A Longitudinal Study of WIC Participation on Household Food Insecurity

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Abstract We examined the association between women's/ children's duration of WIC participation and household food security status. For mothers ($n = 21,863$) and their children ($n = 57,377$) participating in WIC (2001–2006), longitudinal measures of household food security status were collected using a subscale of the USDA Food Security Module. Using logistic regression, household food security status at the last WIC visit was associated with measures of WIC duration (number of trimesters on WIC for pregnant women, and number of WIC visits for children). Among women with prenatal household food insecurity with hunger, odds of any post-partum household food insecurity was reduced with first (AOR = 0.67, 95% CI = 0.48–0.94) or second trimester of entry (AOR = 0.64, 95% CI = 0.45–0.90) versus third. Among children with initial household food insecurity without hunger, an additional WIC visit reduced the odds of any household food insecurity (AOR = 0.92, 95% CI = 0.90–0.94) and of household food insecurity with hunger (AOR = 0.94, 95% CI = 0.89–0.98) at the last visit.

Among those with initial household food insecurity with hunger, an additional WIC visit reduced the odds of any household food insecurity (AOR = 0.96, 95% CI = 0.92–0.99) and of household food insecurity with hunger (AOR = 0.88, 95% CI = 0.83–0.94) at the last visit. Earlier and longer WIC participation may improve household food security status, particularly of vulnerable groups.

Keywords Food security · Program evaluation · WIC

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Introduction

Food insecurity is defined as the lack of access to enough food for an active healthy life that results from the limited or uncertain access to nutritionally adequate and safe foods in socially acceptable ways [1]. While recent statistics indicate that 14.6% of US households experienced household food insecurity in 2008, low-income households and those with children experienced household food insecurity at much higher rates [2]. Approximately 22.3% of those with children under 6 years of age in the United States and 42.2% of households living below the federal poverty line reported food insecurity with or without hunger [2][1]. In addition rates of household food insecurity and hunger were much higher among Blacks (25.7%) and Hispanics (26.9%) than the White non-Hispanic population (10.7%) [2]. In 2008, among households with incomes less than

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[1] As of 2006 the USDA modified the terminology from food insecurity with and without hunger to low food security and very low food security [3].

130% of the poverty threshold and those with children <6 years of age, 45.1% reported food insecurity [2].

The Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) program is a public health program that provides federal grants to states for supplemental foods, health care referrals, and nutrition education. The latter teaches and encourages healthy eating habits for adults as well as children. Eligible populations include low-income pregnant and postpartum women, and infants and children up to age five who are found to be at nutritional risk. Eligibility is restricted to families with incomes below 185% of the federal poverty threshold. Among children, re-certification into the program generally occurs every 6 months. Theoretically, participation in WIC is expected to result in improved outcomes for pregnant women, their infants and young children; it follows that improved levels of food security should reflect improved nutrition in the WIC population.

A large body of research has found that WIC participation during pregnancy contributed to better birth outcomes including birth weight, lower rates of premature deliveries and neonatal risk, as well as improved maternal health outcomes and even savings of federal expenditures through Medicaid [4]. However, despite the widely cited successes, the evaluation of such public health programs are challenging due to design and methodological limitations. For example, one common criticism of WIC evaluations has been the suggestion that the favorable results would overestimate the benefits of the WIC program if, as was assumed, women who participated in WIC were from more advantaged populations than non-participants, despite all participants being low-income [5]. Recent research has taken this possibility of self-selection into account and found that, contrary to expectations, WIC participants are in fact selected from a more disadvantaged population, thus providing support for the strong beneficial program effects on birth outcomes [6]. Similarly, data from the Survey of Income and Program Participation (SIPP) showed that WIC participants had higher rates of affirmative responses to survey questions about food insufficiency and food running out, compared to nonparticipants who appeared to be income-eligible [6].

In other program evaluations, (e.g., Supplemental Nutrition Assistance Program (SNAP), formerly known as Food Stamps), where a similar pattern of high rates of food insecurity among program participants was found, recent research has sought with mixed success to use longitudinal data and other stronger research designs to control for unobserved differences between participants and nonparticipants [7]. For either program, comparing participants to non-participants (even with regression controls for household and individual characteristics) is not a promising approach to estimating true program effects. For the WIC

program, there has only been one small descriptive study to date which examined changes in food security status longitudinally with WIC participation; that study reported a significant reduction in food insecurity after 1 year of WIC participation among the 40% of mothers entering the program already food insecure [8]. The aforementioned study noted that mothers with at least 12 years of education were 3.5 times more likely to become food secure than mothers who did not complete high school [8]. Unfortunately, because the entire sample was on WIC for 1 year, there was no real control group. There has been no research yet using a longitudinal design to measure the effect of differences in the duration of program participation over time on food security outcomes.

The purpose of this research is to examine the association between the duration of WIC participation and household food security status in low income women and children. The analysis employs a large database of administrative records about WIC mothers and children in Massachusetts over time. Because of the challenges with participant/non-participant comparisons discussed above, it is advantageous to focus on the association between length of time on WIC and the outcomes of interest for a population of participants, thereby avoiding the problem of unobserved variables related to motivation for joining the program. The study has two parts: (a) an analysis of household food security status for pregnant women prenatal and post-partum, with variable trimesters of entry into WIC and (b) an analysis of household food security status for children with varying lengths of time on WIC. For pregnant women, length of time on WIC varies because of differences in the trimester of entry to the program. For children, length of time on WIC varies because of differences in the number of repeat visits to the program. This is the first published study of WIC participation duration and food security outcomes using a large administrative data file.

Methods

Our longitudinal study includes data collected from September, 2001 through August, 2006 on children and their mothers from low-income families who participated in the Massachusetts WIC program; the entire state's program was included. Data for WIC are collected every 6 months (at the certification and re-certification visits) and files are created for submission to the Centers for Disease Control and Prevention as part of Massachusetts' participation in the Pregnancy and Pediatric Nutrition Surveillance System. Mother's and children's data were linked because some of the relevant sociodemographic variables (i.e. maternal education) are only available on the mother's file. Children whose mothers had not received WIC during the time included in this dataset could not be included in

the analytic sample. This study underwent review both from the Simmons College Institutional Review Board (IRB) and the IRB for the Massachusetts Department of Public Health. The former assigned this study exempt status while the latter approved it.

Food Security Measure

Household-food security status was based on parent/care-taker responses to a 4-question subscale [9] of the 18-question Food Security Module, developed by the US Department of Agriculture and used primarily by government agencies to assess national food security status in the United States [10]. This 4-question subscale (items and coding shown in Table 1) was developed and implemented before the now-standard 6-item short form was standardized and made available in 2000 [11].

This subscale addressed the following areas: (1) not having enough money to buy food for a balanced meal, (2) adults cutting the size of or skipping meals, (3) frequency of cutting or skipping meals, and (4) adults not eating for a whole day. Household food security status was defined by the number of positive ("yes") responses to the questions (see Table 1): Household Food Security = 0 positive responses; household food insecurity without hunger = 1–2 positive responses; and, household food insecurity with hunger = 3–4 positive responses. Compared to the 18-question scale, the 4-question subscale has a sensitivity of 79%, a specificity of 97%, and a positive predictive value of 92% to identify household food insecurity with and without hunger among households whose income is less than 185% of the poverty threshold and who have children [12]. The survey questions are administered to the woman (for pregnant or post-partum participants) or the caregiver (for

children participants) every 6 months (i.e. at the re-certification visit). Based on the responses to the food security scale, a household may be classified as: (a) food secure, (b) food insecure without hunger or (c) food insecure with hunger. In the analyses, the food security outcomes, used as dependent variables, were defined in two ways: (1) a binary variable indicating any household food insecurity, as distinguished from secure status, or (2) a binary variable indicating household food insecurity with hunger as distinguished from the two more favorable classifications.

Pregnant Women's WIC Participation and Household Food security Status

The sample ($n = 21,863$) consisted of all women in our dataset for whom this was their first pregnancy (i.e. parity = 0) and who were certified into WIC both prenatally and continued to participate in the WIC program during the post-partum period. Other inclusion criteria were having complete data on trimester of entry into WIC, prenatal food security measures, post-natal food security measures, maternal education, maternal race/Hispanic ethnicity, and household size. Those in their first pregnancies were selected in order to ensure that each observation was unique and that we did not have duplicate records for the same mother; this was needed because, during the 5 years of data, mothers may have been on WIC more than once and may not have used the same WIC ID thus not allowing for identifying repeat participation. Only those whose race/ethnicity was reported as non-Hispanic white, non-Hispanic Black, Hispanic or Asian were included in these analyses. Native Americans were excluded because of their small sample size which precluded our ability to control for this in a multivariate analysis.

Table 1 Household 4-question subscale of the 18-question food security scale

#	Question in 18-Question Module	Question Time frame was previous 12 months	Affirmative response	Negative response
1.	First question for food-insecure	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?	1) Often true or 2) Sometimes true	Never true
2.	First question for food-insecure with moderate hunger	In the past 12 months, did you or other adults in your household ever cut the size of your meals or skip meals because there wasn't enough money to buy food?	Yes	No
3.	Follow up to question 2	If yes above, how often did this happen?	1) Almost every month or 2) Some months but not every month	1 or 2 months or I don't know how often
4.	First question for food insecurity with severe hunger	In the past 12 months, did you or other adults in your household ever not eat for a whole day because there wasn't enough money for food?	Yes	No

Among pregnant women, those who entered WIC in earlier trimesters had longer durations between the prenatal and post-partum observations of household food security status.

Children's WIC Participation and Household Food Security Status

Inclusion criteria for the children's analytic sample ($n = 57,377$) were: (1) certification visit (first visit) during the five years available in the data file, (2) the child had more than 1 visit to WIC, (3) complete data on household food security status at certification and last visit, (4) complete data on covariates: maternal education, household size and race/ethnicity, (5) Race/ethnicity was Non-Hispanic White, Hispanic, Black non-Hispanic or Asian. Native Americans were excluded because of their small sample size, which precluded our ability to control for Native American race/ethnicity in this multivariate analysis.

Among children, those who had a greater number of WIC visits had a longer duration of program participation between the initial and final measures of household food security status. Visits are required every 6 months in order for a child to be re-certified into the WIC program; it is generally during these visits that anthropometric data, other social and demographic data and household food security status are collected.

Statistical Analysis

Logistic regression analysis (Proc Logistic, SAS version 9.1) was used to examine the association between duration of WIC participation and final household food security status. In the sample of women, trimester of entry into WIC, as an indicator of duration on WIC, was examined in relation to post-partum (i.e. final) household food security status, controlling for household food security status at the first prenatal visit (i.e. initial status). Among children, number of WIC re-certification visits, as an indicator of WIC duration, was examined in relation to household food security status at the last visit controlling for household food security status at the first visit. Covariates included socioeconomic (SES) variables (i.e., maternal education, household size and race/ethnicity).

First the main effects analyses were conducted and then interactions between duration on WIC and initial household food security status were tested. Based on evidence of a significant interaction indicating that any post-partum household food insecurity ($P < .05$) or post-partum household food insecurity with hunger varied as a function of both WIC duration and initial household food security status, the analyses were stratified by the household's initial food security status.

Results

Pregnant Women's WIC Participation and Post-Partum Household's Food Security

The sample of women included in this analysis (Table 2) was diverse (16.5% Black Non-Hispanic and 28.5% Hispanic), had an average age of 22.6 years at the first prenatal visit, and on average had either less than a high school (34.5%) or a high school (44.9%) education. At the first prenatal visit 31.3% of women reported household food insecurity (Table 3). This declined by the post-partum visit with 23.3% reporting food insecurity.

For pregnant women, in the multiple logistic regression on post-partum household food security status, controlling for maternal education, household size, and ethnicity, significant interactions were found between trimester of entry into WIC and prenatal household food security status ($P < .05$). Thus, the analyses were stratified by prenatal household food security status.

For those whose prenatal household food security status was either secure or insecure without hunger, there was no association between trimester of entry and whether or not there was any household food insecurity or household food insecurity with hunger at the post-partum visit (Table 4). Conversely, for pregnant women who prenatally reported household food insecurity with hunger, risk of any post-partum household food insecurity was significantly reduced

Table 2 Characteristics of pregnant women in the sample

	All ($N = 57,531$)	Final sample ($N = 21,863$)
Mean (SD) maternal age (years)	23.0 (5.5)	22.6 (5.2)
	%	%
Maternal education	$N = 55,656$	
<High school	32.3	34.5
High school	44.4	44.9
College	23.3	20.6
Race/ethnicity	$N = 57,536$	
White non-Hispanic	51.5	47.9
Black non-Hispanic	15.9	16.5
Hispanic	25.6	28.5
Asian	6.8	7.1
Household size	$N = 57,446$	$N = 21,863$
≤2	57.2	62.5
3–5	37.9	32.7
≥6	5.0	4.8
Trimester at initial WIC visit	$N = 53,332$	$N = 21,863$
1st trimester	40.1	48.5
2nd trimester	33.3	40.4
3rd trimester	26.6	11.1

Table 3 Household prenatal and post-partum food security status among women

Household food security	All	Final sample
Prenatal	n = 34,969	n = 21,863
	%	%
Food secure	68.9	68.8
Food insecure without hunger	23.4	23.8
Food insecure with hunger	7.7	7.5
Post-partum	n = 35,903	n = 21,863
	%	%
Food secure	75.4	76.7
Food insecure without hunger	19.4	18.5
Food insecure with hunger	5.2	4.8

if they entered either in the first (AOR = 0.67, 95% CI = 0.48–0.94) or second trimester (AOR = 0.64, 95% CI = 0.45–0.90) compared to the third trimester of pregnancy. Similarly, for this same group of women, earlier trimester of entry was associated with a lower risk of post-partum household food insecurity with hunger; the risk of post-partum household food insecurity with hunger was 39% lower if women entered in the first trimester compared to the third trimester (AOR = .61, 95% CI = 0.40–0.93).

Children's WIC Participation and Changes in Household Food Insecurity

The sample of children used to address this question was diverse (Table 5): 19.5% were Black non-Hispanic, 29.3% were Hispanic, and 6.4% were Asians. Infants generally attended their first WIC visit before 1 month (mean = 0.9 months) and continued through their second birthday (mean age at last visit = 26.4 months), averaging 4 visits during this time span (Table 5). About a third of their mothers (32%) reported less than 12 years of education while almost half reported 12 years of education.

Table 5 Characteristics of children-and their households

Characteristic (N = 57,337)		
Mean (SD) child's age (months)		
At first visit	0.9 (2.0)	
Age at last visit	26.4 (13.0)	
Mean (SD) # WIC visits	4.0 (1.9)	
	%	
Maternal education		
<12 years	32.0	
12 years	46.0	
>12 years	22.3	
Race/ethnicity		
White non-Hisp.	44.9	
Black non-Hisp.	19.5	
Hispanic	29.3	
Asian	6.4	
Household size		
≤2	37.5	
3–5	46.0	
≥6	6.8	
Household food security	First (%)	Last (%)
Food secure	75.7	76.8
Food insecure w/o hunger	19.3	18.6
Food insecure with hunger	5.0	4.6

Among children, multiple logistic regression on final food security status, controlling for maternal education household size, ethnicity and initial household food security status, yielded significant interactions between the number of WIC visits and household food security status at the first observation (P < .01). Because this implied that the relationship between number of visits and final household food security status was different for different levels of food security status at the initial visit, the analyses were stratified by initial household food security status (Table 6).

Table 4 Logistic regression model predicting post-partum household food security status, stratified by prenatal household food security status

	Food secure at prenatal visit (n = 15,033)	Food insecure without hunger at prenatal visit (n = 5,196)	Food insecure with hunger at prenatal visit (n = 1,634)
Prediction of any food insecurity post-partum	AOR (95% confidence interval)		
First vs. third trimester (referent).	0.98 (0.85–1.13)	0.95 (0.78–1.14)	**0.67 (0.48–0.94)**
Second vs. third trimester (referent)	0.96 (0.84–1.11)	1.01 (0.84–1.23)	**0.64 (0.45–0.90)**
Prediction of food insecurity with hunger post-partum			
First vs. third trimester (referent)	0.82 (0.62–1.09)	1.33 (0.87–2.03)	**0.61 (0.40–0.93)**
Second vs. third trimester (referent)	0.76 (0.57–1.02)	1.23 (0.80–1.89)	0.77 (0.50–1.17)

Bolded values are statistically significant (P < .05). Covariates: Race: 3 dummy variables (White NH was the referent group): Hispanic, Black non-Hispanic, Asian, maternal education (<12 years (referent), 12 years and ≥12 years), household size

Table 6 Logistic regression model predicting household food security status at the last child's visit, stratified by household food security status at the first visit

	Food secure at first visit ($n = 43{,}401$)	Food insecure without hunger at the first visit ($n = 11{,}043$)	Food insecure with hunger at the first visit ($n = 2{,}893$)
AOR (95% confidence interval)			
Prediction of any food insecurity at last visit			
Each additional visit	**1.02 (1.004–1.03)**	**0.92 (0.90–.94)**	**0.96 (0.92–0.99)**
Prediction of food insecurity with hunger at last visit			
Each additional visit	1.00 (0.97–1.03)	**0.94 (0.89–.98)**	**0.88 (0.83–0.94)**

Bolded values are significant ($P < .05$). Covariates: Race: 3 dummy variables (White NH was the referent group): Hispanic, Black non-Hispanic, Asian, maternal education (<12 years (contrast category), 12 years and ≥12 years), household size

For children whose households were initially food secure, more visits were associated with slightly higher odds of reporting any household food insecurity at the final observation (AOR = 1.02, 95% CI = 1.004–1.03). However, for these same children there was no association between number of visits and having household food insecurity with hunger at the final observation (Table 6).

Conversely for children whose households were initially food insecure without or with hunger, a greater number of visits were associated with both a reduced likelihood of any household food insecurity and of household food insecurity with hunger at the last visit (Table 6). Among those with household food insecurity without hunger at the first visit, there was an 8% lower risk of any household food insecurity (AOR = 0.92, 95% CI = 0.90–0.94) and a 6% lower risk of household food insecurity with hunger (AOR = 0.94, 95% CI = 0.89–0.98) at the last visit if they had $n + 1$ visits instead of having n visits. Similarly among those who entered WIC with household food insecurity with hunger, there was a 4% lower risk of any household food insecurity (AOR = 0.96, 95% CI = 0.92–0.99) at the last visit and 12% lower odds of household food insecurity with hunger (AOR = 0.88, 95% CI = 0.83–0.94) at the last visit with an additional WIC visit.

Discussion

The purpose of this study was to examine the relationship between length of time of participation in WIC and changes in household food security among both pregnant women and children. In general, the findings show that longer participation in WIC was associated with reduced likelihood of experiencing hunger among both women and infants. Specifically, among pregnant women from households experiencing hunger at their initial visit, more trimesters on WIC was associated with lower likelihood of continuing to have household food insecurity with hunger in the post-partum period. Similarly, for children from

households with any food insecurity or food insecurity with hunger, at their first visit, more time on WIC was associated with reduced likelihood of having any household food insecurity or household food insecurity with hunger in the final observation. The only exception to the directionality of this association was among those children whose households were food secure at the initial WIC visit; in this case there was a small increase in the likelihood of any household food insecurity with an additional WIC visit.

Although there have been numerous studies examining the effect of WIC on a variety of health and nutrition related outcomes, there has been little research to examine WIC participation's association with food security. The present study is the first to use a longitudinal design, and the first to use large administrative data files, to measure the relationship between WIC duration and food security outcomes.

Research has shown that food insecurity is associated with social and health risks including maternal depression [13], obesity in women [14] and children [15], increased rates of iron deficiency and anemia [16], parental reports of developmental risk factors [17], and poorer health and more hospitalizations [18]. Therefore any intervention that could potentially reduce the risk of household food insecurity in general, and more importantly the more severe forms of food insecurity (e.g., with hunger) has the potential to have beneficial effects not only for maternal and child health but on the broad range of educational and behavioral outcomes associated with hunger and food insecurity among children [15, 19].

It is somewhat paradoxical that there was a slight yet significant increase in odds of household food insecurity at the last visit with an additional WIC visit among those children whose households were initially food secure at WIC entry. However, the effect is so small (2% increase in likelihood), that it is nearly negligible in practical terms; it was statistically significant because of the very large sample sizes used in this research. While curious, the overriding results indicate that WIC participation has a positive impact on household food security status.

One possible limitation to the study is that the food insecurity sub-scale is a measure of household adult (not child) food insecurity. Evidence suggests that within food insecure households, children are less likely to experience reductions in food intake likely because adults tend to protect their children when resources are limited [2]. In addition the standard questions refer to the 12 month period preceding the interview, thus introducing the possibility that, there was overlap in the time period to which the questions referred.

Although this study design is observational in nature, selection bias cannot account for the results found. An examination of potential self-selection bias in this sample, showed, similar to other research [6] that those with longer durations on WIC were from a more disadvantaged population rather than an advantaged population. That is, children with a higher number of WIC visits and mothers who entered WIC earlier were more likely to have lower maternal education and to be from households reporting any food insecurity or food insecure with hunger at the initial visit. Thus as others have found, if bias were to explain the differences between these two groups in household food insecurity, results should have been in the opposite direction to that found.

In summary, the results provide support for a beneficial impact of WIC among an ethnically diverse sample of mothers and children, on an important public health issue, that being, household food security status. The policy implication of this research is that earlier and longer WIC participation may improve household food security status, particularly of vulnerable groups.

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