



Total Breastfeeding Duration and Household Food Insecurity in Healthy Urban Children

Peter D. Wong, MBBS, PhD, FRCPC, IBCLC; Patricia C. Parkin, MD, FRCPC; Rosemary G. Moodie, MD, MBA, MPA, FRCPC; David W.H. Dai, MSc; Jonathon L. Maguire, MD, MSc, FRCPC; Catherine S. Birken, MD, MSc, FRCPC; Cornelia M. Borkhoff, PhD; on behalf of the TARGet Kids! Collaboration

From the Department of Paediatrics, Faculty of Medicine (PD Wong, PC Parkin, RG Moodie, JL Maguire, and CS Birken); Joannah & Brian Lawson Centre for Child Nutrition (PC Parkin, JL Maguire, and CS Birken); Institute of Health Policy, Management and Evaluation (PC Parkin, JL Maguire, CS Birken, and CM Borkhoff), University of Toronto; Division of Paediatric Medicine and the Paediatric Outcomes Research Team (PD Wong, PC Parkin, JL Maguire, CS Birken, and CM Borkhoff); Division of Neonatology (RG Moodie); Sick Kids Research Institute (PD Wong, PC Parkin, CS Birken, and CM Borkhoff), Hospital for Sick Children; Department of Paediatrics (JL Maguire); and Li Ka Shing Knowledge Institute (DWH Dai and JL Maguire), St. Michael's Hospital, Toronto, Ontario, Canada

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Address correspondence to Peter D. Wong, 115 Humber College Blvd, Suite 722, Toronto, ON M9V 0A9, Canada (e-mail: peter.wong@sickkids.ca). Received for publication October 17, 2018; accepted February 10, 2019.

ABSTRACT

OBJECTIVE: Health care policy positions breastfeeding as an important part of the solution to household food insecurity; however, there are critical gaps in our knowledge of the relationship between breastfeeding duration (exposure variable) and household food insecurity (outcome variable). Our objective was to examine this relationship.

METHODS: A cross-sectional study was conducted from 2008 to 2016 of healthy urban children (N = 3838) who were 0 to 3 years old and recruited from The Applied Research Group for Kids (TARGet Kids!), a practice-based research network in Toronto, Canada. Total breastfeeding duration was collected from parent-reported questionnaires. Household food insecurity was measured using 1-item and 2-item food insecurity screens. Multivariable regression analysis was performed adjusting for prespecified covariates.

RESULTS: The median total breastfeeding duration was 10.5 months (interquartile range, 6.0–14.0), and 14.7% of households were food insecure. After adjusting for child characteristics (age, sex), maternal characteristics (age, ethnicity, education, employ-

ment), and family characteristics (number of children, single parent family, neighborhood equity score), there was no significant association between total breastfeeding duration and household food insecurity (odds ratio, 0.99; 95% confidence interval, 0.98–1.01). Although low-income families had an increased odds of being household food insecure ($P \leq .001$), we found no significant association between total breastfeeding duration and household food insecurity at varying income levels.

CONCLUSIONS: We found no association between breastfeeding duration and household food insecurity, regardless of family income. Although breastfeeding is associated with improved child health outcomes and considered to be part of the solution to household food insecurity, interventions focused on social determinants may provide more promising targets for the prevention of household food insecurity.

KEYWORDS: breastfeeding; child health; food insecurity; nutrition

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WHAT'S NEW

Health care policy positions breastfeeding as an important part of the solution to household food insecurity. Findings are contrary, however, as total breastfeeding duration is not associated with household food insecurity. Interventions focused on social determinants may provide promising targets for prevention of household food insecurity.

HEALTHY NUTRITION DURING infancy is essential for optimal growth, development, and subsequent health. The ideal nourishment for infants begins with breastfeeding.¹ The World Health Organization and Health Canada recommend exclusive breastfeeding for the first 6 months of life, with the introduction of complementary foods at 6 months and continued breastfeeding beyond 2 years of age.^{1,2} The advantages of breastfeeding for the infant and

mother are well recognized. Further, families may incur lower food and health care costs when mothers breastfeed their infants.³ In Canada, almost 90% of mothers initiate breastfeeding, and 26% exclusively breastfeed for 6 months. These rates are lower among women with low education and household income⁴ and may reflect limited expenditure on intangible resources, such as mother's time off work and breastfeeding supports.

Adequate food security exists when all people in a household have sufficient, safe, and nutritious food that meets their dietary needs and food preferences. By contrast, household food insecurity encompasses a range of experiences including worrying over food access and various degrees of food deprivation. All levels of household food insecurity, from marginal to moderate to severe, remain a worldwide public health concern.⁵ Families with children experiencing household food insecurity are a vulnerable population. Although young children may be shielded by their parents from experiencing food insecurity,⁶ those experiencing even marginal food insecurity are at increased risk of poor health status and developing chronic health conditions in later life.⁷

Health care policy positions breastfeeding as an important part of the solution to household food insecurity;^{8,9} however, there are critical gaps in our knowledge of the relationship between breastfeeding duration (exposure variable) and household food insecurity (outcome variable). Shorter breastfeeding duration may exacerbate important triggers of household food insecurity; for example, the purchase of breast milk substitutes may consume household resources and create income instability.¹⁰ Further, a child who becomes ill may require more health care visits, resulting in increased health care costs and parents' missed work time. Although previous research examining the relationship between household food insecurity (as the exposure variable) and breastfeeding (as the outcome) has demonstrated that mothers in food-insecure households discontinued exclusive breastfeeding earlier than mothers in food-secure households,¹¹ the relationship between breastfeeding duration (exposure variable) and household food insecurity (outcome variable) has not been studied.

Currently, in Canada, there is no comprehensive policy framework designed to address household food insecurity.¹² Understanding the relationship between breastfeeding duration and household food insecurity may lead to effective public health interventions, advance the evidence base for health care policy, and improve child health outcomes. Therefore, our primary objective was to examine the association between total breastfeeding duration and household food insecurity in a cohort of healthy urban Canadian children. Our secondary objective was to explore how family self-reported income influences the relationship between total breastfeeding duration and household food insecurity. We hypothesized that shorter total breastfeeding duration is associated with a higher odds of household food insecurity and that there would be an increased odds of household food insecurity among children from lower income families.

METHODS

STUDY DESIGN AND PARTICIPANTS

This was a cross-sectional study of healthy urban children from birth to 3 years of age. Participants were recruited while attending a scheduled health supervision visit at 1 of 9 The Applied Research Group for Kids (TARGet Kids!) primary care practices between 2008 and 2016. TARGet Kids! is an ongoing open longitudinal cohort set in Toronto, Canada, and the cohort profile has been previously published.¹³ The primary aims of TARGet Kids! are to examine healthy growth and development trajectories of infants and preschool-age children and to link early life exposures to health problems.

Research personnel embedded in participating primary care practices recruited study participants, obtained consent, and collected data. Sociodemographic, lifestyle, and dietary information was collected using a standardized parent-completed survey instrument based on the Canadian Community Health Survey, a national survey that collects information on health determinants for the Canadian population.¹⁴ Parents also completed the Nutrition Screening for Every Preschooler (NutriSTEP) questionnaire, a screening tool designed to assess the nutrition risk of children.¹⁵ Medidata Rave (Medidata Solutions; New York, NY) was used as the secure electronic data capture system and data repository for all TARGet Kids! data.¹³

TARGet Kids! cohort exclusion criteria are health conditions affecting growth (eg, failure to thrive), any chronic health condition (except asthma and mild autism spectrum disorder), severe developmental delay, gestational age of less than 32 weeks, child attending an unscheduled visit due to acute illness, and parents unable to communicate in English. For the purpose of this study, children were included if they were <3.5 years of age (to capture children attending their 3-year-old health supervision visit) and had complete data on exposure and outcome variables. Children who were currently breastfeeding were excluded to ensure a study design focused on household food insecurity status after cessation of breastfeeding had occurred and so total breastfeeding duration could be determined. If a child had complete data from multiple visits, the first visit with an affirmative response for food insecurity was used for analysis; otherwise, the first available visit was used. Ethics approval was granted through the Research Ethics Boards at The Hospital for Sick Children and St. Michael's Hospital (NCT01869530). Written informed consent was obtained from all subjects/patients.

EXPOSURE VARIABLE

The primary exposure variable was total breastfeeding duration, which refers to breastfeeding duration of any kind, including exclusive and partial. This information was determined from parent responses to the following questions: 1) "Has your child ever been breastfed?"; 2) "Is your child currently breastfeeding?"; and 3) "At what age did you stop breastfeeding?" Expressed breast milk was considered as breastfeeding. Estimates of breastfeeding duration by maternal recall have been found to be valid and

reliable in the child's first 3 years of life¹⁶ and has been established in previous studies.¹⁷ Children who were never breastfed were classified as having a total breastfeeding duration of 0 months, and those previously breastfed were assigned the duration at the age breastfeeding stopped.

OUTCOME VARIABLES

The outcome variable was household food insecurity at any time between cessation of breastfeeding and 3.5 years of age. To assess household food insecurity, we used both a 1-item food insecurity screen (2008–2016) and a 2-item screen (2013–2016), the latter of which was added to our parent-completed survey instrument in 2013. The 1-item statement abstracted from the NutriSTEP questionnaire was “I have difficulty buying food I want to feed my children because food is expensive.”¹⁵ The 2-item food insecurity screen (based on the 18-item Household Food Security Survey)¹⁸ included the following statements: 1) “Within the past 12 months, we worried about whether our food would run out before we got money to buy more”; and 2) “Within the past 12 months, the food we bought just didn't last and we didn't have money to buy more.” Affirmative answers to either of the two statements identifies food insecurity with a sensitivity of 97% and a specificity of 83% as compared with the full 18-item Household Food Security Survey.¹⁹ Our group demonstrated that an affirmative answer to the 1-item statement from the NutriSTEP questionnaire identified food insecurity with a sensitivity of 85% and specificity of 91% as compared with the 2-item food insecurity screen.²⁰ Children enrolled between 2008 and 2013 with an affirmative answer to the 1-item NutriSTEP statement and children enrolled between 2013 and 2016 with an affirmative answer to the 1-item NutriSTEP statement or to either of the 2-item food insecurity screen statements were categorized as food insecure.

COVARIATES

Covariates that we a priori identified based on the literature that might influence the relationship between total breastfeeding duration and household food insecurity included child characteristics (age, sex), maternal characteristics (age, ethnicity, education, employment), and family characteristics (number of children, single parent family, neighborhood equity score). Maternal-reported ethnicity was categorized as European, African, Arab, Asian, Latin American, or other, which included mixed ethnicity and indigenous. Maternal education was categorized as primary school, high school, or college. Maternal employment was categorized as no employment, full-time employment, parental leave, part-time employment, or self-employed. The neighborhood equity score was a composite measure of neighborhood well-being across a broad range of thematic domains based on a model of social determinants of health.²¹ Domains included economic opportunity, social development, participation in decision-making, physical surrounds, and healthy lives.

STATISTICAL ANALYSIS

Descriptive statistics were performed for the primary exposure, outcome, and covariates. Univariate logistic regression was used to determine the unadjusted association between total breastfeeding duration and household food insecurity. Total breastfeeding duration in months was modeled as a continuous variable. For the primary analysis, multivariable logistic regression was performed to examine the association between total breastfeeding duration and household food insecurity. All prespecified covariates were thought to be clinically important and were included in the final model regardless of the associated *P* values to prevent biased regression coefficients and falsely inflated *R*² values from data-driven variable selection techniques.

For our secondary objective, we explored whether the relationship between total breastfeeding duration and household food insecurity was modified by family self-reported income (Canadian dollars). Responses to “What was your total family income before taxes last year?” were categorized into lowest income (\$0–\$29,999), lower middle income (\$30,000–\$79,999), higher middle income (\$80,000–\$149,999), and highest income (\$150,000 or more). To perform this analysis, we included self-reported family income categories as covariates and interaction terms between total breastfeeding duration and family self-reported income categories in our primary model. This interaction was tested at a significance level of $\alpha = .05$.

Missing covariate data were handled by multiple imputation using chained equations. Covariates had <10% missing values, except for neighborhood equity score and family self-reported income (<20%). The variance inflation factor was computed for each covariate to test for multicollinearity. All statistical tests were 2 sided, and a priori a significance level of <.05 was specified. Statistical analysis was conducted using R 3.3.1.

RESULTS

A total of 5901 healthy children ages 0 to <3.5 years who had a TARGeT Kids! health supervision visit between 2008 and 2016 were recruited to participate; of those, 5462 had complete data on household food insecurity, and 5167 had complete data on total breastfeeding duration. A further 1329 children who were currently breastfeeding were excluded. Descriptive characteristics of the final study population (*N* = 3838) are shown in [Table 1](#). Median total breastfeeding duration was 10.5 months (interquartile range, 6.0–14.0), mean infant age was 23.2 months (standard deviation [SD], 9.7), and 47.9% of children were female. Mean maternal age was 34.8 years (SD, 4.5), and 53.9% of mothers were employed (full-time, part-time, or self-employed). Family self-reported income categories were lowest income (5.5%), lower middle income (16.4%), higher middle income (33.2%), and highest income (45.0%). Almost 15% of households reported food insecurity.

For our primary objective, in the unadjusted analysis, with each additional month of total breastfeeding duration, the odds of household food insecurity decreased by

Table 1. Subject Characteristics (N = 3838)

Characteristics	Overall*
Total breastfeeding duration (mo), median (IQR)	10.5 (6.0–14.0)
Age (mo), mean (SD)	23.2 (9.7)
Child sex, n (%)	
Female	1838 (47.9)
Male	2000 (52.1)
Maternal age (yr), mean (SD)	34.8 (4.5)
Maternal self-reported ethnicity, n (%)	
European	2341 (67.1)
African	168 (4.8)
Arab	69 (2.0)
East, South, Southeast Asian	611 (17.5)
Latin American	117 (3.4)
Other†	185 (5.3)
Maternal education, n (%)	
Primary school	36 (1.0)
High school	280 (7.5)
College	3431 (91.6)
Number of children, mean (SD)	1.7 (0.8)
Family self-reported income‡, n (%)	
\$0–\$29,999	164 (5.5)
\$30,000–\$79,999	489 (16.4)
\$80,000–\$150,000	990 (33.2)
Over \$150,000	1342 (45.0)
Neighborhood equity score, mean (SD)	65.5 (14.4)
Maternal employment, n (%)	
No employment	726 (20.2)
Full-time employed	1451 (40.3)
Parental leave	932 (25.9)
Part-time employed	435 (12.1)
Self-employed	53 (1.5)
Single parent family, n (%)	
No	3568 (96.5)
Yes	131 (3.5)
Household food insecurity, n (%)	
No	3274 (85.3)
Yes	564 (14.7)

IQR indicates interquartile range; SD, standard deviation.

Note: Neighborhood equity score is a composite measure of neighborhood well-being across a broad range of thematic domains based on a social determinants of health model. Theoretical scores range from 0 (worst outcomes) to 100 (best outcomes).

*Numbers may not add up to the total due to missing values.

†Other includes mixed ethnicity and indigenous.

‡Incomes are expressed in Canada dollars.

2% (odds ratio [OR], 0.98; 95% confidence interval [CI], 0.97–1.00; $P = .02$). However, in the adjusted analysis we found no association between total breastfeeding duration and household food insecurity (OR, 0.99; 95% CI, 0.98–1.01; $P = .20$). Adjustment was made for child characteristics (age, sex), maternal characteristics (age, ethnicity, education, employment), and family characteristics (number of children, single parent family, neighborhood equity score) (Table 2).

For our secondary objective, the interaction between total breastfeeding duration and family self-reported income on household food insecurity was not statistically significant ($P \geq .43$). Family self-reported income was not an effect modifier between total breastfeeding duration and household food insecurity. All of the lower family self-reported income categories (lowest income, \$0–\$29,999; lower middle income, \$30,000–\$79,999; and higher middle income, \$80,000–\$149,999) were statistically significant covariates

($P \leq .001$) in the models with and without the interaction (Table 3).

DISCUSSION

We found no association between total breastfeeding duration and household food insecurity after adjusting for important covariates, suggesting that shorter breastfeeding duration does not appear to place families at increased risk of household food insecurity. We also found that, although lower income families had an increased odds of being household food insecure, there was no association between total breastfeeding duration and household food insecurity at varying income levels.

Food is a basic need and a fundamental human right; however, inequities in household food insecurity are poorly recognized.²² Breastfeeding has been proposed as a part of the solution to household food insecurity. In Canada, prenatal nutrition programs work to assist communities to identify strategies to protect, promote, and support breastfeeding in a population health context.²³ The guiding principles are to allow mothers to make informed decisions and to keep their right to breastfeed free of marketing influences. Similarly, in the United States, the Women, Infants, and Children program reforms have provided comprehensive nutritional education, which includes breastfeeding supports and improvements in attitudes towards breastfeeding.²⁴ The root causes of household food insecurity may

Table 2. Association Between Total Breastfeeding Duration and Household Food Insecurity

Characteristics	Adjusted Odds Ratio (95% CI)
Total breastfeeding duration (mo)*	0.99 (0.98–1.01)
Child age, mo	1.02 (1.00–1.03)
Sex	
Female	1.00 (ref)
Male	1.56 (0.96–1.40)
Maternal age (y)	0.94 (0.92–0.96)
Maternal-self reported ethnicity	
European	1.00 (ref)
African	1.79 (1.20–2.67)
Arab	0.97 (0.48–1.98)
East, South, Southeast Asian	1.77 (1.38–2.28)
Latin American	1.41 (0.86–2.31)
Other†	1.58 (1.06–2.36)
Maternal education	
Primary school	1.00 (ref)
High school	0.93 (0.43–2.04)
College	0.46 (0.21–0.99)
Number of children, n	1.18 (1.05–1.33)
Maternal employment	
No employment	1.00 (ref)
Full-time employed	0.62 (0.48–0.80)
Parental leave	0.57 (0.42–0.77)
Part-time employed	0.87 (0.63–1.20)
Self-employed	1.02 (0.48–2.14)
Single-parent family	
No	1.00 (ref)
Yes	2.35 (1.52–3.26)
Neighborhood equity score	1.00 (0.99–1.01)

CI indicates confidence interval; ref, reference category.

*Unadjusted odds ratio, 0.98 (95% CI, 0.97–1.00).

†Other includes mixed ethnicity and North American indigenous.

Table 3. Adjusted Logistic Regression Models for Association Between Total Breastfeeding Duration and Household Food Insecurity (N = 3838)

Variable	Adjusted*		Adjusted With Income as Covariate†		Adjusted With Interaction‡	
	OR (95% CI)	P Value	OR (95% CI)	P Value	OR (95% CI)	P Value
Total breastfeeding duration (per month)	0.991 (0.977–1.005)	.220	0.993 (0.979–1.008)	.377	0.988 (0.950–1.028)	.558
Family Self-Reported Income						
Lowest income (\$0–\$29,999)			9.018 (5.410–15.032)	<.0001	9.216 (4.279–19.849)	<.0001
Lower middle income (\$30,000–\$79,999)			6.121 (4.402–8.511)	<.0001	5.079 (2.830–9.114)	<.0001
Higher middle income (\$80,000–\$149,999)			2.876 (2.052–4.032)	<.0001	2.980 (1.611–5.511)	.001
Highest income (≥\$150,000)			1.00	—	1.00	—
Interaction						
Total breastfeeding duration × less than \$30,000					1.019 (0.973–1.067)	.430
Total breastfeeding duration × \$30,000–\$79,999					0.997 (0.949–1.047)	.901
Total breastfeeding duration × \$80,000–\$149,999					0.996 (0.942–1.054)	.897
Total breastfeeding duration × ≥\$150,000					1.00	—

OR indicates odds ratio; CI, confidence interval.

All incomes are expressed in Canada dollars.

*Adjusted for child age, child sex, maternal age, maternal ethnicity, maternal education, maternal employment, number of children, single-parent family, and neighborhood equity score.

†Adjusted for all prespecified covariates in primary model and family self-reported income as a covariate.

‡Adjusted for all prespecified covariates in primary model and family self-reported income as a covariate and interaction between total breastfeeding duration × family self-reported income.

require improvements in structural determinants of poverty, such as social welfare and maternity leave provisions.²⁵ Our study provides evidence to support evidence-based solutions that directly address inadequate income and poverty, rather than promotion of individual health behaviors in isolation. Furthermore, qualitative research supports our findings.²²

Our study is unique in that we examined the association of total breastfeeding duration and household food insecurity. In contrast, previous research examined the reverse relationship—that is, the association between household food insecurity and breastfeeding duration. In nationally representative studies, mothers from food-insecure households, as compared to food-secure households, had lower breastfeeding duration.¹¹ Likewise, studies of low-income mothers found that prenatal household food insecurity was associated with lower breastfeeding initiation as compared to those who were food secure.²⁶ Other studies have reported no association between household food insecurity and breastfeeding duration.²⁷ Further, studies have demonstrated that poverty and prenatal food insecurity are highly correlated and related to low breastfeeding initiation rates and short breastfeeding duration.¹¹ In low-income families, breast milk substitute costs were a reason for choosing to initiate breastfeeding.²⁵ Furthermore, poverty creates barriers to breastfeeding and precipitates early cessation of breastfeeding from lack of access to breastfeeding support.²⁵ Although our study had proportions of household food insecurity similar to those of the overall Canadian population, in situations of severe and extreme food insecurity mothers may exclusively breastfeed as the only food source for their infant.²⁸

In Canada, federal policy entitles parents up to 18 months of benefits and leave²⁹ and child benefits as tax-free monthly payments for low-income families; therefore, we were well suited to study the association between total breastfeeding duration and household food insecurity. Studies in the United States and Australia have shown that access to parental leave increased breastfeeding duration among low-income groups.³⁰ Among employed Australian mothers, women who were not managerial employees, who lacked job flexibility, or who experienced psychosocial distress had lower breastfeeding rates.³¹ Thus, early return to maternal employment may shorten breastfeeding duration.³²

Our study population was predominantly of European ethnicity and college educated and came primarily from middle- and high-income families. They may have had increased expenditure on intangible resources, such as lactation support, that prolong breastfeeding duration. In contrast, mothers from low-income families who needed to return to work early to prevent household food insecurity may not have had the support at work to continue breastfeeding or pumping. These are factors that may have contributed to our null finding.

Strengths of our study include the relatively large sample of urban children. The primary exposure variable, total breastfeeding duration, included exclusive and partial breastfeeding, which may be relevant to current breastfeeding

policy objectives.³³ The outcome variable, household food insecurity, was measured using the 2-item food insecurity screen, which has 97% sensitivity and 83% specificity for determining food insecurity,¹⁹ or the 1-item statement from the NutriSTEP questionnaire, which has 85% sensitivity and 91% specificity for determining food insecurity.²⁰ Further, our in-depth clinical data allowed for adjustment of biologically plausible covariates that address social determinants of health, such as the neighborhood equity score and maternal employment.

Our study had limitations. The cross-sectional analysis cannot infer causality. Data from our healthy urban children recruited from primary care practices in a large Canadian city may not be generalizable to children from other urban areas or nonurban children; however, household food insecurity prevalence³⁴ and maternal characteristics of breastfeeding practice³⁵ were similar to other Canadian findings. Next, our primary exposure did not distinguish between exclusive or percentage of mixed feeding with breast milk substitutes, which may underestimate the effect of breastfeeding on household food insecurity. Further, we were not able to adjust for type, access, or affordability of breast milk substitute. Other unmeasured potential confounders may include infant feeding practices (level of mixed feeding), early introduction of solid foods, parental comorbidities (eg, mental health), or lifestyle factors (eg, smoking, alcohol or substance abuse). Finally, our outcome measure might underreport household food insecurity, as mothers may fear being labeled a “bad mother” (social desirability bias),³⁶ and does not distinguish whether lack of food results from quality (preferred food) or quantity (sufficient food). However, the 2-item household food insecurity screen has been validated in the United States, and we can reasonably assume validity for our population. Finally, for some participants, the outcome was determined based on the 1-item screen; however, we demonstrated that the 1-item food insecurity screen has high sensitivity and specificity for determining food insecurity when compared with the 2-item screen.²⁰

CONCLUSIONS

We found that total breastfeeding duration was not associated with household food insecurity, after controlling for prespecified covariates. Family income did not modify this association. Although breastfeeding is associated with improved child health outcomes and considered to be part of the solution to household food insecurity, interventions focused on social determinants may provide more promising targets for the prevention of household food insecurity.

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