹⁵; and maternal depression (mother report on the Center for Epidemiological Studies–Depression Scale).¹⁶ Dichotomous risk factors were scored as 0 = not present, 1 = present.

Body Mass Index

BMI was calculated from the children's weight and height, which was measured at each time point [BMI = weight (kg)/(height (m)²] by trained research assistants using a standard procedure that included having a scale in a set place on a hard floor and a wall-mounted measuring stick. Research staff were instructed to ensure that the child was still on the scale before recording the number and to ensure the child was standing with their backs to the measuring stick with feet together and straight for the height measurement. Height and weight data were checked for unlikely values. A categorical variable was created indicating whether children were underweight (≤ 5 th percentile), normal weight (> 5 th percentile and < 85 th percentile), overweight (≥ 85 th percentile and < 95 th percentile), or obese (≥ 95 th percentile) using CDC national norms adjusted for age and sex.²⁵

Statistical Analysis

Analyses were conducted to examine the prospective effects of BMI on children's EC and DA, the prospective effects of EC and DA on BMI, and to test whether BMI, EC, or DA mediated the effects of income and cumulative risk on children's academic and behavioral functioning. Path analyses were conducted to examine whether BMI predicted rank-order changes in EC or DA and mediated the effects of income and cumulative risk on EC or DA. Analyses also tested whether EC or DA predicted rank-order changes in BMI and mediated the effects of income and cumulative risk on BMI. Cross-lagged panel path models were tested in Mplus 6.0²⁶ using full information maximum likelihood estimation. Analyses suggested that minimal bias was introduced as a result of missing data. Whereas missingness was related to cumulative risk, EC, BMI, social competence, and total problems, the effect sizes of the associations missingness were modest (mean = 0.17; range = 0.02–0.32) and did not reach suggested thresholds for introducing substantial bias (*i.e.*, $r > 0.40$).²⁷ Therefore, families with any data were included in the path analyses. Finally, indirect effects of income and cumulative risk on academic and behavioral functioning were tested to assess whether BMI, EC, or DA mediated their effects. Mplus produces the Sobel test, a conservative test of indirect effects.²⁸

Results

Preliminary Analyses

BMI was examined using both continuous and categorical variables. The stability of the continuous BMI measure was indicated by a significant correlation between T1 and T4 BMI ($r = 0.64$; $p < 0.001$). BMI stability was examined using the categorical BMI measure with a chi-square (χ^2) test to indicate the likelihood that a child in one of the four categories (underweight, normal weight, overweight, or obese) at T1 remained in that category at T4 27

Table 2. T4 BMI Status Cross-Tabulated with T1 BMI Status

T1 BMI	T4 BMI				Total no. (%)
	Under-weight	Normal weight	over-weight	Obese	
Underweight	6	3	0	0	9 (7)
Normal weight	24	60	1	4	89 (70)
Overweight	1	14	2	2	19 (15)
Obese	1	2	2	6	11 (9)
Total no. (%)	32 (25)	79 (62)	4 (3)	12 (9)	128

T1, Time 1; T4, Time 4.

months later. A significant chi-square indicated that children largely remained in their weight categories over time ($\chi^2(9) = 52.98$; $p < 0.001$; see Table 2), with 58% of children maintaining their category. With the small number of children changing status over time, there was insufficient power to test predictors of particular status changes using the categorical BMI variable. Therefore, relations among the study variables were examined using correlational analyses.

The zero-order Pearson correlations among the study variables are summarized in Table 3. Child gender was associated with social competence and total adjustment problems and was included as a covariate in subsequent analyses. Higher T1 BMI was related to lower income, higher cumulative risk, and lower T1 DA, but was unrelated to T1 EC. T1 BMI was associated with lower T4 EC, but unrelated to T4 DA. T1 EC and DA were each related to higher income and lower cumulative risk, but unrelated to T4 BMI. Both T1 EC and DA were associated with academic readiness, social competence, and adjustment problems. Therefore, the hypothesis that BMI would mediate the relations of income and cumulative risk to children's EC, DA, and adjustment was plausible, whereas the hypothesis that EC or DA would mediate the relations of income and cumulative risk to BMI was not.

Path Analyses

A path model was specified that tested child gender, income, and cumulative risk as predictors of T1 BMI, EC, and DA, which, in turn, were specified as predictors of T4 BMI, EC, and DA. In addition, T4 BMI, EC, and DA were tested as predictors of T4 academic readiness, social competence, and total adjustment problems, and the indirect effects of income and cumulative risk on adjustment through BMI, EC, and DA were tested. Statistically significant relations among variables are depicted in Figure 1. Also, the cross-lagged paths among BMI, EC, and DA were depicted, despite being nonsignificant, given their relevance to the study hypotheses.

Higher income was related to lower T1 BMI and higher T1 EC and DA. Higher cumulative risk was related to

Table 3. Correlations among Study Variables

	INC	CR	T1 BMI	T4 BMI	T1 EC	T4 EC	T1 DA	T4 DA	Academic readiness	Social competence	Adjustment problems
Child sex	−0.06	−0.01	0.01	0.08	−0.09	−0.10	−0.15*	−0.19*	−0.10	−0.19*	0.18*
income (INC)	—	−0.61*	−0.21*	−0.24*	0.19*	0.24*	0.24*	0.08	0.22*	0.17*	−0.27*
Cumulative risk (CR)		—	0.24*	0.18*	−0.16*	−0.21*	−0.20*	−0.03	−0.22*	−0.23*	0.28*
T1 BMI			—	0.64*	−0.11	−0.23*	−0.19*	−0.01	−0.06	0.07	0.06
T4 BMI				—	−0.01	−0.13*	−0.10	−0.09	0.01	−0.06	0.18*
T1 executive control (EC)					—	0.42*	0.26*	0.19*	0.29*	0.18*	−0.10
T4 executive control (EC)						—	0.29*	0.19*	0.54*	0.30*	−0.25*
T1 delay ability (DA)							—	0.22*	0.26*	0.21*	−0.25*
T4 delay ability (DA)								—	0.04	0.15*	−0.14*
Academic readiness									—	0.30*	−0.15*
Social competence										—	−0.72*
Adjustment problems											—

Sex is girl=0, boy=1.

* $p < 0.05$.

T1, Time 1; T4, Time 4.

higher T1 BMI. Higher T1 BMI predicted lower T4 EC, after controlling for T1 EC, indicating that it predicted smaller rank-order increases in EC. T1 BMI was not related to rank-order changes in DA, nor was T1 EC or DA related to rank-order changes in BMI. Controlling for gender, income, and cumulative risk, T4 EC predicted greater academic readiness and social competence and lower total adjustment problems. There was a trend toward an effect of T4 BMI on higher adjustment problems, but no relation of T4 BMI to academic readiness or social competence. T4 DA did not predict adjustment above the effects of the other variables.

Given the significant relation of T1 BMI to T4 EC, tests of indirect effects were used to test whether BMI mediated

the effects of income and cumulative risk on EC and adjustment. There was a significant indirect effect of income on T4 BMI through cumulative risk and T1 BMI, indicating that the effect of income on BMI is partly accounted for by cumulative risk ($\beta = -0.07$; $p < 0.05$). There was a trend toward a significant indirect effect of income on T4 EC through T1 BMI ($\beta = 0.03$; $p = 0.08$). Further, there was a trend toward a significant multistep, or multiple mediator, effect of income on T4 EC through cumulative risk and T1 BMI, suggesting that the effect of income on BMI and EC is partly accounted for by cumulative risk ($\beta = 0.02$; $p = 0.05$). Tests of indirect effects also were used to examine whether EC mediated the effects of BMI on children's adjustment. There were significant indirect effects

Figure 1. Standardized path coefficients for model testing the bidirectional effects of BMI, executive control, and delay ability and their mediation of the effects of income and cumulative risk on children's behavioral and academic functioning. EC, executive control; DA, delay ability; T1, Time 1; T4, Time 4.

of T1 BMI on academic readiness ($\beta = -.10$; $p < 0.01$), social competence ($\beta = -.05$; $p < 0.05$), and adjustment problems ($\beta = 0.03$; $p < 0.05$) through T4 EC. There was a trend toward a significant multimediator, indirect effect of income on children's academic readiness through cumulative risk, T1 BMI, and T4 EC, suggesting that the effects of income on children's academic readiness might be accounted for by the combined effects of cumulative risk, BMI, and EC ($\beta = 0.01$; $p = 0.06$).

To characterize the association of obesity with children's EC, we tested the degree of change in children's EC relative to whether they were obese at the start of the study. Children who started the study obese demonstrated significantly lower EC at T4 (mean = 0.65; SD = 0.16), compared to children who were not obese at T1 (mean = 0.78; SD = 0.15; $t = 2.95$; $p = 0.004$), although they did not differ in their levels of EC at T1 (obese mean = 0.25; SD = 0.09; not obese mean = 0.29; SD = 0.14). The rate of growth in EC for children who started the study obese was 19% lower than that of children who were not obese at T1.

Discussion

Using a longitudinal design, this study found that BMI mediates the effect of income and cumulative risk on preschool children's executive control and has negative implications for their academic readiness, social competence, and behavioral adjustment. Consistent with other studies, high BMI and low EC were correlated with low income and high cumulative risk. These findings highlight the compounding of the effects of poverty given that it increases the likelihood of obesity, which, in turn, appears to impact EC. In addition, our findings underscore the importance of understanding and targeting modifiable early-life risk factors for obesity not only to improve health, but also to potentially influence cognitive, academic, and behavioral outcomes, especially for children from vulnerable socioeconomic backgrounds.

In this study, EC did not predict changes in BMI. However, some previous studies did find that poor executive performance and motor function are risk factors for increased BMI.^{29,30} However, in human and animal studies, adiposity has been found to be a source of inflammatory cytokines, which a recent study found mediated cognitive deficits in mice.³¹ In addition, exercise and obesity intervention studies in overweight and obese older children have found improvements in motor skills and general cognitive functions with decreases in BMI percentile,^{32,33} suggesting a directionality similar to our finding. Further, a nationally representative prospective study found that becoming overweight between kindergarten and third grade was a significant risk factor for adverse academic and behavioral school outcomes in girls.⁶ A recent review by Liang and colleagues concluded that although there is evidence to support both directions of the relationship, more research is needed to describe directionality.⁸ Regardless of the order of causal flow, the dual impact of obesity and poor EC on an already high-risk population of children is of significant concern.

BMI did not predict children's DA or vice versa. This finding may reflect a stronger physiological effect of BMI on the prefrontal cortex, implicated more in EC than DA, which also is thought to draw upon motivation systems of the brain in the mesolimbic-dopaminergic pathway.³⁴ Alternatively, in this age group, parents and caregivers may still be more influential in regulating children's food intake. The relationship between DA and BMI may become more meaningful when children are older and more independent in their regulation of food intake.

In previous work, we have reported on the differences we found between EC and DA with regard to social competence and adjustment problems, with EC predicting social competence and behavioral problems, but DA predicting only behavioral problems.¹³ It is possible that social competence (responsibility, organization, and cooperation) is most facilitated by persistence to social rules and norms, attention to the requests of others, and so on, as afforded by executive control. Similarly, perhaps EC is more related to the relegation of internal emotional states (modulation of anger and inhibition of behaviors associated with adjustment problems) than DA. However, it is also possible that we need multiple or more nuanced measures of DA.

In addition, we found a trend toward a direct relation between BMI at age 5 and higher behavioral adjustment problems, including externalizing symptoms, internalizing symptoms, and hyperactivity. Previous studies have documented that children with attention deficit hyperactivity disorder (ADHD), including those who do not currently take medications, are at increased risk for being overweight,^{35,36} and possible behavioral, neurobiological, and genetic underlying mechanisms have been proposed.³⁷ Similar to the conclusion drawn by these studies of ADHD, the clinical implications of the current study support effort to increase awareness and encourage the screening of the possible coexistence of overweight status and neurocognitive and behavioral problems in young children.³⁸

Evidence suggesting that exercise may improve neurocognitive functioning is encouraging^{39,40} and provides a target for further research and intervention. There is compelling evidence in older children and adults that physical activity and fitness enhance cognitive performance.^{41–43} There also is evidence among school-age children that physical activity is associated with academic achievement⁴⁴ and desirable classroom behavior, and a recent report by the Institute of Medicine calls for increased physical activity in schools to promote "brain health" and academic performance.⁴⁵ Advocacy efforts for more physical activity in children, a cornerstone recommendation for obesity prevention, should be further supported by our increasing knowledge about the relationship between BMI, physical activity, and learning.

Strengths of this study include a large sample that is over-represented by lower-income families, longitudinal design that allowed for tests of mediation, and multiple informants (mothers and teachers) and methods of assessment (neuropsychological and questionnaire). In addition, this study

was conducted on preschool children, a critical time period in the development of both adiposity and EC and a relatively understudied developmental period. However, we observed relative stability of BMI between the two time points used. With few children changing weight categories, there was insufficient power to more robustly test our hypotheses. Developmentally, BMI typically reaches its lowest between the ages of 4 and 6 before beginning a gradual increase (adiposity rebound). Therefore, the ability to detect certain relations between BMI, EC, and DA may be obscured by the adiposity rebound, but be detectable at later points in development. Future longitudinal study in this area is needed. Another limitation is that low-income participants who volunteer for research may not be entirely representative of low-income populations in ways that may systematically relate to children's weight status and cognitive abilities. Additionally, given the complex nature of poverty, obesity, and cognitive functioning, there may be unmeasured variables that are related to the variables in our model.²² In particular, there is evidence that physical activity, screen time, diet, and parenting^{46,47} are linked to both BMI and EC in children, and we do not take those factors into account in our model. Additionally, there is evidence suggesting that the relation of cognition and BMI is domain specific.²⁹ Domains outside of EC and DA merit further study. Other early-life predictors, including genetics, prenatal/early life exposures, parenting, and early nutrition and activity environments, should also be explored. Future studies should also follow children longitudinally into later development to further elucidate the relationship of BMI to cognition and behavior over time and test additional mediators and moderators, which could be targeted for intervention (e.g., diet).

Conclusions

Our findings highlight the relevance of BMI to children's EC and behavioral and academic outcomes, especially given that BMI seems to partially account for the effects of low income and cumulative risk on EC. This suggests that the early identification and intervention for overweight status in children, particularly those in low-income contexts, could have broader neurocognitive and social-emotional benefits.

Acknowledgment

This work was funded by the National Institutes of Child Health and Human Development (R01HD054465).

Author Disclosure Statement

No competing financial interests exist.

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