



Stressed Out! Examining family meal decisions in response to daily stressors via ecological momentary assessment in a racially/ethnically diverse population

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ABSTRACT

The impact various sources of stress have on family meal decisions and child health-related behaviors is an understudied area. For this study, 128 racially/ethnically diverse parent/child dyads were recruited from primary care clinics in the Twin Cities, Minnesota between 2015 and 2016. Parent participants completed eight days of ecological momentary assessment, which included end-of-day surveys where the parent reported on (1) sources of daily stress (e.g., family demands, work/school demands) and related family meal choices (e.g., fixed quick meal, skipped meal), (2) meal planning, and (3) parent and child health-related behaviors (e.g., watched TV, ate unhealthy snack). Adjusted generalized estimating equations were used to estimate marginal probabilities and 95% confidence intervals of outcomes by race/ethnicity. Results indicated that common meal-related choices as a result of being stressed varied from fixing a quick/easy meal, buying fast food, everyone fixing their own meal or skipping a meal, or none of the above. When parents reported family demands as the source of stress, children were three times more likely to eat an unhealthy snack. Additionally, children were more likely to eat an unhealthy snack with higher levels of parental stress or if families have not planned the meal the night before. Interventions to lower parental stress and support family meal planning may increase the healthfulness of the home food environment during moments of elevated stress.

1. Introduction

Reducing the prevalence of childhood obesity is a complex challenge. Parental stress and stressful home environments have been associated with childhood obesity and less healthful meal practices (Lytle et al., 2011; Hearst et al., 2012; Black and Aboud, 2011; Topham et al., 2011; Berge et al., 2017). Transient, or “momentary stressors” (e.g., overwhelmed at work, interpersonal problems) may impact parent food-related practices such as restriction and pressure-to-eat feeding behaviors, types of food served at dinner, and whether or not the food is fast-food, homemade, or pre-prepared (Berge et al., 2018). However, less is known about these momentary stressors (e.g., work/school, financial) and their impact on a wider variety of meal preparation practices. Specifically, it is not known whether different types of transient/momentary stressors influence parent meal preparation practices, including meal pre-planning, or parent and child health-related behaviors.

Stressors are defined as environmental or contextual demands that exceed an individual’s resources and coping skills (Dickerson and Kemeny, 2004). Physiology, the home food environment, and the

presence of highly palatable food have been documented to have mixed effects on stress and eating behaviors (i.e., both over- and under-eating when experiencing elevated stress). Several studies have found that interpersonal and work-related stressors (O’Connor et al., 2008), daily hassles, and positive emotions were associated with increased snacking behaviors (Zenk et al., 2014; Evers et al., 2013). Devine and colleagues found via qualitative interviews that work/school and family demands resulted in a perceived need for parents to negotiate between personal and caretaking responsibilities (e.g., preparing family meals), which often resulted in neglecting personal health (Devine et al., 2003). The same researchers also evaluated strategies for managing food stressors (e.g., skipping meals, eating or ordering out, individualized meals, speeding up meal preparation and meal planning behaviors) via a survey with 50 parents (Devine et al., 2009). Results showed that most strategies described by working parents were aimed at coping with, or managing stress, rather than directly addressing sources of stress such as work and family demands (Devine et al., 2009). If stress disrupts meal planning, this could be one explanatory pathway for how transient/momentary stressors impact parent meal decision making processes (e.g., skip meals, serve pre-prepared foods, each person makes own meal)

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that ultimately influence family and child health and behavior across time.

Ecological momentary assessment (EMA) is well-suited to investigate how transient/momentary stressors influence eating and meal-related behaviors, but very little research has applied this methodology to examine these relationships (Reichenberger et al., 2018). The current study further extends this line of research by examining stress and eating patterns that may exhibit different relationships in diverse sub-populations. Additionally, the current study was conducted with parents of 5–7 year old children, who are at an age where they are taking responsibility for their own dietary intake (e.g., at school meals) alongside the parent (Hetherington et al., 1999; Berge et al., 2017).

The overall aim of this study was to investigate the association between the frequency of sources of stress and “in the moment” family meal decisions (preparing quick meals, offering fast-food for meals, or skipping a meal altogether). Additionally, the association between different sources of stress and meal pre-planning, family meal decisions, parent-modeled health-related behaviors, and child health-related behaviors were stratified by race/ethnicity. Lastly, the relationship between sources of stress and daily parent-modeled health-related behaviors and child health-related behaviors (i.e., intake of sugar-sweetened beverages (SSB), fast food, and unhealthy snacks; fruit and vegetable intake, engaging in physical activity, and watching television) were examined.

2. Methods

Data are from Phase I of *Family Matters* (Berge et al., 2017), a 5-year incremental, mixed-methods longitudinal study designed to identify risk and protective factors for childhood obesity in the home environments of racially/ethnically diverse and primarily low-income children ($n = 150$). The study was conducted in Minneapolis-St. Paul between 2014 and 2016. The study was approved by the University of Minnesota’s Institutional Review Board (1107S02666). Detailed descriptions of both Phases of the study are published elsewhere (Berge et al., 2017).

3. Recruitment and eligibility criteria

Eligible children ($n = 150$) and their families were recruited for Phase I of the *Family Matters* study via a letter sent by their family physician. Children were eligible if they were 5–7 years old, had a sibling between the ages of 2–12 years in the same home, lived with their parent/primary guardian more than 50% of the time, shared at least one meal/day with the parent/primary guardian, and identified as African American, Native American, Hispanic/Latino, Hmong, Somali, or White. The sample was intentionally stratified by race/ethnicity (25 per racial/ethnic group) and by child weight status so that half of the children were normal weight ($BMI > 5\%$ ile and $< 85\%$ ile) and half were overweight ($BMI \geq 85\%$ ile). These a priori stratifications were done to identify race/ethnic- or weight-specific home environment factors related to childhood obesity risk.

Families participated in two in-home visits 8–10 days apart where observational data (e.g., 24-hour dietary recalls, video-recorded family tasks) were collected. In between home visits, parents completed eight full days of ecological momentary assessment (EMA), which was completed on a study-provided iPad mini. Participants were notified (via iPad and text message) when they had a survey to complete, and the participant then completed the survey via a unique survey link. The current study used EMA questions (described below) that collected information on daily stressors and subsequent health behaviors.

4. Sample demographics

Of the 150 participants, 22 participants reported no elevated stress and did not meet the inclusion criteria of at least some transient stress for the study. In the analytic sample of parents who reported at least

some stress over the course of the study, EMA was completed for over 1,060 total observation days and the prevalence of at least some daily stress on these days was 60.4%. The racial/ethnic composition of the sample ($n = 128$) was African American (18.0%), Native American (17.2%), Hispanic (18.0%), Hmong (14.1%), Somali (13.3%), and White (19.5%). The sample was low-income, with 70.3% of families earning less than \$35,000 annually. The majority of participants were mothers (94%) who were 34 ± 6.9 years old with 3 ± 1.3 children living in the home. The average child age was 6.4 ± 0.8 years old. Over half of mothers worked full (41.2%) or part-time (22.7%); 63% had a high school diploma or less. Forty-seven percent of mothers were married and 52.3% of households had at least two parents or adult caregivers.

5. Measures

5.1. EMA

Multiple daily measures of EMA were collected on parents over 8 days. Standardized EMA data collection protocols from prior studies (Shiffman et al., 2008) were used, including (1) signal contingent, (2) event contingent, and (3) end-of-day EMA surveys (Shiffman et al., 2008). End-of-day EMA survey items, which gathered an overall picture of the participant’s day (e.g., how stressful the day was, what caused the most stress, what meal-related events occurred as a result of stress) were used for the current study. EMA compliance was high, with 100% of participants meeting protocol requirements. Details regarding the EMA component have been published elsewhere (Berge et al., 2017).

5.2. Parent stress/sources of stress

Parents were asked, “Overall, how STRESSFUL was your day?”. Responses were not at all; a little; moderately; quite a bit; extremely. The parent was not asked about the source of stress if the response was “not at all”; these data were excluded from our analysis. Participants endorsing a stressful day (i.e., a little; moderately; quite a bit; extremely) were additionally asked, “Overall, what caused you the MOST STRESS today?” Responses were: (1) A lot of work at home; (2) A lot of work at school or job; (3) A lot of demands from my family; (4) Financial problems; (5) Conflicts/arguments with a spouse or romantic partner; (6) Conflicts or disciplinary problems with my children; (7) Other (with write-in response). For analysis, stress was grouped into five categories: work/school demands (1 & 2 above); family demands (3 above); financial problems (4 above); family conflicts (5 & 6 above); and other (7 above). Open-ended responses to the “other” category were reviewed. Responses were either back-coded into the above categories, added to two created categories of “health concerns” or “no stress”, or remained as in the “other” category. For example, a written response of “Getting sent home from work sick” was back-coded as health concerns; Conflicts between grandchildren” was back-coded as family conflicts.

5.3. Family meal planning and meal decisions

Family meal planning was assessed by asking parents, “Do you have your meals planned for tomorrow?” with responses of: (1) Yes; all of them; (2) Yes; some of them; and (3) No. Family meal decisions were assessed by, “Did any of the following things happen as a result of being stressed today?” Responses included: (1) I fixed an easy or quick meal; (2) I bought fast food for a meal; (3) Everyone made their own meal; (4) We skipped a meal; and (5) None of the above.

5.4. Parent modeled health-related behaviors

Parents were asked to report on a Likert scale (never, rarely, moderately, often), “Today, how often did your child SEE YOU:” (1) Watch TV/movies or play video games; (2) Exercise or engage in physical activity; (3) Eat fruits or vegetables (not French fries); (4) Eat snack foods

such as chips, French fries, candy, or other sweets baked goods; (5) Eat fast food (e.g., McDonald's, Burger King, Taco Bell), and (6) Drink soda/pop, fruit drinks, sports drinks (e.g., Gatorade) or energy drinks (e.g., Red Bull). Responses of moderately or often were indicator-coded as the parent engaging in the behavior.

5.5. Child health-related behaviors

Parents were asked to report on a Likert scale (never, rarely, moderately, often), "Today, how often did your child:" (1) Watch TV/movies or play video games; (2) Exercise or engage in physical activity; (3) Eat fruits or vegetables (not French fries); (4) Eat snack foods such as chips, French fries, candy, or other sweets/baked goods; (5) Eat fast food (e.g., McDonald's, Burger King, Taco Bell), and (6) Drink soda/pop, fruit drinks, sports drinks (e.g., Gatorade) or energy drinks (e.g., Red Bull). Responses of moderately or often were indicator-coded as the child engaging in the behavior.

6. Statistical analysis

Descriptive analyses were performed to describe the sample of 128 families and evaluate modeling assumptions for the 604 daily EMA surveys on days in which parents reported some elevated stress level. Cross-tabulations for panel data were computed to describe overall frequencies of response (% of time observed on all surveys), between participant response (% of the 128 families responding to the value at least once), and within participant response (% of time the parent responded the same way over the observation period). Adjusted generalized estimating equations (GEEs) with a binomial variance family, logit link, independent working correlation structure, and robust standard errors were used to estimate marginal probabilities and 95% confidence intervals of target outcomes including source of stress, level of stress, reported meal planning on the prior day (operationalized as a lagged, prior day measurement), family meal decision, and parent modeled and child health-related behavior by race/ethnicity. Household race was explored as a categorical predictor of the binary, parent-modeled and child health-related behaviors and sources of stress, level of stress, reported meal planning on the prior day, and family meal decision. Post-hoc pairwise comparisons between race groups employed Dunn-Sidak multiplicity correction to lower inflated type I error rate. All analyses adjust for parent and child sex, parent and child weight status, household structure, and the number of children living in the household. Data management and analysis was performed in Stata 16.1MP (College Station, TX).

7. Results

7.1. Frequency of sources of stress and family meal decisions (Supplementary Table 1)

Across all racial/ethnic groups, the most frequently reported source of stress was work/school demands (55.6%) followed by family demands (16.7%). Irrespective of the source of stress, family members rarely made their own meals or skipped meals because the primary caregiver was stressed (0.0%–1.5%). The most common meal decision in response to stress was none of the above followed by fixing a quick/easy meal. Within each of the different sources of stress, the prevalence of fixing a quick/easy meal ranged from 16.0%–35.1%; the prevalence was highest when work/school demands were reported as the source of stress. The most commonly reported source of stress and meal decision combination was work/school demands resulting in fixing a quick/easy meal, which occurred 19.5% of the time in the full sample. Among families reporting work/school demands, 46.1% reported *ever* having "fixed a quick/easy meal." The within-participant analysis indicated that when parents experienced work/school demands, they engaged in the same behavior (i.e., fixing a quick/easy meal) about 40% of the time.

7.2. Descriptive findings by race/ethnicity

Stress differed across racial/ethnic groups ($p = 0.008$) when adjusting for other demographics (Table 1). Stress was highest among African American parents (average = 2.14, 95% CI: 1.90 to 2.38) and lowest among Native American parents (average = 1.54, 95% CI: 1.22 to 1.86). The likelihood of work/school demands and family demands differed across racial/ethnic groups when adjusting for other demographics ($p = 0.02$ and $p = 0.01$, respectively). Work/school demands were the most likely source of stress for all racial/ethnic groups with Native American parents reporting lowest (0.38) and Hmong parents reporting highest (0.71) levels of stress. Among White, Hmong, Native American and Somali parents, the highest source of stress was family demands, and among African American and Hispanic parents, the highest source of stress was family conflicts (tied with financial concerns for African American parents). The likelihood of buying fast food and skipping a meal in response to stress differed across race /ethnicity ($p < 0.01$); however, probabilities were too low to determine pairwise differences. The adjusted prevalence of parent modeled and child health-related behaviors of eating fruit/veggies (parent modeled: $p = 0.03$, child: $p < 0.001$) and getting physical activity (parent modeled: $p = 0.005$, child: $p < 0.001$) differed across racial/ethnic groups. Parents and children of Hmong families reported the lowest prevalence of eating fruits/veggies and White families reported the highest prevalence (parent modeled: range = 0.36 to 0.64, child: range = 0.19 to 0.62). Hmong parents and Somali children reported the lowest prevalence of physical activity, and Native American families responded with the highest prevalence (parent modeled: range = 0.20 to 0.62, child: range = 0.23 to 0.80).

7.3. Adjusted Source and Level of Stress, Meal Planning and Decisions, and Associations with Parent Modeled Health-related behaviors and child health-related behaviors

Increased level of stress was associated with an increased prevalence of parent's modeling of drinking a sugar-sweetened beverage (SSB), and both parent modeling and children engaging in eating an unhealthy snack ($p \leq 0.01$) (Table 2). Family demands had a nearly three times the adjusted prevalence of the child eating an unhealthy snack compared to work/school demands or health concerns. Similarly, family demands had an increased adjusted prevalence of the child consuming SSBs compared to financial problems or other sources of stress. Meal planning the night before was associated with a two-fold reduction in the adjusted prevalence of the child eating an unhealthy snack ($p < 0.05$).

8. Discussion

Results of the current study both support and extend the limited prior research on stress and the home food environment (Lytle et al., 2011; Hearst et al., 2012; Black and Aboud, 2011; Topham et al., 2011; Berge et al., 2017, 2018). Results support prior findings in the field by showing that stress is an important variable to consider when trying to understand factors that influence the home food environment (Lytle et al., 2011; Hearst et al., 2012; Black and Aboud, 2011; Topham et al., 2011; Berge et al., 2017, 2018). Findings extend prior studies by showing that the most frequently reported source of stress was work/school demands followed by family demands (e.g., conflict with spouse, disciplinary problems with child) in this highly racially/ethnically diverse sample. These findings suggest that stress may be a key factor to target in helping parents with regard to the meal decisions in the home food environment. Future interventions may want to utilize real-time interventions such as ecological momentary intervention (EMI) to intervene on parental stress and to potentially increase coping skills to increase the likelihood of parents making healthful meal decisions.

In addition, results showed that in response to stress, families most often fixed a quick/easy meal or responded to stress in some other way

Table 1

Adjusted 1 predicted prevalence and 95% confidence interval 2 of parental level of stress, source of stress, meal planning, family meal response and parent modeled and child health-related behavior by reported household race/ethnicity.

Adjusted Prevalence (95% CI) of Source of Stress, Level of Stress, Planning of Meals Family Meal Response and Observed Health-Related Behavior of Child across Race							
	African American	Caucasian	Hmong	Hispanic	Native Amer.	Somali	P-value
Level of Stress							
<i>Overall, how STRESSFUL was your day? (1 = a little, 2 = moderately, 3 = quite a bit, 4 = extremely)</i>							
Average ³ (scale 1–4)	2.14 ^b (1.90 to 2.38)	1.60 ^a (1.40 to 1.80)	1.71 ^{ab} (1.42 to 2.01)	1.81 ^{ab} (1.44 to 2.18)	1.54 ^a (1.22 to 1.86)	1.85 ^{ab} (1.60 to 2.10)	0.008
Source of Stress							
<i>Overall, what caused you the MOST STRESS today?</i>							
Family Demands	0.09 ^a (0.01 to 0.17)	0.28 ^a (0.14 to 0.42)	0.16 ^a (0.05 to 0.26)	0.10 ^a (−0.01 to 0.22)	0.29 ^a (0.14 to 0.43)	0.09 ^a (−0.01 to 0.2)	0.02
Work/School Demands	0.59 ^a (0.41 to 0.77)	0.40 ^a (0.24 to 0.55)	0.71 ^a (0.56 to 0.87)	0.65 ^a (0.52 to 0.78)	0.38 ^a (0.22 to 0.54)	0.68 ^a (0.47 to 0.89)	0.01
Family Conflicts	0.13 ^{ab} (0.00 to 0.27)	0.10 ^{ab} (0.04 to 0.15)	0.06 ^{ab} (0.00 to 0.12)	0.19 ^b (0.10 to 0.27)	0.13 ^{ab} (0.05 to 0.22)	0.04 ^a (−0.01 to 0.09)	0.1
Financial Problems	0.13 (0.04 to 0.21)	0.17 (−0.04 to 0.38)	0.04 (0.01 to 0.08)	0.08 (−0.01 to 0.16)	0.10 (−0.01 to 0.20)	0.02 (−0.03 to 0.07)	0.3
Health Concerns	0.12 (−0.01 to 0.25)	0.03 (−0.01 to 0.08)	0.03 (−0.04 to 0.09)	0.03 (−0.02 to 0.07)	0.11 (0.01 to 0.21)	Not Estimable	0.4
Other ⁴	0.05 (−0.02 to 0.12)	0.06 (−0.01 to 0.14)	0.03 (0.00 to 0.06)	0.04 (−0.02 to 0.11)	0.13 (0.01 to 0.26)	0.06 (−0.03 to 0.16)	0.4
Planned the Meal the Night Before ⁵	0.46 (0.22 to 0.71)	0.42 (0.21 to 0.63)	0.61 (0.34 to 0.88)	0.56 (0.32 to 0.80)	0.55 (0.30 to 0.81)	0.71 (0.47 to 0.96)	0.7
Family Meal Decision	<i>Did any of the following things happen as a result of being stressed today?</i>						
Fixed quick meal	0.21 (0.11 to 0.32)	0.26 (0.14 to 0.37)	0.31 (0.15 to 0.47)	0.35 (0.18 to 0.51)	0.31 (0.17 to 0.44)	0.42 (0.26 to 0.58)	0.4
Bought Fast Food	0.12 ^a (0.06 to 0.19)	0.21 ^a (0.08 to 0.34)	0.04 ^a (0.01 to 0.07)	0.05 ^a (0.01 to 0.09)	0.10 ^a (0.03 to 0.17)	0.05 ^a (0.00 to 0.09)	0.006
Everyone made own meal ⁶							
Skip meal	0.03 ^a (−0.01 to 0.07)	0.01 ^a (0.00 to 0.02)	0.04 ^a (−0.01 to 0.09)	0.06 ^a (−0.03 to 0.15)	0.15 ^a (0.04 to 0.26)	0.05 ^a (−0.03 to 0.13)	0.009
None of the above	0.64 (0.53 to 0.75)	0.57 (0.45 to 0.7)	0.59 (0.41 to 0.77)	0.55 (0.39 to 0.71)	0.56 (0.43 to 0.68)	0.51 (0.33 to 0.68)	0.8
Parent Modeled Health Related Behavior (Observed by Child)	<i>Today, how often did child SEE YOU:</i>						
Drink SSB	0.13 (0.03 to 0.23)	0.17 (0.02 to 0.32)	0.14 (0.02 to 0.26)	0.12 (−0.04 to 0.27)	0.19 (0.09 to 0.30)	0.07 (−0.02 to 0.16)	0.8
Eat Fast Food	0.10 (0.04 to 0.17)	0.12 (0.00 to 0.25)	0.06 (0.00 to 0.11)	0.01 (0.00 to 0.02)	0.08 (0.02 to 0.15)	0.10 (0.00 to 0.19)	0.06
Eat Unhealthy Snack	0.26 (0.13 to 0.38)	0.17 (−0.02 to 0.36)	0.20 (0.07 to 0.33)	0.09 (0.02 to 0.16)	0.14 (0.06 to 0.22)	0.22 (0.02 to 0.42)	0.3
Eat Fruit/Veggies	0.38 ^{ab} (0.25 to 0.52)	0.64 ^b (0.46 to 0.83)	0.26 ^a (0.11 to 0.41)	0.56 ^{ab} (0.40 to 0.72)	0.59 ^b (0.45 to 0.74)	0.36 ^{ab} (0.14 to 0.58)	0.03
Get Physical Activity	0.39 ^{ab} (0.24 to 0.55)	0.52 ^{ab} (0.34 to 0.69)	0.20 ^a (0.08 to 0.32)	0.38 ^{ab} (0.22 to 0.53)	0.62 ^b (0.46 to 0.77)	0.22 ^a (0.04 to 0.40)	0.005
Watch TV	0.27 (0.15 to 0.38)	0.20 (−0.04 to 0.45)	0.14 (0.05 to 0.24)	0.18 (0.07 to 0.28)	0.25 (0.15 to 0.35)	0.26 (0.11 to 0.42)	0.6
Child Health Related Behavior	<i>Today, how often DID CHILD:</i>						
Drink SSB ⁷	0.10 (0.02 to 0.18)	0.11 (−0.06 to 0.28)	0.10 (0.01 to 0.18)	0.08 (0.01 to 0.15)	0.10 (0.04 to 0.17)	0.09 (−0.01 to 0.18)	0.9
Eat Fast Food	0.06 (0.02 to 0.1)	0.16 (−0.01 to 0.33)	0.02 (−0.01 to 0.05)	0.03 (0.00 to 0.07)	0.11 (0.02 to 0.19)	0.05 (−0.01 to 0.12)	0.1
Eat Unhealthy Snack	0.26 (0.13 to 0.38)	0.19 (−0.03 to 0.41)	0.13 (0.03 to 0.24)	0.07 (−0.02 to 0.16)	0.19 (0.07 to 0.31)	0.11 (0.00 to 0.22)	0.3
Eat Fruit/Veggies	0.41 ^{ab} (0.29 to 0.53)	0.62 ^b (0.45 to 0.79)	0.19 ^a (0.08 to 0.3)	0.57 ^b (0.42 to 0.72)	0.56 ^b (0.42 to 0.7)	0.29 ^{ab} (0.11 to 0.48)	<0.001
Get Physical Activity	0.60 ^{bc} (0.49 to 0.72)	0.73 ^c (0.58 to 0.88)	0.30 ^{ab} (0.13 to 0.47)	0.60 ^{bc} (0.44 to 0.76)	0.80 ^c (0.66 to 0.94)	0.23 ^a (0.09 to 0.37)	<0.001
Watch TV	0.27 (0.14 to 0.39)	0.42 (0.23 to 0.6)	0.22 (0.12 to 0.32)	0.31 (0.12 to 0.51)	0.31 (0.18 to 0.43)	0.16 (0.06 to 0.27)	0.4

¹All GEE models are adjusted for participant sex, household structure (one parent and no other adults, one parent with other adults, two parents with no other adults, two parents with other adults), and number of children living in the household. Margins sharing a letter in the group label are not significantly different at the 5% level using Dunn-Sidak. Robust standard errors correct for correlations within households. Estimated associations are probabilities for binary outcomes from GEE with binomial family and logit link. Parent and child health-related behaviors are coded as yes if item is selected as Moderate or Often on Likert scale of Never, Rarely, Moderately, or Often.

²Lower bounds for some 95% prevalence confidence intervals are below zero as a result of robust standard errors for uncommon events.

Interpretation example: The estimated prevalence of a Somali child getting physical activity is more than three times lower than Caucasian or Native American children and two times lower than African American or Hispanic children ($p < 0.05$) when adjusting for demographics and multiplicity corrections.

³ Mean estimates with GEE, Gaussian family with identity link and robust standard errors.

⁴ e.g., preparing for a trip, weather while traveling, unexpected house problem

⁵ 348 responses to meals planning the night before are able to be used for lagged analysis purposes.

⁶ Estimate not possible

⁷ SSB = sugar sweetened beverage.

not listed as a choice on the EMA survey (i.e., none of the above). Results also showed that families rarely skipped meals or had everyone make their own meal as a result of stress, and it was common for parents to fix a quick/easy meal when parents experience work/school demands. These findings suggest that parents may benefit from support and resources for meal planning, especially for making quick/easy meals and potentially including meal planning ideas for not only breakfast, lunch, and dinner, but also for snacks. In addition, future research would benefit from qualitative methods to learn more about how meal planning interacts with actual meal behaviors to better clarify this

relationship.

With regard to the high frequency of parents who endorsed the “none of the above” response when asked about whether anything happened as a result of being stressed, there may be several potential explanations for this finding. First, it may be the case that parents who were stressed planned the meal the night before and were more likely to report saying none of the above because they had a plan. Planning ahead for a meal(s) may make a parent more likely to stick with their plan and not alter their course—even in the face of stress. Second, it is also plausible that family meal decisions were simply not impacted by the parent’s stress. Third, it

Table 2
Adjusted prevalence of parent modeled and child health-related behavior with level of stress, sources of stress, meal planning and family meal decision.

	Drink SSB ²	Eat Fast Food	Eat Unhealthy Snack	Eat Fruits/ Veggies	Get Physical Activity	Watch TV
Adjusted prevalence ¹ (95% CI) of Parent Modeled Health-Related Behavior (Observed by Child)						
Level of Stress						
<i>Overall, how STRESSFUL was your day?</i>						
A little	0.10 ^a (0.06 to 0.14)	0.06 (0.03 to 0.09)	0.15 ^a (0.10 to 0.20)	0.58 ^a (0.50 to 0.67)	0.48 (0.40 to 0.56)	0.19 (0.12 to 0.26)
Moderately	0.10 ^a (0.05 to 0.15)	0.07 (0.04 to 0.11)	0.15 ^a (0.09 to 0.21)	0.43 ^a (0.33 to 0.53)	0.35 (0.26 to 0.44)	0.18 (0.12 to 0.24)
Quite a bit	0.20 ^{ab} (0.07 to 0.32)	0.11 (0.03 to 0.18)	0.25 ^a (0.12 to 0.38)	0.38 ^a (0.23 to 0.52)	0.46 (0.32 to 0.61)	0.23 (0.11 to 0.35)
Extremely	0.45 ^b (0.20 to 0.70)	0.07 (-0.01 to 0.15)	0.38 ^a (0.19 to 0.57)	0.41 ^a (0.19 to 0.64)	0.38 (0.18 to 0.58)	0.41 (0.19 to 0.64)
P-value	0.003	0.6	0.01	0.03	0.2	0.1
Source of Stress						
<i>Overall, what caused you the MOST STRESS today?</i>						
Family Demands	0.20 (0.10 to 0.29)	0.07 (0.03 to 0.11)	0.18 (0.09 to 0.27)	0.58 (0.47 to 0.70)	0.57 (0.44 to 0.69)	0.21 (0.09 to 0.32)
Work/School Demands	0.12 (0.06 to 0.17)	0.07 (0.04 to 0.11)	0.17 (0.12 to 0.23)	0.47 (0.38 to 0.56)	0.39 (0.31 to 0.47)	0.17 (0.12 to 0.22)
Family Conflicts	0.10 (0.03 to 0.17)	0.07 (0.00 to 0.14)	0.14 (0.05 to 0.23)	0.54 (0.40 to 0.68)	0.39 (0.25 to 0.52)	0.23 (0.12 to 0.34)
Financial Problems	0.09 (0.01 to 0.18)	0.03 (-0.03 to 0.09)	0.22 (0.08 to 0.36)	0.44 (0.20 to 0.67)	0.31 (0.11 to 0.51)	0.38 (0.15 to 0.60)
Health Concerns	0.12 (-0.04 to 0.28)	NA	0.08 (-0.06 to 0.22)	0.44 (0.20 to 0.68)	0.28 (0.06 to 0.50)	0.20 (0.04 to 0.36)
Other ³	0.10 (0.00 to 0.21)	0.10 (-0.01 to 0.21)	0.21 (0.08 to 0.34)	0.38 (0.21 to 0.54)	0.40 (0.23 to 0.56)	0.21 (0.09 to 0.33)
P-value	0.5	0.9	0.8	0.3	0.06	0.5
Planned the Meal the Night Before						
No	0.15 (0.07 to 0.23)	0.09 (0.04 to 0.14)	0.19 (0.12 to 0.26)	0.46 (0.24 to 0.58)	0.44 (0.35 to 0.53)	0.19 (0.10 to 0.27)
Yes (all /some of them)	0.10 (0.03 to 0.16)	0.05 (0.01 to 0.10)	0.13 (0.07 to 0.18)	0.51 (0.39 to 0.64)	0.34 (0.25 to 0.44)	0.15 (0.08 to 0.22)
P-value	0.3	0.3	0.2	0.5	0.2	0.5
Family Meal Decision						
<i>Did any of the following things happen as a result of being stressed today?</i>						
Fixed quick meal	0.17 ^a (0.08 to 0.26)	0.07 ^a (0.02 to 0.11)	0.25 ^b (0.17 to 0.32)	0.45 ^a (0.33 to 0.56)	0.43 (0.33 to 0.53)	0.28 (0.19 to 0.37)
Bought Fast Food	0.22 ^a (0.12 to 0.33)	0.33 ^b (0.21 to 0.46)	0.26 ^{ab} (0.14 to 0.37)	0.35 ^a (0.22 to 0.49)	0.37 (0.24 to 0.51)	0.17 (0.06 to 0.27)
Everyone made own meal ⁴	0.09 ^a (-0.09 to 0.27)	NA	0.18 ^{ab} (-0.07 to 0.44)	0.18 ^a (-0.07 to 0.44)	0.36 (0.00 to 0.73)	0.18 (-0.07 to 0.44)
Skip meal	0.20 ^a (-0.04 to 0.44)	NA	0.10 ^{ab} (-0.20 to 0.29)	0.40 ^b (0.02 to 0.78)	0.50 (0.22 to 0.78)	0.20 (-0.04 to 0.44)
None of the above	0.09 ^a (0.05 to 0.13)	0.03 ^a (0.01 to 0.06)	0.12 ^a (0.08 to 0.17)	0.54 ^a (0.46 to 0.62)	0.41 (0.34 to 0.49)	0.16 (0.11 to 0.22)
P-value	0.04	<0.001	0.0002	0.04	0.9	0.2
Adjusted prevalence (95% CI) of Child Health-Related Behavior						
Level of Stress						
<i>Overall, how STRESSFUL was your day?</i>						
A little	0.06 (0.03 to 0.10)	0.04 (0.01 to 0.07)	0.13 ^a (0.08 to 0.18)	0.54 (0.44 to 0.64)	0.65 ^a (0.56 to 0.73)	0.28 (0.21 to 0.35)
Moderately	0.09 (0.05 to 0.13)	0.06 (0.03 to 0.09)	0.15 ^a (0.09 to 0.21)	0.42 (0.32 to 0.52)	0.51 ^a (0.41 to 0.61)	0.27 (0.20 to 0.34)
Quite a bit	0.09 (0.00 to 0.17)	0.13 (0.03 to 0.22)	0.27 ^{ab} (0.13 to 0.41)	0.38 (0.21 to 0.54)	0.68 ^a (0.55 to 0.81)	0.36 (0.17 to 0.54)
Extremely	0.21 (0.05 to 0.36)	0.14 (-0.02 to 0.30)	0.45 ^b (0.26 to 0.64)	0.34 (0.13 to 0.56)	0.48 ^a (0.23 to 0.74)	0.41 (0.18 to 0.65)
P-value	0.09	0.1	0.0003	0.2	0.04	0.6
Source of Stress						
<i>Overall, what caused you the MOST STRESS today?</i>						
Family Demands	0.20 ^b (0.11 to 0.29)	0.08 ^a (0.02 to 0.14)	0.31 ^b (0.23 to 0.39)	0.51 (0.41 to 0.62)	0.68 (0.58 to 0.77)	0.29 (0.19 to 0.38)
Work/School Demands	0.07 ^{ab} (0.04 to 0.11)	0.06 ^a (0.03 to 0.09)	0.11 ^a (0.07 to 0.15)	0.43 (0.37 to 0.48)	0.56 (0.50 to 0.62)	0.28 (0.22 to 0.34)
Family Conflicts	0.12 ^{ab} (0.01 to 0.22)	0.07 ^a (0.01 to 0.13)	0.14 ^{ab} (0.04 to 0.24)	0.51 (0.41 to 0.60)	0.58 (0.47 to 0.68)	0.34 (0.22 to 0.46)
Financial Problems	0.03 ^a (-0.02 to 0.07)	0.02 ^a (0.00 to 0.04)	0.29 ^{ab} (0.15 to 0.43)	0.62 (0.44 to 0.81)	0.56 (0.36 to 0.77)	0.42 (0.18 to 0.67)
Health Concerns	0.21 ^{ab} (0.02 to 0.40)	NA	0.10 ^a (0.02 to 0.19)	0.52 (0.28 to 0.75)	0.60 (0.36 to 0.83)	0.22 (0.06 to 0.38)
Other	0.03 ^a (-0.03 to 0.08)	0.09 ^a (0.00 to 0.18)	0.20 ^{ab} (0.06 to 0.34)	0.43 (0.30 to 0.55)	0.62 (0.48 to 0.75)	0.31 (0.16 to 0.47)
P-value	0.01	0.02	<0.001	0.2	0.6	0.7
Planned the Meal the Night Before						
No	0.08 (0.03 to 0.13)	0.06 (0.02 to 0.10)	0.24 (0.15 to 0.33)	0.45 (0.33 to 0.58)	0.57 (0.48 to 0.67)	0.31 (0.20 to 0.41)
Yes (all /some of them)	0.08 (0.03 to 0.13)	0.08 (0.03 to 0.13)	0.13 (0.07 to 0.20)	0.47 (0.33 to 0.61)	0.55 (0.41 to 0.69)	0.25 (0.16 to 0.33)
P-value	0.9	0.6	0.04	0.8	0.8	0.3
Family Meal Decision						
<i>Did any of the following things happen as a result of being stressed today?</i>						
Fixed quick meal	0.10 (0.03 to 0.16)	0.06 ^a (0.01 to 0.12)	0.23 (0.13 to 0.33)	0.44 ^{ab} (0.32 to 0.56)	0.58 (0.46 to 0.69)	0.33 (0.22 to 0.45)
Bought Fast Food	0.15 (0.06 to 0.24)	0.28 ^b (0.16 to 0.39)	0.22 (0.11 to 0.33)	0.28 ^a (0.15 to 0.41)	0.46 (0.31 to 0.61)	0.33 (0.22 to 0.45)
Everyone made own meal	NA	NA	0.09 (-0.09 to 0.27)	0.36 ^{ab} (0.11 to 0.61)	0.45 (0.05 to 0.86)	0.09 (-0.09 to 0.27)
Skip meal	0.10 (-0.07 to 0.27)	NA	0.20 (-0.04 to 0.44)	0.30 ^{ab} (-0.06 to 0.66)	0.60 (0.22 to 0.98)	0.50 (0.30 to 0.70)
None of the above	0.07 (0.04 to 0.10)	0.03 ^a (0.01 to 0.06)	0.13 (0.08 to 0.17)	0.51 ^b (0.42 to 0.60)	0.61 (0.52 to 0.69)	0.26 (0.20 to 0.32)
P-value	0.2	<0.001	0.08	0.04	0.5	0.06

Interpretation example parent-modeled: There is a nearly fourfold increase predicted prevalence of a parent modeling drinking a SSB when the level of stress increases from “A little” or “Moderate” to “Extremely” after adjusting for demographics (P < 0.05).

Interpretation example child: There is a nearly threefold increase in the predicted prevalence of a child eating an unhealthy snack when the source of stress is family demands compared work/school demands or health concerns after adjusting for demographics (P < 0.05). Lower levels of stress compared to extreme stress and a planned meal vs. not having a planned meal have lower estimated probabilities of a child eating an unhealthy snack after adjusting for demographics (P < 0.05).

¹ All GEE models are adjusted for parent sex, child sex self-identified household race, parent weight status, child weight status, household structure (one parent and no other adults, one parent with other adults, two parents with no other adults, two parents with other adults), and number of children living in the household. Margins sharing a letter in the group label are not significantly different at the 5% level using Dunn- Sidak. Robust standard errors correct for correlations within households. Lower bounds for some 95% prevalence confidence intervals are below zero as a result of robust standard errors for uncommon events. Estimated associations are probabilities for binary outcomes (Yes vs. No) from GEE with binomial family and logit link. Parent modeled and child health-related behaviors are coded as yes if item is selected as Moderate or Often on Likert scale of Never, Rarely, Moderately, or Often.

² SSB = sugar sweetened beverage.

³ e.g., preparing for a trip, weather while traveling, unexpected house problem.

⁴ Estimate not possible if NA.

may also be possible that low-income families are less able to be flexible in their food choices because of financial concerns. Thus, there may be more limited food choices in the home, which makes the possibility of everyone making their own meal difficult. While future research is needed to confirm these potential hypotheses, planning ahead or helping families have multiple quick/easy meals that are affordable could be a good intervention point for families.

Study results also found that higher levels of parental stress and stress from family demands was associated with an increased likelihood of consumption of SSBs and unhealthy snacks for both the parent and child. Therefore, intervening on caregiver stress may be important to improve family healthy eating behaviors in diverse populations. If stress disrupts meal planning, this could be one explanatory pathway for how transient stressors impact parent and child health and behavior across days. Future research is needed to confirm this result and to further test whether intervening on parental stress can benefit both parent dietary consumption in addition to child dietary consumption.

A strength of this study was the use of EMA to measure end-of-day stress responses across an eight-day period for both outcomes and exposures. EMA is well-suited to capture between and within-person variation in momentary exposures and behavioral responses across time. This study adds to the limited studies that have employed EMA to evaluate stress and eating behaviors in a very unique racially/ethnically diverse population. There were also other study limitations including, the use of items from scales that have not been validated for use with EMA or with immigrant/refugee populations. A further limitation of the study was that the items measuring sources of stress were created for this study and may not have captured all potential sources of stress or meal planning behaviors. An additional response option in future research may be warranted asking parents to indicate if their meal decision was unaffected by their stress. Furthermore, qualitative research may also be important to carry out to identify additional sources of stress relevant to diverse families with young children to inform future quantitative survey questions. Given this is one of the first studies to examine the association between sources of parental stress and meal decision-making processes it is important to use these study findings in the design of future EMA questions. Future research to replicate these findings should also consider increasing the observation period to evaluate the effects of less reported stressors (e.g., financial problems, health concerns) on meal behaviors. Additionally, while the sample size is considered large for a mixed-methods in-home study with in-depth measures, the sample size was small at the subpopulation level. Thus, future studies with larger racial/ethnic sample sizes are needed to test racial/ethnic differences in health-related behavior responses to various sources of parental stress.

9. Conclusions

Results of the current study indicated that different sources of stress were associated with immediate family meal decisions like fixing quick meals and child health-related behaviors, including drinking SSB and unhealthy snacking. Moreover, the majority of families rarely skipped meals or had everyone make their own meal as a consequence of primary caregiver stress. Interventions targeting parental stress, especially related to work and family demands, such as providing support and resources for healthy options when preparing a quick or easy meal may increase the healthfulness of the home food environment during moments of elevated transient stress with a favorable impact on child eating behaviors and health.

10. Role of authors

All authors are responsible for reported research. All authors have participated in the concept and design, analysis and interpretation of data, drafting or revising of the manuscript, and have approved the manuscript as submitted. Corresponding author Berge is the PI of the

study.

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Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supplementary data

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References

- Lytle, L.A., Hearst, M.O., Fulkerson, J., et al., 2011. Examining the relationships between family meal practices, family stressors, and the weight of youth in the family. *Ann. Behav. Med.* 41 (3), 353–362.
- Hearst, M.O., Sevcik, S., Fulkerson, J.A., Pasch, K.E., Harnack, L.J., Lytle, L.A., 2012. Stressed out and overcommitted! The relationships between time demands and family rules and parents' and their child's weight status. *Health Educ. Behav.* 39 (4), 446–454.
- Black, M.M., Aboud, F.E., 2011. Responsive feeding is embedded in a theoretical framework of responsive parenting. *J. Nutr.* 141 (3), 490–494.
- Topham, G.L., Hubbs-Tait, L., Rutledge, J.M., et al., 2011. Parenting styles, parental response to child emotion, and family emotional responsiveness are related to child emotional eating. *Appetite* 56 (2), 261–264.
- Berge, J.M., Tate, A., Trofholz, A., et al., 2017. Momentary parental stress and food-related parenting practices. *Pediatrics* 140 (6).
- Berge, J.M., Tate, A., Trofholz, A., et al., 2018. Examining within- and across-day relationships between transient and chronic stress and parent food-related parenting practices in a racially/ethnically diverse and immigrant population: Stress types and food-related parenting practices. *Int. J. Behav. Nutr. Phys. Activity* 15 (1), 7.
- Dickerson, S.S., Kemeny, M.E., 2004. Acute stressors and cortisol responses: a theoretical integration and synthesis of laboratory research. *Psychol. Bull.* 130 (3), 355–391.
- O'Connor, D.B., Jones, F., Conner, M., McMillan, B., Ferguson, E., 2008. Effects of daily hassles and eating style on eating behavior. *Health Psychol.* 27 (1S), S20–S31.
- Zenk, S.N., Horoi, I., McDonald, A., Corte, C., Riley, B., Odoms-Young, A.M., 2014. Ecological momentary assessment of environmental and personal factors and snack food intake in African American women. *Appetite* 83, 333–341.
- Evers, C., Adriaanse, M., de Ridder, D.T., de Witt Huberts, J.C., 2013. Good mood food. Positive emotion as a neglected trigger for food intake. *Appetite* 68, 1–7.
- Devine, C.M., Connors, M.M., Sobal, J., Bisogni, C.A., 2003. Sandwiching it in: spillover of work onto food choices and family roles in low- and moderate-income urban households. *Soc. Sci. Med.* 56 (3), 617–630.
- Devine, C.M., Farrell, T.J., Blake, C.E., Jastran, M., Wethington, E., Bisogni, C.A., 2009. Work conditions and the food choice coping strategies of employed parents. *J. Nutr. Educ. Behav.* 41 (5), 365–370.
- Reichenberger, J., Kuppens, P., Liedgruber, M., et al., 2018. No haste, more taste: An EMA study of the effects of stress, negative and positive emotions on eating behavior. *Biol. Psychol.* 131, 54–62.

Hetherington, E.M., Parke, R.D., Locke, V.O., 1999. *Child Psychology: A Contemporary Viewpoint*. McGraw-Hill.

Berge, J.M., Trofholz, A., Tate, A., et al., 2017. Examining unanswered questions about the home environment and childhood obesity disparities using an incremental,

mixed-methods, longitudinal study design: The Family Matters study. *Contemporary Clin Trials*.

Shiffman, S., Stone, A.A., Hufford, M.R., 2008. Ecological momentary assessment. *Ann Rev Clin Psychol* 4, 1–32.