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Longitudinal Associations between Eating and Drinking Engagement during Mealtime and Eating in the Absence of Hunger in Low Income Toddlers

Cin Cin Tan¹, Madison Walczak¹, Elizabeth Roach⁴, Julie C. Lumeng^{1,2,3}, and Alison L. Miller^{1,4}

¹Center for Human Growth and Development, University of Michigan

²Department of Nutritional Sciences, University of Michigan School of Public Health

³Department of Pediatrics, University of Michigan Medical School

⁴Department of Health Behavior and Health Education, University of Michigan School of Public Health

Abstract

To develop effective obesity-related interventions during early life, it is important to identify predictors of eating in the absence of hunger during toddlerhood. Hence, this study examined longitudinal associations between child eating and drinking engagement at 27 months of age and child eating in the absence of hunger (EAH) at 33 months of age (N=91 children; 57.1% boys). At 27 months of age, we coded child eating and drinking engagement during a videotaped naturalistic lunch meal at home. We also obtained mothers' reports of their child's food responsiveness (FR), satiety responsiveness (SR), and desire to drink (DD) using the Child Eating Behavior Questionnaire (CEBQ). Children participated in a standard EAH protocol at 27 and 33 months of age where they were presented with palatable foods and the amount of food eaten was assessed (calculated as total kilocalories consumed). Correlational analyses showed that EAH at 27 months of age was positively related to EAH at 33 months of age and that neither mother-reported child FR or SR were associated with child eating engagement. Mother-reported child DD was associated with child drinking engagement. To predict EAH at 33 months, a regression analysis was conducted in which EAH at 27 months, mother-reported and observed child eating and drinking engagement at 27 months were entered as predictors, controlling for child demographics (i.e., age, sex, race/ethnicity and weight-for-length z-score (WLZ)). Findings were that children who were observed to engage in more drinking at 27 months of age consumed more energy (measured as kcal) in the EAH at 33 months of age. Implications for understanding eating, and drinking, behaviors in toddlerhood are discussed.

Keywords

eating in the absence of hunger; observational; drinking; eating; toddler

First/Corresponding Author Contact information: Cin Cin Tan, PhD, Research Faculty, Center for Human Growth and Development, University of Michigan, 1054NE. Ann Arbor, MI 48109. cctan@umich.edu.

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Childhood obesity is prevalent in the United States (Skinner, Ravanbakht, Skelton, Perrin, & Armstrong, 2018), particularly among children living in low-income families (Pan, May, Wethington, Dalenius, & Grummer-Strawn, 2013). It is seen as early as the first years of life, often tracking into adulthood (Reilly & Kelly, 2010). Eating in the absence of hunger (EAH), or the tendency to consume food past satiation, has been highlighted as an important construct in relation to weight gain in children (Lansigan, Emond, & Gilbert-Diamond, 2015). In preschool, school-age, and adolescent samples, EAH is positively associated with weight status (Fisher & Birch, 2002; Harris, Mallan, Nambiar, & Daniels, 2014; Hill et al., 2008; Lansigan et al., 2015), such that children with higher weight status are more likely to consume food past satiation than children with lower weight status (Hill et al., 2008; Lansigan et al., 2015). Though the association between EAH and weight status has been consistent across many age groups, little work has focused on EAH during toddlerhood (see review by Lansigan et al., 2015).

Research suggests that individuals who grew up in lower-income families may be more likely to eat in the absence of energy need (Hill, Prokosch, DelPriore, Griskevicius, & Kramer, 2016). However, no work has examined the factors that predict EAH in low-income toddlers, although children who grow up in poverty environments are particularly at risk for obesity (Pan et al., 2013). One longitudinal study that evaluated EAH in low-income toddlers (Asta et al., 2016) found that as toddlers grow older, they ate more (i.e., measured as kilocalories consumed) during the EAH protocol (i.e., mean difference) and that EAH at 27 months positively predicted weight gain at 33 months. In other words, this study showed that consuming food past satiation is prevalent and increasing during toddlerhood. Yet, Asta and colleagues' study did not examine individual differences in EAH or continuity in EAH across time. It is important to consider these issues, as understanding whether EAH is a stable construct can inform our understanding of when best to intervene to reduce EAH as an effort to prevent childhood obesity (Kral et al., 2018). In addition, Asta and colleagues' study focused largely on associations between demographics and child affect with EAH, and did not consider how other aspects of toddler eating and drinking behavior may relate to EAH. Identifying additional predictors of EAH during toddlerhood may be important in order to inform effective obesity-related interventions during early life.

One of the child factors that has been examined in relation to obesity risk is eating behavior (Mallan, Nambiar, Magarey, & Daniels, 2014). For example, prior work has measured food responsiveness (FR), which is defined as the child's tendency to eat in response to external cues, and satiety responsiveness (SR), which is defined as the child's ability to regulate food intake in response to satiety (Wardle, Guthrie, Sanderson, & Rapoport, 2001). These constructs are often measured per parental report on the Children's Eating Behavior Questionnaire (CEBQ; Wardle et al., 2001). FR has been proposed as a potentially important "food approach" behavior that characterizes a high level of engagement in eating and may confer obesity risk during early childhood (Syra, Johnson, Wardle, & Llewellyn, 2015). Maternal reports of child higher FR and lower SR have been associated with higher weight status (Carnell & Wardle, 2008, 2009; Domoff, Miller, Kaciroti, & Lumeng, 2015; Sánchez, Weisstaub, Santos, Corvalán, & Uauy, 2016; Sleddens, Kremers, & Thijs, 2008; Spence, Carson, Casey, & Boule, 2011; van Jaarsveld, Boniface, Llewellyn, & Wardle, 2014; Viana,

Sinde, & Saxton, 2008; Webber, Hill, Saxton, Van Jaarsveld, & Wardle, 2009). Yet, studies that have examined associations among maternal reports of child FR and EAH among diverse cohorts of preschoolers and toddlers have found null results (Carnell & Wardle, 2007; Garcia, Power, Fisher, O'Connor, & Hughes, 2016; Mallan et al., 2014). Similarly, studies that have accessed the associations between maternal reports of child SR and EAH in these samples have also mostly found null results (Garcia et al., 2016; Mallan et al., 2014), with an exception of one study of preschoolers and older children that showed EAH was associated with SR (Carnell & Wardle, 2007). One possible reason for this lack of associations could be that assessing child eating behaviors using parental reports has limitations, for example reporter bias. To our knowledge, no studies have employed observational methods to assess child FR or SR by examining eating engagement (i.e., the amount of time child spends eating) during mealtimes. A strength of observational methods is that they are less subject to personal bias and allow for objective assessment of multiple behaviors (Pesch & Lumeng, 2017). It is reasonable to hypothesize that children who are more engaged in eating during a meal (i.e., spending more time eating) will be more likely to consume past satiation during the EAH protocol given that eating engagement can be considered a food approach behavior. Yet, no studies have observed child eating engagement during mealtimes in relation to EAH. Identifying whether eating engagement during mealtimes is an early risk factor for obesogenic eating could inform the development of obesity-prevention strategies during the first few years of life.

Although toddlers often consume a significant number of their calories from beverages (Bonuck, Huang, & Fletcher, 2010), and high engagement in drinking may also be considered an “approach” behavior, limited research has considered drinking engagement in relation to EAH in toddlerhood. Such work has primarily considered the content of what children are drinking, particularly caloric drinks as these are associated with obesity risk (Dubois, Farmer, Girard, & Peterson, 2007). A few recent studies have examined the nature of child drinking engagement, specifically the desire to drink, in order to understand how these may drive the amount of calories consumed through beverages. Desire to drink (DD) has been measured using the CEBQ and is defined as the child’s tendency to drink and frequency of drinking (Wardle et al., 2001). Studies that have examined DD in older children found a positive association between maternal report of DD and weight status at school-age and in early adolescence (Sánchez et al., 2016; Webber et al., 2009). There have been fewer studies of DD in association with weight status in younger children. For instance, two studies failed to find an association between DD and weight status in preschool-aged children (Domoff et al., 2015; Powers, Chamberlin, Schaick, Sherman, & Whitaker, 2006). However, Lora and colleagues (2016) found that DD was indirectly associated with weight status in African American preschool-aged children through the intake of sugar-sweetened beverages (Lora, Hubbs-Tait, Ferris, & Wakefield, 2016). Thus, although drinking engagement may be a behavior that could lead to increased risk for obesity/overweight (e.g., through consuming more high-calorie beverages), to our knowledge, DD has not yet been directly evaluated in relation to obesogenic eating behaviors such as EAH that may signal risk for excessive weight gain during toddlerhood. Furthermore, although Lora and colleagues (2016) found that DD was associated with intake of sugar-sweetened beverages, this study was based on parent-report of child DD and intake of sugar-sweetened beverages.

Toddler drinking engagement has also rarely been observationally assessed, despite the important potential benefits of using observational methods compared to maternal reports of child behaviors (Pesch & Lumeng 2017). Thus, it is unknown whether parent-report of child DD is associated with drinking engagement during mealtimes (i.e., the amount of time a child spends drinking).

Therefore, we had three aims in the current study. First, we examined whether EAH food consumed, as measured in kilocalories (EAH kcal) at 27 months old predicted EAH food consumed, as measured in kilocalories (EAH kcal) at 33 months old. We hypothesized that EAH kcal at 27 months would predict greater EAH kcal at 33 months old. Second, we examined concurrent associations between mother-reported child FR, SR and DD and observed child eating and drinking engagement at 27 months of age. Specifically, we examined whether mother-reported child FR, SR and DD using the CEBQ related to observed child eating and drinking engagement, respectively, during a naturalistic mealtime at 27 months of age. We hypothesized that mother-reported child FR and DD would be positively associated with observed child eating and drinking engagement, and that mother-reported child SR would be negatively associated with observed child eating and drinking engagement. Third, we examined whether mother-reported child FR, SR and DD and observed child eating and drinking engagement at 27 months predicted EAH at 33 months of age. Based on prior research (Crandall & Wardle, 2007; Mallan et al, 2017; Pesch & Lumeng, 2017), we hypothesized that observed child eating and drinking engagement, compared to mother-reported child FR and DD, would be more predictive of EAH at 33 months of age.

Methods

Participants and Recruitment

Participants were recruited via flyers posted in community agencies serving low-income families between 2011 and 2014 (Asta et al., 2016). The study was described as examining whether children with different levels of stress eat differently. Inclusion criteria were that the biological mother was the legal guardian, had an education level less than a 4-year college degree, and was at least 18 years old; the family was eligible for Head Start, Women Infant and Children (WIC) Program, or Medicaid and was English-speaking; and the child was between 21 and 27 months old, was born at a gestational age ≥ 36 weeks, and had no food allergies or significant health problems, perinatal or neonatal complications, or developmental delays. Mothers provided written informed consent. The University of Michigan Institutional Review Board approved the study.

For the current study, we analyzed data from 91 mother-child dyads with complete data on observed eating engagement, observed drinking engagement, and mothers' reports of FR, SR and DD at 27 months, and EAH at 27- and 33 months old. Mother reported on child demographic variables (i.e., sex, age, race/ethnicity), and that the research assistant measured child length and weight in the families' home. Specifically, children were weighed to the nearest 0.1 kg using an electronic Detecto Portable Scale. Length was measured recumbent to the nearest 0.1 cm using a Seca 416 mechanical infantometer. To ensure that the scale was accurate, the scale was calibrated weekly using a standard weight. The

measured child length and weight were used to calculate weight-for-length z-score (WLZ). Participants with incomplete data did not differ from the participants included in the current analyses with regard to child sex, age, or WLZ at 27 months, but there were more Hispanic/non-white toddlers among participants with incomplete data, $\chi^2(1) = 10.15, p < .001$. The children (57.1% boys) included in the analyses had a mean age of 27.33 months old ($SD = .57$) and a mean WLZ at 27 months of 0.36 ($SD = 1.01$). The cohort was racially/ethnically diverse (40.7% Hispanic/non-white).

Study Design and Procedures

Children were videotaped eating a typical lunch in the child's home at 27 months of age. The mother was asked to feed the child a lunch that included at least two different foods and one drink, of the mother's choice. There were no other constraints placed on the nature or timing of the meal. The visit took place following multiple additional home visits by the same research assistant, so families were accustomed to the presence of the research assistant, who set up the videorecorder but provided no instruction and remained uninvolved with the mother and child during lunch by walking away to provide as much "space" for the mother and child as possible. Mother also reported on children's FR, SR and DD at 27 months of age. At 27 and 33 months of age, toddlers participated in a standardized protocol to assess the child's EAH; reported in detail in (Asta et al., 2016) in the child's home after the lunch (described below).

Measures

Observed child eating and drinking engagement.—Trained research assistants coded each lunch video in 10-second intervals to indicate whether or not the child ate or drank in each interval (all coding schemes were developed for the current study). ¹Eating or drinking engagement was coded if the child took a bite, licked food off of hands/plate/table, food crossed lips, or drink crossed lips. Research assistants were trained to begin coding for eating and drinking engagement when food/drink arrived on the table and to stop coding when food/drink was no longer available. Research assistants were trained to a reliability criterion of Cohen's $\kappa > .70$ (eating $\kappa = 0.82$, drinking $\kappa = 0.83$). Upon achieving reliability, coders independently coded the remaining videos; coders double-coded a random selection of 32 videos (20% of the sample) to protect against coder "drift" and reliability for all codes remained above Cohen's $\kappa > .70$. Eating and drinking engagement scores were created by dividing the number of eating or drinking intervals by total intervals (excluding the intervals where food/drink were not available), with higher scores representing greater time spent eating or drinking.

Mother-reported child food responsiveness, satiety responsiveness, and desire to drink.—Our mother-reported measures of child food responsiveness and desire

¹-Of the 162 children who completed the lunch time task, we excluded three videos from analysis because the index child was constantly running in and out of the camera frame during the meal ($n=2$), and technical videotaping error ($n=1$). Eating engagement was coded for the resulting sample of 159 children. Drinking engagement was coded for 128 children ($n=31$ videos were excluded as either no drink was present ($n=18$) or only water was present ($n=13$)). Participants who were excluded did not differ from the participants included in the current analyses with regard to child sex, age, or WLZ at 27 months, but there were more Hispanic/non-white toddlers, $\chi^2(1) = 4.03, p = .04$.

to drink were based on the Child Eating Behavior Questionnaire for Toddler (CEBQ-T), a 29-item parent-report measure that was interviewer-administered to mothers at child age 27 months (Carnell & Wardle, 2007). The CEBQ has been validated for use with low-income children in prior work (Domoff et al., 2015). To reflect the child's tendency to eat in response to external cues, we used the Food Responsiveness (4 items; $\alpha=.77$; e.g., my child is always asking for food). To reflect responsiveness to satiation, we used the Satiety Responsiveness subscales (5 items; $\alpha=.67$, e.g., my child cannot eat a meal if s/he had a snack just before). To reflect child's tendency to drink, we used the subscale Desire to Drink (3 items; $\alpha=.85$; e.g., my child is always asking for a drink). Mothers reported the child's eating and drinking behaviors using a 5-point Likert scale ranging from Never (1) to Always (5), with higher scores indicating more of the behavior.

Eating in the absence of hunger (EAH kilocalories consumed).—Mother-child dyads were invited to participate in a standardized protocol to assess the child's eating in the absence of hunger (EAH) at ages 27- and 33 months in the child's home (Asta et al., 2016). The EAH was conducted after the typical lunch meal described above. After the lunch ended, a research assistant presented a standardized plate of foods and told the child, "Here are some special treats you can eat." To reduce food neophobia (E. Cashdan, 1994), the experimenter ate one Oreo cookie off the plate and said, "I'm going to have one, too. Mmm this is really good. You can eat as much as you want." The child was given free access to the food. Although the child was not left alone during the EAH task in a separate room than the research assistant, the research assistant did walk away to provide as much "space" for the child as possible, which is a standard procedure when assessing EAH at families' home (Hill et al., 2008; Wardle et al., 2001). The mother was asked not to interact with the child during the protocol. Specifically, the research assistant provided this instruction to the mother "For this part of the activity, please don't say anything about the food. We would like to see how your child reacts. Most parents find it hard not to respond to their child eating, so what we would like you to do is to turn your back to your child and work on this questionnaire that we have from our previous visit. This should make it easier." After 10 minutes the plate of food was removed. Remaining food was weighed and kilocalories consumed was calculated (EAH).²

Results

Preliminary Analyses

Descriptive and correlational analyses were conducted. Table 1 presents the means, standard deviations, and correlations among key study variables. Child age and WLZ were not associated with key study variables, with an exception of child WLZ was negatively associated with mother-reported child SR. Independent sample t-tests were conducted to examine whether boys and girls differed on key study variables. There were no sex differences in WLZ, EAH kilocalories consumed at 27 months old, mother-reported child FR, SR, DD, or observed eating and drinking engagement, all p 's > .05, with the exception

². Bivariate analyses were conducted to examine whether food familiarity was associated with the kilocalories consumed during EAH, findings showed these were not associated, all p 's > .05.

that boys ($M = 141.83$ kcal; $SD = 76.40$) consumed more EAH kilocalories at 33 months old than girls ($M = 102.58$ kcal, $SD = 58.55$), $t(89) = 2.67$, $p = .009$. We also examined whether race/ethnicity (non-Hispanic white vs. Hispanic/non-white) differed on key study variables. Non-Hispanic white toddlers ($M = .46$, $SD = .17$) had greater eating engagement than Hispanic/non-white toddlers ($M = .33$, $SD = .17$), $t(89) = 3.40$, $p < .001$, and mothers of non-Hispanic white toddlers ($M = 2.68$, $SD = .85$) reported that their children were less FR than mothers of Hispanic/non-white toddlers ($M = 3.13$, $SD = 1.05$), $t(89) = -2.27$, $p = .03$. Thus, child demographic variables were covaried in the regression analysis.

Primary Analyses

Correlational analyses were conducted to examine the first and second aims (Table 1). First, we examined whether EAH at 27 months related to EAH at 33 months old. Findings showed that consistent with our expectations, EAH at 27 months old was positively associated with EAH at 33 months old. Second, we examined concurrent associations between mother-reported and observed child eating and drinking engagement at 27 months of age. Contrary to expectations, findings showed that mother-reported child FR and SR were not associated with eating engagement, but mother-reported child FR was associated with drinking engagement. As expected, mother reported child DD was positively associated with drinking engagement, but not associated with eating engagement.

Third, we examined whether mother-reported and observed child eating and drinking engagement at 27 months predicted EAH at 33 months of age using regression analysis, controlling for child demographic variables (age, sex, race/ethnicity, and WLZ) and EAH at 27 months (Table 2). Consistent with our expectations, observed, but not mother-reported measures predicted EAH at 33 months of age. Specifically, only observed drinking engagement predicted EAH at 33 months of age ($b = 131.09$; $SE = 56.56$, $p = 0.23$), $F(10, 79) = 3.58$, $p < .001$, $R^2 = .31$.

Discussion

The current study examined 1) the stability of EAH across time, 2) the concurrent associations between mother-reported and observed child eating and drinking engagement at 27 months of age, and 3) whether mother-reported and observed child eating and drinking engagement at 27 months predicted EAH at 33 months of age. EAH demonstrated reasonable stability across time, with EAH at 27 months predicting EAH at 33 months. Regarding concurrent associations between mother-reported and observed eating and drinking engagement at 27 months of age, mother-reported child FR and SR were not associated with observed eating engagement but mother-reported DD was positively associated with observed drinking engagement. Finally, observed child drinking engagement, but not eating engagement or mother-reported eating and drinking engagement at 27 months, predicted greater EAH at 33 months of age.

First, our finding of stability in child EAH across time expands on prior work from the current cohort (Asta, 2016) which found that on average, EAH increased across toddlerhood, but did not examine longitudinal stability. Our finding is consistent with other studies which have also demonstrated the stability of obesogenic eating in children (Ashcroft, Semmler,

Carnell, Van Jaarsveld, & Wardle, 2008; Tanofsky-Kraff et al., 2008). For example, the stability of EAH as measured by questionnaire has been explored in older children (Tanofsky-Kraff et al., 2008), but to our knowledge no studies have evaluated the stability in observed EAH across time, particularly in very young children (Lansigan et al., 2015), which is a unique contribution of the current study. Our finding that EAH emerges early in the lifespan and remains moderately stable also suggests that childhood obesity prevention efforts that focus on EAH (Boutelle et al., 2015) should begin as early as possible.

Second, the finding that neither mother report of child food responsiveness nor satiety responsiveness were not associated with eating engagement was not altogether surprising, as this type of inconsistency has been found in prior work (Haycraft & Blissett, 2008; Lewis & Worobey, 2011; Sacco, Bentley, Carby-Shields, Borja, & Goldman, 2007). There may be various reasons underlying this finding. Mothers have a broader sample of their child's behavior from which to draw compared to objective observers, who are limited to the behaviors captured on video in the context that was recorded. Mothers' ratings of child behaviors on a scale like the CEBQ therefore likely reflect many typical behaviors that mothers have seen their children do across a range of settings, not only mealtime, whereas we observed child eating behaviors specifically during a meal. Mothers' perceptions of their own children have also been shown to differ from those of independent raters in other domains such as temperament (Seifer, Sameroff, Dickstein, Schiller, & Hayden, 2004). Yet, this has not been systematically investigated in the eating and feeding domain. The need for observational research on eating and feeding behaviors has recently been highlighted (Pesch & Lumeng, 2017). A contribution of the current study is therefore that maternal reports seem to yield different information from observational data during this toddlerhood period. As observations by independent raters may pick up on different aspects of eating behaviors compared to mothers, findings may have different implications for understanding early child eating and feeding behaviors as well as potential risk for later obesity (Pesch & Lumeng, 2017). That said, we found that mother reports of child desire to drink was associated with drinking engagement, suggesting that mothers' observations of children are not entirely subjective. It is also possible that mothers report more consistently on child drinking engagement as this construct may be somewhat more narrowly defined compared to eating engagement, which may reflect child responses to many different foods and thus be more challenging to capture using questionnaire-based methods.

Third, we found that observed child behavior, though not maternal report at 27 months, predicted EAH food consumed, as measured in kilocalories, at 33 months. Specifically, toddlers who spent more time drinking during mealtimes at 27 months of age engaged in more EAH by 33 months of age, even when controlling for 27-month EAH. This is the first study to examine toddlers' drinking engagement in relation to EAH. Findings suggest that at this age, drinking engagement at mealtimes may be important to consider as a potential early indicator of later obesogenic eating behavior and possible obesity risk. One possible reason could be that during toddlerhood, how children engage with beverages may be more indicative of their appetitive drive than eating engagement. Prior work has shown that during this period of age, toddlers tend to become picky eaters or reject foods due to food neophobia (Cashdan, 1994; Dovey, Staples, Gibson, & Halford, 2008). Drinking may be less subjected to this phenomenon, with some work suggesting that children who are picky eaters

may prefer to drink their “meals” (Taylor, Wernimont, Northstone, & Emmett, 2015; Wright, Parkinson, Shipton, & Drewett, 2007). Drinking is also not limited by fine motor or oral motor skills. For example, toddlers can suck down a drink easily, whereas manipulating “finger food” may be more challenging for toddlers’ still-developing fine motor and oral motor capacities, which may complicate the eating engagement picture. Compared to drinking engagement, eating engagement may therefore be capturing different aspects of appetitive traits, as suggested by the lack of association we found between drinking and eating engagement. Understanding individual differences in drinking engagement may be particularly important at this age, as toddler-aged children often use bottles or sippy cups between meals (Bonuck et al., 2010). Considering drinking engagement as a potential signal of obesity risk is also consistent with pediatric obesity prevention guidelines (AAP, 2018) suggesting that parents should not purchase or should try to reduce consumption of “empty calories” in beverages for young children (e.g., juice, soda).

In contrast, we did not find an association between mother-reported child FR, SR, or DD and observed EAH. This is consistent with prior studies (Garcia et al., 2016; Mallan et al., 2014), in which maternal reports of child FR or SR were not associated with EAH. Our findings further illustrated that mother-reports at 27 months did not relate to EAH across time, suggesting that although FR has been identified as a type of food approach behavior that may confer obesity risk (Fogel et al., 2018; Lansigan et al., 2015), EAH may not be the process that explains the link between maternal report of child FR or SR and obesity. Even though our finding of no association between mother-reported child eating and EAH was consistent with prior work, more research is needed to unpack these processes during the toddler age period.

Strengths of the current study included the use of both mother-reported and observational methods to predict objectively measured food consumed in kilocalories in the EAH protocol, which reduces bias compared to use of a single method. In addition, compared to prior work, this study included a diverse sample, particularly toddlers from low-income families who are most at risk for obesity (Ogden, Carroll, Kit, & Flegal, 2014). Despite these strengths, there were also limitations. It is important to note that children’s eating and drinking behaviors were observed on one occasion, which may not necessarily be representative of children’s general eating engagement. In addition, we coded eating and drinking engagement during naturalistic mealtimes, which may have introduced variability due to the presence (or absence) of mothers as mothers were given the instruction to “prepare a typical meal”. Hence, to obtain a more accurate picture of children’s eating and drinking engagement, future work could observe children’s eating and drinking engagement patterns across mealtimes (breakfast, lunch, and dinner) for a few days, as well as utilize a diary method to capture maternal ratings of children’s eating and drinking engagement patterns across days. EAH was also assessed directly after the lunch meal, in which we asked the mother to indicate when she thought her child was full. Due to possible variation between mothers and perhaps clarity of child satiety cues, this procedure may also have introduced variability. However, a recent study showed that the amount consumed during the EAH task was not associated with how much children ate during lunch, suggesting that EAH intake in our study also may not be simply a compensatory mechanism among children who consumed less at lunch (Fogel et al., 2018). Nonetheless, future research may consider assessing EAH

on multiple days to obtain more stable estimates. Although we found stability in EAH across time, the association was moderate, suggesting that additional factors contribute to EAH. To reduce children's food neophobia, the research assistant modeled for the child by eating prior to the EAH task, which may have been perceived as a prompt to eat by the children. However, this same prompt was given to all children in the study, therefore any effect on children's behavior would have been related to differential responsiveness to a prompt to eat. Last, we did not assess children's liking of the foods during the EAH protocol, however, we did assess familiarity with the foods and did not find any associations between food familiarity and kilocalories consumed (data available upon request), suggesting that the reason children consumed the foods was not due only to familiarity.

We also did not code drinking engagement when toddlers were provided with water instead of caloric drinks. Other studies examining desire to drink per maternal report found that child's desire to drink was associated with an increase of 50% –61% in children's total sugar-sweetened beverage and fruit juice consumption, but no association between child's desire to drink and water consumption (Lora et al., 2016). Assessing children's drinking engagement specifically in relation to caloric drinks may thus be particularly important when considering early-life obesity prevention strategies. Work with adults showed that water consumption was associated with lower energy intake and obesity risk (Daniels & Popkin, 2010; Dennis et al., 2010; Stookey, Constant, Gardner, & Popkin, 2007). Although understanding children's drinking engagement in relation to non-caloric drinks may also be important, we were interested in examining predictors of obesogenic eating and thus did not assess drinking engagement in the subset of children who were given water (n=13). Further, the small number of children who were given water (n=13) in the current study precluded us from examining whether drinking of non-caloric drinks was associated with EAH. Finally, findings from the current study may not generalize to other toddler-aged children who differ from the children in the current sample.

Conclusions

This study is the first to examine the stability of observed EAH across time during toddlerhood; concurrent associations between mother-reported and observed child eating and drinking engagement; and longitudinal associations between mother-reported and observed child eating and drinking engagement and observed EAH. We found that mother-reported children's desire to drink was positively associated with child drinking engagement during a meal. In addition, drinking engagement during mealtimes at 27 months of age predicted eating past satiation at 33 months of age. These findings are important, considering that the nature of children's beverage drinking behaviors has been associated with increased intake of calories (Bonuck et al., 2010; Lora et al., 2016), yet such drinking behaviors have not been extensively considered with examined with respect to obesogenic eating behaviors such as EAH that may promote childhood obesity risk.

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Abbreviations:

EAH	Eating in the Absence of Hunger
DD	Desire to Drink
FR	Food Responsiveness
SR	Satiety Responsiveness
CEBQ	Children's Eating Behavior Questionnaire
WLZ	Weight-for-Length z-score

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Highlights

- EAH at 27 months of age predicted EAH at 33 months of age.
- Mother-reported child food responsiveness (FR) was not concurrently associated with child eating engagement.
- Mother-reported child desire to drink (DD) was concurrently associated with child drinking engagement.
- Child drinking engagement at 27 months was the most significant predictor of EAH at 33 months.

Table 1.

Means, Standard Deviations, and Correlations between Key Study Variables

	1	2	3	4	5	6	7	8	9
1. Child Age (in months)	--								
2. WLZ at 27 months	.11	--							
3. EAH at 27 months	.14	.11	--						
4. Mother-reported Child SR	.06	-.28**	-.07	--					
5. Mother-Reported Child FR	.02	.04	.14	-.41**	--				
6. Mother-Reported Child DD	-.10	-.04	.07	-.07	.29**	--			
7. Eating Engagement	.09	-.02	.31**	-.14	.00	.03	--		
8. Drinking Engagement	.01	.20	.24**	-.06	.23*	.22*	-.05	--	
9. EAH at 33 months	.05	-.14	.38**	.04	.06	.09	.09	.25*	--
Mean	27.33	0.39	110.35	2.82	2.86	3.96	0.41	0.10	125.01
SD	0.57	1.01	64.79	0.67	0.96	1.06	0.18	0.13	71.67
Range	26–29	–2 – 2	0–390	2–5	1–5	1–5	0–1	0–1	0–355

**
 $p < .01$,*
 $p < .05$.

WLZ= weight-to-length z-score; EAH = eating in the absence of hunger kilocalories consumed; SR = satiety responsiveness; FR= food responsiveness; DD = desire to drink.

Table 2.

Regression Analysis Predicting EAH at 33 months of age

	<i>B</i> (SE)
Intercept	−39.58 (329.92)
EAH at 27 months	.37 (.12) **
Mother-reported Child SR	3.06 (11.89)
Mother-reported Child FR	−.86 (8.34)
Mother-reported Child DD	−.67 (7.10)
Eating Engagement	−9.09 (42.91)
Drinking Engagement	131.09 (56.56) *

**
 $p < .01$.

*
 $p < .05$.

Note: Child age, sex, race/ethnicity and WLZ were controlled for in this model.

WLZ= weight-to-length z-score; EAH = Eating in the absence of hunger kilocalories consumed; SR = satiety responsiveness; FR= food responsiveness; DD = desire to drink.