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Adherence to Screen Time and Physical Activity Guidelines is Associated with Executive Function in US Toddlers Participating in the STRONG Kids 2 Birth Cohort Study

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Objective To test the hypothesis that healthy weight status and adherence to American Academy of Pediatrics (AAP) guidelines for diet and physical activity would extend to greater executive function (EF) at age 24 months.

Study design Parents of 24-month-old children from the STRONG Kids 2 cohort study (n = 352) completed the Behavioral Rating Inventory of Executive Function for Preschoolers (BRIEF-P) and reported physical activities, diet, and screen time. Toddlers met AAP guidelines if they consumed at least 5 servings of fruits and vegetables, were physically active, refrained from sugar-sweetened beverages, and limited daily screen time to <60 minutes. Relationships between EF, 24-month weight status, and meeting AAP guidelines were tested independent of child sex, ethnicity, socioeconomic status, weight status at birth, and maternal pregnancy weight status.

Results Weight-for-length *z*-score had no effect on EF. Toddlers meeting the screen time guideline had greater EF (β, −0.125; 95% CI, 0.234 to −0.008), inhibitory self-control (β, −0.142; 95% CI, −0.248 to −0.029), and emergent metacognition (β, −0.111; 95% CI, −0.221 to 0.002), indicated by lower BRIEF-P scores. Those with more minutes of screen time had poorer overall EF (β, 0.257; 95% CI, 0.118-0.384), inhibitory self-control (β, 0.231; 95% CI, 0.099-0.354), cognitive flexibility (β, 0.217; 95% CI, 0.082-0.342), and emergent metacognition (β, 0.257; 95% CI, 0.120-0.381). Daily physical activity was associated with greater emergent metacognition (β, −0.116; 95% CI, −0.225 to −0.005).

Conclusions Meeting AAP guidelines for physical activity and screen time was related to greater EF in a demographically homogenous sample of toddlers. Future randomized control trials and more diverse samples are needed to confirm the directionality of this relationship. *(J Pediatr 2023;252:22-30)*.

Clinical trial registration ClinicalTrials.gov, NCT03341858.

Executive function (EF), defined as neurocognitive processes pertinent to the regulation of goal-directed behaviors,[1] is linked to overweight and obesity in childhood.[2] Low EF is implicated in lower academic success as early as preschool age,[3] as well as in poorer physical health (including overweight), financial instability, criminal offenses, and substance dependence in adulthood.[4] Inhibitory control is a domain of EF that allows one to regulate behavior, attention, thoughts, and emotions[1] and has been heavily studied in regard to weight status. This is likely due to its role in the regulation of energy intake and subsequently, prevention of excess weight gain.[2] Indeed, several longitudinal studies have observed poor performance on various aspects of inhibitory control in preschool ages to be predictive of body mass index (BMI) *z*-scores throughout childhood.[5,6] Few studies have explored the relationship between early-life weight status in multiple EF domains that are thought to develop rapidly over early childhood, such as working memory (which allows individuals to hold on to information for application to problem-solving situations) and cognitive flexibility (which allows for switching of perspective or focus)[1]; however, children with higher weight status as young as 5-9 years exhibit poorer EF in these domains.[7,8] By advancing our understanding of the relationship of weight status

3-moa	3 months of age	FFQ	Food Frequency Questionnaire
24-moa	24 months of age	FITS	Feeding Infants and Toddlers Study
AAP	American Academy of Pediatrics	SES	Socioeconomic status
BMI	Body mass index	SPARK	Sports, Play, and Active Recreation for Kids
BRIEF-P	Behavioral Rating Inventory of Executive Function for Preschoolers	SSB	Sugar-sweetened beverages
EF	Executive function	WFLZ	Weight-for-length *z*-score

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with these important predictors of success across the lifespan, we add to the understanding of the possible impact of obesity on cognitive development.

Because the prevalence of overweight and obesity tends to rise with age,[9] it is also important to consider how habits of diet and play that emerge around toddlerhood could influence EFs directly and indirectly through their effects on weight status. The American Academy of Pediatrics (AAP) provides evidence-based guidelines for the prevention of childhood obesity in the form of the *Bright Futures* initiative, which encourages (1) 5 or more servings of fruits and vegetables per day; (2) reduced or eliminated intake of sugar-sweetened beverages (SSB); (3) less than 1 hour of screen time daily; and (4) participation in daily physical activity or at least 60 minutes of moderate-to-vigorous physical activity daily.[10] Emerging evidence in older children suggests that adherence to these guidelines positively impacts cognitive function. Specifically, the amount of screen time[11,12] and physical activity,[13] as well as various aspects of diet quality,[14] have been linked to EF in school-aged and adolescent children, although not independently of weight status. A better understanding of the interrelationships among these factors in toddlerhood is needed, as that stage marks a sensitive period of cognitive development[15] and rapid brain growth.[16]

The primary aim of the present analysis was to examine how toddler weight status is related to EF. A secondary aim was to address the possible direct and indirect (through weight status) relationships among adherence to childhood obesity prevention guidelines, health behaviors, and better EF at 24 months of age (24-moa). A sub-aim of these analyses was to explore the impact of additional early-life factors, delivery mode, and feeding mode at 3 months of age (3-moa) as covariates of the relationship between weight status and EF. Determining the relationships among weight status, health behaviors, obesity prevention guidelines, and EF in toddlers could inform interventions aimed at improving adherence to guidelines.

Methods

Data were obtained for mothers and 24-moa dyads enrolled in the STRONG Kids 2 birth cohort study (ClinicalTrials.gov: NCT03341858).[17] This study was approved by the University of Illinois Institutional Review Board (13 448). Women were recruited during their third trimester of pregnancy between May 2013 and January 2017 from the Francis Nelson Center in conjunction with Carle Foundation Hospital (Champaign, IL), Christie Clinic (Champaign, IL), Decatur Memorial Hospital (Decatur, IL), Provena United Samaritans Medical Center, and Danville Polyclinic (Danville, IL) at prenatal visits or birthing classes provided by the sites. For birthing classes, recruitment was conducted by STRONG Kids research staff. For prenatal visits, recruitment materials were distributed by trained clinic or hospital staff. In addition, participants were recruited through local newsletters and other media outlets in the Champaign-Urbana, Danville, and Decatur areas.

Interested mothers were contacted by trained research staff to schedule a meeting during their next prenatal visit to discuss further details of the study and to confirm or decline enrollment. In either case, mothers were provided with a $15 gift card for their time. Online informed consent forms were completed by all participant parents or guardians. Infants with birth conditions that affect feeding or who were born prematurely (<37 weeks) or with a low birth weight (<2.5 kg) were excluded from the cohort study. After using these exclusionary criteria and addressing missing data a final sample of 356 children was retained for analyses (see the EF Measurement section and **Figure 1**; available at www.jpeds.com).

Measures

Demographics. Caregivers responded to a survey that provided their highest level of education, maternal prepregnancy height and weight, childbirth mode, child's birth weight and length, child's ethnicity/race, and household income at 24-moa. Mother's level of education and household income were used to compute composite socioeconomic status (SES) scores, which were divided into low, medium, and high SES. Some caregivers failed to disclose socioeconomic (n = 32), ethnicity (n = 16), prepregnancy weight (n = 13), birth weight (n = 7), and delivery mode (n = 1). There was no significant difference in child sex (mean difference, 0.03; 95% CI, −0.14 to 0.07), ethnicity (mean difference, 0.07; 95% CI, −0.16 to 0.03), 24-moa Weight-for-length *z*-score (WFLZ) (mean difference, 0.02; 95% CI, −0.21 to 0.24), age (mean difference, 0.01; 95% CI, −0.04 to 0.03), and 6-week high SES (mean difference <0.00; 95% CI, −0.10 to 0.10) or low SES (mean difference, 0.02; 95% CI, −0.04 to 0.08) between families lost to follow-up by 24-moa.

Anthropometrics. All 24-moa measurements were obtained during home visits by trained research personnel. After requesting that shoes and any excess, heavy clothing be removed, the average of 2 measurements of height and weight obtained with a portable stadiometer (Seca 213) and a digital scale (HealthOmeter 349KLX), respectively, were recorded. WFLZ was computed using the World Health Organization's child growth standards. Children were classified as obese (≥3.0), overweight (≥2.0), normal weight (−2.0 to <2.0), and underweight (<-2.0) based on established criteria.[18] Maternal prepregnancy height and weight were self-reported and BMI was used to classify mothers as underweight (BMI <18.5 kg/m^2), normal weight (18.5≤ BMI <25), overweight (25≤ BMI <30), or obese (BMI ≥30). Twenty-three participants at 24-moa had missing height and weight measurements.

EF. Parents completed the Behavioral Rating Inventory of EF for Preschoolers (BRIEF-P),[19] which consists of 63 questions on a single-rating scale of frequency—never (1), sometimes (2), or often (3)—of everyday behaviors at home or daycare. A lower score is indicative of better EF—that is, the child exhibits lower frequency of behavioral problems related to EF. Scoring was completed based on recommendations from the survey authors. In brief, the responses were aggregated to compute 5 clinical subscales representing various dimensions of EF (Inhibit, Shift, Emotional Control, Working Memory, and Plan/Organize). According to the scoring recommendations, clinical scales consisting of 3 broader indices were then created: Inhibitory Self-Control (composed of Inhibit and Emotional Control scales), Cognitive Flexibility of Shift and Emotional Control, Emergent Metacognition of Working Memory, and Plan/Organize, along with Overall Executive Function (composed of all 5 scales).

In adherence to the BRIEF-P manual instructions, toddlers missing >12 items overall or >2 items on a scale were excluded from the analyses, and the remaining missing values (0.5%) on this survey were imputed with the response "never," at the guideline provided by the BRIEF-P manual. Survey results were assessed for validity using Negativity and Inconsistency indices.[19] Raw index scores were converted to T-scores and percentiles as instructed in the BRIEF-P manual for descriptive purposes. Raw scores are used in all analyses, as several of our toddlers fell just below 24-moa (n = 183; minimum age, 23.41 months).[20] Age was not associated with any BRIEF-P index and thus was not included as a covariate in the models.

Physical Activity. Parents reported the number of days per week that their child participated in various physical activities for at least 15 minutes using the Sports, Play, and Active Recreation for Kids (SPARK) survey.[21] Total activities reported were summed and used to determine weekly physical activity. Those reporting 1 activity per day were classified as meeting the AAP guideline for toddlers to engage in active play every day. In this case, it was assumed that if at least 7 activities were reported in a week, the child was participating in at least 1 activity per day. Thirteen participants failed to complete the SPARK survey.

Screen Time. The Common Sense Media Survey was used by parents to report their child's screen time.[22] This survey consists of both ratings and open-ended questions to determine the frequency and duration of various types of media, respectively. Minutes of media use that involved screens (ie, TV, DVD, shows on a computer or cellphone, games on a console, computer, cellphone, handheld device, and other uses of apps and computers) were summed to determine total screen time. Outlier values for screen time, as determined by those 3 SD above the mean (2075 minutes/day), were winsorized to the next highest value within 3 SD (685 minutes/day). Those reporting no more than 60 minutes of screen time were classified as meeting the AAP guideline for screen time. One participant failed to complete the Common Sense Media Survey.

Dietary Intake. At 3-moa, mothers completed survey items on feeding mode (ie, exclusive breastfeeding, formula feeding, or both) from the CDC Survey on Infant Feeding Practices Study II.[23] At 24-moa, parents completed the NutritionQuest Child Block Food Frequency Questionnaire (FFQ) for Ages 2-7, consisting of 90 questions pertaining to the child's usual eating habits in the previous 6 months. Food lists developed by NutritionQuest were obtained from National Health and Nutrition Examination Survey II dietary recall data, which provided approximate daily servings of fruits and vegetables and kcal from sugary beverages.[24] Children above (1602 kcal) or below (396 kcal) 2 SD of the mean for total kcal were considered outliers (n = 7) and were excluded, based on typical energy intake of ~1470 kcal for age 2-5 years.[25] Children who consumed at least 5 servings of fruits and vegetables were classified as meeting the AAP guideline for fruit and vegetable servings. The AAP recommends limited consumption of sugary beverages[10]; thus, children who did not consume any energy from sugary beverages were classified as meeting the guideline. Fifty-one participants failed to complete the FFQ, and 8 did not complete the CDC Survey on Infant Feeding Practices Study II.

Statistical Analyses

A path analysis with the structural equation modeling technique was performed with MPlus version 8.4 to assess the direct and indirect relationships between AAP guidelines and heath behaviors with EF (**Figures 2** and **3**). Direct effects were tested to examine AAP guidelines and continuous health behavior relationships with BRIEF-P indices. Indirect effects were tested to explore the possible mediating effect of WFLZ at 24-moa on the relationships of AAP guidelines and continuous health behaviors with BRIEF-P indices. All path coefficients were freely estimated in the models. A threshold of P = .05 was considered significant. P values were corrected for multiple comparisons using a Benjamini–Hochberg procedure with a false discovery rate of 0.1 to determine significance after correction. Because individual testing was the primary interest of this study (ie, to determine relationships between individual components of EF with specific AAP guidelines or continuous health behaviors), P values were considered the primary indicator for hypothesis testing.[26] The full information maximum likelihood approach was used to handle missing data. Unlike traditional maximum likelihood estimation, which requires complete data, this method uses all observed variables for each case, allowing computation of parameter estimates even in the presence of missing data. The full information maximum likelihood approach has been shown to produce unbiased parameter estimates and standard errors when data are at least missing at random.[27] Selection of the covariates—child sex, SES, birth WFLZ, ethnicity, and maternal pre-pregnancy weight status—was based on a priori expected association with EF and WFLZ at 24-moa.[10,19,20] The independent-samples t-test and ANOVA were used to examine these relations in our sample. These analyses and descriptive statistics were conducted in SPSS 28.0 (IBM). Direct and indirect effects were tested using a bootstrap estimation approach with 5000 samples. Bootstrap SEs and CIs of the direct and indirect effects were calculated. Post hoc power analysis revealed that our model was sufficiently powered (95.4%) to detect an effect on overall EF, based on number

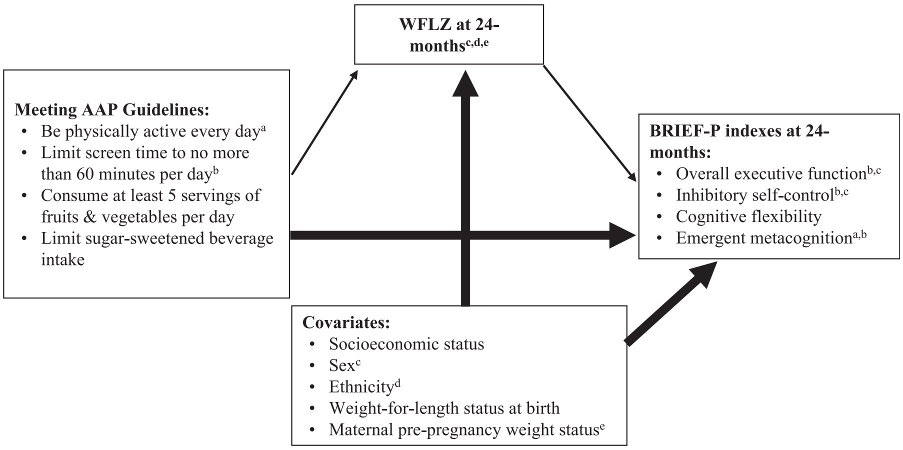

Figure 2. Path model A. Direct and indirect effects (through weight status) of AAP guidelines for physical activity, screen time, and fruit, vegetable, and SSB intakes on EF.

of predictors included in the model (n = 10), observed R^2 of 6.7%, probability level of .05, and sample size of 356.[28,29] Additionally, post hoc power analyses were performed to evaluate the sufficiency of meeting the guideline for fruits and vegetable consumption and 24-moa WFLZ groups owing to their uneven group sizes.[30]

Results

Participant recruitment and data analysis flow can be found in **Figure 1**. Demographic data, weight status, and EF percentiles standardized for age and sex are presented in **Table I**. Adherence to AAP guidelines can be found in **Table II**. Eight percent of toddlers met none of the guidelines, 25% met 1 guideline, 38% met 2 guidelines, 28% met 3 guidelines, and 1% met all 4 AAP guidelines. Note that EF scores were all below the 50th percentile for frequency of problematic behaviors related to poorer EF (**Table I**). Toddlers of mothers with obesity or overweight prior to conception had higher WFLZ at 24-moa (mean difference, 0.73; 95% CI, 0.39 to 1.07) and toddlers who had a higher WFLZ at birth (≥2.0) exhibit higher WFLZ at 24-moa (mean difference, 0.82; 95% CI, −1.63 to 0.01). The *t*-test showed no significant difference in EF by any covariate or in WFLZ at 24-mo by 3-moa feeding mode, delivery mode, ethnicity, or SES in this sample (**Table III**; available at www.jpeds.com). Sex, ethnicity, SES, WFLZ at birth, and maternal pregnancy weight status were included as covariates in subsequent analyses.

Model A Results: Adherence to AAP Guidelines and EF

Adherence to guidelines was not associated with WFLZ. Toddlers adhering to the screen time guideline had significantly greater emergent metacognition (β, −0.111; 95% CI, −0.221 to 0.002), inhibitory self-control (β, −0.142; 95% CI, −0.248 to −0.029), and overall EF abilities (β, −0.125; 95% CI, −0.234 to −0.008), indicated by lower BRIEF-P scores. Those who met the guideline of daily physical activity had greater emergent metacognition (β, −0.116; 95% CI, −0.225 to −0.005). Those meeting the guideline to limit

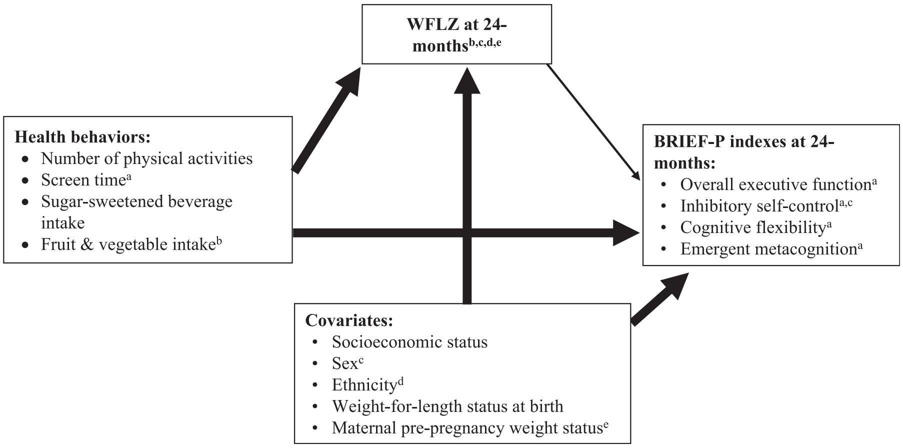

Figure 3. Path model B. Direct and indirect effects (through weight status) of physical activity, screen time, and fruit, vegetable, and SSB intakes on EF.

Table I. Maternal and child characteristics and demographics

Characteristics	Total N	Values
Child sex, n (%)	356	
Male		177 (49.7)
Female		179 (50.3)
Child race, n (%)	340	
Caucasian		255 (75.7)
Asian		18 (5.3)
Black		18 (5.3)
American Indian or Alaskan Native		1 (0.3)
Multiple races		45 (13.4)
SES, n (%)	324	
Low		15 (4.6)
Medium		121 (37.3)
High		188 (58.0)
Child age, mo, mean ± SE	356	24.1 (0.03)
Delivery mode, n (%)	355	
Cesarean		83 (23.4)
Vaginal		272 (76.6)
Feeding mode at 3-moa, n (%)	348	
Exclusively breastfed		238 (68.4)
Mixed feeding		61 (17.5)
Exclusively formula-fed		49 (14.1)
Child WFLZ*		
Birth weight category, n (%)	349	
Underweight		36 (10.3)
Normal weight		299 (85.7)
Overweight		14 (4.0)
24-month weight category, n (%)	333	
Underweight		12 (3.6)
Normal weight		254 (76.3)
Overweight		67 (20.1)
Maternal prepregnancy weight status, n (%)	343	
Normal weight		168 (49.0)
Overweight		85 (24.8)
Obese		90 (26.2)
Standardized EF scores†, mean (SE)	356	
Overall EF		47.2 (1.7)
Inhibitory self-control		45.1 (1.5)
Cognitive flexibility		44.1 (1.5)
Working memory		47.8 (1.8)
Raw EF scores‡, mean (SE)	356	
Overall EF		91.3 (1.0)
Inhibitory self-control		38.4 (0.4)
Cognitive flexibility		29.3 (0.3)
Working memory		38.8 (0.5)

*WFLZ characterized by weight category using the following World Health Organization standard cutoffs: <-2.0, underweight; −2.0 to <2.0, normal weight; ≥2.0 to <3.0, overweight; ≥3.0, obese.
†Data are average percentile scores standardized for sex and age (SE). Lower than 50th percentile indicates reporting fewer problems related to EF relative to the BRIEF-P standard population mean.
‡Data are average raw scores (SE) used in analyses.

SSB had numerically greater emergent metacognition (β, −0.118; 95% CI, −0.240 to 0.001), inhibitory self-control (β, −0.107; 95% CI, −0.232 to 0.020), and overall EF (β, −0.113; 95% CI, −0.237 to −0.010), although the differences were not statistically significant. There was no significant difference in BRIEF-P indices for those meeting the guideline for fruit and vegetable intake. WFLZ at 24-moa was not associated with any BRIEF-P index, nor did it have any mediating effects on the relationships between AAP guidelines and BRIEF-P (**Table IV**; available at www.jpeds.com). AAP guidelines and covariates explained 10.9% of the variance in WFLZ at 24-moa. AAP guidelines, WFLZ, and covariates explained 6.7%, 6.8%, and 6.8% of the

Table II. Adherence to AAP guidelines (%) and mean participant physical activities, screen time, and fruit, vegetable, and SSB intakes

Measures	N	Reported frequency, mean (SE)	Guidelines	% adherence (n)
Physical activities, n/wk	343	10.8 (0.5)	Physically active every day	75.5 (259)
Screen time, min/d	355	98.2 (6.4)	No more than 60 minutes of screen time daily	54.1 (192)
Fruits and vegetables, servings/d	305	2.8 (0.1)	At least 5 servings of fruits and vegetables daily	3.9 (12)
SSB, kcal/d	305	11.5 (1.7)*	Limit SSB	68.9 (210)

*Includes only those who reported any SSB intake (n = 95).

variance in overall EF, inhibitory self-control, and emergent metacognition, respectively. Male children (β, −0.127; 95% CI, −0.237 to −0.023), children of Caucasian ethnicity (β, 0.125; 95% CI, 0.007 to 0.242), and mothers with overweight or obesity prior to pregnancy (β, 0.232; 95% CI, 0.121 to 0.351) had higher WFLZ at 24-moa. Males also had poorer inhibitory self-control (β, −0.117; 95% CI, −0.223 to −0.018). Correction for multiple comparisons abrogated all significant relationships with EF and WFLZ in the model (**Table IV**).

Model B Results: Associations of Physical Activity, Screen Time, and Diet with EF

Toddlers consuming more servings of fruits and vegetables had significantly higher WFLZ at 24-moa (β, 0.131; 95% CI, 0.006-0.252). Although not statistically significant, toddlers with more screen time had higher WFLZ (β, 0.116; 95% CI, −0.012 to 0.233). Screen time was significantly associated with each BRIEF-P index, such that toddlers with more screen time had poorer overall EF (β, 0.257; 95% CI, 0.118-0.384), inhibitory self-control (β, 0.231; 95% CI, 0.099-0.354), cognitive flexibility (β, 0.217; 95% CI, 0.082-0.342), and emergent metacognition (β, 0.257; 95% CI, 0.120-0.381). Intake of SSB, consumption of fruit or vegetables, and physical activity were not associated with any BRIEF-P index. SSB and number of physical activities also were not associated with WLZ at 24-moa (**Table V**; available at www.jpeds.com). WFLZ at 24-moa had no effect on any BRIEF-P index, nor did it have any mediating effect on the relationships between health behaviors and BRIEF-P. Health behaviors, WFLZ, and covariates explained 8.1%, 7.9%, 5.8%, and 7.7% of the variance in overall EF, inhibitory self-control, cognitive flexibility, and emergent metacognition, respectively, and health behaviors and covariates explained 11.7% of the variance in WFLZ at 24-moa. Male children (β, −0.120; 95% CI, −0.230 to −0.021), children of Caucasian ethnicity (β, 0.121; 95% CI, 0.005-0.240), and mothers with overweight or obesity prior to pregnancy (β, 0.213; 95% CI, 0.101-0.329) had higher WFLZ at 24-moa. Males also had poorer inhibitory self-control (β, −0.106; 95% CI, −0.209

to −0.007). After correction for multiple comparisons, all effects remained significant in the model except for the direct association between fruit and vegetable servings with higher WFLZ at 24-moa (**Table V**).

Discussion

The current study expands on prior findings of poorer EFs linked to higher weight status[2,5,7,8] and factors influencing weight regulation in older children,[2,11-14] by addressing these relationships in a large cohort of toddlers for each EF domain individually and as a composite score. The results suggest that associations between health behaviors and EFs may precede observed relationships between EFs and weight status. Toddlers meeting the guideline to limit screen time to no more than 1 hour per day had better inhibitory self-control and emergent metacognition, as well as overall EF. Lower total screen time also was predictive of higher overall EF and each domain of EF. Meeting the guideline to be physically active every d was associated with greater emergent metacognition. Although associations specific to meeting guidelines was abrogated on correction for multiple comparisons, this should be interpreted with caution, owing to the interest in individual testing of relationships between EFs and guidelines. Alternatively, this result may be simply a further indicator (aside from effect sizes) of the weaker association of EFs with guidelines compared with continuous variables, which had greater variability. Overall, these findings suggest that obesity risk factors are relevant, and that adherence to guidelines for daily physical activity and screen time limitations may be advantageous not only for weight regulation, but also for cognitive development.

Although much of the work surrounding EFs and weight status has focused on the causal relationship of the former on the latter, this relationship is likely to be birectional. Indeed, up-regulation of inflammatory cytokines and other obesity-associated biomarkers may have consequences for brain growth and development.[31,32] A study of 9- to 11-year-olds showed that the relationship between increased BMI and lower EF was mediated by cortical thickness of the prefrontal cortex, the maturation of which has been linked to EF development.[33] Despite these previous observations in older children, there was no association between weight status and any domain of EF in the current sample of toddlers; however, a high proportion of the current sample was of healthy weight at 24-moa. Post hoc power analyses revealed low power (17%) to detect an effect on overall EF, based on a Cohen *d* value of 0.110.

Therefore, our results may indicate that the relationship between greater weight status and EF emerges later in childhood; toddlers must rely heavily on their caregiver for dietary intake, but this reliance tends to decrease throughout childhood as they naturally become more independent. In this sample, toddlers of mothers with overweight or obesity prior to conception had higher WFLZ at 24-moa. Although noncausal, this may suggest a role for caregiver weight status on weight management in early childhood and may be a reflection of the relevance of family-wide interventions for promoting optimal health behaviors in young children. Longitudinal work in this area could elucidate the age at which relationships between EF and weight status emerge, and whether parent weight status and behaviors continue to track with child weight status throughout early life.

Although a priori covariates were implemented for regression analyses, we also explored other early-life associations with EF in an effort to promote the generalizability of our results, regardless of diet and delivery mode during infancy. Comparing groups who were exclusively breastfed to those who were formula-fed or mixed-fed at 3-moa revealed no significant differences in any domain of EF. In contrast, a recent study reported that each month of exclusive breastfeeding was associated with a decreased risk of clinically defined working memory deficit in 6-year-olds, even after adjusting for SES, among other factors; however, no relationship was found for inhibition or overall EF.[34] It is possible that the relationship between breastfeeding and EF is not observable until the child is older (6 years vs 2 years). On the other hand, previous work in a large sample of infants (n = 11 134) suggested that the negative relationship of delivery via cesarean with cognitive outcomes may be rescued by age 3 years.[35] Consistent with this work, our results showed no relationship between infant delivery mode and EF. The present study sample demonstrated an especially high proportion of exclusively breastfed infants at 3-moa (68%) and vaginally delivered infants (77%), whereas only 40% of infants aged <6 months are exclusively breastfed worldwide,[36] and ∼68% of children in the US are delivered vaginally.[37] Considering this and the cross-sectional nature of the present study, longitudinal analyses exploring relationships of early-life feeding and delivery mode with EFs throughout childhood in a more diverse sample are needed.

Many parents and guardians in this sample reported toddler SSB intake, screen time, and physical activities in meeting AAP guidelines similar to previous findings in a national, cross-sectional analysis of the 2008 Feeding Infants and Toddlers Study (FITS) of >600 2-year-olds (defined as age 24-35.9 months). In the FITS, ∼70% of the toddlers did not meet the recommended 5 servings of fruits and vegetables per day, ∼55% consumed SSB on a daily basis, ∼20% exceeded 2 hours of screen time per day, and only 30% engaged in active play outside for at least 1 hour per day.[38] Our current sample yielded an especially low adherence rate (5%) for consumption of 5 servings of fruits and vegetables per day. Surprisingly, post hoc power analyses indicated that the power to detect a significant difference between those meeting and not meeting the guideline for fruits and vegetables for overall EF was likely sufficient (74.4%), based on a Cohen *d* of 0.301. However, no significant relationships were found between EFs and fruits and vegetable guideline or intake. Regardless, it is still possible that low adherence and lack of variability in the current sample impacted these findings, possibly owing to imprecise assessment in serving sizes for toddlers, given that the Block FFQ Ages 2-7 does not inquire about food serving sizes (only beverages).

Furthermore, as young children tend to meet recommendations for daily fruit servings but not for vegetable servings (and especially nonstarchy vegetables),[39] a less crude analysis of diet quality is likely required to detect an effect and should be considered in future analyses.

Even on inquiry of beverage portions, SSB also was not related to EFs, even though those meeting the guideline for SSB exhibited trend toward better EF. Many parents reported no intake of SSB, and those who did report intake of SBB reported very little (11.5 kcal/day). Recent NHANES data suggest that males and females aged 2-5 years consumed 65 kcal and 59 kcal from SSB daily, respectively, an average that is likely skewed by the older ages, because intake of SSB tends to increase across childhood age groups. Even for children aged 6-11 years, the daily kcal from SSB almost doubles, to 133 kcal in males and 104 kcal in females.[40] Therefore, considering our highly educated sample of families and the young age of our sample, it is possible that these kcal estimations of SSB are fairly accurate but are not necessarily generalizable. Regardless of study limitations, the lack of relationship between diet and EF was surprising, given the evidence in older children showing relationships between SSB, fruit and vegetable intake, and diet quality (of which these are a hallmarks) and EF.[14]

Limiting screen time to no more than 60 minutes per day was not associated with cognitive flexibility, and the relationships with the other indices were not as strong as those with the continuous screen time variable. Although noncausal, this may indicate that more than 60 minutes of screen time by toddlers negatively impacted EF. Because the emotional control subscale overlaps for cognitive flexibility and inhibitory self-control, the lack of association between limiting screen time and cognitive flexibility also may indicate greater influence of the inhibition subscale in the relationship between screen time and inhibitory self-control (composed of inhibit and emotional control subscales). Mechanisms for the relationship between screen time and EFs are unclear, however. Nathanson and Fries proposed two mechanisms: one dependent on the specific content, some of which may alter the child's perception of the social world (eg, fast-paced, fantasy television that requires and rewards inefficient information processing),[12] and the other involves the indirect effect of screen time on EF through other behaviors. In fact, screen time has been negatively correlated with both physical activity and sleep time in toddlerhood.[12,41]

Our results showing greater working memory in toddlers who were more physically active supports observations that physical activity interventions can improve EF in school-aged children;[13,38,42] however, these findings are novel in suggesting that this relationship begins in toddlerhood and may be specific to emergent metacognition. Physical activity has numerous health benefits relevant to development, including the up-regulation of important neurodevelopmental growth factors.[43] In fact, magnetic resonance imaging studies comparing school-aged children, characterized by their fitness level and/or involvement in a physical activity intervention, exhibited functional[44] and structural changes,[45] respectively, in areas of the brain associated with EF, along with better performance on cognitive control tasks.

This sample of toddlers was a highly homogenous demographic representation, and future studies should aim to recruit a more ethnically and socioeconomically diverse sample. Given the greater risk for high screen use, obesity, low physical activity, and poor diet in children of non-Caucasian ethnicities/races and lower SES,[46,47] this is especially important to address in future studies. Another limitation of the present study was the methods of assessment for physical activity and diet. Measurement of physical activity was through parental report of number of activities engaged in for at least 15 minutes per week. As a result, actual time spent doing physical activity could not be determined, and the actual AAP Bright Futures guideline for 60 minutes of moderate-to-vigorous physical activity per day could not be determined. Diet was assessed through FFQ, which introduces bias related to assumption of serving sizes and reliance on parent memory of diet over the last 6 months. Future work should aim to collect time spent doing physical activities and more precise measures of SSB, fruit, and vegetable intake.

Toddlers with less screen use who meet the AAP guidelines for both screen time and physical activity exhibited better EF, suggesting a potential role of these health behaviors in cognitive development. Based on observations in older children, these study results suggest that relationships between more sedentary and less active play with poorer EF emerges earlier in life compared with weight status. However, owing to the aforementioned limitations and the cross-sectional study design, these results should be interpreted with caution. In addition, a majority (67%) of toddlers met multiple guidelines, suggesting that health behaviors in toddlerhood tend to coincide. Future studies should explore interactions and coincidence of health behaviors, as well as their effects on EF development. Exploring the interplay of these factors and growth trajectories over time could be foundational to the understanding of their impact on early-life cognitive development. Regardless of limitations, this work is among the few studies to explore multiple EF domain relationships with weight status and health behaviors in a large sample of toddlers, emphasizing the need for future, robust studies to determine the significance of building healthy habits from a young age to promote early EF development. ■

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Data Statement

Data sharing statement available at www.jpeds.com.

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50 Years Ago in *The Journal of Pediatrics*

The Continued Importance of the Meckel Scan

Jaros R, Schussheim A, Levy LM. Preoperative diagnosis of bleeding Meckel's diverticulum utilizing 99m technetium pertechnetate scinti-imaging. J Pediatr 1973;82:45-9.

Meckel diverticulum results from incomplete obliteration of the vestigial vitelline duct and is the most common congenital abnormality of the gastrointestinal tract, affecting approximately 2% of the population.[1] Meckel diverticulum is located in the ileum and usually contains ectopic gastric mucosa, which can cause ulceration of the adjacent ileal mucosa and rectal bleeding but also can contain pancreatic, duodenal, or colonic mucosa. Fifty years ago, children with rectal bleeding of unknown etiology would undergo an exploratory laparotomy in search of a Meckel diverticulum or other cause. In 1973, ^{99}technetium pertechnetate scintigraphy, now known as the Meckel scan, was first used in pediatric patients perioperatively to diagnose Meckel diverticulum with ectopic gastric mucosa. Jaros et al used the technology in 5 children with rectal bleeding of unknown etiology. Two of these children had positive scans and subsequently had surgery to excise a Meckel diverticulum; 3 children had normal scans and avoided unnecessary laparotomies.

Although most patients remain asymptomatic, a recent study of 945 children with Meckel diverticulum found that 60% presented with bowel obstruction including intussusception, 36% presented with bleeding, and 8% presented with inflammation, which can appear as appendicitis-like symptoms in a patient with a normal appendix.[2] Many imaging modalities, including angiography, video capsule endoscopy, and small-bowel enteroscopy, can detect a Meckel diverticulum but are not commonly used for this purpose. Although there have been technical advances to the scan since 1973, when Polaroid films augmented a 90-minute digital recording, it maintains the same underlying technology. Now, premedication with H_2 antagonists often is used to enhance tracer uptake into gastric tissue, and a Meckel scan has high sensitivity and specificity, both approaching 100%.[3] Today, the Meckel scan remains the study of choice in hemodynamically stable patients with rectal bleeding and should be used for prompt recognition and differentiation of this congenital anomaly from other conditions with similar clinical presentations.

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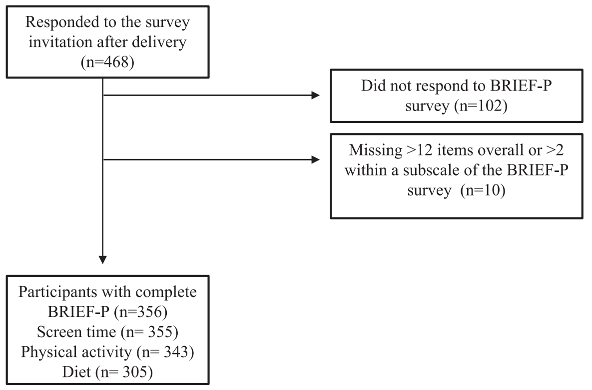

Figure 1. Study recruitment and data analysis flow.

Table III. Means of the BRIEF-P indices and WFLZ at 24-moa by sex, ethnicity, SES, WFLZ at birth, maternal prepregnancy weight status, delivery mode, and feeding mode at 3-moa

Variables	Overall EF	Cognitive flexibility	Inhibitory self-control	Emergent metacognition	WFLZ at 24-moa
Sex					
Females (n)	89.67 ± 1.34 (87.06-92.25)	28.93 ± 0.44 (28.10-29.80)	37.60 ± 0.59 (36.44-38.75)	38.14 ± 0.65 (36.86-39.40)	0.55 ± 0.10 (0.35-0.74)
Males (n)	93.03 ± 1.38 (90.32-95.74)	29.71 ± 0.44 (28.86-30.59)	39.25 ± 0.62 (38.01-40.45)	39.53 ± 0.67 (38.19-40.82)	0.81 ± 0.11 (0.59-1.04)
P value	.078	.215	.057	.137	.084
Ethnicity					
Caucasian (n)	90.91 ± 1.12 (88.72-93.11)	29.13 ± 0.36 (28.44-29.82)	38.28 ± 0.50 (37.32-39.25)	38.67 ± 0.56 (37.60-39.78)	0.73 ± 0.86 (0.57-0.90)
Other (n)	90.82 ± 1.90 (87.26-94.61)	29.48 ± 0.66 (28.19-30.82)	37.95 ± 0.90 (36.22-39.75)	38.44 ± 0.90 (36.68-40.20)	0.38 ± 0.16 (0.06-0.70)
P value	.970	.622	.755	.818	.054
SES*					
Low (n)	99.40 ± 5.96 (86.63-112.17)	31.93 ± 2.02 (27.60-36.27)	42.00 ± 2.69 (36.24-47.76)	41.93 ± 2.74 (36.07-47.80)	0.67 ± 0.29 (0.05-1.29)
Medium (n)	90.57 ± 1.68 (87.24-93.90)	28.81 ± 0.53 (27.77-29.85)	38.08 ± 0.76 (36.59-39.58)	38.80 ± 0.82 (37.17-40.43)	0.61 ± 0.14 (0.34-0.88)
High (n)	91.66 ± 1.27 (89.15-94.17)	29.59 ± 0.42 (28.75-30.42)	38.59 ± 0.58 (37.44-39.73)	38.80 ± 0.62 (37.58-40.01)	0.71 ± 0.10 (0.51-0.92)
P value†	.206	.127	.219	.403	.839
WFLZ at birth					
<2.0 (n)	91.43 ± 5.80 (80.59-103.08)	28.93 ± 1.52 (26.06-32.07)	37.43 ± 2.32 (32.92-42.07)	39.43 ± 2.98 (33.80-45.36)	**−0.08 ± 0.41 (−0.87-0.74)**
≥2.0 (n)	91.11 ± 0.99 (89.20-93.06	29.29 ± 0.32 (28.66-29.93)	38.35 ± 0.45 (37.48-39.23)	38.71 ± 0.48 (37.78-39.66)	**0.74 ± 0.08 (0.59-0.89)**
P value	.956	.815	.688	.809	**.040**
Maternal prepregnancy weight status					
Healthy weight (n)	93.14 ± 2.06 (89.06-97.23)	29.34 ± 0.62 (28.11-30.58)	39.39 ± 0.93 (37.60-41.22)	39.89 ± 1.02 (37.85-41.88)	**0.49 ± 0.09 (0.32-0.66)**
Overweight or obese (n)	89.44 ± 1.10 (88.27-92.63)	29.19 ± 0.37 (28.48-29.91)	37.98 ± 0.50 (37.01-38.96)	38.37 ± 0.53 (37.33-39.42)	**1.22 ± 0.15 (0.91-1.51)**
P value	.242	.827	.175	.182	**<.001**
Delivery mode					
Vaginal (n)	91.22 ± 1.08 (89.16-93.37)	29.29 ± 0.35 (28.61-29.98)	38.32 ± 0.48 (37.41-39.28)	38.83 ± 0.53 (37.83-39.89)	−0.65 ± 0.09 (0.49-0.83)
Cesarean (n)	92.05 ± 2.07 (87.86-96.00)	29.51 ± 0.65 (28.22-30.77)	38.90 ± 0.91 (37.18-40.70)	38.98 ± 1.01 (37.83-39.89)	0.76 ± 0.16 (0.43-1.08)
P value	.726	.761	.572	.896	.584
Feeding mode at 3-moa					
Exclusively breastfed (n)	91.20 ± 1.11 (89.10-93.40)	29.31 ± 0.36 (28.62-30.04)	38.23 ± 0.50 (37.27-39.27)	38.79 ± 0.56 (37.72-39.91)	0.63 ± 0.09 (0.45-0.81)
Mixed- or formula-fed (n)	90.88 ± 1.74 (87.47-94.40)	29.19 ± 0.59 (28.07-30.38)	38.47 ± 0.77 (36.95-39.99)	38.51 ± 0.85 (36.89-40.20)	0.72 + 0.13 (0.45-0.99)
P value	.871	.854	.783	.780	.589

All values are reported as mean ± SE (95% CI). All statistics were from an independent-samples *t*-test with SE, 95% CIs, and *P* values calculated using the bootstrap with 5000 samples unless noted otherwise. Bold type denotes a significant result ($P < .05$).
*SES is a composite score of mother's level of education and household income, which was divided into low, medium, and high SES.
†Represents *P* value for between-group difference by ANOVA.

Table IV. Path model A: Standardized regression coefficients of the direct and indirect effects of adherence to AAP guidelines on BRIEF-P indices, with WFLZ at 24-moa as a mediator variable

Variables	Point estimate (95% CI)	SE	*P* value	Adjusted *P* value*
Direct path from guidelines to WFLZ				
Physically active every day	−0.005 (−0.116 to 0.106)	0.057	.94	1.0
No more than 60 minutes of screen time	−0.055 (−0.166 to 0.053)	0.057	.33	.637
At least 5 servings of fruits and vegetables	0.096 (−0.032 to 0.219)	0.065	.14	.392
Limit SSB	0.107 (−0.028 to 0.234)	0.066	.11	.411
Direct path from WFLZ to BRIEF-P indices				
Overall EF	−0.003 (−0.123 to 0.112)	0.06	.96	1.0
Cognitive flexibility	−0.033 (−0.152 to 0.086)	0.061	.58	.902
Inhibitory self-control	0.006 (−0.116 to 0.124)	0.060	.93	1.0
Emergent metacognition	0.011 (−0.108 to 0.123)	0.059	.86	1.0
Effects of guidelines on overall EF				
Physically active every day				
Total	−0.082 (−0.190 to 0.029)	0.056	.14	.413
Direct	−0.082 (−0.190 to 0.029)	0.056	.14	.436
Indirect	0.00002 (−0.007 to 0.008)	0.003	.997	.997
No more than 60 min of screen time				
Total	**−0.125 (−0.233 to −0.008)**	**0.057**	**.03**	.56
Direct	**−0.125 (−0.234 to −0.008)**	**0.057**	**.03**	.42
Indirect	0.0002 (−0.009 to 0.010)	0.005	.97	1.0
At least 5 servings of fruits and vegetables				
Total	−0.053 (−0.154 to 0.046)	0.051	.30	.622
Direct	−0.053 (−0.156 to 0.047)	0.052	.31	.62
Indirect	−0.0003 (−0.016 to 0.014)	0.007	.97	1.0
Limit SSB				
Total	−0.114 (−0.237 to 0.010)	0.064	.08	.373
Direct	−0.113 (−0.237 to 0.010)	0.065	.08	.407
Indirect	−0.003 (−0.017 to 0.014)	0.008	.97	1.0
Effects of guidelines on cognitive flexibility				
Physically active every day				
Total	−0.044 (−0.155 to 0.065)	0.056	.43	.753
Direct	−0.044 (−0.155 to 0.065)	0.056	.43	.730
Indirect	0.0002 (−0.008 to 0.009)	0.004	.97	1.0
No more than 60 min of screen time				
Total	−0.090 (−0.202 to 0.027)	0.059	.12	.395
Direct	−0.092 (−0.205 to 0.026)	0.059	.12	.420
Indirect	0.002 (−0.007 to 0.014)	0.005	.71	1.0
At least 5 servings of fruits and vegetables				
Total	−0.056 (−0.148 to 0.034)	0.047	.23	.56
Direct	−0.053 (−0.148 to 0.040)	0.048	.27	.630
Indirect	−0.003 (−0.020 to 0.011)	0.007	.66	.999
Limit SSB				
Total	−0.090 (−0.226 to 0.046)	0.069	.19	.507
Direct	−0.086 (−0.224 to 0.051)	0.070	.22	.560
Indirect	−0.004 (−0.023 to 0.010)	0.008	.66	.973
Effect of guidelines on inhibitory self-control				
Physically active every day				
Total	−0.044 (−0.153 to 0.071)	0.057	.44	.725
Direct	−0.044 (−0.154 to 0.071)	0.058	.44	.704
Indirect	−0.00003 (−0.007 to 0.008)	0.004	.99	1.0
No more than 60 min of screen time				
Total	**−0.143 (−0.248 to −0.029)**	**0.056**	**.01**	.560
Direct	**−0.142 (−0.248 to −0.029)**	**0.056**	**.01**	.280
Indirect	−0.0003 (−0.010 to 0.010)	0.005	.95	1.0
At least 5 servings of fruits and vegetables				
Total	−0.047 (−0.146 to 0.049)	0.050	.35	.632
Direct	−0.047 (−0.148 to 0.051)	0.051	.35	.653
Indirect	0.001 (−0.014 to 0.016)	0.007	.94	1.0
Limit SSB				
Total	−0.107 (−0.231 to 0.019)	0.064	.10	.400
Direct	−0.107 (−0.232 to 0.020)	0.065	.10	.431
Indirect	0.001 (−0.017 to 0.016)	0.008	.94	1.0
Effects of guidelines on emergent metacognition				
Physically active every day				
Total	**−0.116 (−0.224 to −0.004)**	**0.056**	**.04**	.448
Direct	**−0.116 (−0.225 to −0.005)**	**0.056**	**.04**	.373
Indirect	0.001 (−0.008 to 0.007)	0.004	.99	1.0
No more than 60 min of screen time				
Total	**−0.112 (−0.222 to 0.002)**	**0.057**	**.047**	.376
Direct	**−0.111 (−0.221 to 0.002)**	**0.057**	**.049**	.343

(*continued*)

Table IV. Continued

Variables	Point estimate (95% CI)	SE	*P* value	Adjusted *P* value*
Indirect	−0.001 (−0.010 to 0.010)	0.005	.90	1.0
At least 5 servings of fruits and vegetables				
Total	−0.053 (−0.148 to 0.045)	0.049	.28	.627
Direct	−0.054 (−0.150 to 0.046)	0.050	.28	.603
Indirect	0.001 (−0.013 to 0.016)	0.007	.88	1.0
Limit SSB				
Total	−0.117 (−0.239 to 0.003)	0.062	.06	.373
Direct	−0.118 (−0.240 to 0.001)	0.063	.06	.336
Indirect	0.001 (−0.015 to 0.016)	0.007	.88	1.0

Statistics in bold type denote a significant result ($P < .05$) before correction for multiple comparisons. Covariates included in the model were child sex, SES, ethnicity, WFLZ at birth, and maternal prepregnancy weight status.

**P* values are corrected for multiple comparisons using a Benjamini–Hochberg procedure with a false discovery rate of 0.1 to determine significance after correction.

Table V. Path model B: Standardized regression coefficients of the direct and indirect effects of health behaviors on BRIEF-P indices, with WFLZ at 24-moa as a mediator variable

Variables	Point estimate (95% CI)	SE	P value	Adjusted P value*
Direct path from health behaviors to WFLZ				
Number of physical activities	−0.024 (−0.148 to 0.086)	0.060	.69	.991
Screen time	0.116 (−0.012 to 0.233)	0.062	.06	.336
Fruit and vegetable servings	**0.131 (0.006-0.252)**	**0.062**	**.04**	.249
SSB kcal	−0.091 (−0.229 to 0.014)	0.062	.14	.713
Direct path from WFLZ to BRIEF-P indices				
Overall EF	−0.032 (−0.154 to 0.088)	0.062	.60	1.0
Cognitive flexibility	−0.061 (−0.179 to 0.059)	0.061	.32	.943
Inhibitory self-control	−0.015 (−0.139 to 0.110)	0.062	.82	.937
Emergent metacognition	−0.021 (−0.143 to 0.096)	0.061	.73	.973
Effects of health behaviors on overall EF				
Number of physical activities				
Total	−0.028 (−0.168 to 0.088)	0.065	.67	.987
Direct	−0.029 (−0.170 to 0.088)	0.065	.66	.999
Indirect	0.001 (−0.008 to 0.012)	0.005	.17	.680
Screen time				
Total	**0.254 (0.114-0.378)**	**0.067**	**<.001**	**.008**
Direct	**0.257 (0.118-0.384)**	**0.067**	**<.001**	**.056**
Indirect	−0.004 (−0.023 to 0.011)	0.008	.65	1.0
Fruit and vegetable servings				
Total	−0.067 (−0.179 to 0.056)	0.059	.26	.971
Direct	−0.063 (−0.179 to 0.063)	0.061	.30	.988
Indirect	−0.004 (−0.026 to 0.013)	0.009	.65	1.0
SSB kcal				
Total	−0.045 (−0.169 to 0.125)	0.075	.54	1.0
Direct	−0.048 (−0.172 to 0.125)	0.075	.52	1.0
Indirect	0.003 (−0.009 to 0.022)	0.008	.70	.98
Effects of health behaviors on cognitive flexibility				
Number of physical activities				
Total	−0.035 (−0.171 to 0.075)	0.063	.57	1.0
Direct	−0.037 (−0.175 to 0.075)	0.063	.56	1.0
Indirect	0.001 (−0.009 to 0.014)	0.005	.78	.929
Screen time				
Total	**0.210 (0.076-0.336)**	**0.067**	**.002**	**.014**
Direct	**0.217 (0.082-0.342)**	**0.067**	**.001**	**.028**
Indirect	−0.007 (−0.026 to 0.008)	0.009	.41	.998
Fruit and vegetable servings				
Total	−0.031 (−0.142 to 0.090)	0.060	.60	1.0
Direct	−0.024 (−0.139 to 0.100)	0.061	.70	.956
Indirect	−0.008 (−0.030 to 0.008)	0.010	.40	1.0
SSB kcal				
Total	−0.031 (−0.144 to 0.126)	0.068	.65	1.0
Direct	−0.037 (−0.151 to 0.123)	0.068	.59	1.0
Indirect	0.006 (−0.006 to 0.028)	0.008	.51	1.0
Effects of health behaviors on inhibitory self-control				
Number of physical activities				
Total	−0.005 (−0.133 to 0.101)	0.059	.93	.93
Direct	−0.005 (−0.134 to 0.101)	0.059	.93	.964
Indirect	0.0004 (−0.008 to 0.011)	0.004	.93	.947
Screen time				
Total	**0.229 (0.098-0.351)**	**0.064**	**<.001**	**.019**
Direct	**0.231 (0.099-0.354)**	**0.064**	**<.001**	**.014**
Indirect	−0.002 (−0.020 to 0.015)	0.008	.84	.922
Fruit and vegetable servings				
Total	−0.088 (−0.200 to 0.032)	0.059	.14	.653
Direct	−0.086 (−0.202 to 0.039)	0.061	.16	.689
Indirect	−0.002 (−0.021 to 0.016)	0.009	.83	.93
SSB kcal				
Total	−0.025 (−0.162 to 0.163)	0.082	.76	.946
Direct	−0.027 (−0.166 to 0.166)	0.083	.75	.977
Indirect	0.001 (−0.011 to 0.019)	0.007	.86	.926
Effects of health behaviors on emergent metacognition				
Number of physical activities				
Total	−0.039 (−0.181 to 0.072)	0.065	.54	1.0
Direct	−0.040 (−0.183 to 0.074)	0.065	.54	1.0
Indirect	0.001 (−0.008 to 0.011)	0.004	.91	.962

(*continued*)

Table V. Continued

Variables	Point estimate (95% CI)	SE	*P* value	Adjusted *P* value*
Screen time				
Total	**0.255 (0.118-0.012)**	**0.066**	**<.001**	**.011**
Direct	**0.257 (0.120-0.381)**	**0.067**	**<.001**	**.009**
Indirect	−0.002 (−0.021 to 0.012)	0.008	.76	.925
Fruit and vegetable servings				
Total	−0.062 (−0.171 to 0.062)	0.058	.29	1.0
Direct	−0.059 (−0.172 to 0.067)	0.059	.32	.996
Indirect	−0.003 (−0.172 to 0.014)	0.009	.76	.967
SSB kcal				
Total	−0.059 (−0.172 to 0.094)	0.068	.38	1.0
Direct	−0.061 (−0.175 to 0.092)	0.068	.37	1.0
Indirect	0.002 (−0.010 to 0.020)	0.007	.79	.922

Statistics in bold type denote a significant result ($P < .05$). Covariates included in the model were child sex, SES, ethnicity, WFLZ at birth, and maternal prepregnancy weight status.
**P* values are corrected for multiple comparisons using a Benjamini–Hochberg procedure with a false discovery rate of 0.1 to determine significance after correction.