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INFLUENCE OF PARENT AND COMMUNITY FACTORS ON INFANT SNACKING

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INFLUENCE OF PARENT AND COMMUNITY FACTORS
ON INFANT SNACKING

BY

AMY MICHELLE MOORE

A DISSERTATION SUBMITTED IN PARTIAL FULFILLMENT OF THE
REQUIREMENTS FOR THE DEGREE OF

DOCTOR OF PHILOSOPHY

IN

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UNIVERSITY OF RHODE ISLAND

2020

DOCTOR OF PHILOSOPHY DISSERTATION
OF
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2020

ABSTRACT

Snacking has increased among young children in recent decades, yet little is known about snacking during infancy. Therefore, three studies were conducted to explore the influence of parent and community factors on infant snacking. Across the three studies, findings suggest that infants are snacking on less healthy foods, mothers may offer snacks to prevent hunger and manage infant behavior, and less healthy snacks are widely available in the retail food stores. The first study was a secondary analysis of data from the Nurture study that examined the prevalence of less healthy snack intake at three time points (4-6, 7-9, and 10-12 months of age) and examined prospective associations between less healthy snack intake and infant weight trajectories in a predominantly low-income cohort of non-Hispanic Black mothers ($n = 666$). Multilevel growth curve models explored associations of baby snacks and sweets with infant weight-for-length (WFL) z-scores. Findings suggest that less healthy snack intake increased across infancy with 3.0 baby snacks/day and 1.0 sweets/day at 10-12 months. Growth curve models showed that infants who had sweets >2 x/day had significantly higher WFL z-scores during the second half of infancy compared to infants who never had sweets. Findings suggest that less healthy snacks, specifically sweets, may contribute to infant adiposity. The second study was a recurrent cross-sectional qualitative study exploring how low-income mothers define snacking and reasons for offering snacks during infancy. Semi-structured interviews were conducted with a purposive sample of mothers ($n = 15$) when infants were approximately 6 and 12 months of age. A thematic analysis approach was used to identify codes and themes. Findings suggest that snacks are commonly offered during infancy and that mothers define snacks as smaller portions

that help with hunger between meals. In addition, during early infancy mothers described snacks as sweet, and across the first year of life mothers described using snacks to manage behavior. The third study was an observational study to assess the availability, price, and nutritional content of commercial infant foods and snacks in retail food stores in low-income communities across Rhode Island. A random sample of grocery stores (n = 14) and supermarkets (n = 8) was selected from low-income census tracts. A 14-item tool was developed for this study to assess the nutrition environment of commercial infant foods (e.g., infant formula, purees) and snacks (e.g., puffs, yogurt melts). Finding suggests that most grocery stores (n = 13) and all supermarkets (n = 8) sold commercial infant foods and snacks. The types of infant foods and snacks available in grocery stores varied with infant formula having the highest availability followed by puffs (grain-based, n = 10 and corn-based, n = 10) and purees in jars/packs (n = 8). The types of infant foods and snacks available in supermarkets were less varied with the majority of products available in all stores. Infant foods and snacks were generally lower in price per standard serving in grocery stores compared to supermarkets, and infant foods were generally higher in price per standard serving compared to infant snacks in both store types. Broadly, snacking begins during infancy, and less healthy snacks may contribute to the risk of infant adiposity. Mothers use snacks to prevent hunger between meals and to manage infant behavior, and commercial infant snacks are widely available in low-income communities. Results from these studies suggest that caregivers may benefit from additional guidance related to healthy snacking during infancy, and additional programs and policies are needed to encourage the availability of healthy infant snacks in retail food stores.

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PREFACE

This Dissertation was written to comply with the University of Rhode Island graduate school Manuscript Dissertation Format. This Dissertation contains three manuscripts:

Manuscript 1: Associations of less healthy snack food consumption with infant weight-for-length z-score trajectories: Findings from the Nurture cohort study. This manuscript has been published in *Nutrients* [2019;11(11):2752].

Manuscript 2: A recurrent cross-sectional qualitative study exploring how low-income mothers define snacking and reasons for offering snacks during infancy. This manuscript has been written in a form suitable for publication in *Appetite*.

Manuscript 3: Availability, price, and nutritional content of commercial infant foods and snacks in retail food stores in low-income communities across Rhode Island. This manuscript has been written in a form suitable for publication in the *International Journal of Environmental Research and Public Health*.

TABLE OF CONTENTS

ABSTRACT	ii
ACKNOWLEDGMENTS	iv
PREFACE.....	v
TABLE OF CONTENTS.....	vi
LIST OF TABLES	viii
LIST OF FIGURES	x
MANUSCRIPT 1.....	1
ABSTRACT.....	2
INTRODUCTION	3
METHODS	6
RESULTS	10
DISCUSSION	16
REFERENCES	21
MANUSCRIPT 2.....	26
ABSTRACT.....	27
INTRODUCTION	28
METHODS	31
RESULTS	36
DISCUSSION	43
REFERENCES	50

MANUSCRIPT 3.....	54
ABSTRACT.....	55
INTRODUCTION	56
METHODS	60
RESULTS	65
DISCUSSION.....	70
REFERENCES	76
EXTENDED LITERATURE REVIEW	81
REFERENCES	96
APPENDICES	102
APPENDIX A.....	102
APPENDIX B	104
APPENDIX C	105
APPENDIX D.....	108
APPENDIX E	109
APPENDIX F.....	111
APPENDIX G.....	114
APPENDIX H.....	121
APPENDIX I	125
APPENDIX J	128
APPENDIX K.....	133
APPENDIX L	137

LIST OF TABLES

TABLE	PAGE
MANUSCRIPT 1	
Table 1. Sociodemographic characteristics of mother-infant dyads participating in the Nurture study (n = 666).	11
Table 2. Medians (IQR) for selected foods and sugar-sweetened beverages consumed by infants per day.	13
Table 3. Multilevel growth curve models for infant WFL z-score trajectories.	15
Supplemental Table 1. Bivariate correlations between foods and sugar-sweetened beverages (SSB) consumed by infants from 4 to 12 months.	25
MANUSCRIPT 2	
Table 1. Semi-structured interview guide questions for interviews conducted with mothers when infants were 6 and 12 months of age.	33
Table 2: Sociodemographic characteristics of mother-infant dyads at 6 month interviews (n = 15).	36
Table 3: Table 3: Themes and supporting quotations from interviews with mothers when infants were 6 months of age (n = 15).	40
Table 4: Themes and supporting quotations from interviews with mothers when infants were 12 months of age (n = 12).	42
Table 5: Mean infant feeding styles by snacks offered versus snacks not offered at 6 months of age.	43

TABLE	PAGE
MANUSCRIPT 3	
Table 1. Characteristics of low-income census tracts included in the nutrition environment assessment compared to State Characteristics.	66
Table 2: Availability, pricing, and selected nutritional content for infant foods and snacks in grocery stores (n = 14) located in low-income communities. ...	68
Table 3: Availability, pricing, and selected nutritional content for infant foods and snacks in supermarkets (n = 8) located in low-income communities.	69
Table 4: Mean NEMS-S scores in retail food stores in low-income communities by store type.	70
Supplemental Table 1: Categorization of infant foods and snacks (n -14) included in the nutrition environment measure	80

LIST OF FIGURES

FIGURE	PAGE
MANUSCRIPT 1	
Figure 1. Adjusted models for change in (a) baby snacks and (b) sweets consumption and weight-for-length (WFL) z-scores by time point for infants in the Nurture study.....	16

MANUSCRIPT 1

Associations of less healthy snack food consumption with infant weight-for-length

z-score trajectories: Findings from the Nurture cohort study

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ABSTRACT

Little is known about the impact of less healthy snack foods on weight trajectories during infancy. This secondary analysis of data from the Nurture cohort explored prospective associations of less healthy snack foods with infant weight trajectories. Pregnant women were recruited and, upon delivery of a single live infant, 666 mothers agreed to participate. Mothers completed sociodemographic and infant feeding questionnaires, and infant anthropometrics were collected during home visits at 3, 6, 9, and 12 months. Less healthy snack food consumption was assessed by asking how frequently baby snacks and sweets were consumed each day during the previous three months. Multilevel growth curve models explored associations of baby snacks and sweets with infant WFL z-scores. On average, mothers were 27 years old, 71.5% were non-Hispanic Black, and 55.4% had household incomes of <\$20,000/year. Consumption of less healthy snack foods increased during infancy with a median intake of 3.0 baby snacks/day and 0.7 sweets/day between 10-12 months. Growth curve models showed that infants who consumed sweets >2x/day had significantly higher WFL z-scores during the second half of infancy compared to infants who never consumed sweets. Less healthy snacks may contribute to the risk of obesity during infancy and promoting healthy snack food choices during this critical time is important.

INTRODUCTION

Food preferences and dietary patterns that impact weight trajectories emerge during infancy [1]. Recent national data suggest that 8% of infants and toddlers are at risk for obesity (weight-for-length [WFL] ≥ 95 th percentile) with non-Hispanic Black infants and toddlers at greater risk compared to non-Hispanic Whites [2]. Foods and beverages consumed during infancy influence food preferences and subsequent dietary patterns [3]. For example, higher consumption of fruits and vegetables [4], sweet desserts [3], and sugar-sweetened beverages (SSB) [5] are associated with higher consumption in later childhood. Less healthy dietary patterns, which include foods high in added sugars, sodium, and saturated fats, are associated with an increased risk for obesity during infancy [6] and later childhood [7]. However, there is little evidence relating to the impact of the frequency and timing of less healthy snack foods on infant weight trajectories. There is, therefore, a need to examine the impact of how the frequency and timing of less healthy snack food consumption may contribute to obesogenic dietary patterns. This information will help inform national dietary recommendations for this age group [8,9].

Infancy includes a period of rapid dietary transition, from an exclusively milk-based diet to one that includes solid foods [1,10,11]. Parental feeding decisions that follow recommended guidelines, including the appropriate timing and introduction of nutrient-dense solid foods, have been shown to be protective against obesity [12–14]. The American Academy of Pediatrics (AAP) recommends the introduction of solid foods at approximately 6 months of age to complement breastmilk or formula [14]. Parents are encouraged to offer a wide variety of healthy foods with varying flavors and

textures. Around 9 months of age, meal and snack routines are recommended with three nutrient-dense meals and two or three snacks per day. Parents are also encouraged to avoid less healthy foods with added sugars and limit sodium, saturated fats, and refined grains [14,15]. Despite widespread recognition of the immediate [14,16] and longer-term [17,18] benefits of consuming healthy foods starting early in life, recent National Health and Nutrition Survey (NHANES) data suggest that between 6 and 11 months of age, 25% of infants did not consume any vegetables and 17% did not consume any fruits on a given day [19]. Along with suboptimal vegetable and fruit intake, infants between 6 and 11 months of age consumed a variety of less healthy snack foods with over 50% consuming a sweet or salty snack each day [19]. Similarly, results from the Feeding Infants and Toddlers Study (FITS), a predominantly non-Hispanic White sample, suggest that less healthy snack food consumption increases across infancy, with 9% of infants between 6 and 8 months of age and nearly 20% of infants between 9 and 11 months of age consuming at least one sweet or salty snack each day [20]. Disparities also begin to emerge during infancy with non-Hispanic Black infants consuming fewer vegetables and fruits and more sweet and salty snacks compared to non-Hispanic White infants [19]. Increasing trends in the consumption of less healthy snacks during infancy is particularly concerning given these snacks may displace healthier foods and also contribute excess calories. Additionally, there is limited research on less healthy snacking in low-income, non-Hispanic infants, which makes examining snacking in this population important.

Recent increases in childhood obesity coincide with increases in snack food marketing, snacking frequency, and overall calorie contribution from snack foods [21–

23], with the greatest increases in populations most at risk for childhood obesity, including low-income and non-Hispanic Black households [20,24]. Experts agree that the impact of snack foods on weight status depends on the frequency and energy-density of snack foods [22,24]. Preschool-aged children consume around three snacks per day, which contribute nearly 30% of daily calories with the majority of those calories coming from less healthy snacks [19,22,23]. This increases during early childhood with nearly 54% of daily calories coming from less healthy snacks [23]. However, studies with older children and adolescents reveal that snacking may have favorable effects on weight status due to increases in healthy snack foods (e.g., fruits and vegetables) [25,26]. In contrast to older children, recent studies of preschool-aged children suggest that a large proportion of snack foods are from less healthy sweet and salty snacks, and these energy-dense snack foods may lead to excess calories and subsequent obesity [22,23,27]. However, little is known about the impact of less healthy snack foods on weight trajectories during the first year of life. Therefore, the purpose of this analysis was to 1) describe the prevalence of less healthy snack food (baby snacks and sweets) consumption across important transitions in infant feeding, and 2) explore the relationship of baby snacks and sweets with infant WFL z-score trajectories in a predominantly low-income, racially diverse cohort. We hypothesized that greater consumption of baby snacks and sweets would be associated with higher WFL z-scores after controlling for confounding variables. This study is one of the first to examine the impact of less healthy snack foods on infant weight trajectories in a low-income, diverse cohort.

MATERIALS AND METHODS

Study Design and Participants

This was a secondary analysis of data from the Nurture study, a prospective observational birth cohort of predominantly non-Hispanic, Black mothers and their infants residing in the Southeastern USA [28]. The Nurture study was designed to explore longitudinal associations between various infant caregivers and infant adiposity during the first year of life. Women between 20-36 weeks gestation were recruited from a county health department prenatal clinic and a private prenatal clinic in Durham, North Carolina from 2013 to 2015. Recruited mothers were ≥ 18 years of age with a singleton pregnancy with no known congenital abnormalities. After delivery, mothers confirmed continued interest in participating or were excluded if: no longer interested, their infants were born before 37 weeks gestation or were unable to take breastmilk or formula by mouth at hospital discharge. A total of 666 mother-infant dyads were enrolled in the study. Details on the study design have been provided elsewhere [28]. Mothers provided written informed consent and parental permission for their infants. All procedures were approved by Duke University Medical Center Institutional Review Board (human subjects committee, Pro 0036242).

Measures

Data collection occurred from 2013 to 2016. Trained data collectors conducted four home visits when infants were 3, 6, 9 and 12 months of age. Mothers completed sociodemographic and infant feeding questionnaires, and infant heights and weights were measured during each home visit. Mothers reported how frequently infants consumed foods and beverages each day during the previous three months using items

from the Infant Feeding Practices Study II (IFPS II) [29] and the Feeding Infants and Toddlers Study (FITS) [30]. Items included how frequently infants consumed baby snacks (teething biscuits, puffs, and melts), sweets (cookies, cakes, or candy), SSBs, fruits (not including fruit juice), vegetables (not including vegetable juice), dairy (yogurt and cheese), protein (meat, fish, and eggs), grains (breakfast cereals, crackers, bread, pasta, and rice), breastmilk, and infant formula each day. Based on AAP recommendations for the introduction of solid foods [14], any foods and beverages (other than breastmilk and infant formula) consumed between birth and 3 months of age were further categorized as early introduction to solid foods.

Sociodemographics

Sociodemographic characteristics were collected at recruitment and during each home visit. Maternal variables of interest included age, prepregnancy body mass index (BMI), race (Black, White, or Other), education ($\leq$ high school diploma, some college, college graduate, or graduate degree), household income ($\leq$ \$20,000, \$20,001-\$40,000, $\geq$ \$40,001), Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) status, and total number of weeks of any breastfeeding between birth and 12 months. Infant variables of interest included gender, birth weight for gestational age (WGA) z-scores, and WFL z-scores.

Exposure Variable (categorical) – Baby Snacks and Sweets

Less healthy snack food consumption during the first year of life was assessed using two items: 1) “How often was he or she [their infant] fed baby snacks (teething biscuits, puffs, or melts) during the month.” and 2) “How often was he or she [their infant] fed sweets (cookies, cakes, or candy) during the month.” Response options for both items

were: 0 = never, 1 = just to try, 2 = sometimes but less than once/day, and from 3 = 1 time/day to 7 = 5 or more times/day. To capture important transitions in infant feeding, monthly responses for baby snacks and sweets were averaged across three months (4-6 months, 7-9 months, and 10-12 months) to create an average score for each time point. To reflect AAP recommendations for snacking frequency, averaged scores for baby snacks were further categorized as: 0 = never (never, just to try, or less than once/day), 1 = sometimes (1-3 times/day), or 2 = often (>3 times/day). Given the narrow distribution of scores for sweets, averaged scores were categorized as: 0 = never (never, just to try, or less than once/day), 1 = sometimes (1-2 times/day), or 2 = often (>2 times/day).

Outcome Variable (continuous) – Infant WFL z-scores

Standardized measurements of infant recumbent length (ShorrBoard Portable Length Board, Issaquah, WA) and weight (Seca Infant Scale, Hanover, MD) were collected in triplicate by trained staff during the four home visits. An average of the three measurements was used to calculate age- and sex-specific WFL z-scores at 3, 6, 9, and 12 months using World Health Organization reference standards [31].

Covariates

Several mother and infant sociodemographic characteristics were examined as possible covariates based on previous findings of an association with infant weight status (pre-pregnancy BMI, birth WGA z-scores, total number of weeks any breastfeeding (non-exclusive), and early introduction of solid foods) [17]. Other possible covariates were examined based on research suggesting an association with infant feeding and infant weight status (mother's age, race, education, household

income, and infant gender) [29]. Covariates were included in adjusted models when the magnitude of the association between baby snacks or sweets consumed and WFL z-scores changed by approximately 10% when added separately to the model [32].

Statistical Analyses

Descriptive statistics including means and standard deviations or medians and interquartile ranges for continuous variables and frequencies and percentages for categorical variables were used to summarize sociodemographic characteristics and infant feeding. Spearman's rho correlation coefficients were computed to examine the associations between foods and SSBs (as continuous variables) consumed averaged across three time points (i.e., 4-12 months). Multilevel growth curve models were used to explore the prospective associations of baby snacks and sweets consumed between 4-6 months, 7-9 months, and 10-12 months with infant WFL z-scores at 6 months, 9 months, and 12 months. These models are appropriate for longitudinal data with repeated measures, and were built following published guidelines [33], with infant age as the measure of time point (level 1) nested within infants (level 2). Baby snacks and sweets were modeled as fixed effects with individual infants' slopes and intercepts modeled as random effects. Models were estimated using restricted maximum likelihood estimation (REML) [33], and a change in Bayesian Information Criteria (BIC) of >10 was used to indicate significant improvement in model fit [34]. All participants who completed at least one home visit were included in models. First, an unconditional means model (model 1) with no predictors was estimated and used to calculate the intraclass correlation coefficient (ICC). A larger ICC indicates more between-infant variation and a smaller ICC indicates more within-infant variation in

WFL z-scores. Second, an unconditional (unadjusted) growth model (model 2) was estimated to examine the impact of time point as a fixed effect on infant WFL z-scores. Time point was centered at 4-6 months to reflect recommendations for solid food introduction, such that the intercept represented mean WFL z-scores at 6 months, and the slope represented change in mean WFL z-scores per time point. Next, conditional (adjusted) growth models were estimated to examine the effects of level 2 categorical predictors, baby snacks (model 3) and sweets (model 4). Baby snacks and sweets were modeled as never (reference), sometimes, and often to examine differences in less healthy snack food frequency and timing on WFL z-scores. Both models were adjusted to control for the potential confounding effects of infant birth WGA z-scores and total number of weeks of any breastfeeding (i.e., the only covariates changing the magnitude of the association by approximately 10%). Interactions between baby snacks and sweets and maternal covariates (race, prepregnancy BMI, and income) were explored and were not significant at $p < 0.05$. All analyses were conducted using SAS 9.4 (SAS Institute, Cary, NC), and a p value of < 0.05 was used to determine statistical significance.

RESULTS

Sociodemographics

Table 1 shows sociodemographic characteristics of mother-infant dyads participating in the Nurture study. Mothers were on average 27.1 ($SD = 5.8$) years of age with a mean pre-pregnancy BMI of 29.9 ($SD = 9.3$). Mothers were predominantly non-Hispanic Black (71.5%) with over half reporting a household income of $\leq \$20,000/\text{year}$ (55.4%). Nearly half of infants were female (48.8%), and birth WGA z-scores ($M = -0.3$, $SD = 0.9$) and WFL z-scores (across all time points) were within the

normal range. Infants were non-exclusively breastfed an average of 14.7 weeks ($SD = 18.2$) with 82.9% of infants consuming breastmilk at least one time per day between birth-3 months of age, 54.7% between 4-6 months, 39.3% between 7-9 months, and 35.2% between 10-12 months. One-third of mothers (30.3%) reported introducing any solid foods before 4 months of age.

Table 1. Sociodemographic characteristics of mother-infant dyads participating in the Nurture study.

Mother Characteristics	n	Mean (SD) or %
Age (years)	666	27.1 (5.8)
Pregnancy BMI	666	29.9 (9.3)
Race	661	
Black		71.5
White		19.2
Other		8.9
Ethnicity, Latina	661	6.5
Education	663	
≤ High school diploma		47.8
Some college		30.3
College graduate		15.5
Graduate degree		6.3
Household Income	607	
≤\$20,000		55.4
\$20,001-\$40,000		19.1
≥\$40,001		16.7

Table 1 (cont.). Sociodemographic characteristics of mother-infant dyads participating in the Nurture study.

Infant Characteristics	n	Mean (SD) or %
Gender, female	666	48.8
Race	661	
Black		68.6
White		15.0
Other		14.9
Ethnicity, Latina/o	661	8.9
Birth WGA z-score	666	-0.31 (0.9)
WFL z-score, mean		
3 months	534	0.14 (1.1)
6 months	492	0.39 (1.1)
9 months	456	0.56 (1.0)
12 months	466	0.64 (1.0)
Total Weeks Breastfed ^a	657	14.7 (18.2)
Early Introduction of Solids ^b	534	30.3

^a Includes any foods and SSB (other than breastmilk or formula) consumed from birth to 3 months of age. ^b Includes any breast feeding. WGA, weight-for-gestational age; WFL, weight-for-length

Consumption of baby snacks and sweets during the first year of life

Very few mothers introduced baby snacks ($n = 7$) or sweets ($n = 3$) between birth and 3 months. Overall, 25.8% of infants consumed at least one baby snacks per day between 4-6 months, 82.2% between 7-9 months, and 87.6% between 10-12 months. Similarly, 7.1% of infants consumed at least sweets per day between 4-6 months, 28.7% between 7-9 months, and 47.2% between 10-12 months. Table 2 shows medians (IQR) for baby snacks and sweets consumed per day across the first year of life. Baby snacks consumption increased across the first year of life reaching a median of 3.0 (IQR = 2.0-4.0) times/day between 10-12 months. Sweets consumption also increased reaching a median of 0.7 (IQR = 0.0-1.7) times/day between 10-12 months.

Spearman's rho correlations for less healthy snacks and other foods consumed from 4-12 months are shown in Supplement 1. There was a weak negative correlation between baby snacks ($\rho = -0.16$) and sweets ($\rho = -0.12$) with breastmilk, and a weak positive correlation between baby snacks ($\rho = 0.03$) and sweets ($\rho = 0.06$) and infant formula. Baby snacks were positively correlated with all other foods and SSBs with values ranging from 0.17 to 0.47. Similarly, sweets were positively correlated with all other foods and SSBs with values ranging from 0.22 to 0.49.

Table 2. Medians (IQR) for selected foods and sugar-sweetened beverages consumed by infants per day.

	0 to 3 mths.	4 to 6 mths.	7 to 9 mths.	10 to 12 mths
Infant Dietary Characteristics	n = 534	n = 492	n = 456	n = 466
Baby snacks^a	0.0 (0.0-0.0)	0.0 (0.0-1.0)	2.7 (1.3-3.7)	3.0 (2.0-4.0)
Sweets^b	0.0 (0.0-0.0)	0.0 (0.0-0.0)	0.0 (0.0-1.0)	0.7 (0.0-1.7)
SSB^c	0.0 (0.0-0.0)	0.0 (0.0-0.0)	0.0 (0.0-1.7)	1.0 (0.0-2.7)
Fruits	0.0 (0.0-0.0)	0.7 (0.0-2.0)	3.0 (2.0-4.0)	3.7 (2.7-4.0)
Vegetables	0.0 (0.0-0.0)	0.7 (0.0-2.3)	3.0 (2.0-4.0)	3.7 (2.7-4.0)
Breastmilk	5.0 (2.3-7.0)	4.7 (0.0-7.0)	6.0 (0.0-7.0)	4.2 (0.0-7.0)
Formula	5.3 (2.0-7.0)	6.7 (5.0-7.0)	6.0 (5.0-7.0)	5.3 (3.3-6.0)

^a Includes teething biscuits, puffs, and melts. ^b Includes cakes, cookies, and candies. ^c SSB (sugar-sweetened beverages) includes juice drinks, soda, and sweetened tea.

Association of baby snacks and sweets with infant WFL z-scores trajectories

Multilevel growth curve models for prospective associations of baby snacks and sweets consumed at 4-6 months, 7-9 months, and 10-12 months with infant WFL z-scores at 6 months, 9 months, and 12 months are shown in Table 3 and Figure 1. A mean WFL z-score of $\beta = 0.52$ (SE = 0.04, $p < 0.001$) was observed for the unconditional means model (model 1), which assumes static WFL z-scores across infancy. Model 1 also shows that 79% of the variance (ICC 0.79) in infant WFL z-score exists between infants. The unconditional (unadjusted) growth model (Model 2), shows that infant

WFL z-score trajectories increased and were within the normal range across the time points (4-6 months, $\beta = 0.38$, $SE = 0.05$, $p < 0.001$; 7-9 months, $\beta = 0.17$, $SE = 0.03$, $p < 0.001$; 10-12 months, $\beta = 0.25$, $SE = 0.03$, $p < 0.001$). In conditional (adjusted) growth models that included baby snacks (model 3), infant WFL z-score trajectories were on average higher at 4-6 months compared to unconditional growth models and increased across the time points (4-6 months, $\beta = 0.52$, $SE = 0.06$, $p < 0.001$; 7-9 months, $\beta = 0.20$, $SE = 0.07$, $p = 0.005$; 10-12 months, $\beta = 0.30$, $SE = 0.08$, $p < 0.001$). However, there were no significant main or interaction effects of baby snacks with infant WFL z-score trajectories for any category (never, sometimes, or often) or time point (4-6, 7-9, or 10-12 months). In conditional (adjusted) growth models that included sweets (model 4), infant WFL z-score trajectories were on average higher at 4-6 months when compared to unconditional growth models and increased across the time points (4-6 months, $\beta = 0.54$, $SE = 0.06$, $p < 0.001$; 7-9 months, $\beta = 0.16$, $SE = 0.04$, $p < 0.001$; 10-12 months, $\beta = 0.19$, $SE = 0.04$, $p < 0.001$). The main effect of sweets ($F_{2,246} = 3.23$, $p = 0.03$) and interaction effects of sweets by time point ($F_{4,805} = 2.44$, $p = 0.04$) on WFL z-score trajectories were significant. There was a significant sweets by time point interaction at 4-6 months, infants consuming sweets often was negatively associated with infant WFL z-scores ($\beta = -0.46$, $SE = 0.17$, $p = 0.009$) when compared to infants who never consumed snacks. There was a significant sweets by time point interaction at 7-9 months, infants consuming sweets often was positively associated with infant WFL z-scores ($\beta = 0.48$, $SE = 0.18$, $p = 0.01$) when compared with infants who never had sweets. There was also a significant sweets by time point interaction at 10-12 months, infants consuming sweets often was positively associated with infant WFL z-scores (β

= 0.53, SE = 0.18, $p = 0.004$) when compared to infants who never had sweets. There were no other significant sweets by time point interactions.

Table 3. Multilevel growth curve models for infant WFL z-score trajectories.

		Model 1 Unconditional Means n = 666	Model 2 Unconditional Growth n = 666	Model 3 Conditional Growth n = 532	Model 4 Conditional Growth n = 532
Fixed Effects					
Intercept					
Initial Status (Time ₁)		0.52 (0.04)**	0.38 (0.05)**	0.52 (0.06)**	0.54 (0.06)**
Slope (change in WFL z-scores)					
Time ₁			.0	.0	.0
Time ₂			0.17 (0.03)**	0.20 (0.07)**	0.16 (0.04)**
Time ₃			0.25 (0.03)**	0.30 (0.08)**	0.19 (0.04)**
Baby Snacks x Time ₁					
Never	364			.0	
Sometimes	91			0.11 (0.07)	
Often	36			-0.08 (0.10)	
Baby Snacks x Time ₂					
Never	76			.0	
Sometimes	174			-0.12 (0.11)	
Often	201			0.07 (0.12)	
Baby Snacks x Time ₃					
Never	57			.0	
Sometimes	132			-0.14 (0.11)	
Often	276			0.02 (0.13)	
Sweets x Time ₁					
Never	456				.0
Sometimes	24				0.11 (0.12)
Often	11				-0.46 (0.17)*
Sweets x Time ₂					
Never	320				.0
Sometimes	66				-0.09 (0.14)
Often	65				0.48 (0.18)*
Sweets x Time ₃					
Never	245				.0
Sometimes	109				0.04 (0.14)
Often	111				0.53 (0.18)*
Random Effects					
Level 1		0.22 (0.01)**	0.21 (0.01)**	0.20 (0.01)**	0.20 (0.05)**
Intercept		0.84 (0.06)**	0.85 (0.06)**	0.79 (0.05)**	0.79 (0.05)**
Model Fit					
BIC		3023.7	2978.4	2926.3	2919.0

Table 3 includes parameter estimates with standard errors in parentheses. Models 3 (baby snacks) and 4 (sweets) adjusted for birth weight-for-gestational age z-scores and total weeks any breastfeeding. Baby snacks and sweets were modeled as never [reference], sometimes, and often. Time was modeled as infant age (time₁ = 4-6 months [reference]; time₂ = 7-9 months; time₃ = 10-12 months). Covariance Structure = VC; Estimation Method = REML; Between-within degrees of freedom. Model 1 ICC = .79; * $p < 0.01$, ** $p < 0.001$.

Figure 1. Adjusted models for change in (a) baby snacks and (b) sweets consumption and weight-for-length (WFL) z-scores by time point for infants in the Nurture Study. Baby snacks and sweets consumption are categorized as never, sometimes or often. a-b, significant sweets x time interaction for infants consuming snacks often when compared to never, $p < 0.01$. There were no other significant interactions.

DISCUSSION

The goal of this analysis was to explore the association between less healthy snack foods (baby snacks and sweets) and infant WFL z-score trajectories during the first year of life. In this sample of predominantly low-income, non-Hispanic Black mothers and their infants, 25% of infants consumed baby snacks and 7% consumed sweets between 4-6 months of age. There was an increasing trend across the first year of life, where 87% of infants consumed baby snacks and 47% consumed sweets by 10-12 months of age. Our results suggest that consuming sweets impacts infant weight trajectories. At 7-9 and 10-12 months of age, infants consuming sweets often ($>2x/day$) had higher WFL z-scores compared to infants who never had sweets. Continued efforts to reduce less healthy foods during infancy, especially sweets (e.g., cookies, cakes, and candies), may be critical to the development of healthy food preferences, dietary patterns, and weight trajectories that begin to emerge during this early developmental period.

The findings that mothers introduced less healthy snack foods during the first year of life are consistent with previous research [19,20]. Data from NHANES found increasing trends for less healthy snack foods, where 5% of young infants (birth-5

months) and 50% of older infants (6-11 months) consumed a sweet or salty snack each day, which is consistent with the IFPS II and our study. The AAP recommends three nutrient-dense small meals and two or three small snacks per day [14], which leaves little room for discretionary calories from nutrient-poor foods. Notably, the FITS found that self-reported snack foods provided about one-fifth of an infant's daily energy needs [35]. Although not all snacks were nutrient-poor (e.g., 48% consumed fruits and 9% consumed vegetables), over 20% of infants consumed sweets, SSBs, or desserts. Given the prevalence and energy contribution of less healthy snack foods during the first year of life, it is critical to examine if these snacking patterns contribute to early weight gain and to investigate factors that influence parents and other caregivers to offer less healthy snack foods during infancy.

This study adds to the literature as one of the first to explore the association between less healthy snack foods with infant WFL z-score trajectories. In line with our *a priori* hypothesis, sweets consumption had a significant impact on weight trajectories between 4 and 12 months of age. Of interest is our finding that infants who consumed sweets more often (>2 times/day) during early complementary feeding (4-6 months) had lower WFL z-scores. Although this was a significant finding, results should be interpreted with caution given the very small sample size in that sweets category. In contrast, between 7-9 and 10-12 months, infants who consumed sweets often had higher WFL z-scores compared to infant who never has sweets. This is also in contrast to other studies finding no association or a protective association between snack foods and weight status in older children [25,26,36]. However, our study targeted less healthy snacking during infancy and results may reflect that infants have little room for discretionary or “empty”

calories. In contrast to our *a priori* hypothesis, baby snacks did not have a significant impact on infant weight trajectories at any category or time point. This finding suggests that commercially available baby snacks may not contribute sufficient discretionary calories that may place infants at risk for obesity.

To our knowledge, this was one of the first studies to explore the impact of commercially available baby snacks (teething biscuits, puffs, and melts), which are snacks marketed specifically to the parents of infants, on infant weight trajectories. A recent study found that many commercially available infant and toddler foods contain added sugars and salt [37], which are not recommended for this age group [14] and may also contribute excess calories. Although baby snacks did not have a significant impact on infant weight trajectories in our study this area warrants further exploration. Particularly given that food and beverages offered during early infancy influence food preferences, dietary patterns, and weight trajectories that often persist into later childhood, further exploring the impact of commercially available baby snacks on infant weight status and promoting healthy snacking is important.

The primary limitation of this study was the use of self-report infant dietary questionnaires, which have been shown to be biased by under- and overreporting, to examine less healthy snack food consumption. However, the dietary questionnaire has been used in other cohort studies [29,30], and the validity is supported by similar findings of less healthy snack food consumption in a large national sample [19]. The dietary questionnaire also did not include serving sizes, so the energy contribution of baby snacks and sweets is unknown. Future studies should consider including 24-hour recalls to collect data on serving size to assess the energy contribution of snack foods.

To assess less healthy snacking behaviors, our study examined baby snacks (teething biscuits, puffs, and melts) and sweets (cookies, cakes, and candies); however, it is unknown if mothers would describe these foods as snacks or if there are other foods that mothers would describe as snacks that were not included in our analysis. However, given recent increases in less healthy snack food consumption during early childhood [22], these snack foods warrant examination as independent predictors of infant weight trajectories. Future studies may consider qualitative research with mothers of young infants to understand how mothers define snacking and to explore factors that influence snacking during infancy. Although social desirability bias may contribute to underreporting of less healthy snack food consumption, the prevalence of less healthy snack foods in our sample were in line with other studies assessing snack food consumption during infancy [19,20]. In addition, very few infants in the Nurture study had WFL z-scores placing them at risk for obesity, therefore we were unable to examine the impact of less healthy snacks by weight status (i.e., normal weight compared to infants at risk for obesity).

This study adds to the literature on snack food consumption during infancy and has a number of strengths that warrant mention. This analysis included primarily low-income, non-Hispanic Black mothers and their infants who are underrepresented in the research literature. Including underrepresented groups in research is a public health priority and is a vital component of reducing health disparities [38]. In addition, this study examined less healthy snack food consumption across important transitions in infant feeding (i.e., from a milk-based diet to solid foods). Given that less healthy dietary patterns that begin during infancy often track into later childhood and have been

associated with increased weight status, examining the impact less healthy snacks on weight during infancy is essential. In addition, future studies may consider examining snack food consumption and weight status during the toddler years to understand how snacking and weight trajectories track across the first two years of life. This study also highlights the need for recommendations around healthy snack foods, particularly in this young age group who are learning to eat and developing food preferences.

Conclusions

This analysis of the Nurture study, a cohort of predominantly low-income, non-Hispanic Black mothers and their infants, found that mothers introduce less healthy snacks during the first year of life. Our results suggest that less healthy sweets (cookies, cakes, and candies) are associated with increased weight trajectories during later infancy, making these snack foods important targets for childhood obesity prevention efforts. Given that less healthy snacks are offered during early infancy and may contribute to the risk of adiposity, promoting healthy snack food choices during this critical window is important. Future studies should explore drivers of snacking during infancy to help inform the evidence-base for healthy snacking recommendation during infancy. In addition, understanding the drivers of infant snacking would help to inform developmentally appropriate infant feeding interventions and help to address factors in the food environment that influence less healthy snacking during infancy.

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SUPPLEMENTAL TABLE

Supplemental Table 1. Bivariate correlations between foods and sugar-sweetened beverages (SSB) consumed by infants from 4 to 12 months.										
	Baby snacks ^a	Sweets ^b	SSB ^c	Fruits	Vegetables	Dairy ^d	Protein ^e	Grains ^f	Breastmilk	Formula
Baby snacks ^a	—									
Sweets ^b	0.30*	—								
SSB ^c	0.17**	0.48*	—							
Fruits	0.43*	0.23*	0.07	—						
Vegetables	0.41*	0.22*	0.13**	0.78*	—					
Dairy ^d	0.39*	0.37*	0.24*	0.42*	0.44*	—				
Protein ^e	0.39*	0.49*	0.29*	0.43*	0.47*	0.53*	—			
Grains ^f	0.47*	0.31*	0.27*	0.35**	0.40*	0.29*	0.37*	—		
Breastmilk	-0.16**	-0.12**	-0.27*	0.01	0.04	0.08	-0.04	-0.26*	—	
Formula	0.03	0.06	0.08*	-0.06	-0.05	-0.17*	-0.18*	0.15**	-0.63*	—

^a Includes teething biscuits, puffs, and melts. ^b Includes cakes, cookies, and candies. ^c Includes juice drinks, soda, or sweeten tea. ^d Includes yogurt and cheese.

^e Includes meat, fish and eggs. ^f Includes breakfast cereal, crackers, bread, pasta, rice, and infant cereal. ** p < 0.05, * p < 0.001

MANUSCRIPT 2

A recurrent cross-sectional qualitative study exploring how low-income mothers define snacking and reasons for offering snacks during infancy

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ABSTRACT

Despite increases in snacking in recent decades, little is known about snacking during infancy. This qualitative study explored how low-income mothers define snacking and explored their reasons for offering snacks during infancy. This study used a recurrent cross-sectional study design where semi-structured interviews were conducted with mothers when infants were 6 and 12 months of age. A purposive sample of mothers of infants between 3 and 6 months of age (N = 15) was recruited from Women, Infants, and Children (WIC) offices and childcare centers serving low-income families in Rhode Island. Interviews were audio-recorded and transcribed verbatim. Two independent thematic analyses were conducted to identify codes and themes for the 6 and 12 month interviews. Themes for the 6 month interviews for how mothers define snacking for their infants were: snacks are consumed between meals, snacks are smaller portions, and snacks are sweet. At the 12 month interviews, mothers continued to define snacking in the same way with the exception of snacks are sweet, and one additional theme emerged: snacks do not include all food groups. Reasons for offering snacks varied between the interviews. At the 6 month interviews, mothers described infant hunger and at the 12 month interviews, mothers described exposure to different flavors and textures. At both interviews, mothers described that snacks help manage infant behaviors. Findings suggest that mothers define snacks as smaller portions that help with hunger between meals. However, during early infancy mothers describe snacks as sweet and across the first year of life mothers described using snacks to manage behavior, which makes providing parents with guidance on healthy snacking during the first year of life important.

1. INTRODUCTION

Snacking in young children has increased in recent decades (Piernas & Popkin, 2010). Snacking, broadly defined as the act of consuming foods between meals for older children (Hess, 2016; Younginer et al., 2016), may start during infancy. However, inconsistent use of the definitions for snacks and snack foods in the literature (Hess, 2016) has made it challenging to understand snacking during this early developmental period. For example, snack foods are often described as energy-dense, nutrient-poor (or unhealthy) and typically include cookies, cakes, and chips (Blaine, Kachurak, Davison, Klabunde, & Fisher, 2017; Hamner, Perrine, Gupta, Herrick, & Cogswell, 2017; Hess, 2016), which are not recommended during infancy. Data from the Feeding Infants and Toddlers Study (FITS) showed that 37% of infants between 6 and 8 months and 72% of infants between 9 and 11 months consumed at least one unhealthy sweet or salty snack food per day (Deming et al., 2017). Greater intake of unhealthy snack foods has been associated with poor infant diet quality (Vadiveloo, Tovar, Østbye, & Benjamin-Neelon, 2019) and increased infant weight status (Moore et al., 2019). Similarly, unhealthy snack foods have been associated with poor diet quality (Kachurak, Bailey, Davey, Dabritz, & Fisher, 2019) and increased weight status (Kachurak, Davey, Bailey, & Fisher, 2018) in preschool-aged children, as well as unhealthy caregiver snacking (Gibson et al., 2020). Low-income caregivers of preschool-aged children have often defined snacking as a small portion of food given between meals to help with hunger (Younginer et al., 2016) and their reasons for offering snacks include both nutritive (e.g., to help with hunger) and non-nutritive (e.g., to manage behavior) purposes (Blaine et al., 2015). However, little is known about how low-income caregivers of infants

define snacking and their reasons for offering snacks during infancy. Understanding these factors would provide valuable insights to help inform national dietary guidelines and interventions that promote healthy snacking during infancy.

The American Academy of Pediatrics (AAP) recommends exclusive breastfeeding until 6 months of age, the introduction of a wide variety of nutrient-dense complementary foods starting at approximately 6 months of age, followed by three nutrient-dense meals and two or three small nutrient-dense snacks per day starting at 9 months of age (American Academy of Pediatrics, 2013). Recommendations also include offering vegetables and/or fruits with each meal and snack, and avoiding unhealthy foods with added sugars and limiting sodium, saturated fats, and refined grains (American Academy of Pediatrics, 2013). Despite these recommendations, snacks commonly consumed during infancy and toddlerhood are often high in added sugars, sodium, and refined grains (Deming et al., 2017; Hamner et al., 2017). Data from the National Health and Nutrition Survey (NHANES) showed that 5% of infants between birth and 5 months consumed an unhealthy sweet or salty snack, dessert or sweetened beverage each day; this increased to 51% between 7 and 11 months, and 91% between 12 and 23 months (Miles & Siega-Riz, 2017). Given the early introduction and contribution of unhealthy snacks to infant and toddler diets, understanding the reasons for offering snacks during the first year of life warrants further exploration.

Mothers are often the primary caregivers responsible for infant feeding and thus influence infant eating behaviors and food preferences (Birch, Arbor, Savage, & Ventura, 2009; Savage, Fisher, & Birch, 2007). This makes mothers important targets for understanding infant snacking and reasons for offering snacks during this early

developmental period. Child eating behaviors and food preferences are influenced by the types and amounts of foods made available and through feeding styles and practices (Birch et al., 2009; Lumeng, Taveras, Birch, & Yanovski, 2015; Savage et al., 2007). Feeding styles, which caregivers develop during the first year of an infant's life (Thompson et al., 2009), include the attitudes and behaviors used by caregivers to influence eating behaviors (Blissett, 2011). One study with low-income mothers found that caregiver feeding styles were differentially associated with infant growth and dietary intake (Thompson, Adair, & Bentley, 2013). For example, this study found that pressuring (e.g., using food to soothe) and indulgent (e.g., setting no limits on the types and amounts of food) caregiver feeding styles were associated with higher energy intake. The same study found that caregiver restriction, (e.g., setting limits on the types and amounts of food) was associated with lower energy intake. A previous study also found that pressuring was associated with earlier solid food introduction (Doub, Moding, & Stifter, 2015). In older children, caregiver feeding styles that use food to reward behavior or to regulate emotions have been associated with higher energy-dense snack intake by the child (Rodenburg, Kremers, Oenema, & Van De Mheen, 2014). While the literature on infant feeding by caregivers is rapidly growing, little is known about how caregiver feeding styles might influence the timing and types of snacks introduced during infancy.

Caregiver factors that influence infant eating behaviors and food preferences have been extensively studied (Anzman-Frasca, Ventura, Ehrenberg, & Myers, 2018; Birch et al., 2009; Hetherington, Cecil, Jackson, & Schwartz, 2011; Savage, Fisher, & Birch, 2007a), although less attention has been given to how these factors might influence

snacking and the types of snacks offered during infancy. Understanding these factors may be particularly important among low-income families, where children are at greater risk for poor diet quality (Au et al., 2018) and obesity (Ogden, Carroll, Kit, & Flegal, 2014) starting early in life. However, little is known about how low-income mothers define snacking and their reasons for offering snacks during infancy. Therefore, this recurrent cross-sectional qualitative study described 1) how mothers of infants define snacking during infancy, 2) what, why, and when mothers offer snacks when infants were 6 and 12 months of age, and 3) the infant feeding styles of mothers who introduced snacks before 6 months of age, in a predominantly low-income sample of mothers.

2. METHODS

2.1 Study Design and Participants

A recurrent cross-sectional study design was used to conduct semi-structured interviews with mothers when infants were approximately 6 and 12 months of age to explore how mothers define snacking and their reasons for offering snacks during infancy. A purposive sample of mothers of infants was recruited by the lead researcher (AMM) in waiting areas at the Special Supplemental Nutrition Programs for Women, Infants, and Children (WIC) offices and childcare centers serving low-income families in Rhode Island. Mothers were informed of the broad study goal (to understand snacking during infancy) and procedures for the study, including two, 45-minute interviews plus sociodemographic and infant feeding questionnaires, and were screened if interested. Eligible mothers were ≥ 18 years of age with an infant between 3 and 6 months of age who resides primarily in the mother's home. Mothers were ineligible if they did not speak English or their infant had any food restrictions or chronic medical conditions that

impacted feeding. Nineteen mothers were screened, and 15 mothers were eligible ($n = 2$, did not speak English and $n = 2$, were not interested) and provided informed consent. Immediately following each interview, mothers were provided with a \$30.00 grocery store gift card for their participation. All study procedures were approved by the University of Rhode Island Institutional Review Board.

2.2 Procedures

2.2.1 Interview Guides

Semi-structured interview guides (Table 1) were developed by members of the research team with expertise in child feeding, health psychology, and qualitative research methods. Interview guides were developed using the Social Ecological Model (SEM; Bronfenbrenner, 1979) within the context of the Food Choice Process Model (Sobal & Bisogni, 2009) as a theoretical framework. The SEM emphasizes that health behaviors are influenced by multiple interacting factors, including individual, household and community factors (Bronfenbrenner, 1979), and these factors influence the development of eating behaviors and food preferences during infancy (Birch & Douthett, 2014). The Food Choice Process Model describes how personal values and beliefs guide complex food decisions over time (Sobal & Bisogni, 2009). Interview guides were partially adapted from previous qualitative research on snacking behaviors conducted with caregivers of preschool-aged children (Younginer et al., 2016), which included open-ended questions on how mothers define snacking in that age group. Interview guides were pilot tested, with a small independent sample of mothers ($n = 2$) who met the eligibility criteria for the main study, and feedback from the mothers was used to finalize the interview guides. Questions for both interview guides were identical and

included 12 open-ended questions organized into how mothers define snacking during infancy (domain 1) and reasons for what, when, why, who, and where snacks were offered during infancy (domain 2). All mothers were asked questions from domain 1 though only mothers who reported offering snacks were asked all of the questions from domain 2. Mothers who reported not offering snacks were instead asked 3 open-ended questions to explore factors that influenced their decision (e.g., “Tell me more about how you made this decision [to not offer snacks]?”). This study includes results for how mothers define snacking during infancy (domain 1) and why and when (a subset from domain 2) mothers offered snacks during infancy.

Table 1: Semi-structured interview guide questions for interviews conducted with mothers when infants were 6 and 12 months of age.

Domain 1: Snacking definition^a

1. What does the word ‘snack’ mean to you?
2. How are snacks different from a meal?
3. What are some examples of snacks at this age?

Domain 2: Reasons to offer snacks

1. How did you decide when to start offering snacks?^b
 2. Who decides when your child has a snack?
 3. Tell me about your first experience offering a snack?
 4. Why did you decide to offer your child a snack?
 5. Who decides how much your child eats for a snack?
 6. Where does your infant typically have a snack?
 7. Where do you typically purchase snacks?
 8. How do you decide what snacks to purchase?
 9. What are your thoughts on snacks made specifically for infants?
-

^a Questions adapted from Younginer et al., 2016. ^b Mothers (n = 4 at 6 months and n = 0 at 12 months) who had not offered snacks were asked: “Tell me more about how you made this decision?”

2.2.2 Data Collection

All interviews were conducted by the lead researcher (AMM; a female Ph.D. candidate in Nutrition) using semi-structured interview guides. Interviews were conducted in English when infants were approximately 6 and 12 months of age and

occurred at a convenient time and location for the mother (e.g., public library or home). All interviews were digitally recorded, and field notes were collected during and immediately following the interviews.

Mothers also completed researcher administered sociodemographic and infant feeding questionnaires following both interviews. Mothers reported their age, height and weight, race, ethnicity, education level, household income, and federal nutrition program participation, and age, sex, height and weight, race, ethnicity, and age of solid food and snack food introduction for their infant. Feeding styles were assessed using the Infant Feeding Style Questionnaire (IFSQ), a validated measure to assess caregiver beliefs on how to best feed their infant and the behaviors used during feeding (Thompson et al., 2009). The IFSQ includes five infant feeding styles used by caregivers: responsive (responds to hunger and satiety cues and provides structure around what foods are available), restrictive/controlling (concerned with decreasing how much the infant is eating and setting limits to healthful foods), indulgent (setting no limits on what or how much the infant is eating), pressuring/controlling (concerned with increasing how much the infant is eating and uses food to soothe), and laissez-faire (setting few limits on what or how much the infant is eating with limited interaction during feeding). Items were measured on a 5-point scale with higher scores indicating greater use of that feeding style. Given the relative stability of feeding styles overtime (Thompson et al., 2013), for this study, the IFSQ was used to describe the feeding styles of mothers who offered snacks and mothers who had not offered snacks by 6 months of age.

2.2.3 Data Analysis

Interviews were transcribed verbatim by trained undergraduate research assistants and verified for accuracy by the lead researcher (AMM) to ensure descriptive validity. A thematic analysis approach (Braun & Clarke, 2006) was used to identify major patterns of meaning or themes related to infant snacking at 6 and 12 months of age. This iterative analysis approach allows for both deductive and inductive approaches, allowing for *a priori* and emergent codes based on the mothers' comments. Prior to coding the transcripts, codes reflecting study research questions (e.g., the definition of snacking) and theoretical framework (e.g., why and when snacks were offered) were developed by AMM. Two trained researchers (AMM and KB) used the six-phase approach specified by Braun and Clarke (2006) for thematic analysis. This included reading and re-reading all transcripts to become familiar with the data and independently generating initial codes to reduce bias. Initial coded segments were sorted and organized into a codebook, and codes were then analyzed and reduced to develop preliminary and final themes from interviews when infants were approximately 6 and 12 months of age. To reduce bias, researchers held regular meetings to discuss codes and themes. All discrepancies were discussed until both researchers agreed that codes and themes were represented by the data. Themes from both interviews were identified and reported separately to capture important transitions in infant feeding. NVivo 12 for Macintosh (QSR International, Melbourne, Australia) was used to organize and compare data from all interviews. Descriptive statistics were conducted using SAS 9.4 (SAS Institute, Cary, NC).

3. RESULTS

3.1 Participants

Table 2 includes the sociodemographic characteristics of mother-infant dyads ($N = 15$). Mothers were on average 28.3 ($SD = 5.9$) years of age, predominantly non-Hispanic White (60.0%) and nearly half reported household incomes of $\leq \$20,000/\text{year}$ (46.7%). Most mothers participated in WIC (87.7%) or SNAP (60.0%) at the first interview when infants were 6 months of age. More than half of the infants were male (60.0%) with average weight-for-length (WFL) z-scores of 0.6 ($SD = 1.6$) at 6 months and 1.6 ($SD = 1.2$) at 12 months. All mothers reported introducing solid foods prior to 6 months with an average age of introduction of 4.1 ($SD = 0.6$) months. Most mothers ($n = 11$) reported introducing snacks prior to 6 months with an average age of introduction 4.5 ($SD = 0.9$) months. Three mothers were unable to be reached for the 12 month interview, however, all mothers who completed the 12 month interview ($n = 12$) reported introducing snacks prior to the interview.

Table 2: Sociodemographic characteristics of mother-infant dyads at 6 month interviews ($N=15$).^a

	Mean (SD) or %
Mother Characteristics	
Age (years)	28.3 (5.9)
BMI (kg/m^2) ^b	30.8 (7.3)
Race	
White	60.0
Multiracial	20.0
Black	13.3
American Indian	6.7
Ethnicity, Hispanic	26.7
Education	
Some high school	26.7
High school graduate/GED	60.0
Some college	13.3

Table 2 (con't): Sociodemographic characteristics of mother infant dyads at 6 month interviews (N=15).^a

Household Income	
≤\$20,000	46.7
\$20,001-\$40,000	33.3
≥\$40,001	20.0
WIC participant	86.7
SNAP participant	60.0
Food Insecurity ^c	53.3
Number of children in home	1.9 (1.1)
Infant Characteristics	
Sex, male	60.0
WFL z-scores ^d	
6 months	0.6 (1.6)
12 months	1.6 (1.2)
Race	
White	40.0
Black	13.3
Multiracial	46.7
Ethnicity, Hispanic	33.3
Age of solid food introduction ^e	4.1 (0.6)
Age of snack food introduction ^f	4.5 (0.9)

^a Data are from 6 month interviews unless otherwise noted. ^b Body mass index (BMI) calculated from self-reported height and weight. ^c 6-item USDA food security survey covering the previous 12 months collected at 12 month interview. ^d Weight-for-length (WFL) calculated from self-reported infant height and weight. ^e n = 15 mothers who reported introducing solid foods prior to 6 month interview. ^f n = 11 mothers who reported introducing snack foods prior to 6 month interview.

3.2 Themes from interviews with mothers when infants were 6 and 12 months of age.

Themes are presented by interview guide domains and quotations from mothers are provided to give context for interview themes at 6 (Table 3) and 12 (Table 4) months.

3.2.1 Themes for interviews when infants were 6 months of age

Domain 1: Infant snacking definition

To understand how mothers define snacking prior to 6 months of age, all mothers were asked “What does the word ‘snack’ mean to you?” and “How are snacks different from a meal?” Mothers described snacks as having several purposes and three themes emerged 1) snacks are consumed between meals, 2) snacks are smaller portions, and 3) snacks are sweet. Most mothers described that snacks are consumed between meals

similar to older children and adults. One mother stated, “[A snack is] something, um, between meals.... I would be really hungry if I only ate three times a day, um, he needs something to keep him a little less hungry.” Mothers also described snacks as smaller portions, one mother stated, “A snack is not really an actual meal that you [infants] could fill up on.” Many mothers used taste to describe snacks, with most using sweet to describe snacks. One mother stated, “I guess, I would consider a snack like a fruit or something that's healthy for them. Not that I don't think he can't have something sweet but for the most part a fruit, um, or cookie....”

How mothers described snacks was consistent between mothers who had offered snacks and mothers who had not offered snacks. Mothers who had not offered snacks ($n = 4$) were asked, “Tell me more about how you made this decision [to not offer snacks]?” One mother reported that she had offered a variety of solid foods (sweet potato, avocado, chicken) though she did not consider these snacks. She stated, “Um, so everything that's on a shelf is a very processed food... I think that's why I haven't introduced snacks.” Another mother stated a similar reason for not offering snacks, “I have seen at the store those chips for babies made out of vegetables. Instead of vegetables they have a lot of preservatives and stuff. For me, I would not offer those types of snacks.”

When asked, “What are some examples of snacks for infants at this age?”, mothers free-listed examples of snacks from four main categories: 1) commercially available infant snacks (puffs, yogurt melts, teething biscuits, baby cookies), 2) fruits (apples, bananas, jarred baby foods), 3) grain-based (crackers, rice cereal), and 4) dairy (baby

yogurt, cheese). Three mothers free-listed chips and two mothers free-listed vegetables (green beans, sweet potatoes) as examples of snacks.

Domain 2: Reasons for when and why snacks were offered

Mothers who reported offering snacks (n = 11) were asked questions from Domain 2. When asked “How did you decide when to start offering snacks?” and “Why did you decide to offer your child a snack?” three themes emerged 1) infants seemed hungry, 2) infants showed interest, and 3) snacks help manage behavior. Most mothers described that infant behaviors were changing, and they seemed hungry after milk or formula feedings and showed interest in other foods. One mother stated, “... he cried, he was crying a lot, so I knew he was hungry still. It's [snacks] what you need to fill him. Like he was just, he was still hungry and he's not overweight.” Another mother stated, “When she started showing interest in eating. So when I was eating, she would look at me, she would watch me eat. She would also, um, do the little lip-smacking, like licking her lips type thing when she saw me getting the food. So then that made me look at cues, like, okay she's ready to start eating stuff other than formula.” Mothers also described that snacks are used for non-nutritive purposes to manage behavior. One mother stated, “When he gets a little fussy, I give him something [a snack] to distract him or give him something to do.”

Table 3: Themes and supporting quotations from interviews with mothers when infants were 6 months of age (n = 15).^a

Domain	Theme	Quotations
Domain 1: Infant snacking definition	Snacks are consumed between meals.	<p><i>Mothers who reported offering snacks:</i></p> <p>“It’s kinda a hold-over until the meal.”</p> <p>“It’s just to hold her over until the next meal. That’s what I think a snack is.”</p> <p><i>Mother who reported not offering snacks:</i></p> <p>“Kinda the same for an adult, like it’s an in-between meal. Whenever you want something, um, to kinda tide you over until you actually have your next meal.”</p>
	Snacks are smaller portions.	<p><i>Mothers who reported offering snacks:</i></p> <p>“And it’s like a smaller portion. And it’s not usually something so heavy.”</p> <p>“Dinner is more like a big bowl of the baby food opposed to just, like, just a little bit.”</p> <p><i>Mother who reported not offering snacks:</i></p> <p>“Cause a snack is a way smaller portion than a meal. And his meal is formula, a lot of formula.”</p>
	Snacks are sweet.	<p><i>Mothers who reported offering snacks:</i></p> <p>“Because a snack is sweet and the meal I try to focus it more on like something that would make him strong.... For a snack, in my opinion, it’s something sweet.”</p> <p>“... it’s healthy but it’s not, it’s also kinda sweet sometimes too. I feel like sometimes babies like sweets or something like that is more considered a snack.”</p> <p><i>Mother who reported not offering snacks:</i></p> <p>“It’s a sweet... like a little sweet, and a little sweetness in your system.”</p>
Domain 2: When and why snacks were offered	Infants seemed hungry.	<p><i>Mothers who reported offering snacks:</i></p> <p>“Well, like I said, he cried, he was crying a lot, so I knew he was hungry still. It’s what you need to fill him. Like he was just, he was still hungry and he’s not overweight.”</p> <p>“Um... she seemed to be craving more than formula. Like the formula wasn’t doing it.”</p>
	Infants showed interest.	<p><i>Mothers who reported offering snacks:</i></p> <p>“Um, I kinda went based on after she started jar food. And she seemed to get the hang of it. It took her a while, but she seemed to get the hang of it pretty good, and um so then I started introducing snacks food like puffs.”</p> <p>“When she started showing interest in eating.... do the little lip-smacking, like licking her lips type thing when she saw me getting the food.”</p>
	Snacks help manage behavior.	<p><i>Mothers who reported offering snacks:</i></p> <p>“But, you know, towards five months or so, they don’t eat as often so I feel like you’re just kinda sitting there hanging out. It [snacks] also kinda gives them something to do.”</p> <p>“Something easy to have him do... [snacks] keep him occupied while we’re out and about.”</p>

^a Mothers (n = 11) reported offering snacks prior to 6 month interview.

3.2.2 Themes from interviews with mothers when infants were 12 months of age.

Domain 1: Infant snacking definition

To understand how mothers define snacking between 7 to 12 months of age, all mothers were again asked “What does the word ‘snack’ mean to you?” and “How are snacks different from a meal?” Mothers again described snacks as having several purposes and three themes emerged. Two themes were identical across both interviews 1) snacks are consumed between meals, 2) snacks are smaller portions and one additional theme emerged 3) snacks do not include all food groups. One mother stated, “So a meal is, like, a protein, maybe a grain, and, um, like, a side. And then, like, a snack for me, because I try to be a little healthy, would be, like, a piece of a fruit, um, a vegetable maybe... and, like, even for those little puffs. Those are a snack.”

All mothers (n = 12) reported offering snacks between 7 to 12 months. When asked, “What are some examples of snacks for infants at this age?”, mothers again free-listed examples of snacks. Four categories were identical and included similar foods across both interviews: 1) commercially available infant snacks (puffs, yogurt melts, teething biscuits, baby cookies), 2) fruits (apples, bananas, blueberries), 3) grain-based (crackers, cereal), 4) dairy (baby yogurt, cheese, pudding). Two additional categories were free-listed during this interview: 5) vegetables (green beans, carrots) and 6) protein (edamame, peanut butter).

Domain 2: Reasons for when and why snacks were offered

All mothers reported offering snacks and were again asked questions from Domain 2. When asked “How did you decide when to start offering snacks?” and “Why did you decide to offer your child a snack?” three themes emerged 1) snacks expose infants to

different textures, 2) snacks expose infants to different flavors, and 3) snacks help manage behavior. Mothers described that snacks expose infants to different textures and flavors. One mother stated, “So it seems like snacks, not only kinda help keep her hunger down between meals, but they also kinda, help me be mindful about exposing her to different flavors.” Most mothers again described that snacks can be used for non-nutritive purposes to help manage behavior. One mother stated, “When I give him snacks, it’s just like I don’t really know. Is it really to help him be full? Most of the time it is to keep him calm, so I just give him little snacks.”

Table 4: Themes and supporting quotations from interviews with mothers when infants were 12 months of age (n = 12).^a

Domain	Theme	Quotations
Domain 1: Infant snacking definition	Snacks are consumed between meals.	<p>“Um, I feel like it’s just something to hold them over, you know until the next real meal comes.”</p> <p>“Snacking is kinda, um, like in-between meals for her... I might give her, when she wakes up, I might give her, uh, like, what I call a snack or something to hold her over until dinner.”</p>
	Snacks are smaller portions.	<p>“I guess a snack to me is, like, you know, like some small portion of, like, something.”</p> <p>“Just, like, something small... a snack for him is like these little puff things. Um, a pouch is even a snack to me for him because it gives him, like, just enough.”</p>
	Snacks do not include all food groups.	<p>“...what I consider a, like, meal is mashed potatoes, and like, meatloaf, stuff like that I’ll give her. Um, where as a snack I consider that, like, the Goldfish, stuff like that. Like the Goldfish, the crackers, the little yogurt drops.”</p> <p>“... with a meal, you get your vegetable, your protein, and like, some kind of starch, you know. With a snack, it’s just like a fruit. Like, one fruit, you know.”</p>
Domain 2: When and why snacks were offered	Snacks expose infants to different textures.	<p>“I give him like those veggie straws. Um, and those actually, I kinda introduced those because I thought they were helping him like learn to chew because a lot foods are so mushy. I want him to have something more textured.”</p> <p>“I started it off with like, with like soft, soft stuff, and then once um he got older and um, you know, started getting his teeth in I started with stuff he could chew.”</p>
	Snacks expose infants to different flavors.	<p>“Um, they have like these little like granola bars um, yogurt bites um, like little vanilla cookies, um little puffs, but they have like different flavors for them. And they have like little pouches, um, they come with like different flavors.”</p> <p>“I’ll choose like an interesting flavor of something she might not have had before.”</p>
	Snacks help manage behavior.	<p>“... when I give him snacks, it’s just like I don’t really know. Is it really to help him be full? Most of the time it is to keep him calm, so I just give him little snacks.”</p> <p>“Before he would go for a nap I would give him a [teething] cookie. While he was sitting here in his chair or um, just to keep him you know, calm and tamed, and for his teething too.”</p>

^a All mothers (n = 12) reported offering snacks prior to the 12 month interview.

3.2 Infant feeding styles

Infant feeding styles of mothers who offered snacks and mothers who had not offered snacks by 6 months of age are presented in Table 5. Collectively, mothers in both groups scored higher on responsive and restrictive feeding styles and lower on pressuring and laissez-faire feeding styles. Mothers who offered snacks by 6 months of age scored higher on indulgent feeding styles compared to mothers who had not offered snacks ($M = 2.69$, $SD = 0.46$ vs. $M = 1.34$, $SD = 0.64$).

Table 5. Infant feeding styles by snacks offered versus snacks not offered at 6 months of age (N =15).		
Feeding Style	Offered (n = 11)	Not Offered (n = 4)
	M(SD)	M(SD)
Responsive	4.14 (0.68)	4.04 (1.04)
Restrictive	3.83 (0.82)	3.07 (1.14)
Indulgent	2.69 (0.46)	1.34 (0.64)
Pressuring	2.46 (0.60)	2.37 (0.94)
Laissez-faire	2.19 (0.58)	2.57 (0.98)

*Feeding styles are scored on a 1-5 scale.

4. DISCUSSION

This recurrent cross-sectional qualitative study explored how mothers define snacking and their reason for offering snacks when infants were 6 and 12 months of age in a predominantly low-income sample of mothers and their infants. This study found that mothers described snacks by timing (snacks are consumed between meals) and portion size (snacks are smaller). Both of these themes were consistent across interviews conducted at 6 and 12 months of age, suggesting that foods consumed between meals and smaller portions are important when defining snacking during the first year of life. Mothers also used taste to describe snacks when compared to meals (snacks are sweet) at 6 months. This theme did not persist at 12 months, and in contrast, mothers used food

groups to describe snacks when compared to meals (snacks do not include all food groups), which is consistent with recommendations to include nutritious foods from each of the main food groups (American Academy of Pediatrics, 2013). At 6 months, mothers described reasons for offering snacks related to changing infant behaviors (infants seemed hungry and interested in food) and described that snacks help manage infant behavior. Themes related to infant hunger and interest in food did not persist at 12 months, and in contrast, mothers described offering snacks to expose infants to new flavors and textures. However, using snacks to manage infant behavior did persist at 12 months. Interestingly, mothers in this sample predominantly reported a responsive feeding style; however, this was inconsistent with themes related to using snacks to manage infant behavior. Our findings suggest that snacks are commonly offered during infancy and that mothers define snacks as smaller portions that help with hunger between meals. Given that mothers in this sample offered snacks for nutritive and non-nutritive purposes, continued efforts to reduce non-nutritive snacking and to develop evidence-based recommendations for snacking during infancy are critical.

The finding that mothers described snacks by timing and portion size at 6 and 12 months is consistent with another qualitative study with low-income parents of preschool-aged children, which found that several factors were important when defining snacks including the timing (in-between meals), portion size (smaller), and intended purpose (to prevent hunger) (Younginer et al., 2016). This is also consistent with a review by Hess et al. (2016) in that these factors are key in defining snacking (or the act of eating a snack). Infant feeding styles used by parents that are responsive to infant hunger and satiety cues are important for the development of healthy eating behaviors

and foods preferences by the child (Anzman-Frasca et al., 2018; Birch et al., 2009; Hetherington et al., 2011; Savage et al., 2007a), and is a best-practice recommendation (Pérez-Escamilla, Segura-Pérez, & Lott, 2017). Expert committee guidelines provide recommendations for responsive feeding during the first year of life that include recommendations to limit energy-dense, nutrient-poor foods and suggest small portions of fruit and vegetables as snacks to help with hunger (Pérez-Escamilla et al., 2017). However, given that unhealthy snacks are introduced during infancy, future guidelines might consider providing additional recommendations for healthy snacks.

This study also found that mothers used taste to describe snacks when compared to meals (snacks are sweet) at 6 months, which is consistent with other studies suggesting that snack foods are often considered unhealthy sweet and salty foods (Blaine et al., 2017; Hamner et al., 2017). Interestingly, mothers described snacks as sweet at 6 months with some mothers expressing ambivalence about the healthfulness of snacks. For example, one mother stated, "... [a snack] it's healthy but it's not, it's also kinda sweet sometimes too." Mother listed the following sweets when asked to provide examples of age-appropriate snacks during the first half of infancy: commercially available infant snack foods (e.g., puffs, yogurt melts) and fruits (e.g., apples, bananas). Results from NHANES showed that 5% of infants consume sweet and salty snacks each day prior to 6 months (Miles & Siega-Riz, 2017). The consumption of sweet snacks persist and are significant contributors of added sugars in later infancy. For example, results from FITS showed that between 6 to 8 months, infants consumed discretionary sweets (e.g., cookies, cakes) with added sugars contributing 5% of daily energy intake (Deming et al., 2017). Consumption of discretionary sweets increased between 9 to 11 months with

added sugars contributing nearly 14% of daily energy intake (Deming et al., 2017). In addition, infants who consumed discretionary sweets were more likely to consume sweets during early childhood (Rose, Birch, & Savage, 2017), which may impact weight status. However, mothers in this sample did not make a distinction between sweet snacks with added sugars (e.g., puffs, yogurt melts) and natural sugars (e.g., fruits). Our research among low-income mothers underscores how important it is for healthcare providers to discuss and provide guidance related to the introduction of healthy solid foods and snacks. Given that added sugars are not recommended for this age group (American Academy of Pediatrics, 2013), and are associated with adverse health outcomes (Herrick, Fryar, Hamner, Park, & Ogden, 2020), recommendations should include guidance to help parents reduce added sugars and make healthy snack choices for their young children.

This study also explored reasons why mothers offer their infants snacks. At 6 months, mothers described offering snacks due to changing infant behaviors, including mothers described that crying signaled hunger between milk feedings. Infant perceived as “fussy” often receive complementary foods (i.e., solids foods) earlier (Wasser et al., 2011), and our results suggest mothers offered snacks due to infant behavior (i.e., crying or fussiness). Mothers also described that once infants showed interest in other foods it was appropriate to offer snacks. In contrast, during this same period, mothers offered snacks for non-nutritive purposes (to manage infant behavior). Although using food to manage infant behavior is not recommended, this finding is consistent with another qualitative study with low-income mothers of preschool-age children who report using snacks to manage behavior (Fisher et al., 2015). In addition, older children from low-

income families who were offered snacks for non-nutritive purposes (e.g., using food to manage behaviors) have been shown to be less likely to meet dietary recommendations (Blaine et al., 2015). This suggests that mothers may benefit from guidance on non-nutritive strategies for responding to infant behavior.

Mothers in this study scored highest on responsive feeding compared to the other infant feeding styles, a best-practice recommendation (Pérez-Escamilla et al., 2017). This finding is consistent with another study where mothers of infants also scored highest on responsive feeding (Thompson et al., 2013) compared to the other feeding styles. However, in the Thompson et al study, pressuring and indulgent feeding were associated with greater energy intake and age-inappropriate feeding, suggesting that these feeding styles may be important intervention targets. Mothers in the current study who offered snacks prior to 6 months scored higher on indulgent feeding compared to mothers who had not offered snacks. However, given the small sample needed to answer the primary qualitative research question, statistical tests to examine differences in feeding styles between mothers who had and had not offered snacks were not feasible. In addition, mothers in this study also described using a responsive feeding style when asked why they introduced snacks. This suggests that mothers are familiar with responding to infant hunger and satiety cues and that social desirability bias may influence their responses. However, based on the types of snacks offered during infancy, mothers may be less familiar with healthy snack choices, which makes healthy recommendations essential. Future studies should examine the impact of feeding styles on infant snacking behaviors in a larger, diverse sample of caregivers.

This study has several strengths including examining how mothers describe snacking and reasons that mothers offer snacks during the first and the second half of infancy. Given that caregivers begin to provide unhealthy sweet and salty snacks during early infancy, our findings add context for how low-income mothers make decisions around infant snacking. However, this study is not without limitations. Most mothers in this sample participated in WIC, which offers anticipatory guidance on infant feeding (e.g., responding to hunger and satiety cues and introducing solids foods), and thus mothers in this sample may not represent other low-income mothers who do not participate in federal nutrition programs. Snack foods have also been consistently described as unhealthy and, therefore social desirability bias may have influenced how mothers described snacking, types of snacks, and their infant feeding styles. Lastly, the lead author (AMM) who conducted the interviews and analysis is trained in early childhood nutrition, which could potentially bias interpretations. However, all interview transcripts were independently coded by two trained researchers to increase the reliability and validity of our findings.

4.1 Conclusion

Snacking behaviors in young children have increased in recent decades (Piernas & Popkin, 2010) and are influenced by many factors, yet little is known about snacking behaviors during infancy. Mothers described snacks as small portions that help prevent hunger in-between meals. Mothers also describe snacks as sweet during the first half of infancy, and some sweet snacks (e.g., cookies, cakes, yogurt melts) may contribute added sugars, which are not recommended for this age group. Mothers also used snacks to manage infant behavior, a practice that may override an infant's hunger and satiety

cues leading to suboptimal eating behaviors and increased weight status. Based on our findings, there is an urgent need for evidence-based, developmentally-appropriate recommendations for snacking behaviors during infancy. Recommendations should provide guidance on healthy snack choices and discourage the use of snacks for non-nutritive purposes. In addition, interventions targeting snacking and promoting healthful snacking behaviors starting during infancy could improve overall diet quality and help infants develop optimal eating behaviors.

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MANUSCRIPT 3

Availability, price, and nutritional content of commercial infant foods and snacks in retail food stores in low-income communities across Rhode Island

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ABSTRACT

The availability of commercial complementary foods and snacks have increased in recent decades, yet little is known about the availability of these complementary foods in low-income communities. This observational study assessed the availability, price, and nutritional content of commercial infant foods and snacks in retail food stores in low-income communities across Rhode Island. A random sample of retail food stores (grocery stores, $n = 14$; supermarkets, $n = 8$) was selected from low-income census tracts. A tool that included 14-items was developed for this study to assess the nutrition environment of infant foods (e.g., infant formula, purees) and snacks (e.g., puffs, yogurt melts). The Nutrition Environment Measures Survey in Stores (NEMS-S) was used to assess the overall nutrition environment including the availability, price, and quality of healthful staple foods compared to less healthful foods. Data were collected by trained research assistants using standardized procedures over 4 weeks. Descriptive statistics were used to summarize commercial infant foods and snacks and the overall nutrition environment. Most grocery stores ($n = 13$) and all supermarkets ($n = 8$) sold some type of commercial infant food or snack. The types of infant foods and snacks available in grocery stores varied with infant formula having the highest availability ($n = 13$) followed by puffs (grain-based, $n = 10$ and corn-based, $n = 10$) and purees in jars/packs ($n = 8$). In contrast, the types of infant foods and snacks available in supermarkets were less varied with the majority of products available in all stores. Infant foods and snacks were generally lower in price per standard serving in grocery stores compared to supermarkets, and infant foods were generally higher in price per standard serving compared to infant snacks. Infant foods and snacks are widely available in retail food

stores, and most infant snacks contain added sugars, it is essential to provide caregivers with guidance on choosing age-appropriate nutrient-dense infant snacks. This study suggests that retail food stores in low-income communities, specifically smaller grocery stores, might benefit from programs and policies that encourage the availability of healthful commercial infant foods and snacks.

1. INTRODUCTION

The introduction of nutrient-dense complementary foods is essential for optimal infant growth and development [1,2]. Early exposures to complementary foods shape the development of infant food preferences and eating behaviors, and subsequent dietary patterns and health outcomes [3,4]. Studies show that the intake of nutrient-dense foods (fruits and vegetables [5]), as well as the intake of nutrient-poor foods (sweet desserts [6]) during infancy, are associated with greater intake of these foods in early childhood. Disparities in the types of complementary foods provided by caregivers emerge during infancy. Data from a large nationally representative sample showed that non-Hispanic Black and Hispanic infants between 6 and 11 months had lower intakes of fruits and vegetables and greater intakes of sweet and salty snacks compared to non-Hispanic White infants [7,8]. In addition, some low-income caregivers report that several factors influence their complementary food choices including the availability, price, perceived nutritional quality, and perceived likability [9]. Low-income caregivers often have less access to retail food stores (e.g., supermarkets) that sell a wide variety of competitively priced healthy foods [10,11], which may impact the types of complementary foods provided. For example, diverse low-income communities often have fewer large retail food stores and more convenience stores compared to higher-income communities [10–12]. However, little is known about the availability and price of complementary foods in retail food stores in low-income communities.

The American Academy of Pediatrics (AAP) infant feeding guidelines recommend that caregivers introduce nutrient-dense complementary foods when infants approximately 6 months of age, starting with single-ingredient foods (e.g., fruit and

vegetable purees and iron-fortified infant cereals), to complement the nutrition provided by breastmilk or infant formula [2]. Guidelines recommend transitioning to 2 to 3 nutrient-dense meals and snacks per day at 9 months of age with continued breastmilk and/or infant formula until 12 months [2]. Caregivers are also encouraged to avoid added sugars and to limit sodium and refined grains [2,13], given that infants have limited room for discretionary calories. Although guidelines provide recommendations related to the types and timing of nutrient-dense complementary foods and snacks [2,14,15], data from the Feeding Infants and Toddler Study (FITS) 2008 showed that the intake of discretionary calories from nutrient-poor snacks (e.g., cookies, cakes, ice cream, and chips) starts during early infancy [16]. Similarly, data from the National Health and Nutrition Examination Survey (NHANES) revealed nutrient-poor sweet and salty snack intake along with low fruit and vegetable intake during infancy [7], suggesting that nutrient-poor snacks may displace essential nutrient-dense foods. Findings from a recent qualitative synthesis suggest that caregivers receive complementary feeding guidance from a variety of sources (e.g., friends, family, professionals, and food manufacturers) [17]. Caregivers also experience challenges adhering to recommended guidelines [17] and choosing nutrient-dense complementary foods [9].

Caregivers are exposed to a wide variety of commercially available complementary foods, which are foods and snacks marketed to the parents of infants between 4 and 12 months of age. Commercial infant foods and snacks are mass-produced and are generally ready-to-eat or require minimal preparation [18], and the marketing of these foods has increased in recent decades [19]. Commercial infant foods (e.g., fruit and

vegetable purees and iron-fortified infant cereals) are generally nutrient-dense, do not include added sugars, and are low in sodium [20,21]. A recent study found that infants who consumed commercial infant foods (e.g., fruit, vegetable, and dinner purees) had better diet quality compared with infants who did not consume these foods [22]. However, this study did not include commercial infant snacks (e.g., puffs, melts, and cookies), which are often consumed during infancy [23] and are associated with poor diet quality [24]. Findings from studies assessing the nutritional content of commercial infant and toddler snacks show that these foods are often high in added sugars, sodium, and refined grains [8,16], which are recommended to avoid or to limit during this early developmental period [2].

Some studies have examined the availability and nutritional content of commercial infant foods and snacks in the US more broadly [19–21], and one study examined the availability and nutritional content of toddler foods in low-income compared to high-income communities [25]. The availability and price of healthful foods in retail food stores in low-income communities may impact a caregiver's ability to make healthful choices [10,11], and therefore examining the availability and price of infants foods and snacks in these communities may be important for understanding factors that influence infant health during complementary feeding. However, to our knowledge, no studies have examined the availability, price and nutritional content of commercial infant foods and snacks in low-income communities. Given recent increases in the availability of commercial complementary foods and disparities in the types of complementary foods provided during infancy, the purpose of this study was to 1) develop and test a measure to assess the availability, price, and nutritional content of commercial infant foods and

snacks, and 2) describe the availability, price, and quality of healthful staple foods in a sample of retail food stores in low-income communities.

2. MATERIALS AND METHOD

An observational study of retail food stores (grocery stores and supermarkets) in low-income communities across Rhode Island (RI) was conducted during April 2019. This study was granted exempt status by the URI Institutional Review Board.

2.1 Study Sample – Low-income Census Tracts and Retail Food Stores

A purposive sample of 15 low-income census tracts across all five counties in RI, designated as Opportunity Zones (low-income census tracts eligible to receive private-sector tax incentives to spur economic growth and development [26]), were included in this study. For this study, retail food stores (or stores that primarily sell fresh or preserved food products and household goods) were targeted given the wide variety of foods typically available. Following methods by Hillier *et al.* [27], retail food stores were categorized as grocery stores (smaller local or regional full-service stores with >1 cash register and >3 aisles of food) and supermarkets (large regional or national chain full-service stores with ≥ 8 cash registers). Warehouse stores, drug stores, dollars stores, and convenience stores were excluded since these stores are not primarily involved in food retail and vary widely in the types of foods available. Retail food stores (grocery stores and supermarkets) located in low-income census tracts were identified using geographic information systems (ArcGIS, Esri Redlands, CA) mapping and publicly available online directories. All retail food stores in each census tract were documented, and a random sample of 25 stores was selected across all five counties. However, the greater Providence area includes a larger proportion of low-income census tracts

designated as Opportunity Zones and thus represents a larger proportion of this sample. Selected retail food stores were verified using store websites and/or calling stores to verify location and hours of operation. Upon verification, one store (a specialty food store) was excluded from the sample leaving a total sample of 24 retail food stores. Two stores ($n = 1$, international grocery store; $n = 1$, convenience store) were excluded during data collection since these stores did not meet the initial inclusion criteria. A final sample of 22 retail food stores were included in this analysis.

2.2 Measures

2.2.1 Nutrition Environment Assessment – Commercial Infant Foods and Snacks

A 14-item tool was developed for this study to assess the availability, price, and nutritional content of commercial infant foods and snacks in the selected retail food stores. The tool was based on previous work by Glanz *et al.* that explored the overall nutrition environment of retail food stores comparing the availability, prices, and quality of healthful compared to less healthful foods (details provided below) [28]. Based on previous work related to foods marketed to the parents of infants and toddlers, infant foods were operationalized as any foods and snacks that companies indicate are specifically intended for infants between 4 to 12 months of age (stages 1-3) [19]. Although there is some variability in biological age/developmental stage definitions between food manufacturers, usual definitions for infant foods and snacks include stage 1 (finely pureed foods intended for infants aged 4 to 6 months), stage 2 (strained foods intended for infants aged 7 to 8 months), and stage 3 (tender chunks of foods intended for infants aged 9 to 12 months). Infant foods and snacks from five categories (infant formula, single food group (SFG), mixed food groups (MFG), grain-based snacks, and

dairy-based snacks) and two package types (glass jars or plastic packs and pouches) for pureed and strained foods, were considered for inclusion. Based on previous research [19], members of the research team with expertise in child nutrition and child development reviewed commonly available foods marketed to the parents of infants and selected a total of 14 foods ($n = 9$, infant foods; $n = 5$, infant snacks) for inclusion in this nutrition environment assessment. Infant foods included were infant formula; fruit (puree, SFG), vegetable (puree, SFG), mixed fruit and vegetable (puree, MFG), and mixed fruit and/or vegetable with protein (puree, MFG) in jars/packs; fruit (puree, SFG), vegetable (puree, SFG), and mixed fruit and vegetable (puree, MFG) in pouches; and iron-fortified rice cereal. Although infant formula is regulated by the Food and Drug Administration (FDA) for nutritional content [29], infant formula was included to understand availability and price. Infant snacks included were puffs (grain-based), puffs (corn-based), teething cookies, yogurt melts (dairy-based), and baby yogurt.

To standardize data collection a reference brand (i.e., a widely available brand) and reference product (i.e., a widely available product) [30] were indicated for each infant food and snack (see Supplemental Table 1 for details). When the reference brand and/or product was not available an alternate brand and/or product was selected, and details were documented by data collectors. The availability of infant foods and snacks was assessed using the following item, “Does this store sell [selected infant food or snack]?” Infant foods and snacks were considered available if the depth-of-stock was greater than or equal to one. Price was assessed using the retail price (not sale price) in US dollars, which was used to calculate the price per standard serving for each infant food and snack. Information regarding selected nutritional content, including calories (kcal),

added sugars (g), and sodium (mg) per serving, were obtained from the Nutrition Facts label. In line with other studies [20,31], to account for variability in serving sizes within the same infant food and snack categories, the reference amount customarily consumed (RACC) or standard serving size per eating occasion was used to calculate price, calories, added sugars, and sodium per standard serving.

2.2.2 Nutrition Environment Assessment – Overall Nutrition Environment

The overall nutrition environment of the selected retail food stores was assessed using the Nutrition Environment Measures Survey-Stores (NEMS-S) [28]. The NEMS-S is a valid and reliable measure used to assess the availability, price, and quality of healthful foods compared to ‘regular’ (or less healthful foods) in retail food stores. This 11-item measure includes fruits and vegetables plus nine other foods known to contribute to a healthy diet (e.g., low-fat milk, whole grain bread) and comparable foods of the same brand known to contribute excess fat and calories (e.g., whole milk, refined grain bread). The NEMS-S includes three subscale scores (availability, price, and quality) and a total score (sum of subscale scores). Availability subscale scores range from 0 to 30, with higher scores meaning a greater number of healthful foods were available. Price subscale scores range from -9 to 18, with higher scores meaning healthful foods were less expensive compared to less healthful foods. Quality subscale scores include only fresh fruits and vegetables and range from 0 to 6, with higher scores meaning greater than 50% of the fruits and vegetables available were of acceptable quality. Total NEMS-S scores range from -9 to 54. Data from the NEMS-S was used to describe the overall nutrition environment in relation to the nutrition environment of infant foods and snacks.

2.3 Data Collection

2.3.1 Training and Pilot Testing

Data collectors ($n = 3$) were trained undergraduate research assistants with nutrition backgrounds. All data collectors completed NEMS online training modules (<https://nems-upenn.org/training>) related to data collection. Additional training (approximately 5 hours) was conducted by the lead author (AMM) and included field training. Both the infant food and snack items and the NEMS-S items were piloted in a small sample of retail food stores ($n = 4$) by the lead author and the trained data collectors. Minor changes were made to the infant food and snack items following the pilot, and data collectors received feedback on data collection.

2.3.2 Data Collection

Data were collected and managed using REDCap (Research Electronic Data Capture), a web-based software platform designed for research studies [32]. The REDCap mobile device app was used to collect data in the retail food stores and the web-based platform was used to manage data. All data were collected using standardized procedures developed by Glanz *et al.* including conducting assessments Monday-Friday between 9:00 am - 5:00 pm [28]. In addition, assessments were conducted over 4 weeks to limit confounding due to restocking and seasonality. Aisles of the retail food stores that were marked as including infant foods, along with the dairy aisle, were assessed for infant foods and snacks.

2.4 Data Analysis

Data analysis was conducted using SAS 9.4 (SAS Institute, Cary, NC) and Microsoft Excel for Mac (Version 16.34). Descriptive statistics, including means

(standard deviations) and medians (interquartile ranges), were calculated for census tract characteristics and the nutrition environment assessments in retail food stores (grocery stores and supermarkets). Serving sizes and nutritional content, including calories (kcal), added sugars (g), and sodium (mg) per standard serving, for infant foods and snacks (when available) were summarized for each store type.

3. RESULTS

3.1 Census Tract and Retail Food Store Characteristics

A total of 22 retail food stores (grocery stores, $n = 14$; supermarkets, $n = 8$) in low-income census tracts were included in this nutrition environment assessment. On average, grocery stores in this sample had 3.9 ($SD = 1.5$) and supermarkets had 10.3 ($SD = 0.9$) cash registers. Most grocery stores participated in federal nutrition assistance programs, such as the Supplemental Nutrition Assistance Program (SNAP; $n = 13$) and Women, Infants, and Children (WIC; $n = 8$), and all supermarkets ($n = 8$) participated in both programs. On average, nutrition environment assessments were completed in 30.8 ($SD = 9.3$) minutes in grocery stores and 39.5 ($SD = 8.5$) minutes in supermarkets. Table 1 includes characteristics of the low-income census tracts where the retail food stores were located compared to State characteristics. Census tracts included in this study had lower median household incomes, higher poverty rates, and were more racially and ethnically diverse compared to the State.

Table 1. Characteristics of low-income census tracts included in the nutrition environment assessment compared to State characteristics.^a

Characteristic	Low-income Census Tracts Sampled ^b	Rhode Island
Median Household Income (\$)	37,031	61,043
Poverty Rate (%)	26.4	13.4
Persons Under 5 Years (%)	5.2	5.2
Non-Hispanic, White (%)	69.1	80.9
Non-Hispanic, Black (%)	12.7	6.5
Hispanic (%)	21.4	14.6

^a Data from the US Census Bureau (<https://www.census.gov/quickfacts>) from 2013-2017 American Communities Survey. ^b All census tracts designated as urban, low-income communities. Includes median or mean percent for sampled census tracts: Bristol (030500, 030700), Kent (020200), Newport (040500), Providence (000101, 000600, 000800, 011100, 015200, 016100, 016700, 017900, 018500), Washington (050801, 051504).

3.2 Availability, Price, and Nutritional Content of Commercial Infant Foods and Snacks

Table 2 (grocery stores) and Table 3 (supermarkets) include results for the availability, price, and nutritional content of infant foods and snacks across store types. Most grocery stores sold some type of infant food (n = 13) or snack (n = 10). The availability of infant foods varied by store with infant formula having the highest availability (n = 13). This was followed by fruit (n = 8), vegetable (n = 8), mixed fruit and vegetable (n = 8), iron-fortified rice cereal (n = 7), and mixed fruit and/or vegetable with a protein (n = 5) purees in jars/packs. Pouches were available in stores with fruit (n = 9), mixed fruit and vegetable (n = 6), and vegetable (n = 4) purees in pouches available. The availability of infant snacks also varied by store with puffs (grain-based, n = 10; corn-based, n = 10) having the highest availability. Followed by yogurt melts (n = 7), teething cookies (n = 3), and baby yogurt (n = 2). All supermarkets sold some type of infant food (n = 8) or snack (n = 8). Most infant foods were available in all supermarkets except for mixed fruit and/or vegetable with a protein (n = 5) purees in jars/packs, fruit (n = 5) and vegetable (n = 2) purees in pouches. Most infant snacks were available in all stores except for puffs (corn-based, n = 4) and baby yogurt (n = 4).

The price per standard serving of infant foods and snacks varied by store type. The price of infant formula was higher in grocery stores compared to supermarkets (\$0.20 vs. \$0.18 per 100 grams). The price of other infant foods and snacks available in grocery stores were generally lower compared to the price of these foods in supermarkets. Across both store types, on average, fruit or vegetable purees in jars/packs sold as stage 1 cost more per standard serving compared to mixed fruit and vegetables and mixed fruit and/or vegetables with protein purees in jars/packs sold as stage 2. Pouches had the highest average price per standard serving with lower prices in grocery stores compared to supermarkets. On average, infant snacks had lower prices per standard serving in grocery stores compared to supermarkets except for baby yogurt (prices were equivalent). The nutritional content of infant foods is regulated [33] and, therefore, infant food purees did not contain added sugars and median sodium content ranged from 5 mg to 50 mg per serving. Most infant snacks across both store types contained added sugars with baby yogurt had the highest added sugars content (6.0 g/standard serving), followed by yogurt melts, puffs, and teething cookies. Sodium content in infant snacks ranged from 0 mg to 50 mg per standard serving.

Table 2. Availability, pricing, and selected nutritional content for infant foods and snacks in grocery stores (n = 14) located in low-income communities.

	n	RACC (g) ^a	Cost (USD) ^b M (SD)	Calories (kcal) ^c M (SD)	Added Sugars (g) M (SD)	Sodium (mg) M (IQR)
Infant Foods^a						
Infant formula (powder) ^e	13	100	0.20 (0.03)	38 (0.0)	0 (0.0)	9.5 (0.0)
Fruit, single or multiple (jars/packs, stage 1)	8	110	0.95 (0.15)	85 (10.7)	0 (0.0)	10 (6.3)
Vegetable, single or multiple (jars/packs; stage 1)	8	110	1.09 (0.13)	59 (18.1)	0 (0.0)	10 (30.0)
Mixed, fruit and vegetable (jars/packs, stage 2)	8	110	0.67 (0.04)	63 (8.8)	0 (0.0)	25 (30)
Mixed with protein (jars/packs, stage 2)	5	110	0.72 (0.03)	113 (5.0)	0 (0.0)	5 (5.0)
Fruit, single or multiple (pouch, stages 2)	9	110	1.15 (0.38)	60 (0.0)	0 (0.0)	15 (0.0)
Vegetable, single or multiple (pouch, stages 2)	4	110	0.89 (0.03)	45 (17.3)	0 (0.0)	50 (5.0)
Mixed, fruit and vegetable (pouch, stages 2)	6	110	0.90 (0.20)	57 (8.2)	0 (0.0)	20 (7.5)
Rice cereal (dry, stage 1)	7	15	0.17 (0.02)	57 (4.9)	0 (0.0)	5 (2.5)
Infant Snacks						
Puffs (grain-based, stage 3) ^f	10	7	0.31 (0.07)	25 (0.0)	1 (0.0)	0 (0.0)
Puffs (corn-based, stage 3) ^g	10	7	0.29 (0.07)	33 (2.6)	0 (0.0)	45 (5.0)
Teething cookies (stage 3) ^h	3	7	0.09 (0.01)	20 (0.0)	1 (0.0)	15 (0.0)
Yogurt melts (stage 3) ⁱ	7	7	0.41 (0.12)	30 (0.0)	2.1 (0.4)	20 (0.0)
Baby yogurt (fruit, stage 2)	2	110	0.62 (0.0)	100 (0.0)	6 (0.0)	50 (0.0)

^a Reference amount customarily consumed (RACC) or standard serving size per eating occasion that is used by manufacturers to determine serving size as listed on the Nutrition Facts label. RACC used in this analysis to standardize across brands and product sizes. ^b Cost calculated per RACC. ^c Calories, added sugar, and sodium calculated per RACC. ^d Stage 1 (finely pureed foods that are meant for infants aged 4 to 6 months); Stage 2 (strained foods that are meant infants aged 7 to 8 months); Stage 3 (tender chunks that are meant for infants aged 9 to 12 months). ^e Infant formulas are regulated by the Food and Drug Administration (FDA) and nutritional content is relatively consistent between formulas; calculations based on 100g of infant formula (no RACC). ^f Includes rice and/or wheat. ^g Includes corn. ^h Includes cookies or biscuits marketed for teething. ⁱ Includes dairy. *USD = United States dollars; IQR = interquartile range.

Table 3. Availability, pricing, and selected nutritional content for infant foods and snacks in supermarkets (n = 8) located in low-income communities.

	n	RACC (g) ^a	Cost (USD) ^b M (SD)	Calories (kcal) ^c M (SD)	Added Sugars (g) M (SD)	Sodium (mg) M (IQR)
Infant Foods^a						
Infant formula (powder) ^e	8	100	0.18 (0.07)	38 (0.0)	0 (0.0)	9.5 (0.0)
Fruit, single or multiple (jars/packs, stage 1)	8	110	1.07 (0.08)	80 (11.9)	0 (0.0)	10 (10.0)
Vegetable, single or multiple (jars/packs; stage 1)	8	110	1.14 (0.08)	59 (18.9)	0 (0.0)	10 (17.5)
Mixed, fruit and vegetable (jars/packs, stage 2)	8	110	0.68 (0.04)	68 (7.1)	0 (0.0)	5 (0.0)
Mixed with protein (jars/packs, stage 2)	5	110	0.71 (0.02)	102 (4.8)	0 (0.0)	15 (0.0)
Fruit, single or multiple (pouch, stages 2)	5	110	1.62 (0.21)	66 (5.5)	0 (0.0)	5 (2.5)
Vegetable, single or multiple (pouch, stages 2)	2	110	1.59 (0.28)	70 (0.0)	0 (0.0)	15 (0.0)
Mixed, fruit and vegetable (pouch, stages 2)	8	110	1.39 (0.36)	65 (7.6)	0 (0.0)	15 (15)
Rice cereal (dry, stage 1)	8	15	0.16 (0.02)	56 (5.2)	0 (0.0)	5 (2.5)
Infant Snacks						
Puffs (grain-based, stage 3) ^f	8	7	0.48 (0.10)	25 (0.0)	1.0 (0.0)	0 (0.0)
Puffs (corn-based, stage 3) ^g	4	7	0.39 (0.04)	35 (0.0)	0.0 (0.0)	45 (0.0)
Teething cookies (stage 3) ^h	8	7	0.22 (0.02)	28 (4.6)	0.4 (0.5)	20 (5.0)
Yogurt melts (stage 3) ⁱ	8	7	0.54 (0.11)	30 (0.0)	4.6 (1.0)	20 (5.0)
Baby yogurt (fruit, stage 2)	4	110	0.62 (0.02)	100 (0.0)	6.0 (0.0)	50 (0.0)

^a Reference amount customarily consumed (RACC) or standard serving size per eating occasion that is used by manufacturers to determine serving size as listed on the Nutrition Facts label. RACC used in this analysis to standardize across brands and product sizes. ^b Cost calculated per RACC. ^c Calories, added sugar, and sodium calculated per RACC. ^d Stage 1 (finely pureed foods that are meant for infants aged 4 to 6 months); Stage 2 (strained foods that are meant infants aged 7 to 8 months); Stage 3 (tender chunks that are meant for infants aged 9 to 12 months). ^e Infant formulas are regulated by the Food and Drug Administration (FDA) and nutritional content is relatively consistent between formulas; calculations based on 100g of infant formula (no RACC). ^f Includes rice and/or wheat. ^g Includes corn. ^h Includes cookies or biscuits marketed for teething. ⁱ Includes dairy. *USD = United States dollars; IQR = interquartile range.

3.3 Availability, Price, and Quality of Healthful Foods

Table 4 includes results for the availability, price, and quality of healthful foods compared to regular (or less healthful) foods across store type. Healthful foods (e.g., fresh fruits and vegetables, low-fat dairy, and whole grains) were available in all retail food stores. The mean availability subscale score (range 0 to 30) was 19.4 (*SD* = 5.6) for grocery stores and 24.3 (*SD* = 4.4) in supermarkets. Healthful foods varied in price when compared to regular options with healthful food generally more expensive. The

mean price subscale score (range -9 to 18) was 2.9 ($SD = 2.6$) in grocery stores and 3.4 ($SD = 4.4$) in supermarkets. Quality was assessed for fruits and vegetables, the mean quality subscale score (range 0 to 6) was 5.1 ($SD = 1.3$) in grocery stores and 5.8 ($SD = 3.0$). The mean total score, a composite of the three subscales with scores ranging from -9 to 54, for the overall nutrition environment of grocery stores was 27.5 ($SD = 8.1$) and 33.8 ($SD = 4.7$) in supermarkets.

Table 4. Mean NEMS-S scores in retail food stores in low-income communities by store type. ^a		
	Grocery Stores (n = 14)	Supermarkets (n = 8)
Availability Score ^b	19.4 (5.6)	24.3 (4.4)
Price Score ^c	2.9 (2.4)	3.4 (4.4)
Quality Score ^d	5.1 (1.3)	5.8 (3.0)
Total Score ^e	27.5 (8.1)	33.8 (4.7)

^a Higher scores indicate greater availability, lower prices, and better quality for the healthier options compared to “regular” options. ^b Scores range from 0 to 30. ^c Scores range from -9 to 18. ^d Scores range from 0 to 6. ^e Total scores range from -9 to 54.

4. DISCUSSION

This observational study explored the availability, price, and nutritional content of commercial infant foods and snacks in retail food stores (grocery stores and supermarkets) in low-income communities. This study found that most grocery stores (n = 13) and all supermarkets (n = 8) sold some type of commercial infant food or snack. The types of infant foods and snacks available in grocery stores varied with infant formula having the highest availability (n = 13) followed by puffs (grain-based, n = 10 and corn-based, n = 10) and purees in jars/packs (n = 8). In contrast, the types of infant foods and snacks available in supermarkets were less varied with the majority of products available in all stores. Infant foods and snacks were generally lower in price per standard serving in grocery stores compared to supermarkets, and infant foods were generally higher in price per standard serving compared to infant snacks in both store

types. Although infant foods and snacks were low in sodium, infant snacks contained up to 6 grams of added sugars per standard serving. Findings from this study suggest that there is a need for continued public health efforts to help retail food stores offer healthful nutrient-dense infant foods and snacks.

Our findings that commercial infant foods and snacks are available in most grocery stores and supermarkets are consistent with recent studies showing that commercial infant and toddler foods and snacks (or complementary foods) are widely available in the US [20,21]. This is also consistent with nationally representative samples showing that up to half of US infants consume some type of commercial infant food and/or snack each day [8,30,34]. For example, recent findings from the FITS 2016 showed that the most commonly consumed complementary foods by infants 4 to 6 months of age were fortified infant cereal followed by commercial fruit and vegetable purees [34]. The same study showed that infants 6 to 12 months of age commonly consumed fortified infant cereal followed by grain-based commercial finger foods [34]. Commercial infant foods and snacks are often ready-to-serve which makes these foods convenient to include in infant diets during complementary feeding. A recent synthesis of qualitative studies related to infant feeding found that caregivers often experience complementary feeding as difficult or stressful [17], which may help to explain recent increases in the availability of commercial infant foods and snacks. In addition, recent findings suggest that infants who consumed commercial infant foods (e.g., fruit, vegetable, and dinner purees) had better diet quality compared with infants who did not consume these foods [22]. Therefore, commercial infant foods may be a convenient way for caregivers to offer infants nutrient-dense complementary foods. In contrast, findings from other

studies examining the nutritional content of some commercial infant snacks show that these foods are often higher in sugars, added sugars, sodium, and refined grains [8,16], and are associated with poor diet quality [24]. Our findings suggest that commercial infant snacks are available in most grocery stores and all supermarkets, which makes providing caregivers with guidance on choosing nutrient-dense complementary foods important.

Findings from our study that the availability of infant foods and snacks varied between retail food stores (grocery stores and supermarkets) is consistent with studies showing that smaller grocery stores typically have fewer options and less variety compared to larger supermarkets. Supermarkets often provide reliable access to a wide variety of nutrient-dense foods compared to smaller grocery stores, however, low-income and diverse communities often have fewer supermarkets and greater smaller retail food stores [10–12], which may impact the types of commercial infant foods and snacks caregivers purchase for their infants. For example, iron-rich complementary foods (e.g., iron-fortified infant cereals) are recommended starting at approximately 6 months of age [2]. Although research suggests that iron-fortified infant cereals are a commonly consumed complementary food [34], our findings suggest that half of the grocery stores in low-income communities did not have this product available. Similarly, fruit and vegetable purees are recommended starting at approximately 6 months [2], our findings suggest that just under half of the grocery stores did not have these products available. This may impact a caregiver's ability to include nutrient-dense complementary foods and subsequently impact infant health. Given that food availability is an important driver of consumption [35], programs and policies to

encourage smaller retail food stores to carry a variety of nutrient-dense infant foods (e.g., iron-fortified infant cereals, fruit and vegetable purees) are important.

Food prices may also impact caregiver choices around purchasing commercial infant foods and snacks. Infant foods and snacks were generally lower in price per standard serving in grocery stores compared to supermarkets. This finding was unexpected given that supermarkets generally offer lower prices [36], and this finding may have been driven by half of the grocery stores in our sample identified as discount food stores. In both grocery stores and supermarkets, infant foods were generally higher in price per standard serving compared to infant snacks. However, most infant snacks contained added sugars and were generally higher in sodium, which are not recommended as optimal complementary foods. However, the lower cost of some infant snacks per standard serving may be driving caregiver complementary food choices.

Recent studies have examined the availability and nutritional content of commercial infant and toddler foods and snacks widely available in the US [19–21]. One study that examined the availability and nutritional content of toddler foods in low-income compared to high-income communities found that sugar content was high in commercial infant snacks and baby yogurts in sold both communities [25]. This is consistent with our findings that infant snacks are commonly available in retail food stores in low-income communities and that most commercial infant snacks contain added sugars. These findings suggest that infant snacks that include added sugars may be important targets for public health and intervention efforts. In addition, targeting infant snacks that include added sugars may help reduce early disparities in infant diet quality. For example, non-Hispanic Black and Hispanic infants between 6 and 12

months of age have greater intakes of sweet and salty snacks [7,8], which may displace healthier nutrient-dense foods.

To provide context for our findings related to the availability, price, and nutritional content of commercial infant foods and snacks, we assessed the overall nutrition environment of grocery stores and supermarkets using the NEMS-S. The overall nutrition environment of the retail food stores in this sample was comparable to results in other studies conducted in low-income communities [35,37]. However, subscale and total scores for grocery stores were lower than supermarkets, meaning that healthful staple foods were generally less available, higher-priced, and poorer quality in grocery stores compared to supermarkets. This adds context to our finding that the types of infant foods and snacks available in grocery stores varied with some infant snacks having greater availability and lower prices per standard serving compared to infant foods. Given that the availability and prices of healthful foods in retail food stores in low-income communities may impact a caregiver's ability to make healthful choices [10,11], small retail food stores (specifically grocery stores) may be important targets to increase the availability of healthful infant foods.

This study has several strengths including sampling retail food stores across a variety of low-income communities to assess the nutrition environment related to infant foods and snacks. Although this study included foods and snacks commonly consumed by infants, we did not include all foods marketed to parents of infants available in the US during 2018, and as such other infant foods and/or snacks of nutritional concern may not have been assessed. We limited our analysis of the nutritional content of infant foods and snacks to calories, added sugars, and sodium, meaning that other nutrients that are

important during infancy (e.g., iron) were not included. The availability and pricing of foods often vary across geographic regions, and as such comparing the price of a standard serving of infant and toddler foods across RI may not reflect differences in pricing related to these differences. Lastly, this study includes grocery stores and supermarkets where caregivers often purchase foods for their families. However, given that low-income communities have fewer supermarkets and large grocery stores, caregivers may purchase foods for their infants at other smaller stores (i.e., convenience stores) that were not included in this study. Future research would benefit from including additional retail food store types to better understand the nutrition environment of commercial infant foods and snacks.

Conclusion

This observational study of the availability, price, and nutritional content of commercial infant foods and snacks in low-income communities, extends the existing literature availability and nutritional content of these foods in the US. Given that infant foods and snacks are widely available in retail food stores, and some infant snacks contain added sugars, it is essential to provide caregivers with guidance on choosing age-appropriate nutrient-dense snacks. In addition, our study suggests that retail food stores in low-income communities, specifically smaller grocery stores, might benefit from programs and policies that encourage the availability of healthful commercial infant foods and snacks to help infants establish healthy food preferences and eating behaviors starting early in life.

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SUPPLEMENTAL TABLE

Supplemental Table 1. Categorization of infant foods and snacks (n = 14) included in the nutrition environment measure.							
Food Category	Food Groups ^a	Packaging Type	Biological Age or Stage ^b	Reference Brand ^c	Reference Product ^c	Serving Size (g) ^d	RACC (g) ^e
Infant Formula, powder ^f	-	Container/Can	0-12 months	Similac	Advance	100	n/a
Fruit, single or multiple	SFG	Jars/packs	Stage 1	Gerber	Banana	113	110
Vegetable, single or multiple	SFG	Jars/packs	Stage 1	Gerber	Peas	113	110
Fruit and vegetable, mixed	MFG	Jars/packs	Stage 2	Gerber	Any	113	110
Fruit and/or vegetable & protein	MFG	Jars/packs	Stage 2	Gerber	Any	113	110
Fruit, single or multiple	SFG	Pouch	Stages 1	Gerber	Banana	113	110
Vegetable, single or multiple	SFG	Pouch	Stages 1	Gerber	Peas	113	110
Fruit and vegetable, mixed	MFG	Pouch	Stages 2	Gerber	Any	113	110
Rice cereal, dry	SFG	Box	Stage 1	Gerber	Plain	15	15
Puffs (grain) ^g	SFG	Container	Stage 3	Gerber	Strawberry	7	7
Puffs (corn) ^h	SFG	Container	Stage 3	Gerber	Cheddar	7	7
Teething cookie ⁱ	SFG	Container	Stage 3	Gerber	Arrowroot	5	7
Yogurt Melts ^j	MFG	Container	Stage 3	Gerber	Strawberry	7	7
Baby yogurt	SFG or MFG	Container	Stage 2	Gerber	Strawberry	99	110

^aSingle Food Group (SFG); Mixed Food Group (MFG). ^bStage 1 (finely pureed foods that are meant for infants aged 4 to 6 months); Stage 2 (strained foods that are meant for infants aged 7 to 8 months); Stage 3 (tender chunks that are meant for infants aged 9 to 12 months). ^cReference brand and reference product used to standardize measure. Where not available, alternate brand or product were documented. ^dMean manufacturer serving size as listed on the Nutrition Facts label. ^eReference amount customarily consumed (RACC) or standard serving size per eating occasion that is used by manufacturers to determine serving size as listed on the Nutrition Facts label. RACC used in this analysis to standardize across brands and product sizes.

^fInfant formulas are regulated by the Food and Drug Administration (FDA) and nutritional content is relatively consistent between formulas. ^gIncludes rice and/or wheat. ^hIncludes corn.

ⁱIncludes cookies or biscuits marketed for teething. ^jIncludes dairy.

EXTENDED LITERATURE REVIEW

1. INTRODUCTION

Mounting evidence suggests that the period from conception to 24 months (or the “first 1000 days”) plays a critical role in the development and prevention of childhood obesity [1–3]. Given the importance of optimal nutrition to support healthy growth and development during infancy (birth to 12 months of age), this literature review explores the following 1) physical growth and development during infancy, 2) nutrition-related factors that influence growth and development during infancy, and 3) parent and community factors that influence diet during infancy.

2. PHYSICAL GROWTH & DEVELOPMENT DURING INFANCY

Growth and development occur more rapidly during infancy than at any other developmental stage [4]. Anthropometric measurements, including weight and recumbent length, are used by healthcare providers to monitor growth and development across the first year of life. This section reviews the assessment of growth and development and disparities in these factors that begin to emerge during infancy.

Assessment of Infant Physical Growth

Birth Weight Assessment. The birth weight of a newborn is an important indicator of an infant’s health status. Most infants in the United States (US) are born full-term (37 to 42 weeks) and typically have birth weights between 2500 to 3800 grams [5]. However, approximately 10% of infants in the US are born preterm (<37 weeks) and typically have lower birth weights (<2500 grams, low-birth-weight; <1500 grams, very-low birth weight; <1000 grams, extremely low-birth weight), and are subsequently at risk for poor growth and development [5]. Although birth weight is an important

indicator of infant health status and has been associated with weight status during early childhood [6], details regarding the assessment and implications of birth weight are outside of the scope of this review.

Infant Growth Assessment. Adequate nutrition is essential for optimal growth and development during infancy, and regular anthropometric measurements are used to identify potential growth and development problems (e.g., slow or excessive weight gain) [4]. Anthropometric measurements including weight, length or stature, and head circumference are commonly used to assess growth in infants and toddlers up to 3 years of age [4]. Since 2010, the Centers for Disease Control and Prevention (CDC) and the American Academy of Pediatrics (AAP) have recommended the use of World Health Organization (WHO) growth charts to interpret anthropometric measurements between 0 to 24 months of age and by sex [4,7]. The WHO growth charts were based on a large international sample of healthy infants and toddlers living in conditions that support optimal growth and development (e.g., exclusive or predominant breastfeeding, non-smoking households). In contrast, the 2000 CDC growth charts, which are no longer recommended for use in this age group, were based on a smaller sample of US infants predominantly fed infant formula. Several WHO growth charts are available (e.g., weight-for-age, length-for-age, and weight-for-length) to plot and interpret growth in this age group. Weight-for-length (WFL) growth charts are commonly used to compare trends in weight gain compared to length gain over time. The WHO and AAP recommend using the 2nd percentile (two standard deviations below the mean) and the 98th percentile (two standard deviations above the mean) to identify potential growth and development problems [4,7]. These percentiles are qualitatively classified as low-

WFL (<2nd percentile) and high-WFL ($\geq$ 98th percentile). Healthcare providers are encouraged to frequently measure, plot, and interpret growth charts for all infants at well-visits (AAP recommends five visits during the first year of life), and provide caregivers with guidance and/or referrals to a specialist (e.g., pediatric dietitians) to prevent growth and development problems [4].

Suboptimal Infant Physical Growth & Disparities

Suboptimal Infant Growth – Rapid Weight Gain. There is a wide range of healthy growth patterns for infants with slight normative variations in physical growth typically related to infant illness or inappropriate infant feeding [4]. An area of research that has received much attention in the infant growth literature is rapid weight gain, which is defined as upward centile crossing in weight growth charts (or .67 change in standard deviation, which is equivalent to the distance between each percentile line on standard growth charts) [8]. Rapid weight gain during infancy is suboptimal and is an important factor in the development of obesity during childhood [9], and has been associated with increased blood pressure [10] and increased risk for diabetes [11]. A recent systematic review and meta-analysis showed that rapid weight gain during infancy was associated with higher odds of overweight/obesity during childhood and later adulthood [9].

Modifiable Factors Associated with Rapid Weight Gain. Evidence suggests that nutrition may contribute to rapid weight gain during infancy and the development of obesity later in life [9]. Several potentially modifiable factors related to infant nutrition have been examined including formula feeding, feeding beyond satiety, adding cereal to bottles, using food to soothe, the early introduction of solid foods (or complementary foods), and infant feeding styles [9,12]. Other maternal factors have also been examined

as contributors to infant rapid weight gain and later obesity including smoking status, weight status, and socioeconomic status [9]. All of these factors are important targets for prevention and intervention efforts; however, the core of this review focuses on the timing and types of solid foods (or complementary foods) offered during infancy and the subsequent impacts on infant health.

Suboptimal Infant Growth – Prevalence and Disparities. Although nationwide data suggest that childhood obesity prevalence in the US has declined or stabilized in recent years, obesity prevalence continues to be disproportionately high in low-income [13] and racially and ethnically diverse populations [14,15]. Disparities in the risk for obesity emerge starting early in life. Findings from the National Health and Nutrition Examination Survey (NHANES) showed that 7.1% of infants and toddlers in the US have high-WFLs ($\geq 98^{\text{th}}$ percentile) placing them at risk for obesity [14]. The same study showed that more non-Hispanic Black (7.3%) and Hispanic (8.8%) infants and toddlers have high-WFLs compared to non-Hispanic Whites (5.5%).

Suboptimal Infant Growth Tracks into Early Childhood and Beyond. Findings that obesity often tracks across the lifespan [16,17] are consistent with findings from the NHANES that showed that 13.9% of preschool-aged children have obesity [18]. Disparities also persist with non-Hispanic Black (10.4%) and Hispanic (15.6%) preschool-aged children having a higher prevalence of obesity compared to non-Hispanic White (5.2%) preschool-aged children [15]. Taveras *et al.* found that after adjusting for socioeconomic status and parental obesity, non-Hispanic Black and Hispanic children had greater odds of being exposed to modifiable risk factors during infancy that are associated with obesity (e.g., limited breastfeeding, early introduction

of complementary foods, and sugar-sweetened beverage intake) when compared with non-Hispanic Whites [1]. These factors may help explain why some children are disproportionately impacted by obesity. Given early obesity often tracks into adulthood [16,17], and subsequently increases the risk for chronic diseases [19,20], there is an urgent need to examine risk factors for obesity during infancy.

Assessment of Infant Development – Developmental Milestones

Infant Motor Development. Infants are born with automatic (or unlearned) reflexes including rooting, suckling, and swallowing that are essential for early feeding [4,21]. These reflexes are gradually replaced by more purposeful movements during the first few months of life. Gross motor development or the gradual ability to control voluntary muscle movements, is an important component of infant growth and development [21]. In relation to solid food introduction (or complementary feeding), gross motor developments like sitting with caregiver support (around 4 months of age) and sitting in a highchair (6 months of age) often signal that an infant is developmentally ready for the introduction of solid foods [4]. Gross motor development continues across infancy with sitting alone (7 months of age), supported standing (8 months of age), and supporting walking (11 months of age) [4].

Infant Digestive System Development. Infants are born with the ability to digest and absorb a wide variety of macro- and micro-nutrients; however, digestive and absorptive capacity is limited though improves during the first year of life [4]. For example, at approximately 6 months of age, infants are able to digest complex starches, fats, and proteins due to improvements in enzymatic activity. In relation to solid food

introduction (or complementary feeding), digestive system development often signals that an infant is developmentally ready for the introduction of solid foods.

Infant Cognitive Development. Optimal nutrition is essential for optimal cognitive development during infancy [4,22]. Findings suggest that poor nutrition including inadequate energy and protein intake and inadequate intake of important micronutrients (e.g., iron, iodine) may lead to poor cognitive development [23]. This makes the introduction of nutrient-dense solid foods (or complementary foods) during infancy important.

Infant Hunger and Satiety Cue Development. Along with motor, digestive, and cognitive development, hunger and satiety cues develop during infancy [4,24]. Often concurrent with gross motor development, starting at approximately 6 months of age, infant hunger and satiety cues become more developed and recognizable to caregivers [24]. For example, at approximately 6 months, infant cues including cries or fussiness and moving head toward spoons often signal hunger. At this same time, infant cues including cessation of sucking, turning their head away from food, and spitting out food often signal satiety. At approximately 5 to 12 months, infants signal hunger by reaching for or point to spoons and foods and signal satiety by eating slowly and pushing food away. Caregivers are encouraged to be able to recognize and respond to infant hunger and satiety cues to promote optimal feeding and avoid overfeeding.

3. FACTORS THAT INFLUENCE INFANT GROWTH & DEVELOPMENT

Infancy includes a period of rapid growth and development that includes important dietary transitions, from an exclusively milk-based diet to a diet that includes a variety of solid foods [25–27]. Parental feeding decisions including the timing of solid food

(complementary foods) introduction, the types of solid foods offered, and the context in which these foods are offered have lasting impacts on infant eating behaviors and infant health outcomes [4,28]. This section reviews infant energy and nutrient needs, infant feeding guidelines and recommendations, and the dietary intakes of US infants.

Infant Energy and Nutrient Needs

Energy and nutrients recommendations were developed by the Institute of Medicine's Food and Nutrition Board and the National Academy of Sciences, and include Dietary Reference Intakes (DRIs) to identify age-specific macro- and micro-nutrient recommendations for infants between birth to 6 months of age and 7 to 12 months of age [29]. Additionally, the AAP provides guidelines and recommendations on infant nutrition and infant feeding [4]. There are currently no Dietary Guidelines for Americans (DGAs) for infants and toddlers.

Infant Energy Needs. Energy needs are high during infancy, and individual calorie needs range from 80 to 120 calories per kilogram of body weight [29]. Factors that influence calorie needs include weight, growth rates, physical activity, and sleep [4,29]. From birth to 6 months, average individual calorie needs are 108 calories per kilogram of body weight and from 7 to 12 months, average calorie needs are 98 calories per kilogram of body weight.

Infant Nutrient Needs. Due to rapid growth and development, nutrient needs are also high during infancy. Table 1 provides the DRIs for macronutrients and fat-soluble micronutrients, Table 2 provides the DRIs for water-soluble vitamins, and Table 3 provides the DRIs for minerals for infants and toddlers from birth to 3 years of age [29].

Table 1. Dietary Reference Intakes (DRIs) for macronutrients & fat-soluble vitamins.

Age		Carbohy- drate (grams/day)	Fat (grams/day)	n-6 PUFA (grams/day)	n-3 PUFA (grams/day)	Protein (grams/day)	Vitamin A (µg RAE)	Vitamin D (µg[IU])	Vitamin E (α-tocopherol) (mg)	Vitamin K (µg)
0-6 months	AI	60	31	4.4	0.50	9.1 (1.52/kg)	400	5.0 (200)	4	2
	EAR									
	RDA									
	UL						600 µg preformed	25 (1,000)	ND	ND
7-12 months	AI	95	30	4.6	0.50		500	5.0 (200)	5	2.5
	EAR					9.9 (1.1/kg)				
	RDA					1.5 g/kg				
	UL						600 µg preformed	50 (2,000)	200	ND
1-3 years	AI	19 g/day of total fiber	ND	ND	0.7 g/day α-linolenic acid			5.0 (200)		30
	EAR	100					210		5	
	RDA	130				13 (1.10/kg)	300		6	
	UL						600 µg preformed	50 (2,000)	200	ND

Table 2. Dietary Reference Intakes (DRIs) for water-soluble vitamins.

Age		Vitamin C (mg)	Thiamin (mg)	Riboflavin (mg)	Niacin (NE)	Vitamin B6 (mg)	Folate (µg)	Vitamin B12 (µg)	Pantothenic Acid (mg)	Biotin (µg)
0-6 months	AI	40	0.2	0.3	2	0.1	65	0.4	1.7	5
	EAR									
	RDA									
	UL	ND	ND	ND	ND	ND	ND	ND	ND	ND
7-12 months	AI	50	0.3	0.4	4	0.3	80	0.5	1.8	6
	EAR									
	RDA					1.5 g/kg				
	UL	ND	ND	ND	ND	ND	ND	ND	ND	ND
1-3 years	AI									
	EAR	13	0.4	0.4	5	0.4	120	0.7	2	
	RDA	15	0.5	0.5	6	0.5	150	0.9		
	UL	400	ND	ND	10	30 mg as pyroxidine	300	ND	ND	ND

Table 3. Dietary Reference Intakes (DRIs) for minerals.

Age		Calcium	Chromium (µg)	Copper (µg)	Fluoride (mg)	Iodine (µg)	Iron (mg)	Magnesium (mg)	Manganese (mg)	Phosphorous (mg)	Selenium (µg)	Zinc (mg)
0-6 months	AI	210	0.2	200	0.01	110	0.27	30	0.003	100	15	2.0
	EAR											
	RDA											
	UL	ND	ND	ND	0.7	ND	40	ND	ND	ND	45	4
7-12 months	AI	270	5.5	220	0.5	130		75	0.6	275	20	
	EAR						6.9					2.5
	RDA						11					3
	UL	ND	ND		0.9	ND	40	ND	ND	ND	60	5
1-3 years	AI	500	11		0.7				1.2			
	EAR			260		65	3.0	65		380	17	2.5
	RDA			340	6	90	7	80		460	20	3
	UL	400	ND	1,000	1.3	200	40	65 mg supplementary	2	3.0g	90	7

Nutrients of Concern during Infancy. Infant formula and breastmilk have all the nutrients that an infant needs until approximately 6 months of age, and breastmilk also includes immune-enhancing proteins that confer added health benefits [4]. However, iron is a nutrient of concern at approximately 6 months of age. Iron supplementation is recommended for exclusively breastmilk fed infants starting at approximately 4 months of age and should continue until iron-fortified complementary foods are introduced. For non-exclusively breastmilk fed and/or infant formula fed infants, iron-rich complementary foods (e.g., iron-fortified infant cereals, legumes and/or meats) are recommended starting at approximately 6 months of age given that endogenous iron stores are depleted [4]

Infant Feeding Recommendations

Infant Feeding Recommendations. The Dietary Guidelines for Americans (DGAs) have not historically included dietary guidance for infants and toddlers under 2 years of age. However, efforts to include infants and toddlers in the 2020 DGAs are currently underway [30,31]. In the absence of national guidelines, the AAP has issued comprehensive guidelines and recommendations for infant feeding and nutrition since 1978 [4]. Current recommendations include exclusive breastfeeding for the first 6 months of life, followed by the introduction of nutrient-dense complementary foods as an infant is developmentally ready (approximately 6 months of age). Recommendations suggest starting with single-ingredient foods (e.g., iron-fortified infant cereal, fruits, and vegetables), to complement the nutrition provided by breastmilk and/or infant formula [4]. At 9 months of age, guidelines recommend transitioning to 2 to 3 nutrient-dense meals and snacks per day continued breastmilk and/or infant formula until 12 months [4]. Caregivers are encouraged to offer a wide variety of nutrient-dense foods, such as fruits and vegetables, with varying flavors and textures at every meal and snack. In addition, caregivers are encouraged to avoid added sugars and to limit sodium and refined grains and delay fruit juice and cow-milk introduction until 12 months of age [4,32].

Infant Dietary Intake and Disparities. Despite widespread recognition of the immediate [4,33] and longer-term [34,35] benefits of consuming nutrient-dense complementary foods starting during infancy, recent National Health and Nutrition Survey (NHANES) data suggest that between 6 and 11 months of age, 25% of infants did not consume any vegetables and 17% did not consume any fruits on a given day

[36]. Along with suboptimal fruit and vegetable intake, data showed that 5% of infants between birth and 5 months consumed an unhealthy sweet or salty snack, dessert or sweetened beverage each day; this increased to 51% between 7 and 11 months, and 91% between 12 and 23 months [36]. Similarly, results from the Feeding Infants and Toddlers Study (FITS), a predominantly non-Hispanic White sample, suggest that less healthy snack food consumption increases across infancy, with 9% of infants between 6 and 8 months of age and nearly 20% of infants between 9 and 11 months of age consuming at least one sweet or salty snack each day [37]. Disparities also begin to emerge during infancy with non-Hispanic Black infants consuming fewer vegetables and fruits and more sweet and salty snacks compared to non-Hispanic White infants [36]. Increasing trends in the consumption of less healthy snacks during infancy is particularly concerning given these snacks may displace healthier foods and also contribute excess calories.

Increases in suboptimal dietary intake, including less healthy snacks, coincides with increases in snack food marketing, snacking frequency, and overall calorie contribution from snacks [38–40], with the greatest increases in populations most at risk for childhood obesity, including low-income and non-Hispanic Black households [36,40]. Experts agree that the impact of snacks on weight status depends on the frequency and energy-density of snacks [39,41]. Preschool-aged children consume around three snacks per day, which contributes nearly 30% of daily calories with the majority of those calories coming from less healthy snacks [36,39,40]. This increases during early childhood with nearly 54% of daily calories coming from less healthy snacks [40]. However, studies with older children and adolescents revealed that snacking may have

favorable effects on weight status due to increases in healthy snack foods (e.g., fruits and vegetables) [42,43]. In contrast to older children, recent studies of preschool-aged children suggest that a large proportion of snack foods are from less healthy sweet and salty snacks, and these energy-dense snack foods may lead to excess calories and subsequent obesity [39,40,44]. Given the introduction of snacks and the contribution of unhealthy snacks to infant and toddler diets, understanding the reasons for offering snacks during the first year of life warrants further exploration.

4. PARENT & COMMUNITY FACTORS THAT INFLUENCE INFANT DIET

Caregiver Infant Feeding Styles - Infant Diet

Caregiver Infant Feeding Styles. Mothers are often the primary caregivers responsible for infant feeding and thus influence infant eating behaviors and food preferences [26,45]. This makes mothers important targets for understanding infant snacking and reasons for offering snacks during this early developmental period. Child eating behaviors and food preferences are influenced by the types and amounts of foods made available and through feeding styles and practices [26,45,46]. Feeding styles, which caregivers develop during the first year of an infant's life [47], include the attitudes and behaviors used by caregivers to influence eating behaviors [48]. One study with low-income mothers found that caregiver feeding styles were differentially associated with infant growth and dietary intake [49]. For example, this study found that pressuring (e.g., using food to soothe) and indulgent (e.g., setting no limits on the types and amounts of food) caregiver feeding styles were associated with higher energy intake. The same study found that caregiver restriction, (e.g., setting limits on the types and amounts of food) was associated with lower energy intake. A previous study also

found that pressuring was associated with earlier solid food introduction [50]. In older children, caregiver feeding styles that use food to reward behavior or to regulate emotions have been associated with higher energy-dense snack intake by the child [51]. While the literature on infant feeding by caregivers is rapidly growing, little is known about how caregiver feeding styles might influence the timing and types of snacks introduced during infancy making this an important area of study.

Commercial Infant Foods & Snacks - Infant Diet

Commercial Infant Food and Snacks. Caregivers of infants are exposed to a wide variety of commercially available complementary foods, which are foods and snacks marketed to the parents of infants between 4 and 12 months of age. Commercial infant foods and snacks are mass-produced and are generally ready-to-eat or require minimal preparation [52], and the marketing of these foods has increased in recent decades [38]. Commercial infant foods (e.g., fruit and vegetable purees and iron-fortified infant cereals) are generally nutrient-dense, do not include added sugars, and are low in sodium [53,54]. A recent study found that infants who consumed commercial infant foods (e.g., fruit, vegetable, and dinner purees) had better diet quality compared with infants who did not consume these foods [55]. However, this study did not include commercial infant snacks (e.g., puffs, melts, and cookies), which are often consumed during infancy [56] and are associated with poor diet quality [57]. Findings from studies assessing the nutritional content of commercial infant and toddler snacks show that these foods are often high in added sugars, sodium, and refined grains [37,58], which are recommended to avoid or to limit during this early developmental period [4].

Commercial Infant Foods and Snacks – Retail Food Environment. Data suggest that parents and caregivers of infants experience challenges adhering to infant feeding guidelines [59] and choosing nutrient-dense complementary foods [60]. Some low-income caregivers report that several factors influence their complementary food choices including the availability, price, perceived nutritional quality, and perceived likability [60]. Low-income caregivers often have less access to retail food stores (e.g., supermarkets) that sell a wide variety of competitively priced healthy foods [61,62], which may impact the types of complementary foods provided. For example, diverse low-income communities often have fewer large retail food stores and more convenience stores compared to higher-income communities [61–63]. Some studies have examined the availability and nutritional content of commercial infant foods and snacks in the US more broadly [38,53,54], and one study examined the availability and nutritional content of toddler foods in low-income compared to high-income communities [64]. The availability and price of healthful foods in retail food stores in low-income communities may impact a caregiver’s ability to make healthful choices [61,62], and therefore examining the availability and price of infants foods and snacks in these communities may be important for understanding factors that influence infant health during complementary feeding and beyond.

5. CONCLUSION

The introduction of nutrient-dense complementary foods is essential for optimal infant growth and development during infancy [4,28]. Early exposures to complementary foods shape the development of infant food preferences and eating behaviors, and subsequent dietary patterns and health outcomes [25,65]. Studies show

that the intake of nutrient-dense foods (fruits and vegetables [66]), as well as the intake of nutrient-poor foods (sweet desserts [67]) during infancy, are associated with greater intake of these foods in early childhood. Recent increases in childhood obesity coincide with increases in nutrient-poor snack intake, snack marketing, and the overall calorie contribution from snacks [38–40], with the greatest increases in populations most at risk for childhood obesity, including low-income and non-Hispanic Black and Hispanic households [36,40]. This is also concerning given that nutrient-poor snacks may displace healthier nutrient-dense foods. Given that food preferences and eating behaviors develop during infancy and often persist into adulthood,[27,68] understanding the impact of nutrient-poor snacks on infant weight trajectories as well as factors that influence caregiver snack choices during infancy are important. Therefore, the broad aim of this dissertation research project was to conduct three studies to explore the influence of parent and community factors on snacking during infancy among low-income families.

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APPENDIX A

Secondary Data Analysis Plan (Aim 1)

Aim 1 - Secondary Data Analysis Plan

1. Research Aim/Question:

- a. To describe snack foods offered to infants during the first year of life in low-income families.
- b. To what extent are infant snack foods associated with WFL z-scores at 12 months of age.

2. Hypothesis:

- a. Infant snack foods (teething biscuits, puffs, melts) and sweets (cakes, cookies, candies) will be positively associated with WFL z-scores.

3. Methods:

- a. Descriptives of mothers/infants (sociodemographic factors).
- b. Descriptives (prevalence) of infant foods at 3, 6, 9, and 12 months.
- c. Multilevel Growth Curve Models

4. Items/Measures:

- a. Exposure variable: Snack foods offered between 3, 6, 9, and 12 months
 - i) Infant snack foods (teething biscuits, puffs, melts)
 1. Item C191 at 3, 6, 9, and 12 months
 2. Stratification: none, sometime, often
 - ii) Sweets (cakes, cookies, and candies)
 1. Item C192 at 3, 6, 9, and 12 months
 2. Stratification: none, sometimes, often
- b. Outcome variable: WFL z-scores at 3, 6, 9, and 12 months
 - i) Collected using standardized procedures
 - ii) Calculated using WHO 2006 international growth standards
 - a. Centers for Disease Control, Use of WHO and CDC growth charts for children aged 0-59 months in the United States: Recommendations and reports, MMWR (2010), 1-14.
- c. Confounding variables: assess maintain if theoretically relevant or explain 10%
 - i) infant birth weight
 - ii) infant sex
 - iii) maternal race
 - iv) maternal BMI (pre-post pregnancy)
 - v) maternal smoking status
 - vi) infant feeding (breast milk, formula, or mixed)

5. Planned Tables:

- a. Table 1. Participant sociodemographics
- b. Table 2. Food and beverages consumed
- c. Table 3. Correlation table – foods and beverages
- d. Table 4. Growth model results
- e. Figure 1. Growth model results

6. Analysis Plan:

- a. Descriptive characteristics of mother-infant dyads will be calculated, including means (standard deviations) or medians (interquartile range) for continuous variables, and frequencies (percentages) for categorical variables.

- c. Descriptive characteristics for foods and beverages consumed at 3, 6, 9, 12 months and categorize snack consumption (none, sometime, often).
 - d. Multilevel Growth Curve Models
 - a. Examine associations between infant snacking at each time point (0-3, 4-6, 7-9, 10-12 months of age) and WFL z-scores at each time point (0-3, 4-6, 7-9, 10-12 months of age). Possibly exclude 0-3 months pending distribution.
 - b. Overall result – association over the entire first year
 - c. Interactions - time by snack category to assess differences across time points
- 7. Proposed Journals:**
- a. TBD
- 8. Proposed Co-authors:**
- a. Amy Moore
 - b. Maya Vadiveloo
 - c. Karen McCurdy
 - d. Sara Benjamin Neelon & Nurture team
 - e. Alison Tovar
- 9. Brief References**
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APPENDIX B

Study Recruitment Flyer (Aim 2)

Dr. Alison Tovar and Amy Moore from the University of Rhode Island are conducting a study for mothers with infants between 3 to 6 months old.

The study provides an opportunity to talk about infant snack foods and snacking.

The study includes two visits – each visit will last about 60 minutes. You will receive \$60.00 for your time!

APPENDIX C

Participant Consent Form (Aim 2)

**THE
UNIVERSITY
OF RHODE ISLAND**

**COLLEGE OF
HEALTH SCIENCES**

DEPARTMENT OF NUTRITION AND FOOD SCIENCES

125 Fogarty Hall, Kingston, RI 02881 USA

p: 401.874.2253

f: 401.874.5974

web.uri.edu/mfs

Consent Form for Research

BACKGROUND

You are being asked to take part in a research study. Before you decide to participate, it is important for you to understand why this research is being done and what it will involve. Please take time to read the following information carefully. Please ask if there is anything that is not clear or if you would like more information. If you have more questions later, Alison Tovar or Amy Moore from the Department of Nutrition and Food Sciences at the University of Rhode Island, the persons mainly responsible for this study, will discuss them with you.

The purpose of this research study is to understand your thoughts and opinions on infant snack foods and snacking during the first year of life, and to understand if grocery stores in your community offer infant snack foods. You are being asked to participate because you are at least 18-years old and have an infant between the ages of 3 and 8 months old. We are asking you to participate in two, 60 minute interviews and complete surveys about your family.

STUDY PROCEDURES

It will take approximately 2 hours to complete this study. As part of this study you will be asked to take part in two, 60 minute interviews. Questions will be asked about your thoughts and opinions on infant snack foods and snacking during the first-year life. The first interview will take place when your infant is about 6 to 8 months old. The second interview will take place when your infant is about 12 months old. Both interviews will be scheduled at a convenient time for you and your family. You will also be asked to complete surveys about how you feed your infant and about your family (including ages, family income, and your education). Free childcare will be available during both interviews, if needed. You will also be asked to provide the name and location of the grocery store you shop at most often.

Both interviews will be audio recorded and transcribed by the researchers. Audio recordings will be labeled with a code that is linked to your identity. Audio recordings and transcriptions will be kept in a locked filing cabinet and on a password protected computer in Fogarty Hall, room 119. Upon completion of the study recordings and transcriptions will be archived, and destroyed after 3 years.

RISKS

The risks of this study are minimal. You may feel upset thinking about or talking about personal information related to infant snack foods and snacking. These risks are similar to those you experience when discussing personal information with others. If you feel upset from this experience, you can tell the researcher, and she will tell you about resources available to help.

BENEFITS

There is no benefit to you from being in the study. Your taking part may help develop a greater understanding of mother's thoughts and opinions about infant snack foods and snacking during the first year of life.

The University of Rhode Island is an equal opportunity employer committed to community, equity, and diversity and to the principles of affirmative action.

IRB NUMBER: HU1718-071
IRB APPROVAL DATE: December 21, 2018
IRB EXPIRATION DATE: December 21, 2019

CONFIDENTIALITY

We will keep all research records that identify you private to the extent allowed by law. Records and audio recordings about you will be kept in a locked filing cabinet and on a password protected computer in Fogarty Hall, room 119. Only those who work with this study or are performing their job duties for the University of Rhode Island will be allowed access to your information. Your name will not be kept with your responses from the interviews and short survey. In publications, your name will be removed.

PERSONS TO CONTACT

If you have any questions, complaints or concerns about your participation in this research study, you can contact Dr. Alison Tovar by phone at (401) 874-9855 or by email at alison_tovar@uri.edu. You can also contact Amy Moore by phone at (740) 591-7984 or by email at amy_moore@uri.edu at any time.

Institutional Review Board: Contact the Institutional Review Board (IRB) if you have questions regarding your rights as a research participant. Also, contact the IRB if you have questions, complaints or concerns that you do not feel you can discuss with the investigators. The University of Rhode Island IRB may be reached by phone at (401) 874-4328 or by e-mail at researchintegrity@etal.uri.edu.

Vice President for Research and Economic Development: You may also contact the Vice President for Research and Economic Development by phone at (401) 874-4576.

VOLUNTARY PARTICIPATION

Research studies include only people who choose to take part. You can tell us that you do not want to be in this study. You can start the study and then choose to stop the study later. This will not affect your relationship with the investigator.

COMPENSATION TO PARTICIPANTS

You will receive a \$30.00 supermarket gift card for your participation in each interview. In total, you will receive \$60.00 in supermarket gift cards if you complete both interviews.

CONSENT

By signing this consent form, I confirm I have read the information in this consent form and have had the opportunity to ask questions. I will be given a signed copy of this consent form. I voluntarily agree to take part in this study.

Printed Name of Participant

Signature of Participant

Date

Printed Name of Person Obtaining Consent

Signature of Person Obtaining Consent

Date

THE
UNIVERSITY
OF RHODE ISLAND
INSTITUTE OF RESEARCH
AND ECONOMIC
DEVELOPMENT

IRB NUMBER: HU1718-071
IRB APPROVAL DATE: December 21, 2018
IRB EXPIRATION DATE: December 21, 2019

AUDIO ADDENDUM TO THE CONSENT FORM FOR RESEARCH

By signing this consent form, I confirm that I give my permission for audio recording(s) of me, to be used for the purposes listed above, and to be retained for three years.

Printed Name of Participant

Signature of Participant

Date

Printed Name of Person Obtaining Consent

Signature of Person Obtaining Consent

Date

Please sign both consent forms, and keep one for your records.

Permission to Re-contact

Study staff from the Dr. Tovar's Research Group at The University of Rhode Island may want to contact you in the future about new studies we are conducting. Please let us know if you agree or do not agree to being contacted in the future.

Please choose an option below, print and sign your name.

A) I give permission for researchers to contact me in the future for research studies.

PRINT NAME

DATE

SIGN NAME

B) I do **NOT** give permission for researchers to contact me in the future for similar research studies.

IRB NUMBER: HU1718-071
IRB APPROVAL DATE: December 21, 2018
IRB EXPIRATION DATE: December 21, 2019

APPENDIX D

Participant Recruitment Letter (Aim 2)

THE
UNIVERSITY
OF RHODE ISLAND

NUTRITION AND FOOD SCIENCES

125 Fogarty Hall, Kingston, RI 02881 USA p: 401.874.2253 f: 401.874.5974 cels.uri.edu/nfs

Dear Participant:

My name is Amy Moore and I am a graduate student at the University of Rhode Island. I am working with Dr. Alison Tovar, the person in charge of the study, for my final research project. For my final research project, I would like to learn about your thoughts and opinions on infant snacking during the first year of life. Given how essential it is for infants to eat healthy foods for disease prevention, we believe this work is important. Because you are at least 18 years old and have an infant between the ages of 3 and 6 months old, we are inviting you to participate in this research study.

If you agree to be in the research study, we are asking you to participate in two interviews that will last about 60 minutes. In all, it will take about 2 hours of your time to complete the study and you will get \$30.00 for each interview you complete (total is \$60.00). We will set up a convenient time and location for us to meet for both interviews. Complimentary childcare will be available during our interviews, if needed.

Thank you for your interest in participating in this research project. Your input will help us understand more about your thoughts and opinions on infant snack foods. I am more than happy to set-up a time to talk more about the study. If you have any questions, you can reach Dr. Alison Tovar at (401) 874-9855 or alison_tovar@uri.edu. I can be reached at (740) 591-7984 or amy_moore@uri.edu. Thank you for your time.

Sincerely,

Amy Moore, MS
Student Investigator/Researcher

University of Rhode Island
Department of Nutrition
119 Fogarty Hall
Kingston, RI 02881
Phone: (740) 591-7984
Email: amy_moore@uri.edu

Alison Tovar, PhD, MPH
Principle Investigator/Researcher

University of Rhode Island
Department of Nutrition
143C Fogarty Hall
Kingston, RI 02881
Phone: (401) 874-9855
Email: alison_tovar@uri.edu

APPENDIX E

Screening Questionnaire (Aim 2)

Researcher: Please read the following to the participant and fill-in the appropriate answers.

My name is Amy Moore and I am a graduate student at the University of Rhode Island. I am working on my final research project, and I would like to learn about your thoughts and opinions on snacking during the first year of your son or daughter's life.

This study includes two, one-hour interviews on infant snacking. It will take about 2 hours of your time to complete the study. We will set up a convenient time and location to meet for both sessions. Complimentary childcare can be made available during our sessions. You will be given a \$30.00 in grocery gift card after each session, for a total of \$60.00 for both sessions.

Is this something you would be interested in?

If no, thank the participant for her time.

If yes, proceed below.

Researcher: I'll just ask you a few questions to see if you are eligible?

1. What is your age? _____
2. Do you have an infant between 3 and 6 months old, who lives with you most of the time?
☐ Yes
☐ No
3. Does your infant have a diagnosed feeding disorder (e.g., failure to thrive, oral motor skills delay)?
☐ Yes
☐ No
4. Does your infant have dietary restrictions or a medical condition that impacts the way you feed him/her (e.g., dysphagia or swallowing disorders, gastrointestinal problems)?
☐ Yes
☐ No
5. Does the participant speak English?
☐ Yes
☐ No

If item 1 = ≥ 18 years, items 2 and 5 = yes and items 3 and 4 = no; participant is eligible.

Participant Eligible: ☐ YES ☐ NO

If **NO**, thank participant for their time.

If **YES**, you are eligible to participate.

Let's schedule a convenient day and time for your first interview.

FYI: Interviews will be conducted when the participant's son or daughter is 6 months and 12 months old. Both interviews should be scheduled within ± 2 weeks of infant turning 6 months (or immediately if infant is over 6 months) and 12 months.

Infant DOB: ____ month / ____ day / ____ year (see above for scheduling session)

Interview Date/Time: _____

Location: _____

Contact #: _____

Do you prefer *phone call* or a *text message* (circle one) to remind you of our appointment?

What is the best time to reach you? _____

Additional Contact: email _____ FB _____

Would you like childcare during our interviews? ☐ YES ☐ NO

If yes, which interviews? 6 months 12 months (circle all that apply)

How many children? _____ What ages? _____

Researcher: I will call you one week prior to our scheduled interview to remind you of our session.
Thank you for your time - I look forward to talking with you again soon.

APPENDIX F

6 Month Interview Guide (Aim 2)

Screening # _____ / Participant # _____

6 Month Interview Guide

Thank you for meeting with me today – I appreciate your time. My name is Amy Moore and I am graduate student at the University of Rhode Island. I am interested in your thoughts, opinions, and experiences around infant snacking. My hope is that our talks will help me have a better understanding of snacking during the first year of an infant's life.

Our talk today will include questions about infant snacking and infant snacks foods. Our goal will be to talk about snacking and infant snack foods you may have offered your infant from birth until now (that is, from birth until about 6 months old). Keep in mind that there are no right or wrong answers, and your answers will be kept private (*review confidentiality*). Our talk will last about 45 minutes and will be recorded.

What questions might you have? (*answer any questions*) Okay, let's get started.

Interview Guide

We will start by talking about typical day in your child's life and your thoughts on parenting.

1. Tell me about a typical day in your child's life?
2. What are some of your favorite things about parenting? Least favorite?
3. Is there anything specifically that you are trying to teach your child right now?
 - a. Do you have any specific goals or hopes for your child's future?
4. What are some of his/her favorite foods?

As a reminder, these next questions are asking about snacking from birth until about 6 months.

1. What does the word "snack" mean to you?
2. What are some examples of snacks at this age?
3. How are snacks different from a meal?
4. How did you decide when to start offering your child snacks?

*If participant **has not** offered her child snacks, continue with part A:*

PART A:

- a. Tell me more about how you made this decision [to not offer snacks]?
- b. Who helped you make this decision? Do you think snacks are necessary?
- c. What are your next steps for offering snacks to your child? (probes: when? what?)

INTERVIEW COMPLETE FOR MOTHERS WHO HAVE NOT OFFERED SNACKS

*If participant **has** offered her child snacks, continue with part B (#1 below):*

PART B:

1. Tell me about who decides when your child has a snack? (probes: other caretakers? doctors?)
2. Tell me about who decides what snacks to offer?
3. Tell me about your first experience with infant snacks?
 - a. Why did you offer your child a snack? (probe: fussy? hungry?)
 - b. What kinds of foods do you offer your infant for snacks?
 - c. Tell me about your infant's favorite snack.
 - d. How does (s/he) respond when you offer a snack?
4. Who decides how much your infant eats for a snack?
 - a. Tell me about how (you/they) made that decision.
5. Where does your infant have his/her snack? (probe: at home, on the go, daycare)
6. Where do you typically purchase snacks for your infant?
 - a. How do you decide what snacks to purchase?
7. *If your infant is in daycare, what types of snacks do you send for him/her?*
 - a. Does your daycare have rules about the types of snacks you can send?

Now let's talk about snack foods made specifically for infants (show list of foods).

8. What are your thoughts on snack foods made for infants (e.g., snack pouches, puffs)?
 - a. Here is a list of common snack foods made specifically for infants:
 - i. Which of these snack foods have you heard about?
 - ii. Tell me what you think about these snack foods?
 - iii. Which of these snack foods have you offered to your infant?

The following questions should be asked if time permits (i.e., interview <45 minutes)

1. When you think about feeding your child/infant what comes to mind?
2. If it were up to you, what would be an ideal way to feed your child?
3. As a parent, what values do you have when thinking about feeding your child?
4. What do you think is most important to you when thinking about feeding your child?
 - a. probes: To just eat so they can grow/share family meals
5. What factors do you think will influence what/how you feed your infant/child?
6. When you think about your child's health, what are your goals for your child?

Tell Participant: We will take a few minutes to look at examples of snack foods made for infants. I am interested if you have seen these products, or products like these in the stores where you shop, and if you have purchased these snack foods for your infant. I would also like to know more about why you purchased these products (if applicable).

A. Baby Puffs

Seen in stores? ___ Yes or ___ No

Offered to infant? ___ Yes or ___ No

If Yes, at what age? _____

Where? _____

Why? _____

B. Baby Melts

Seen in stores? ___ Yes or ___ No

Offered to infant? ___ Yes or ___ No

If Yes, at what age? _____

Where? _____

Why? _____

C. Baby Crunchies (Finger Puffs)

Seen in stores? ___ Yes or ___ No

Offered to infant? ___ Yes or ___ No

If Yes, at what age? _____

Where? _____

Why? _____

D. Baby Teething Biscuits

Seen in stores? ___ Yes or ___ No

Offered to infant? ___ Yes or ___ No

If Yes, at what age? _____

Where? _____

Why? _____

Version 06.27.18

APPENDIX G

6 Month Sociodemographic Questionnaire (Aim 2)

Screening # _____ / Participant # _____

Sociodemographic Questionnaire – Administered at 6 Month Interview

Researcher: Please read the following items to the participant and check the appropriate box(es).

Mother/Family Characteristics

I have a few questions about you and your family; this will take about 5 minutes to complete.

1. What is your DOB? _____. Age _____.
2. Do you consider yourself Hispanic or Latina? Please select one.
 - ☐ Yes
 - ☐ No
3. How would you best describe your race? Please select all that apply.
 - ☐ White
 - ☐ African American or Black
 - ☐ American Indian or Alaska Native
 - ☐ Asian
 - ☐ Pacific Islander or Hawaiian Native
 - ☐ Other (please specify: _____)
4. How would you describe your current relationship status? Please select one.
 - ☐ Single
 - ☐ Married/Partnered
 - ☐ Separated/Divorced
 - ☐ Widowed
5. How would you describe your current employment status? Please select one.
 - ☐ Full-time
 - ☐ Part-time
 - ☐ Not employed
 - ☐ Retired
 - ☐ Other: _____
6. What was your household income before taxes during the previous year (e.g., 2016)? Select one.
 - ☐ ≤ \$20,000
 - ☐ \$20,001 to \$30,000
 - ☐ \$30,001 to \$40,000
 - ☐ ≥ \$40,001

Screening # _____ / Participant # _____

7. How would you describe the highest-grade level you completed? Please select one.

- ☐ Some high school
- ☐ High school diploma or GED
- ☐ Some college
- ☐ College degree
- ☐ Graduate degree

8. Do you currently receive WIC benefits?

- ☐ Yes
- ☐ No

9. Do you currently receive SNAP benefits?

- ☐ Yes
- ☐ No

10. Including yourself, how many people live in your household? _____

8a. How many of the above (say number) are family members/relatives? _____

8b. How many of the above (say number) are friends? _____

11. How many children under the age of 18 live in your household? _____

a. What are their ages (in months/years)? Child 1: _____ (target infant)

Child 2: _____

Child 3: _____

Child 4: _____

Child 5: _____

12. What is your height? _____ ft. _____ in.

13. What is your current weight? _____ lbs.

14. What was your pre-pregnancy weight? _____ lbs.

Infant Characteristics

15. What is your baby's (Child 1 above) gender?
- ☐ Male
- ☐ Female
16. Do you consider him/her Hispanic or Latina/o? Please select one.
- ☐ Yes
- ☐ No
17. How would you best describe his/her race? Please select all that apply.
- ☐ White
- ☐ African American or Black
- ☐ American Indian or Alaska Native
- ☐ Asian
- ☐ Pacific Islander or Hawaiian Native
- ☐ Other (please specify: _____)
18. What is his/her height/length? _____ (note units mother reports)
19. What is his/current weight? _____ (note units mother reports)
20. What did he/she weigh at birth? _____ (note units mother reports)

Infant Feeding Questions

Now I have a few questions about the first foods you gave your baby (insert name of child).

1. Was your baby ever breastfed or fed breast milk?
- ☐ Yes If yes, how long (convert to weeks)? _____
- ☐ No
- ☐ Don't know.
2. Are you currently breastfeeding?
- ☐ Yes If yes, how much longer do you intend to breast feed (convert to weeks)? _____
- ☐ No
- ☐ Don't know.
3. How old was your baby when you stopped breast feeding?
- Age in months _____ or Age in weeks _____ or DK/Can't Recall _____

Screening # _____ / Participant # _____

4. Was your baby ever fed formula?

- ☐ Yes If yes, how long (convert to weeks)? _____
- ☐ No
- ☐ Don't know.

5. Are you currently feeding your baby formula?

- ☐ Yes If yes, how much longer do you intend to feed formula (convert to weeks)? _____
- ☐ No
- ☐ Don't know.

6. How old was your baby when you stopped breast feeding?

Age in months _____ or Age in weeks _____ or DK/Can't Recall _____

7. When did your baby start eating something other than breastmilk or formula?

- ☐ Has not started yet
- ☐ 1 month
- ☐ 2 months
- ☐ 3 months
- ☐ 4 months
- ☐ 5 months
- ☐ 6 months

8. What types of foods does your baby eat? (only if Q1 is 1-6 months; check all that apply)

- ☐ baby foods (___ cereal, ___ fruits, ___ veggies, ___ meats, ___ desserts, ___ baby snacks)
- ☐ table foods (___ mashed/blended, ___ finely chopped, ___ coarsely chopped/sliced)
- ☐ Other: _____

9. Where does your baby normally eat? (check all that apply)

- ☐ in bed/crib
- ☐ in car seat
- ☐ in caregiver's arms/lap
- ☐ in a high chair
- ☐ at home
- ☐ at childcare
- ☐ Other: _____

10. Do you often worry about how much your baby is eating?

☐ No

☐ Yes, please explain: _____

11. Please think about everything your baby has eaten – even foods that someone else might have fed him or her. How often was he or she fed it, on average, during the month.

	Baby Birth to 3 Months Old	Baby 4 to 6 Months Old
11A. Fruit	☐ ₀ Never ☐ ₁ Just to try it ☐ ₂ Sometimes but less than once/day ☐ ₃ 1 time/day ☐ ₄ 2 times/day ☐ ₅ 3 times/day ☐ ₆ 4 times/day ☐ ₇ 5 or more times/day	☐ ₀ Never ☐ ₁ Just to try it ☐ ₂ Sometimes but less than once/day ☐ ₃ 1 time/day ☐ ₄ 2 times/day ☐ ₅ 3 times/day ☐ ₆ 4 times/day ☐ ₇ 5 or more times/day
11B. Vegetables (not including french fries)	☐ ₀ Never ☐ ₁ Just to try it ☐ ₂ Sometimes but less than once/day ☐ ₃ 1 time/day ☐ ₄ 2 times/day ☐ ₅ 3 times/day ☐ ₆ 4 times/day ☐ ₇ 5 or more times/day	☐ ₀ Never ☐ ₁ Just to try it ☐ ₂ Sometimes but less than once/day ☐ ₃ 1 time/day ☐ ₄ 2 times/day ☐ ₅ 3 times/day ☐ ₆ 4 times/day ☐ ₇ 5 or more times/day
11C. Baby snack foods (teething biscuits, puffs, melts, Baby Mum-Mums)	☐ ₀ Never ☐ ₁ Just to try it ☐ ₂ Sometimes but less than once/day ☐ ₃ 1 time/day ☐ ₄ 2 times/day ☐ ₅ 3 times/day ☐ ₆ 4 times/day ☐ ₇ 5 or more times/day	☐ ₀ Never ☐ ₁ Just to try it ☐ ₂ Sometimes but less than once/day ☐ ₃ 1 time/day ☐ ₄ 2 times/day ☐ ₅ 3 times/day ☐ ₆ 4 times/day ☐ ₇ 5 or more times/day
11D. Cakes, cookies, or candy	☐ ₀ Never ☐ ₁ Just to try it ☐ ₂ Sometimes but less than once/day ☐ ₃ 1 time/day ☐ ₄ 2 times/day ☐ ₅ 3 times/day ☐ ₆ 4 times/day ☐ ₇ 5 or more times/day	☐ ₀ Never ☐ ₁ Just to try it ☐ ₂ Sometimes but less than once/day ☐ ₃ 1 time/day ☐ ₄ 2 times/day ☐ ₅ 3 times/day ☐ ₆ 4 times/day ☐ ₇ 5 or more times/day
11E. French fries, tator tots, or other fried potatoes	☐ ₀ Never ☐ ₁ Just to try it ☐ ₂ Sometimes but less than once/day ☐ ₃ 1 time/day ☐ ₄ 2 times/day ☐ ₅ 3 times/day ☐ ₆ 4 times/day ☐ ₇ 5 or more times/day	☐ ₀ Never ☐ ₁ Just to try it ☐ ₂ Sometimes but less than once/day ☐ ₃ 1 time/day ☐ ₄ 2 times/day ☐ ₅ 3 times/day ☐ ₆ 4 times/day ☐ ₇ 5 or more times/day

Screening # _____ / Participant # _____

	Baby Birth to 3 Months Old	Baby 4 to 6 Months Old
11F. Yogurt or cheese	☐ ₀ Never ☐ ₁ Just to try it ☐ ₂ Sometimes but less than once/day ☐ ₃ 1 time/day ☐ ₄ 2 times/day ☐ ₅ 3 times/day ☐ ₆ 4 times/day ☐ ₇ 5 or more times/day	☐ ₀ Never ☐ ₁ Just to try it ☐ ₂ Sometimes but less than once/day ☐ ₃ 1 time/day ☐ ₄ 2 times/day ☐ ₅ 3 times/day ☐ ₆ 4 times/day ☐ ₇ 5 or more times/day
11G. Ice cream or pudding	☐ ₀ Never ☐ ₁ Just to try it ☐ ₂ Sometimes but less than once/day ☐ ₃ 1 time/day ☐ ₄ 2 times/day ☐ ₅ 3 times/day ☐ ₆ 4 times/day ☐ ₇ 5 or more times/day	☐ ₀ Never ☐ ₁ Just to try it ☐ ₂ Sometimes but less than once/day ☐ ₃ 1 time/day ☐ ₄ 2 times/day ☐ ₅ 3 times/day ☐ ₆ 4 times/day ☐ ₇ 5 or more times/day
11H. Breakfast cereals, crackers, bread, pasta, rice	☐ ₀ Never ☐ ₁ Just to try it ☐ ₂ Sometimes but less than once/day ☐ ₃ 1 time/day ☐ ₄ 2 times/day ☐ ₅ 3 times/day ☐ ₆ 4 times/day ☐ ₇ 5 or more times/day	☐ ₀ Never ☐ ₁ Just to try it ☐ ₂ Sometimes but less than once/day ☐ ₃ 1 time/day ☐ ₄ 2 times/day ☐ ₅ 3 times/day ☐ ₆ 4 times/day ☐ ₇ 5 or more times/day

12. At what age did your baby start eating snacks?

- ☐ Has not started yet
- ☐ DK
- ☐ 1 month
- ☐ 2 months
- ☐ 3 months
- ☐ 4 months
- ☐ 5 months
- ☐ 6 months

Household Food Security Survey – Short Form

Researcher: I'm going to read you several statements that people have made about their food situation. For these statements, please tell me whether the statement was often true, sometimes true, or never true for (you/your household) in the last 12 months—that is, since last (name of current month).

1. The food that (I/we) bought just didn't last, and (I/we) didn't have money to get more." Was that often, sometimes, or never true for (you/your household) in the last 12 months?
 - ☐ Often true
 - ☐ Sometimes true
 - ☐ Never true
 - ☐ DK or Refused

2. (I/we) couldn't afford to eat balanced meals. Was that often, sometimes, or never true for (you/your household) in the last 12 months?
 - ☐ Often true
 - ☐ Sometimes true
 - ☐ Never true
 - ☐ DK or Refused

3. In the last 12 months, since last (name of current month), did (you/you or other adults in your household) ever cut the size of your meals or skip meals because there wasn't enough money for food?
 - ☐ Yes
 - ☐ No (Skip 17a)
 - ☐ DK (Skip 17a)

3a. [IF YES ABOVE, ASK] How often did this happen—almost every month, some months but not every month, or in only 1 or 2 months?

 - ☐ Almost every month
 - ☐ Some months but not every month ☐ Only 1 or 2 months
 - ☐ DK

4. In the last 12 months, did you ever eat less than you felt you should because there wasn't enough money for food?
 - ☐ Yes
 - ☐ No
 - ☐ DK

5. In the last 12 months, were you every hungry but didn't eat because there wasn't enough money for food?
 - ☐ Yes ☐ No ☐ DK

APPENDIX H

6 Month Infant Feeding Styles Questionnaire (Aim 2)

Participant #: _____

INFANT FEEDING STYLE QUESTIONNAIRE (IFSQ) – Behavior (1-44) and Beliefs (1-39)							
<p><i>Read to the Participant:</i> I will now read a set of statements. These statements are neither right nor wrong. We just want to know your opinion. Some of these statements may seem similar but are actually different so please listen carefully.</p> <p>GIVE RESPONDENT THE NEVER-ALWAYS AND DISAGREE-AGREE RESPONSE CHARTS AS GUIDE AND GO THROUGH THE RESPONSE CHART READING THE NUMBER AND THE CORRESPONDING RESPONSE TO EACH. Tell me which response best describes how you feel about the statement. I will repeat the response back to you just to make sure I have it recorded correctly.</p>							
Researcher: Place a check in the appropriate response box.	Never	Seldom	Half of the time	Most of the time	Always	Choose not to answer	N/A (not fed to baby yet)
First let's talk about infants... when I say INFANT I'm referring to children from birth to 12 months							
1. I let (name of child) decide how much to eat.	(1)	(2)	(3)	(4)	(5)	(6)	(7)
2. When (name of child) has/had a bottle, I prop/propped it up.	(1)	(2)	(3)	(4)	(5)	(6)	(7)
3. I allow (name of index child) to eat fast foods if s/he wants to do so.	(1)	(2)	(3)	(4)	(5)	(6)	(7)
4. I allow (name of index child) to drink soda or sugared drinks to stop him/her from crying or being fussy.	(1)	(2)	(3)	(4)	(5)	(6)	(7)
5. Name of child watches TV while eating.	(1)	(2)	(3)	(4)	(5)	(6)	(7)
6. I keep track of how much (name of child) eats.	(1)	(2)	(3)	(4)	(5)	(6)	(7)
7. I give/gave (name of child) cereal in the bottle.	(1)	(2)	(3)	(4)	(5)	(6)	(7)
8. I allow (name of index child) to eat desserts or sweets if s/he wants to do so.	(1)	(2)	(3)	(4)	(5)	(6)	(7)
9. I carefully control how much (name of child) eats.	(1)	(2)	(3)	(4)	(5)	(6)	(7)
10. I watch TV while feeding (name of child).	(1)	(2)	(3)	(4)	(5)	(6)	(7)
11. I allow (name of index child) to eat fast foods to make sure s/he eats enough.	(1)	(2)	(3)	(4)	(5)	(6)	(7)
12. I try to get (name of child) to eat even if s/he seems not hungry.	(1)	(2)	(3)	(4)	(5)	(6)	(7)
13. If (name of child) will not try a new food that I give him/her, I will work hard to have him/her try it during that meal.	(1)	(2)	(3)	(4)	(5)	(6)	(7)
14. I allow (name of index child) to eat desserts or sweets to make sure s/he eats enough.	(1)	(2)	(3)	(4)	(5)	(6)	(7)
15. I allow (name of index child) to eat in front of the TV if s/he wants to do so.	(1)	(2)	(3)	(4)	(5)	(6)	(7)
16. I am very careful not to feed (name of child) too much.	(1)	(2)	(3)	(4)	(5)	(6)	(7)
17. I allow (name of index child) to eat desserts or sweets to keep him/her happy.	(1)	(2)	(3)	(4)	(5)	(6)	(7)
18. I praise (name of child) after each bite to encourage her/him to finish her/his food.	(1)	(2)	(3)	(4)	(5)	(6)	(7)
19. I allow (name of index child) to eat in front of the TV to get him/her to eat.	(1)	(2)	(3)	(4)	(5)	(6)	(7)
20. I try to get (name of child) to finish his/her food.	(1)	(2)	(3)	(4)	(5)	(6)	(7)
21. I allow (name of index child) to drink soda or sugared drinks to keep him/her happy.	(1)	(2)	(3)	(4)	(5)	(6)	(7)

Participant #: _____

Researcher: Place a check in the appropriate response box.	Disagree	Slightly Disagree	Neutral	Slightly Agree	Agree	Choose not to answer	N/A (not fed to baby yet)
1. When an infant cries it usually means he or she needs to be fed	(1)	(2)	(3)	(4)	(5)	(6)	(7)
2. An infant less than 6 months old needs more than formula or breastmilk to be full	(1)	(2)	(3)	(4)	(5)	(6)	(7)
3. I think it is okay to prop an infant's bottle	(1)	(2)	(3)	(4)	(5)	(6)	(7)
4. Putting cereal in the bottle is good because it helps an infant feel full	(1)	(2)	(3)	(4)	(5)	(6)	(7)
5. The best way to make an infant stop crying is to feed him or her	(1)	(2)	(3)	(4)	(5)	(6)	(7)
6. It's important for the parent to decide how much an infant should eat	(1)	(2)	(3)	(4)	(5)	(6)	(7)
7. It's important that an infant finish all of the milk in his or her bottle	(1)	(2)	(3)	(4)	(5)	(6)	(7)
8. An infant less than 6 months needs more than formula or breastmilk to sleep through the night	(1)	(2)	(3)	(4)	(5)	(6)	(7)
9. Cereal in the bottle will help an infant sleep through the night	(1)	(2)	(3)	(4)	(5)	(6)	(7)
10. An infant should never eat fast food	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Now let's talk about toddlers- by TODDLERS I mean children from 12 months to 2 years of age.							
11. If a toddler wants to eat in front of the TV, he or she should be allowed to do so.	(1)	(2)	(3)	(4)	(5)	(6)	(7)
12. The best way to make a toddler stop crying is to feed him or her	(1)	(2)	(3)	(4)	(5)	(6)	(7)
13. A toddler should never eat sugary food like candy, ice cream, cake and cookies	(1)	(2)	(3)	(4)	(5)	(6)	(7)
14. If a toddler wants to eat fast foods, he or she should be allowed to do so.	(1)	(2)	(3)	(4)	(5)	(6)	(7)
15. A toddler should be allowed to eat desserts or sweets to stop him/her from crying or being fussy.	(1)	(2)	(3)	(4)	(5)	(6)	(7)
16. A toddler should be allowed to eat in front of the TV to get him/her to eat.	(1)	(2)	(3)	(4)	(5)	(6)	(7)
17. A toddler should never eat fast food	(1)	(2)	(3)	(4)	(5)	(6)	(7)
18. A toddler should be allowed to drink soda or sugared drinks to keep him/her happy.	(1)	(2)	(3)	(4)	(5)	(6)	(7)
19. A toddler should be allowed to eat fast foods to make sure he or she eats enough.	(1)	(2)	(3)	(4)	(5)	(6)	(7)
20. It's very important that a toddler finish all the food that is on his or her plate	(1)	(2)	(3)	(4)	(5)	(6)	(7)
21. A toddler should be able to eat whatever he or she wants for snacks	(1)	(2)	(3)	(4)	(5)	(6)	(7)
22. It's okay for a toddler to walk around while eating as long as he or she eats	(1)	(2)	(3)	(4)	(5)	(6)	(7)
23. A toddler should be allowed to eat fast foods to keep him/her happy.	(1)	(2)	(3)	(4)	(5)	(6)	(7)
24. A toddler should be allowed to eat desserts or sweets to keep him/her happy.	(1)	(2)	(3)	(4)	(5)	(6)	(7)

Participant #: _____

Researcher: Place a check in the appropriate response box.	Disagree	Slightly Disagree	Neutral	Slightly Agree	Agree	Choose not to answer	N/A (not fed to baby yet)
25. A toddler should never eat junk food like potato chips, Doritos, and cheese puffs	(1)	(2)	(3)	(4)	(5)	(6)	(7)
26. A toddler should be allowed to drink soda or sugared drinks to stop him/her from crying or being fussy.	(1)	(2)	(3)	(4)	(5)	(6)	(7)
27. A toddler should be allowed to eat in front of the TV to keep him/her happy.	(1)	(2)	(3)	(4)	(5)	(6)	(7)
28. It's important for a parent to have rules about how much a toddler eats	(1)	(2)	(3)	(4)	(5)	(6)	(7)
29. A toddler should be allowed to eat fast foods to stop him/her from crying or being fussy.	(1)	(2)	(3)	(4)	(5)	(6)	(7)
30. If a toddler wants to drink soda or sugared drinks, he or she should be allowed to do so.	(1)	(2)	(3)	(4)	(5)	(6)	(7)
31. A toddler should be allowed to eat desserts or sweets to make sure he or she eats enough	(1)	(2)	(3)	(4)	(5)	(6)	(7)
32. A toddler should be able to eat whatever he or she wants when eating out at a restaurant	(1)	(2)	(3)	(4)	(5)	(6)	(7)
33. A toddler should only eat healthy food	(1)	(2)	(3)	(4)	(5)	(6)	(7)
34. A toddler should be allowed to eat in front of the TV to stop him/her from crying or being fussy.	(1)	(2)	(3)	(4)	(5)	(6)	(7)
35. It's important to help or encourage a toddler to eat	(1)	(2)	(3)	(4)	(5)	(6)	(7)
36. If a toddler wants to eat desserts or sweets, he or she should be allowed to do so.	(1)	(2)	(3)	(4)	(5)	(6)	(7)
37. A toddler should be allowed to drink soda or sugared drinks to make sure he or she drinks enough	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Now let's talk about you and (name of index child).							
38. (Name of child) knows when s/he is full	(1)	(2)	(3)	(4)	(5)	(6)	(7)
39. (Name of child) knows when s/he is hungry and needs to eat	(1)	(2)	(3)	(4)	(5)	(6)	(7)

Participant #: _____

Researcher: Place a check in the appropriate response box.	Never	Seldom	Half of the time	Most of the time	Always	Choose not to answer	N/A (not fed to baby yet)
22. When (name of child) cries, I immediately feed him/her.	(1)	(2)	(3)	(4)	(5)	(6)	(7)
23. If (name of child) seems full, I encourage him/her to finish his/her food anyway.	(1)	(2)	(3)	(4)	(5)	(6)	(7)
24. I allow (name of index child) to eat fast foods to stop him/her from crying or being fussy.	(1)	(2)	(3)	(4)	(5)	(6)	(7)
25. I allow (name of index child) to eat in front of the TV to keep him/her happy.	(1)	(2)	(3)	(4)	(5)	(6)	(7)
26. (Name of child) knows when s/he is full.	(1)	(2)	(3)	(4)	(5)	(6)	(7)
27. I try to get (name of child) to finish his/her breastmilk or formula	(1)	(2)	(3)	(4)	(5)	(6)	(7)
28. I allow (name of index child) to eat in front of the TV to stop him/her from crying or being fussy.	(1)	(2)	(3)	(4)	(5)	(6)	(7)
29. I allow (name of index child) to eat fast foods to keep him/her happy.	(1)	(2)	(3)	(4)	(5)	(6)	(7)
30. I pay attention when (name of child) seems to be telling me that s/he is full or hungry.	(1)	(2)	(3)	(4)	(5)	(6)	(7)
31. I allow (name of index child) to drink soda or sugared drinks if s/he wants to do so.	(1)	(2)	(3)	(4)	(5)	(6)	(7)
32. I talk to (name of child) to encourage him/her to eat.	(1)	(2)	(3)	(4)	(5)	(6)	(7)
33. I allow (name of child) to eat when s/he is hungry.	(1)	(2)	(3)	(4)	(5)	(6)	(7)
34. I allow (name of index child) to eat desserts or sweets to stop him/her from crying or being fussy.	(1)	(2)	(3)	(4)	(5)	(6)	(7)
35. (Name of child) knows when s/he is hungry.	(1)	(2)	(3)	(4)	(5)	(6)	(7)
36. I allow (name of index child) to drink soda or sugared drinks to make sure s/he drinks enough.	(1)	(2)	(3)	(4)	(5)	(6)	(7)
37. I let (name of child) eat junk food like potato chips, Doritos and cheese puffs.	(1)	(2)	(3)	(4)	(5)	(6)	(7)
38. I talk to (name of child) to encourage him/her to drink his/her formula or breastmilk.	(1)	(2)	(3)	(4)	(5)	(6)	(7)
39. I make sure (name of child) does not eat junk food like potato chips, Doritos and cheese puffs.	(1)	(2)	(3)	(4)	(5)	(6)	(7)
40. If (name of child) will not try a new food I've given him/her, I will try it again with him/her later on.	(1)	(2)	(3)	(4)	(5)	(6)	(7)
41. I let (name of child) eat fast food.	(1)	(2)	(3)	(4)	(5)	(6)	(7)
42. I show (name of child) how to eat by taking a bite myself, or pretending to take a bite.	(1)	(2)	(3)	(4)	(5)	(6)	(7)
43. I make sure (name of child) does not eat sugary food, like candy, ice cream, cakes or cookies.	(1)	(2)	(3)	(4)	(5)	(6)	(7)
44. I keep track of what food (name of child) eats.	(1)	(2)	(3)	(4)	(5)	(6)	(7)

APPENDIX I

12 Month Interview Guide (Aim 2)

Screening # _____ / Participant # _____

12 Month Interview Guide

Thank you for meeting with me today – I appreciate your time. My name is Amy Moore and I am graduate student at the University of Rhode Island. I am interested in your thoughts, opinions, and experiences around infant snacking and infant snack foods. My hope is that our talks will help me have a better understanding of snacking during the first year of an infant's life.

Our talk today will include questions about infant snacking and infant snacks foods. Our goal will be to talk about snacking and infant snack foods you may have offered your infant from the last time we met (that is, about 6 months old) until now (about 12 month old). Keep in mind that there are no right or wrong answers, and your answers will be kept private (*review confidentiality*). Our talk will last about 45 minutes and will be recorded.

What questions might you have? (*answer any questions*) Okay, let's get started.

Interview Guide

We will start by talking about typical day in your child's life and your thoughts on parenting.

1. Tell me about a typical day in your child's life?
2. What are some of your favorite things about parenting? Least favorite?
3. Is there anything specifically that you are trying to teach your child right now?
 - a. Do you have any specific goals or hopes for your child's future?
4. What are some of his/her favorite foods?

As a reminder, these next questions are asking about snacking from 6 months old until now.

1. What does the word "snack" mean to you?
2. What are some examples of snacks at this age?
3. How are snacks different from a meal?
4. How did you decide when to start offering your child snacks?

*If participant **has not** offered her child snacks, continue with part A:*

PART A:

- a. Tell me more about how you made this decision [to not offer snacks]?
- b. Who helped you make this decision? Do you think snacks are necessary?
- c. What are your next steps for offering snacks to your child? (probes: when? what?)

INTERVIEW COMPLETE FOR MOTHERS WHO HAVE NOT OFFERED SNACKS

Version 06.27.18

*If participant **has** offered her child snacks, continue with part B (#1 below):*

PART B:

1. Tell me about who decides when your child has a snack? (probes: other caretakers? doctors?)
2. Tell me about who decides what snacks to offer?
3. Tell me about your first experience with infant snacks?
 - a. Why did you offer your child a snack? (probe: fussy? hungry?)
 - b. What kinds of foods do you offer your infant for snacks?
 - c. Tell me about your infant's favorite snack.
 - d. How does (s/he) respond when you offer a snack?
4. Who decides how much your infant eats for a snack?
 - a. Tell me about how (you/they) made that decision.
5. Where does your infant have his/her snack? (probe: at home, on the go, daycare)
6. Where do you typically purchase snacks for your infant?
 - a. How do you decide what snacks to purchase?
7. *If your infant is in daycare*, what types of snacks do you send for him/her?
 - a. Does your daycare have rules about the types of snacks you can send?

Now let's talk about snack foods made specifically for infants (show list of foods).

8. What are your thoughts on snack foods made for infants (e.g., snack pouches, puffs)?
 - a. Here is a list of common snack foods made specifically for infants:
 - i. Which of these snack foods have you heard about?
 - ii. Tell me what you think about these snack foods?
 - iii. Which of these snack foods have you offered to your infant?

The following questions should be asked if time permits (i.e., interview <45 minutes)

1. When you think about feeding your child/infant what comes to mind?
2. If it were up to you, what would be an ideal way to feed your child?
3. As a parent, what values do you have when thinking about feeding your child?
4. What do you think is most important to you when thinking about feeding your child?
 - a. probes: To just eat so they can grow/share family meals
5. What factors do you think will influence what/how you feed your infant/child?
6. When you think about your child's health, what are your goals for your child?

Tell Participant: We will take a few minutes to look at examples of snack foods made for infants. I am interested if you have seen these products, or products like these in the stores where you shop, and if you have purchased these snack foods for your infant. I would also like to know more about why you purchased these products (if applicable).

A. Baby Puffs

Seen in stores? ___ Yes or ___ No

Offered to infant? ___ Yes or ___ No

If Yes, at what age? _____

Where? _____

Why? _____

B. Baby Melts

Seen in stores? ___ Yes or ___ No

Offered to infant? ___ Yes or ___ No

If Yes, at what age? _____

Where? _____

Why? _____

C. Baby Crunchies (Finger Puffs)

Seen in stores? ___ Yes or ___ No

Offered to infant? ___ Yes or ___ No

If Yes, at what age? _____

Where? _____

Why? _____

D. Baby Teething Biscuits

Seen in stores? ___ Yes or ___ No

Offered to infant? ___ Yes or ___ No

If Yes, at what age? _____

Where? _____

Why? _____

Version 06.27.18

APPENDIX J

12 Month Sociodemographic Questionnaire (Aim 2)

Screening # _____ / Participant # _____

Sociodemographic Questionnaire – Modified 12 Month Interview

Mother/Family Characteristics

I have a few questions about you and your family, this will take about 5 minutes to complete.

1. How would you describe your current relationship status? Please select one.
 - ☐ Single
 - ☐ Married/Partnered
 - ☐ Separated/Divorced
 - ☐ Widowed
2. How would you describe your current employment status? Please select one.
 - ☐ Full-time
 - ☐ Part-time
 - ☐ Not employed
 - ☐ Retired
 - ☐ Other: _____
3. What was your household income before taxes during the previous year (e.g., 2016)? Select one.
 - ☐ ≤ \$20,000
 - ☐ \$20,001 to \$30,000
 - ☐ \$30,001 to \$40,000
 - ☐ ≥ \$40,001
4. How would you describe the highest-grade level you completed? Please select one.
 - ☐ Some high school
 - ☐ High school diploma or GED
 - ☐ Some college
 - ☐ College degree
 - ☐ Graduate degree
5. Do you currently receive WIC benefits?
 - ☐ Yes
 - ☐ No
6. Do you currently receive SNAP benefits?
 - ☐ Yes
 - ☐ No

Screening # _____ / Participant # _____

7. Including yourself, how many people live in your household? _____
- 8a. How many of the above (say number) are family members/relatives? _____
- 8b. How many of the above (say number) are friends? _____
8. How many children under the age of 18 live in your household? _____
- a. What are their ages (in months/years)? Child 1: _____ (target infant)
- Child 2: _____
- Child 3: _____
- Child 4: _____
- Child 5: _____
9. What is your height? _____ ft. _____ in.
10. What is your current weight? _____ lbs.

Infant Characteristics

11. What is his/her height/length? _____ (note units mother reports)
12. What is his/current weight? _____ (note units mother reports)

Infant Feeding Questions

Now I have a few questions about the first foods you gave your baby (insert name of child).

1. Was your baby ever breastfed or fed breast milk?
- ☐ Yes If yes, how long (convert to weeks)? _____
- ☐ No
- ☐ Don't know.
2. Are you currently breastfeeding?
- ☐ Yes If yes, how much longer do you intend to breast feed (convert to weeks)? _____
- ☐ No
- ☐ Don't know.
3. How old was your baby when you stopped breast feeding?
- Age in months _____ or Age in weeks _____ or DK/Can't Recall _____

Screening # _____ / Participant # _____

4. Was your baby ever fed formula?
- ☐ Yes If yes, how long (convert to weeks)? _____
 - ☐ No
 - ☐ Don't know.
5. Are you currently feeding your baby formula?
- ☐ Yes If yes, how much longer do you intend to feed formula (convert to weeks)? _____
 - ☐ No
 - ☐ Don't know.
6. How old was your baby when you stopped breast feeding?
- Age in months _____ or Age in weeks _____ or DK/Can't Recall _____
7. When did your baby start eating something other than breastmilk or formula?
- ☐ Has not started yet
 - ☐ 1 month
 - ☐ 2 months
 - ☐ 3 months
 - ☐ 4 months
 - ☐ 5 months
 - ☐ 6 months
8. What types of foods does your baby eat? (only if Q1 is 1-6 months; check all that apply)
- ☐ baby foods (___cereal, ___ fruits, ___ veggies, ___ meats, ___ desserts, ___ baby snacks)
 - ☐ table foods (___ mashed/blended, ___ finely chopped, ___ coarsely chopped/sliced)
 - ☐ Other: _____
9. Where does your baby normally eat? (check all that apply)
- ☐ in bed/crib
 - ☐ in car seat
 - ☐ in caregiver's arms/lap
 - ☐ in a highchair
 - ☐ at home
 - ☐ at childcare
 - ☐ Other: _____

10. Do you often worry about how much your baby is eating?

☐ No

☐ Yes, please explain: _____

11. Please think about everything your baby has eaten – even foods that someone else might have fed him or her. How often was he or she fed it, on average, during the month.

	7 to 9 Months Old	9 to 12 Months Old
11A. Fruit	☐ ₀ Never ☐ ₁ Just to try it ☐ ₂ Sometimes but less than once/day ☐ ₃ 1 time/day ☐ ₄ 2 times/day ☐ ₅ 3 times/day ☐ ₆ 4 times/day ☐ ₇ 5 or more times/day	☐ ₀ Never ☐ ₁ Just to try it ☐ ₂ Sometimes but less than once/day ☐ ₃ 1 time/day ☐ ₄ 2 times/day ☐ ₅ 3 times/day ☐ ₆ 4 times/day ☐ ₇ 5 or more times/day
11B. Vegetables (not including french fries)	☐ ₀ Never ☐ ₁ Just to try it ☐ ₂ Sometimes but less than once/day ☐ ₃ 1 time/day ☐ ₄ 2 times/day ☐ ₅ 3 times/day ☐ ₆ 4 times/day ☐ ₇ 5 or more times/day	☐ ₀ Never ☐ ₁ Just to try it ☐ ₂ Sometimes but less than once/day ☐ ₃ 1 time/day ☐ ₄ 2 times/day ☐ ₅ 3 times/day ☐ ₆ 4 times/day ☐ ₇ 5 or more times/day
11C. Baby snack foods (teething biscuits, puffs, melts, Baby Mum-Mums)	☐ ₀ Never ☐ ₁ Just to try it ☐ ₂ Sometimes but less than once/day ☐ ₃ 1 time/day ☐ ₄ 2 times/day ☐ ₅ 3 times/day ☐ ₆ 4 times/day ☐ ₇ 5 or more times/day	☐ ₀ Never ☐ ₁ Just to try it ☐ ₂ Sometimes but less than once/day ☐ ₃ 1 time/day ☐ ₄ 2 times/day ☐ ₅ 3 times/day ☐ ₆ 4 times/day ☐ ₇ 5 or more times/day
11D. Cakes, cookies, or candy	☐ ₀ Never ☐ ₁ Just to try it ☐ ₂ Sometimes but less than once/day ☐ ₃ 1 time/day ☐ ₄ 2 times/day ☐ ₅ 3 times/day ☐ ₆ 4 times/day ☐ ₇ 5 or more times/day	☐ ₀ Never ☐ ₁ Just to try it ☐ ₂ Sometimes but less than once/day ☐ ₃ 1 time/day ☐ ₄ 2 times/day ☐ ₅ 3 times/day ☐ ₆ 4 times/day ☐ ₇ 5 or more times/day
11E. French fries, tator tots, or other fried potatoes	☐ ₀ Never ☐ ₁ Just to try it ☐ ₂ Sometimes but less than once/day ☐ ₃ 1 time/day ☐ ₄ 2 times/day ☐ ₅ 3 times/day ☐ ₆ 4 times/day ☐ ₇ 5 or more times/day	☐ ₀ Never ☐ ₁ Just to try it ☐ ₂ Sometimes but less than once/day ☐ ₃ 1 time/day ☐ ₄ 2 times/day ☐ ₅ 3 times/day ☐ ₆ 4 times/day ☐ ₇ 5 or more times/day

Screening # _____ / Participant # _____

	7 to 9 Months Old	9 to 12 Months Old
11F. Yogurt or cheese	☐ ₀ Never ☐ ₁ Just to try it ☐ ₂ Sometimes but less than once/day ☐ ₃ 1 time/day ☐ ₄ 2 times/day ☐ ₅ 3 times/day ☐ ₆ 4 times/day ☐ ₇ 5 or more times/day	☐ ₀ Never ☐ ₁ Just to try it ☐ ₂ Sometimes but less than once/day ☐ ₃ 1 time/day ☐ ₄ 2 times/day ☐ ₅ 3 times/day ☐ ₆ 4 times/day ☐ ₇ 5 or more times/day
11G. Ice cream or pudding	☐ ₀ Never ☐ ₁ Just to try it ☐ ₂ Sometimes but less than once/day ☐ ₃ 1 time/day ☐ ₄ 2 times/day ☐ ₅ 3 times/day ☐ ₆ 4 times/day ☐ ₇ 5 or more times/day	☐ ₀ Never ☐ ₁ Just to try it ☐ ₂ Sometimes but less than once/day ☐ ₃ 1 time/day ☐ ₄ 2 times/day ☐ ₅ 3 times/day ☐ ₆ 4 times/day ☐ ₇ 5 or more times/day
11H. Breakfast cereals, crackers, bread, pasta, rice	☐ ₀ Never ☐ ₁ Just to try it ☐ ₂ Sometimes but less than once/day ☐ ₃ 1 time/day ☐ ₄ 2 times/day ☐ ₅ 3 times/day ☐ ₆ 4 times/day ☐ ₇ 5 or more times/day	☐ ₀ Never ☐ ₁ Just to try it ☐ ₂ Sometimes but less than once/day ☐ ₃ 1 time/day ☐ ₄ 2 times/day ☐ ₅ 3 times/day ☐ ₆ 4 times/day ☐ ₇ 5 or more times/day

12. At what age did your baby start eating snacks?

- ☐ Has not started yet
- ☐ DK
- ☐ 1 month
- ☐ 2 months
- ☐ 3 months
- ☐ 4 months
- ☐ 5 months
- ☐ 6 months

APPENDIX K

12 Month Sociodemographic Questionnaire (Aim 2)

Screening # _____ / Participant # _____

Sociodemographic Questionnaire – Modified 12 Month Interview

Mother/Family Characteristics

I have a few questions about you and your family, this will take about 5 minutes to complete.

1. How would you describe your current relationship status? Please select one.
 - ☐ Single
 - ☐ Married/Partnered
 - ☐ Separated/Divorced
 - ☐ Widowed
2. How would you describe your current employment status? Please select one.
 - ☐ Full-time
 - ☐ Part-time
 - ☐ Not employed
 - ☐ Retired
 - ☐ Other: _____
3. What was your household income before taxes during the previous year (e.g., 2016)? Select one.
 - ☐ ≤ \$20,000
 - ☐ \$20,001 to \$30,000
 - ☐ \$30,001 to \$40,000
 - ☐ ≥ \$40,001
4. How would you describe the highest-grade level you completed? Please select one.
 - ☐ Some high school
 - ☐ High school diploma or GED
 - ☐ Some college
 - ☐ College degree
 - ☐ Graduate degree
5. Do you currently receive WIC benefits?
 - ☐ Yes
 - ☐ No
6. Do you currently receive SNAP benefits?
 - ☐ Yes
 - ☐ No

Screening # _____ / Participant # _____

7. Including yourself, how many people live in your household? _____
- 8a. How many of the above (say number) are family members/relatives? _____
- 8b. How many of the above (say number) are friends? _____
8. How many children under the age of 18 live in your household? _____
- a. What are their ages (in months/years)? Child 1: _____ (target infant)
- Child 2: _____
- Child 3: _____
- Child 4: _____
- Child 5: _____
9. What is your height? _____ ft. _____ in.
10. What is your current weight? _____ lbs.

Infant Characteristics

11. What is his/her height/length? _____ (note units mother reports)
12. What is his/current weight? _____ (note units mother reports)

Infant Feeding Questions

Now I have a few questions about the first foods you gave your baby (insert name of child).

1. Was your baby ever breastfed or fed breast milk?
- ☐ Yes If yes, how long (convert to weeks)? _____
- ☐ No
- ☐ Don't know.
2. Are you currently breastfeeding?
- ☐ Yes If yes, how much longer do you intend to breast feed (convert to weeks)? _____
- ☐ No
- ☐ Don't know.
3. How old was your baby when you stopped breast feeding?
- Age in months _____ or Age in weeks _____ or DK/Can't Recall _____

Screening # _____ / Participant # _____

4. Was your baby ever fed formula?
- ☐ Yes If yes, how long (convert to weeks)? _____
 - ☐ No
 - ☐ Don't know.
5. Are you currently feeding your baby formula?
- ☐ Yes If yes, how much longer do you intend to feed formula (convert to weeks)? _____
 - ☐ No
 - ☐ Don't know.
6. How old was your baby when you stopped breast feeding?
- Age in months _____ or Age in weeks _____ or DK/Can't Recall _____
7. When did your baby start eating something other than breastmilk or formula?
- ☐ Has not started yet
 - ☐ 1 month
 - ☐ 2 months
 - ☐ 3 months
 - ☐ 4 months
 - ☐ 5 months
 - ☐ 6 months
8. What types of foods does your baby eat? (only if Q1 is 1-6 months; check all that apply)
- ☐ baby foods (___cereal, ___ fruits, ___ veggies, ___ meats, ___ desserts, ___ baby snacks)
 - ☐ table foods (___ mashed/blended, ___ finely chopped, ___ coarsely chopped/sliced)
 - ☐ Other: _____
9. Where does your baby normally eat? (check all that apply)
- ☐ in bed/crib
 - ☐ in car seat
 - ☐ in caregiver's arms/lap
 - ☐ in a highchair
 - ☐ at home
 - ☐ at childcare
 - ☐ Other: _____

10. Do you often worry about how much your baby is eating?

☐ No

☐ Yes, please explain: _____

11. Please think about everything your baby has eaten – even foods that someone else might have fed him or her. How often was he or she fed it, on average, during the month.

	7 to 9 Months Old	9 to 12 Months Old
11A. Fruit	☐ Never ☐ Just to try it ☐ Sometimes but less than once/day ☐ 1 time/day ☐ 2 times/day ☐ 3 times/day ☐ 4 times/day ☐ 5 or more times/day	☐ Never ☐ Just to try it ☐ Sometimes but less than once/day ☐ 1 time/day ☐ 2 times/day ☐ 3 times/day ☐ 4 times/day ☐ 5 or more times/day
11B. Vegetables (not including french fries)	☐ Never ☐ Just to try it ☐ Sometimes but less than once/day ☐ 1 time/day ☐ 2 times/day ☐ 3 times/day ☐ 4 times/day ☐ 5 or more times/day	☐ Never ☐ Just to try it ☐ Sometimes but less than once/day ☐ 1 time/day ☐ 2 times/day ☐ 3 times/day ☐ 4 times/day ☐ 5 or more times/day
11C. Baby snack foods (teething biscuits, puffs, melts, Baby Mum-Mums)	☐ Never ☐ Just to try it ☐ Sometimes but less than once/day ☐ 1 time/day ☐ 2 times/day ☐ 3 times/day ☐ 4 times/day ☐ 5 or more times/day	☐ Never ☐ Just to try it ☐ Sometimes but less than once/day ☐ 1 time/day ☐ 2 times/day ☐ 3 times/day ☐ 4 times/day ☐ 5 or more times/day
11D. Cakes, cookies, or candy	☐ Never ☐ Just to try it ☐ Sometimes but less than once/day ☐ 1 time/day ☐ 2 times/day ☐ 3 times/day ☐ 4 times/day ☐ 5 or more times/day	☐ Never ☐ Just to try it ☐ Sometimes but less than once/day ☐ 1 time/day ☐ 2 times/day ☐ 3 times/day ☐ 4 times/day ☐ 5 or more times/day
11E. French fries, tator tots, or other fried potatoes	☐ Never ☐ Just to try it ☐ Sometimes but less than once/day ☐ 1 time/day ☐ 2 times/day ☐ 3 times/day ☐ 4 times/day ☐ 5 or more times/day	☐ Never ☐ Just to try it ☐ Sometimes but less than once/day ☐ 1 time/day ☐ 2 times/day ☐ 3 times/day ☐ 4 times/day ☐ 5 or more times/day

APPENDIX L

Nutrition Environment Measures Survey-Stores & Infant Foods (Aim 3)

Confidential

Aim 3 - Data Collection in Grocery Stores
Page 1 of 26

NEMS-S-IF

Store ID	<div></div> <div>(each store will have a unique store ID; see schedule for this #)</div>
Store Name	<div></div>
Store Address	<div></div>
Number of Cash Registers	<div></div> <div>((does not include self-checkout registers))</div>
Number of Self-Checkout Cash Registers	<div></div> <div>((only self-checkout; enter 0 if n/a))</div>
Assessment Start Date & Time	<div></div> <div>((click on now))</div>
Does the store accept WIC?	<div>☐ Yes</div> <div>☐ No</div>
Does the store accept SNAP (formerly food stamps)?	<div>☐ Yes</div> <div>☐ No</div>
Measure 1: Milk	
Locate the milk aisle. Determine if the store sells milk and use the regular price (i.e., not the sale price) to complete the following section.	
Does this store sell milk?	<div>☐ Yes</div> <div>☐ No</div>
Is low-fat milk (skim or 1%) available?	<div>☐ Yes</div> <div>☐ No</div>
If low-fat milk is not available is 2% available?	<div>☐ Yes</div> <div>☐ No</div>
Reference brand for milk	<div></div> <div>(store brand if available)</div>
Lowest fat milk available?	<div>☐ skim</div> <div>☐ 1%</div> <div>☐ 2%</div>

Shelf space for lowest fat milk available = PINT

- ☐ 0
☐ 1-5
☐ 6-10
☐ 11-15
☐ 16+
(number of pints available)

Shelf space for lowest fat milk available = QUART

- ☐ 0
☐ 1-5
☐ 6-10
☐ 11-15
☐ 16+
(number of quarts available)

Shelf space for lowest fat milk available = HALF
GALLON

- ☐ 0
☐ 1-5
☐ 6-10
☐ 11-15
☐ 16+
(number of half gallons available)

Shelf space for lowest fat milk available = GALLON

- ☐ 0
☐ 1-5
☐ 6-10
☐ 11-15
☐ 16+
(number of gallons available)

Shelf space for whole milk = PINT

- ☐ 0
☐ 1-5
☐ 6-10
☐ 11-15
☐ 16+
(number of pints available)

Shelf space for whole milk = QUART

- ☐ 0
☐ 1-5
☐ 6-10
☐ 11-15
☐ 16+
(number of quarts available)

Shelf space for whole milk = HALF GALLON

- ☐ 0
☐ 1-5
☐ 6-10
☐ 11-15
☐ 16+
(number of half gallons available)

Shelf space for whole milk = GALLON

- ☐ 0
☐ 1-5
☐ 6-10
☐ 11-15
☐ 16+
(number of gallons available)

Pricing for whole milk (quart)

Pricing for whole milk (half gallon)

Pricing for lowest fat milk available (quart)

Pricing for lowest fat milk available (half gallon)

Measure 2: Fruit

Locate the fruit aisle. Determine if the store sells fruit and use the regular price (i.e., not the sale price) to complete the following questions.

Does this store sell fruit?

- ☐ Yes
☐ No

Are bananas available?

- ☐ Yes
☐ No

Price

(do not enter \$ sign)

Unit

- ☐ price per piece
☐ price per lb

How many pieces per unit?

(e.g., if 2 for \$1.00, enter 2)

Quality

- ☐ acceptable
☐ unacceptable

Are apples available?

- ☐ Yes
☐ No

Red delicious is reference. If n/a use cheapest apple variety.

(list cheapest variety only if ref n/a)

Price

(do not enter \$ sign)

Unit

- ☐ price per piece
☐ price per lb

How many pieces per unit?

(e.g., if 2 for \$1.00, enter 2)

Quality

- ☐ acceptable
☐ unacceptable

Are oranges available?	☐ Yes ☐ No
Navels are reference variety. If n/a use next cheapest variety.	
<div>{list cheapest variety only if ref n/a}</div>	
Price	<div>{do not enter \$ sign}</div>
Unit	☐ price per piece ☐ price per lb
How many pieces per unit?	<div>{e.g., if 2 for \$1.00, enter 2}</div>
Quality	☐ acceptable ☐ unacceptable
Are grapes available?	☐ Yes ☐ No
Red seedless are reference variety. If n/a use next cheapest variety.	
<div>{list cheapest variety only if ref n/a}</div>	
Price	<div>{do not enter \$ sign}</div>
Unit	☐ price per piece ☐ price per lb
How many pieces per unit?	<div>{e.g., if 2 for \$1.00, enter 2}</div>
Quality	☐ acceptable ☐ unacceptable
Are cantaloupes available?	☐ Yes ☐ No
Price	<div>{do not enter \$ sign}</div>
Unit	☐ price per piece ☐ price per lb
How many pieces per unit?	<div>{e.g., if 2 for \$1.00, enter 2}</div>

Quality	☐ acceptable ☐ unacceptable
Are peaches available?	☐ Yes ☐ No
Price	<input type="text"/> (do not enter \$ sign)
Unit	☐ price per piece ☐ price per lb
How many pieces per unit?	<input type="text"/> (e.g., if 2 for \$1.00, enter 2)
Quality	☐ acceptable ☐ unacceptable
Are strawberries available?	☐ Yes ☐ No
Price	<input type="text"/> (do not enter \$ sign)
Unit	☐ price per piece ☐ price per lb
How many pieces per unit?	<input type="text"/> (e.g., if 2 for \$1.00, enter 2)
Quality	☐ acceptable ☐ unacceptable
Are honeydew melons available?	☐ Yes ☐ No
Price	<input type="text"/> (do not enter \$ sign)
Unit	☐ price per piece ☐ price per lb
How many pieces per unit?	<input type="text"/> (e.g., if 2 for \$1.00, enter 2)
Quality	☐ acceptable ☐ unacceptable
Are watermelon available?	☐ Yes ☐ No

Seedless watermelons are reference variety. If n/a use next cheapest variety.	<hr/>
	{list cheapest variety only if ref n/a}
Price	<hr/>
	{do not enter \$ sign}
Unit	☐ price per piece ☐ price per lb
How many pieces per unit?	<hr/>
	{e.g., if 2 for \$1.00, enter 2}
Quality	☐ acceptable ☐ unacceptable
Are pears available?	☐ Yes ☐ No
Anjou pears are reference variety. If n/a use next cheapest variety.	<hr/>
	{list cheapest variety only if ref n/a}
Price	<hr/>
	{do not enter \$ sign}
Unit	☐ price per piece ☐ price per lb
How many pieces per unit?	<hr/>
	{e.g., if 2 for \$1.00, enter 2}
Quality	☐ acceptable ☐ unacceptable
Total types of fruits from this list available in store?	<hr/>
	{value between 0 to 10}
General comments for fruits	<hr/>

Measure 3: Vegetables

Locate the vegetable aisle. Determine if the store sells vegetables and use the regular price (i.e., not the sale price) to complete the following questions.

Does this store sell vegetables?	☐ Yes ☐ No
Are carrots available?	☐ Yes ☐ No
Use 1 pound bag as reference. If n/a use next smallest size bag.	<input type="text"/> (leave blank if ref available; list next smallest amount if ref n/a)
Price	<input type="text"/> (do not enter \$ sign)
Unit	☐ price per piece ☐ price per lb
How many pieces per unit?	<input type="text"/> (e.g., if 2 for \$1.00, enter 2)
Quality	☐ acceptable ☐ unacceptable
Are tomatoes available?	☐ Yes ☐ No
Use loose tomatoes as reference. If n/a use next smallest amount (e.g., bag, bunch of 4, etc.)	<input type="text"/> (leave blank if ref available; list next smallest amount if ref n/a)
Price	<input type="text"/> (do not enter \$ sign)
Unit	☐ price per piece ☐ price per lb
How many pieces per unit?	<input type="text"/> (e.g., if 2 for \$1.00, enter 2)
Quality	☐ acceptable ☐ unacceptable
Are sweet peppers available?	☐ Yes ☐ No

Use green bell peppers as reference. If n/a use next smallest amount (e.g., bag, bunch of 4, etc.)

(leave blank if ref available; list next smallest amount if ref n/a)

Price

(do not enter \$ sign)

Unit

- ☐ price per piece
☐ price per lb

How many pieces per unit?

(e.g., if 2 for \$1.00, enter 2)

Quality

- ☐ acceptable
☐ unacceptable

Are broccoli available?

- ☐ Yes
☐ No

Use bunch broccoli as reference. If n/a use next smallest amount (e.g., bag).

(leave blank if ref available; list next smallest amount if ref n/a)

Price

(do not enter \$ sign)

Unit

- ☐ price per piece
☐ price per lb

How many pieces per unit?

(e.g., if 2 for \$1.00, enter 2)

Quality

- ☐ acceptable
☐ unacceptable

Are lettuce available?

- ☐ Yes
☐ No

Use green leaf lettuce (non-bagged) as reference. If n/a use another type of non-bagged lettuce.

(leave blank if ref available; list next smallest amount if ref n/a)

Price

(do not enter \$ sign)

Unit

- ☐ price per piece
☐ price per lb

How many pieces per unit?	<hr/>
	(e.g., if 2 for \$1.00, enter 2)
Quality	☐ acceptable ☐ unacceptable
Are corn available?	☐ Yes ☐ No
Use loose ears of corn as reference. If n/a use another type of corn (e.g., bunches, bundles) but do not include canned or frozen corn.	<hr/>
	(leave blank if ref available; list next smallest amount if ref n/a)
Price	<hr/>
	(do not enter \$ sign)
Unit	☐ price per piece ☐ price per lb
How many pieces per unit?	<hr/>
	(e.g., if 2 for \$1.00, enter 2)
Quality	☐ acceptable ☐ unacceptable
Are celery available?	☐ Yes ☐ No
Price	<hr/>
	(do not enter \$ sign)
Unit	☐ price per piece ☐ price per lb
How many pieces per unit?	<hr/>
	(e.g., if 2 for \$1.00, enter 2)
Quality	☐ acceptable ☐ unacceptable
Are cucumbers available?	☐ Yes ☐ No
Use loose regular cucumbers as reference. If n/a use another type of cucumber or bagged/bunches.	<hr/>
	(leave blank if ref available; list next smallest amount if ref n/a)

Price	<hr/>
	(do not enter \$ sign)
Unit	☐ price per piece ☐ price per lb
How many pieces per unit?	<hr/>
	(e.g., if 2 for \$1.00, enter 2)
Quality	☐ acceptable ☐ unacceptable
Are cabbage available?	☐ Yes ☐ No
Use loose heads of green cabbage as reference. If n/a use another type of cabbage or bagged.	<hr/>
	(leave blank if ref available; list next smallest amount if ref n/a)
Price	<hr/>
	(do not enter \$ sign)
Unit	☐ price per piece ☐ price per lb
How many pieces per unit?	<hr/>
	(e.g., if 2 for \$1.00, enter 2)
Quality	☐ acceptable ☐ unacceptable
Are cauliflower available?	☐ Yes ☐ No
Use loose heads of white cauliflower as reference. If n/a use another type of cauliflower or bagged.	<hr/>
	(leave blank if ref available; list next smallest amount if ref n/a)
Price	<hr/>
	(do not enter \$ sign)
Unit	☐ price per piece ☐ price per lb
How many pieces per unit?	<hr/>
	(e.g., if 2 for \$1.00, enter 2)
Quality	☐ acceptable ☐ unacceptable

Total types of vegetables from this list available in store?

(value between 0 to 10)

General comments for vegetables

Measure 4: Ground Beef

Locate the ground beef aisle. Determine if the store sells ground beef and use the regular price (i.e., not the sale price) to complete the following questions.

Does this store sell ground beef?

- ☐ Yes
☐ No

Is lean ground beef (90% lean, 10% fat) available?

- ☐ Yes
☐ No

Price

(list price per lb; do not include \$)

Is lean ground beef (< 10% fat) available?

- ☐ Yes
☐ No

Price

(list price per lb; do not include \$)

Is lean ground turkey (< 10% fat) available?

- ☐ Yes
☐ No

Price

(list price per lb; do not include \$)

of varieties of lean ground beef (< 10% fat)?

- ☐ 0
☐ 1
☐ 2
☐ 3
☐ 4
☐ 5
☐ 6+

Is standard ground beef (80% lean, 20% fat) available?

- ☐ Yes
☐ No

Price

(list price per lb; do not include \$)

Is standard alternate ground beef (if 80:20 is n/a) available?

- ☐ Yes
☐ No

% fat of standard alternate ground beef

Price

{list price per lb; do not include \$}

General comments for ground beef

Measure 5: Hot Dogs

Locate the hot dog aisle. Determine if the store sells hot dogs and use the regular price (i.e., not the sale price) to complete the following questions.

Does this store sell hot dogs?

☐ Yes
☐ No

Does the store sell Oscar Mayer 98% fat-free wieners (turkey/beef), < 1g fat?

☐ Yes
☐ No

Price

{do not include \$}

Does the store sell Oscar Mayer regular wieners (turkey/pork/chicken), 12g fat?

☐ Yes
☐ No

Price

{do not include \$}

General comments for hot dogs

Measure 6: Frozen Dinners

Locate the frozen dinner aisle. Determine if the store sells frozen dinners and use the regular price (i.e., not the sale price) to complete the following questions.

Healthier Option: Lean Cuisine (low-fat option)

Regular Option: Stouffer's

Does this store sell frozen dinners?

☐ Yes
☐ No

Does the store sell Stouffer's brand (preferred or reference brand)?

☐ Yes
☐ No

If the store does not sell Stouffer's brand, list alternate brand with low-fat dinners available.		_____
Reduced-fat frozen dinners available (< 9g fat/8-11 oz)?	☐ Yes ☐ No	
Shelf-space available for frozen dinners (measure only if reduced-fat options are available) - reduced-fat dinners vs regular dinners. Proportion =	☐ < =10% ☐ 11-33% ☐ 34-50% ☐ 51%+	
Lean Cuisine Lasagna (reduced fat) available?	☐ Yes ☐ No	
Package Size		_____
		{include units}
Cost		_____
		{do not include \$}
Lean Cuisine Roast Turkey Breast (reduced fat) available?	☐ Yes ☐ No	
Package Size		_____
		{include units}
Cost		_____
		{do not include \$}
Lean Cuisine Meatloaf (reduced fat) available?	☐ Yes ☐ No	
Package Size		_____
		{include units}
Cost		_____
		{do not include \$}
Is Stouffer's Lasagna (regular option) available?	☐ Yes ☐ No	
Package Size		_____
		{include units}
Cost		_____
		{do not include \$}
Is Stouffer's Roasted Turkey Breast (regular option) available?	☐ Yes ☐ No	

Package Size

(include units)

Cost

(do not include \$)

Is Stouffer's Meatloaf (regular option) available?

☐ Yes
☐ No

Package Size

(include units)

Cost

(do not include \$)

General comments for frozen dinners

Measure 7: Baked Goods

Locate the baked goods aisle. Determine if the store sells baked goods and use the regular price (i.e., not the sale price) to complete the following questions.

Healthier Option: Low-fat Baked Goods < 3g fat/serving = bagel

Regular Option: Regular Baked Goods > 4g fat/serving or 400kcal/serving = regular muffin

Does this store sell baked goods?

☐ Yes
☐ No

Are single bagels available (healthier option)?

☐ Yes
☐ No

grams fat/per single bagel

calories/per single bagel

price/per single bagel

(do not include \$)

Are packaged/bagged bagels available (healthier option)?

☐ Yes
☐ No
☐ n/a

Amount/package of bagels

grams fat/per single bagel

calories/per single bagel

price/per single bagel

(do not include \$)

Are muffins available (regular option)?

☐ Yes
☐ No

Amount/package of bagels

grams fat/per single bagel

price/per single bagel

(do not include \$)

calories/per single bagel

General comments for baked goods

Measure 8: Beverages

Locate the beverages aisle. Determine if the store sells beverages and use the regular price (i.e., not the sale price) to complete the following questions.

Healthier Option: Diet Coke or Minute Made 100% juice

Regular Option: Coke or Minute Made juice drink

Does this store sell beverages?

☐ Yes
☐ No

Does this store sell Diet Coke (12 pack, 12oz)?

☐ Yes
☐ No

Price

(do not include \$)

Does this store sell Diet Coke (6 pack, 12oz)?

☐ Yes
☐ No

Price

{do not include \$}

Does this store sell Coke (12 pack, 12oz)?☐ Yes
☐ No

Price

{do not include \$}

Does this store sell Coke (6 pack, 12oz)?☐ Yes
☐ No

Price

{do not include \$}

Does this store sell Minute Maid 100% juice (64 oz,
half gallon)?☐ Yes
☐ No

Price

{do not include \$}

Does this store sell Minute Maid juice drink (64 oz,
half gallon)?☐ Yes
☐ No

Price

{do not include \$}

General comments for beverages

Measure 9: Bread

Locate the bread aisle. Determine if the store sells bread and use the regular price (i.e., not the sale price) to complete the following questions.

Healthier Option: Whole grain bread (100% WG or WW)

Regular Option: White bread (made with refined flour)

Does this store sell bread?☐ Yes
☐ No

Does this store sell Nature's Own 100% Whole Wheat
Bread (healthier option)?☐ Yes
☐ No

Loaf size☐ Yes
☐ No
(list in ounces)

Loaf price	☐ Yes ☐ No (list in ounces)
# of 100% whole wheat bread and whole grain bread (all brands)	☐ 0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6+
Does this store sell Nature's Own Butter Bread (regular option)?	☐ Yes ☐ No
Loaf size	☐ Yes ☐ No (list in ounces)
Loaf price	☐ Yes ☐ No (list in ounces)
General comments for bread	

Measure 10: Chips

Locate the chips aisle. Determine if the store sells chips and use the regular price (i.e., not the sale price) to complete the following questions.

Healthier Option: Baked Lays Potato Chips (< 3g fat/1oz serving)

Regular Option: Lays Potato Chips Classic

Does this store sell chips?	☐ Yes ☐ No
Does this store sell Baked Lays Potato Chips (healthier option)?	☐ Yes ☐ No
Size	☐ Yes ☐ No (list in ounces)
Price	<hr/> (do not include \$)

# of varieties of low-fat chips (all brands)	☐ 0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6+
Does this store sell Lays Potato Chips Classics (regular option)?	☐ Yes ☐ No
Size (use comparable size to healthier option)	☐ Yes ☐ No (list in ounces)
Price	<hr/>
	(do not include \$)
General comments for chips	<hr/>

Measure 11: Cereal

Locate the cereal aisle. Determine if the store sells cereal and use the regular price (i.e., not the sale price) to complete the following questions.

Healthier Option: Cheerios (plain)**Regular Option: Cheerios (flavored)**

Does this store sell cereal?	☐ Yes ☐ No
Does this store sell Cheerios (plain)?	☐ Yes ☐ No
Size	<hr/>
	(in ounces)
Price	<hr/>
	(do not include \$)
Does this store sell Cheerios (flavored; honey nut or other flavor)?	☐ Yes ☐ No
Size	<hr/>
	(in ounces)

Price

{do not include \$}

General comments for cereal

Measure 12: Infant Formula

Locate the infant formula aisle. Some stores may keep infant formula behind the customer service counter.

Does this store sell infant formula?

- ☐ Yes
☐ No
{if yes, continue below}

Reference Brand {store brand}

{If a store brand is not available, use Similac as the reference brand.}

Does the store offer a powder infant formula?

- ☐ Yes
☐ No

What is the largest size available?

{list units on can/jar/bottle}

What is the price of the largest size available?

{do not enter \$ sign; no price listed, enter 99}

Does the store offer a concentrated liquid infant formula?

- ☐ Yes
☐ No

What is the largest size available?

{list units on can/jar/bottle}

What is the price of the largest size available?

{do not enter \$ sign; no price listed, enter 99}

Does the store offer a ready-to-use infant formula?

- ☐ Yes
☐ No

What is the largest size available?

{list units on can/jar/bottle}

What is the price of the largest size available?

{do not enter \$ sign; no price listed, enter 99}

	Store Brand	Similac	Enfamil	Gerber	Nestle	Earth's Best	Happy Baby Organics	Other
What brands of infant formula are available?	☐	☐	☐	☐	☐	☐	☐	☐
Is formula readily available on the shelf?	☐ Yes ☐ No							
If no, where does the customer go to pick-up the formula (e.g., customer service)?	_____							
General comments for infant formula.	_____							

Measure 13: Infant First Foods/Meals

Locate the infant foods aisle. Some stores may not have these types of foods specifically for infants.

Does this store sell foods specifically for infants (e.g., infant on the package or in the product name)?	☐ Yes ☐ No (if yes, continue below)
Reference Brand (store brand)	_____ (If a store brand is not available, use Gerber as the reference brand.)
Does the store sell 100% fruit purees?	☐ Yes ☐ No (this includes any brand; does not include pouches)
Are 100% fruit purees available in...	☐ stage 1 ☐ stage 2 ☐ stage 3 ☐ stage 4 ☐ n/a or doesn't say (this includes any brand; check all that apply)
What is the largest size available in stage 1?	_____ (list units on jar/container)
What is the price of the largest size in stage 1?	_____
Reference flavor (this can be any 100% fruit puree, e.g., banana or banana and strawberry).	_____
Does the store sell 100% vegetable purees?	☐ Yes ☐ No (this includes any brand; does not include pouches)

Are 100% vegetable purees available in...	☐ stage 1 ☐ stage 2 ☐ stage 3 ☐ stage 4 ☐ n/a or doesn't say (this includes any brand; check all that apply)
What is the largest size available in stage 1?	_____
	(list units on jar/container)
What is the price of the largest size in stage 1?	_____
Reference flavor (this can be any 100% vegetable puree, e.g., peas or banana and carrots).	_____
Does the store sell 100% mixed F/V purees?	☐ Yes ☐ No (this includes any brand; does not include pouches)
Are 100% mixed F/V purees available in...	☐ stage 1 ☐ stage 2 ☐ stage 3 ☐ stage 4 ☐ n/a or doesn't say (this includes any brand; check all that apply)
What is the largest size available in stage 1?	_____
	(list units on jar/container)
What is the price of the largest size in stage 1?	_____
Reference flavor (this can be any 100% mixed F/V puree, e.g., kale and apples).	_____
Does the store sell 100% mixed meal purees? (must include a protein)	☐ Yes ☐ No (this includes any brand; does not include pouches)
Are 100% mixed meal purees available in...	☐ stage 1 ☐ stage 2 ☐ stage 3 ☐ stage 4 ☐ n/a or doesn't say (this includes any brand; check all that apply)
What is the largest size available in stage 1?	_____
	(list units on jar/container)
What is the price of the largest size in stage 1?	_____

Reference flavor (this can be any 100% mixed meal puree, e.g., chicken and carrots).	_____
Does the store sell 100% mixed meal purees in pouches? (must include a protein)	☐ Yes ☐ No (this includes any brand)
Are 100% mixed meal purees in pouches available in...	☐ stage 1 ☐ stage 2 ☐ stage 3 ☐ stage 4 ☐ n/a or doesn't say (this includes any brand; check all that apply)
What is the largest size available in stage 1?	_____ (list units on jar/container)
What is the price of the largest size in stage 1?	_____
Reference flavor (this can be any 100% mixed meal puree in pouches, e.g., chicken and carrots).	_____
Does the store sell plain dry rice cereal? (typically comes in a box)	☐ Yes ☐ No (this includes any brand)
Is plain dry rice cereal available in...	☐ stage 1 ☐ stage 2 ☐ stage 3 ☐ stage 4 ☐ n/a or doesn't say (this includes any brand; check all that apply)
What is the largest size available in stage 1?	_____ (list units on jar/container)
What is the price of the largest size in stage 1?	_____
Does the store plain prepared rice cereal? (typically comes in a jar)	☐ Yes ☐ No (this includes any brand)
Is plain prepared rice cereal available in...	☐ stage 1 ☐ stage 2 ☐ stage 3 ☐ stage 4 ☐ n/a or doesn't say (this includes any brand; check all that apply)
What is the largest size available in stage 1?	_____ (list units on jar/container)

What is the price of the largest size in stage 1?	_____
Does the store sell shelf-stable yogurt for infants? (typically comes in a plastic container)	☐ Yes ☐ No (this includes any brand)
Is shelf-stable yogurt available in...	☐ stage 1 ☐ stage 2 ☐ stage 3 ☐ stage 4 ☐ n/a or doesn't say (this includes any brand; check all that apply)
What is the largest size available in stage 1?	_____ (list units on jar/container)
What is the price of the largest size in stage 1?	_____
Reference flavor (this can be any flavor of shelf-stable yogurt for infants).	_____
Does the store sell refrigerated yogurt for infants? (typically comes in a plastic container)	☐ Yes ☐ No (this includes any brand)
Is refrigerated yogurt available in...	☐ stage 1 ☐ stage 2 ☐ stage 3 ☐ stage 4 ☐ n/a or doesn't say (this includes any brand; check all that apply)
What is the largest size available in stage 1?	_____ (list units on jar/container)
What is the price of the largest size in stage 1?	_____
Reference flavor (this can be any flavor of refrigerated infant yogurt).	_____
General comments for infant first foods/meals.	_____

Measure 14: Infant Snack Foods

Locate the infant foods aisle. Some stores may not have these types of foods specifically for infants.

Does this store sell snacks specifically for infants
(e.g., infants on the package or in the product name)?

- ☐ Yes
☐ No
 (if yes, continue below)

Reference Brand (store brand)

 (If a store brand is not available, use Gerber as the reference brand.)

Does the store sell puffs for infants?

- ☐ Yes
☐ No
 (this includes any brand; does not include pouches)

What is the largest size available?

 (list units on jar/container)

What is the price of the largest size?

Reference flavor (this can be any flavor).

Does the store sell teething biscuits for infants?

- ☐ Yes
☐ No
 (this includes any brand)

What is the largest size available?

 (list units on jar/container)

What is the price of the largest size?

Reference flavor (this can be any flavor).

Does the store sell yogurt melts for infants?

- ☐ Yes
☐ No
 (this includes any brand)

What is the largest size available?

 (list units on jar/container)

What is the price of the largest size?

Reference flavor (this can be any flavor).

Does the store sell 100% fruit pouches for infants?

- ☐ Yes
☐ No
(this includes any brand)

What is the largest size available?

(list units on jar/container)

What is the price of the largest size?

Reference flavor (this can be any flavor).

Does the store sell 100% veggie pouches for infants?

- ☐ Yes
☐ No
(this includes any brand)

What is the largest size available?

(list units on jar/container)

What is the price of the largest size?

Reference flavor (this can be any flavor).

Does the store sell mixed fruit and veggie pouches for infants?

- ☐ Yes
☐ No
(this includes any brand)

What is the largest size available?

(list units on jar/container)

What is the price of the largest size?

Reference flavor (this can be any flavor).

Does the store sell cookies for infants?

- ☐ Yes
☐ No
(this includes any brand)

What is the largest size available?

(list units on jar/container)

What is the price of the largest size?

Reference flavor (this can be any flavor).

Does the store sell any other snacks specifically for infants?

☐ Yes
☐ No

If yes, list a maximum of 3 snacks specifically for infants. Include brand name, product name, largest size, and price.

General comments for infant snack foods

Assessment End Date and Time

{{click on now}}